



A SOFT PATH WATER
PARADIGM SHIFT

FEDERAL POLICIES

To

ADVANCE

DECENTRALIZED AND
INTEGRATED WATER
RESOURCE
INFRASTRUCTURE

Valerie I. Nelson
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This Report was written by Valerie I. Nelson and does not necessarily represent the views of individuals and organizations that participated in workshops and other discussions and reviews. Recommendations for long-range changes in research, funding and regulatory approaches are made by the author exclusively.

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EXECUTIVE SUMMARY

The Hard Path vs. Soft Path Choice

In the mid-1800's, a fateful decision was made by American cities to begin installing miles of underground pipes to bring potable water to residents and then dispose of the wastewater and stormwater in nearby rivers, lakes or oceans. This "hard path" engineering has brought substantial public health benefits. But, there is growing evidence of how disruptive centralized distribution and collection is to regional water hydrologies and of how expensive it is to build and maintain. Recently, from a variety of quarters, there has been a flickering of interest in reopening earlier arguments that "soft path" approaches that treat and reuse water and wastewater at or near the site of use might be a more sustainable approach for the nation after all.

A key change from the 1800's is that technologies, such as membranes and remote telemetry controls, have advanced to the point where public health can be protected at the individual site, and the need for piping in clean water and piping out pollutants for disposal miles away is no longer the decisive factor. Soft path approaches have a lighter footprint in the environment, which has been heavily disrupted and stressed by the accumulation of hard path infrastructure. Localized capture of water, and treatment, reuse, and disposal of wastewater can restore streams, aquifers, wetlands and habitat. And, since about 70% of costs of the hard path solutions are in the underground piping system,

this treatment and reuse at the site could turn out to bring substantial cost-savings as well. In the long-run, the nutrients in wastewater may be of value in agriculture, and synergies with distributed energy production and other infrastructure may also be important.

Soft Path Systems at the Margins

Advocates for soft path approaches have been promoting decentralized systems on the fringes of the water and wastewater sector for the last decade. Technologies include: advanced onsite or cluster wastewater systems in rural or suburban unsewered areas, stormwater retention rain gardens and cisterns in urban areas, reuse of stormwater and wastewater for toilet flushing or irrigation, point of use water treatment and water conservation appliances, and other nonstructural and low impact development designs in new subdivisions and infill developments.

There are a variety of recent signs of mainstream, institutional interest in these decentralized technologies. The Commissioner of the Bureau of Reclamation mentioned in 2005 Senate testimony that decentralized desalinization might well be cheaper than constructing miles and miles of new water lines in the rural West. The Conservation Law Foundation acknowledges that its lawsuit forcing billions to be spent on the classic hard path sewer system and ocean outfall in Eastern Massachusetts has disastrously disrupted stream flows and groundwater, and vows to advocate for decentralized approaches in the future.

In Los Angeles, a broad range of stakeholders have been convinced that hundreds of millions of dollars could be saved by not shipping precious stormwater out to the ocean through flood control canals, but instead retaining it for on-site landscape irrigation and, in the process, reducing demand for new water supplies piped down from central California. Gulf Coast experts recognize that decentralized infrastructure was less vulnerable to damage from Hurricane Katrina than were centralized systems. And, engineers have come back from trips to China and Europe with alarming stories about a collapse of America's hard path water and wastewater infrastructure as the "gold standard" for modern sanitation. These stories have sparked a curiosity about the decentralized and holistic water infrastructure designs that are a hallmark of much of the innovation overseas.

Obstacles to the Soft Path in Water Resource Infrastructure

However, there are great obstacles to a shift from hard path to soft path solutions in water resource infrastructure throughout the U.S. In part, the decades of prior investment in underground pipes and treatment plants make it difficult for water and wastewater managers to even think about diverting scarce funds away from fixing aging water and sewer lines and into building new soft path systems. Economists assert that "sunk costs" should always be ignored when looking forward, but this requires a shift to longer-term, more innovative planning and strategies at a point when both public and private sectors in the U.S. have drifted to shorter and shorter time-frames. In contrast, developing

countries without infrastructure already in the ground can more easily "leapfrog" into emerging soft path systems and approaches, leaving the U.S. farther and farther behind.

Much of the potential for decentralized systems to increase the efficiency and lighten the footprint of the infrastructure is foreseen by advocates. But, as in all such transitions to a new paradigm, the precise technologies and applications are still evolving and often higher in price than they can eventually be.

Methodologies for assembling and deploying wide networks of these systems to restore damaged ecosystems and to revitalize communities are also just emerging. Many of the most important innovations are in institutions and markets, where government, the private sector, non-governmental organizations, and consumers will have to broaden their perspectives and take responsibility for dispersed treatment on private properties. Without proper support and resources, however, the uncertainties and higher costs of the nascent soft path will block the necessary exploration and "winnowing" of best practice.

There are also a host of institutional and market rigidities and barriers to beginning a long-term shift to a soft path approach over time. These include siloed bureaucracies that fail to consider the inefficiencies and adverse impacts of their separate hard path projects; engineers and construction workers who are only trained in hard path designs; a range of interested parties that would stand to lose from a soft path approach, including municipalities that annex new taxpayers through extension of sewer lines, and construction companies and

unions that only work on hard path projects; declining research budgets for breakthrough technologies and pilot projects; a pervasive risk aversion throughout the water field; and a self-perpetuating absence of good examples in the ground. Self-perpetuating because without good examples in surrounding towns it is hard to argue for an innovation in your own community, and without good demonstration projects, the benefits of the soft path approach can't be documented.

In a private market, a good new product can begin with a niche market and quickly transform an entire sector, as can be seen with cell phones replacing land lines, automobiles replacing horse-drawn carriages, etc. In a heavily-regulated, public-private market like the water field, however, no process such as economists have described as the "winds of creative destruction" exists. Innovators have trouble selling their products and services in a system in which regulators, municipal utilities, engineers, unions, and other entrenched bureaucracies or interests can refuse to alter the rules and practices or to retrain in new approaches. Indeed, often just one of these constituencies can block a new approach that a majority of local stakeholders might support.

The Federal Role in Perpetuating a Hard Path

The federal government plays a significant role in perpetuating the hard-path approach. Regulatory structures were devised which assumed that modern sanitation and safe drinking water could only be provided through centralized distribution or collection and treatment. Progress in small towns was

achieved, for example, when public water lines were extended to all homes, or when failing private septic systems were replaced by public sewers and point-source treatment plants. Federal subsidies to local projects from a host of federal agencies were built around those assumptions as well. What this means is that local water protection advocates typically have to ask their communities to buck federal and state regulators, as well as give up federal subsidies, if they are to advance a soft path solution.

Multiple federal agencies have also gotten involved in a piecemeal fashion in one or another aspect of water infrastructure – through water supply or water quality concerns, flood control, housing, rural development, etc. But rarely is a serious integrated water perspective taken at any level. This "siloing" of mission and the lack of coordination among agencies have led to federally-mandated and federally-funded projects that have collectively overstressed the environment and wasted resources.

This report is about what the federal government could do to advance a soft path water paradigm across the U.S., difficult as that may be. Clearly, the most significant federal actions would be to remove the strong bias in federal funding and regulations favoring hard path solutions, to integrate and coordinate the missions of federal agencies involved with water supply and quality, and to ramp up and revitalize basic research and demonstration programs. Pilot projects would cover the costs and risks of early innovations and would develop and try out the new institutional structures needed for soft path system management.

In the process, the government would also be signaling the private and non-profit sectors that large new markets should be opening over time for new decentralized technologies, and the talents and resources of venture capitalists, major technology corporations with substantial research budgets, real estate developers committed to more sustainable development, and new non-profit research foundations could be harnessed as well. Because small-scale treatment units are generally on private property, the private sector can play a more substantial role than it can with large, centralized systems on public property. These new private markets need to be encouraged as engines of reform and innovation, and state and local regulators should carefully expand the suite of new technologies that can be used. Federal tax incentives would stimulate market expansion. As the markets develop, however, public oversight will be needed to assure both high-quality service for all income levels and consistency with broader water resource and community plans.

These critical changes in federal policy will be difficult to accomplish in an era when the federal government shies away from imposing new mandates on state or local governments and is facing major federal budget deficits. However, there are modest, short-term opportunities for federal help to soft path water “change agents” at the local level. Both federal agencies and Congressional committees still support the concept of grants for innovative environmental projects, studies, and conferences, and for the piloting of new technologies at federal facilities. Advocacy at the national level

could potentially divert more of these funds to the soft path water field, and through demonstrated success of soft path approaches, slowly build the case for more substantial reform of federal policies over time.

A New Alliance for the Soft Path

This project began out of frustration that soft path advocates were having so little success in persuading the Congress to introduce funding incentives for soft path projects in EPA’s Clean Water State Revolving Fund and in the highway trust fund. Several questions motivated the study: Why were soft path proposals meeting so much resistance in the Congress? Should advocates look beyond EPA to see how other federal agencies could promote the soft path agenda? Which policy changes could have the biggest impact? Was part of the problem that advocates were unnecessarily disorganized and not seen as credible?

A series of four one-day workshops was convened from November, 2005 to January, 2006 that explored the potential for development of “new strategies and new alliances” to advance the soft path water agenda. An unusually diverse group of environmental, industry, engineering, utility, homebuilding, and public interest groups met with local advocates and researchers from across the country to identify the needs and opportunities for developing soft path projects and to consider a range of options for federal policy.

Recommendations for Short-Term Federal “Support”

The following short-term recommendations for federal policy initiatives emerged from this consensus-building process:

- Support for pilot and demonstration projects in federal facilities and in local communities
- Research on full monetary and non-monetary benefits and costs of soft and hard path approaches, and pricing or other mechanisms to better align local decisions with long-run environmental and economic sustainability
- Linking the soft path water field to the “green building” movement and development of similar “standards” and “ratings”
- Exploration of how to tie federal subsidies and permits to an integrated water supply and water quality plan in a watershed
- Support for a network of local advocates and experts, through education, tools, and capacity-building
- Work with federal leadership to provide guidance on the benefits of soft path approaches to federal agencies and to the nation.

Recommendations for Long-Term Federal Leadership

These projects, which are well within the capacity of the current political environment to support, can be vital in helping change agents across the country develop and implement soft path technologies and related institutional reforms. Progressives and conservatives alike see the unique strength of America in its history of vital civic engagement. It is true that committed and creative activists and entrepreneurs have begun

to work on soft path water projects at the local level. These groups may, in the process, discover the language and set of solutions that can motivate the public to support the soft path approach more broadly. But without more substantial federal commitments to break down the funding and regulatory barriers to the soft path, the likelihood is still that the decentralized technologies will flourish only at the margins of hard path engineering.

Without restoration of a more serious basic and applied research program in universities and institutes, the complexities of water hydrologies and the disruptions or, conversely, the restorative capabilities of various types of infrastructure will not be understood. The suite of breakthrough technologies and institutional reforms will remain underdeveloped. The U.S. could continue to import innovative technologies and concepts from overseas, as it does now in the hard path water and wastewater field, but research in universities is also a key element in the training of high-skill American engineers.

Demonstration projects and pilots will provide models and increase confidence in soft path approaches, but if major funding and regulatory programs are not reformed, opportunities for widespread adoption of these innovations will still be limited. And, while the development of a green building and private sector approach to water resource technologies may penetrate new development in environmentally-progressive coastal states, the spread of new concepts into older communities and middle America is not assured.

The research for this project, therefore, also suggests that more substantial long-term federal policy initiatives are needed. The following recommendations were developed by the author of this report, but were not specifically discussed in the “new alliance” workshops. These recommendations include:

National Leadership:

- Establish a national, inter-agency project to articulate a vision for federal action to achieve long-term sustainability in the water resource infrastructure sector;
- Establish an approach that properly supports and partners with local and private sector initiatives, but which also recognizes the indispensable role of the federal government in research, financing incentives, and regulatory reform.

Research:

- Fund comprehensive surveys of emerging research and new applications of integrated and decentralized infrastructure in developed countries, such as in Europe, Australia and Japan, and in developing “leap frog” economies, such as China and India;
- Fund the formation of several Centers of Excellence at universities or research institutes, for the purposes of coordinating basic and applied research in soft path water infrastructure;
- Initiate research in water, wastewater, and reuse applications of bio-mimicry, biotechnology, nano-technology and other leading edges of science;

- Study a broad range of potential institutional reforms, including integrated water management, privatized system management and financing structures, and local performance-based codes and ordinances;
- Research infrastructure options that integrate some or all systems across the “water chain” (source, use, treatment, reuse, disposal), at “multiple scales” (individual site, neighborhood, city, watershed), and in diverse settings (rural Greenfield development, suburban areas, and cities);
- Stimulate private and non-profit foundation investments in technology-related research, by helping to create large national markets based on voluntary national standards and by signaling a long-term commitment to greater efficiencies and a lighter footprint in the infrastructure;
- Develop 50-year projections on water supply and quality, and explore the likely impact of alternative infrastructure paths, including the use of soft path infrastructure both to complement and substitute for hard path projects.

Financing Reform:

- Shift some of the policy and budget discussions away from the current preoccupation with how much the federal government should contribute to fixing the aging hard path water and wastewater infrastructure and focus on how to rebuild an

- ethic and practice of innovation in the sector;
- Create financial incentives for use of soft path approaches in all federal subsidy programs, including EPA's Clean Water and Drinking Water State Revolving Funds, and USDA, HUD, Commerce, and other grant or loan programs;
 - Expand eligibilities for federal funding to include support for systems on homeowners' private property, including water conservation technologies, advanced onsite wastewater treatment, rain gardens and other stormwater retention designs, and graywater and wastewater reuse;
 - Prohibit use of federal funds for infrastructure projects that promote land development in water-sensitive areas;
 - Incorporate soft path water systems in any new federal tax incentive programs for green buildings;
 - Collaborate with progressive financing institutions, such as the World Bank, insurance companies, real estate mortgage companies and others, in setting standards for investments in sustainable infrastructure and Green Building projects;
 - Implement an integrated water resource planning requirement for all recipients of federal water infrastructure subsidies, including both water supply and water quality projects from a variety of agencies.
- Regulatory Reform:*
- Fund a study group to identify problems in the current regulatory structure, which is based in hard path approaches and which divides authorities into separate spheres of water quality, water quantity, surface water and groundwater, flood control, endangered species, etc. This group should consider alternatives for both incremental reform and significant new federal legislation;
 - Develop mechanisms for incorporating soft path technologies into municipal point-source wastewater and stormwater permits, through such requirements as "soft path technology portfolios" similar to renewable energy portfolios;
 - Incorporate "adaptive management" and "performance-based" approaches into the federal permit process so that higher-risk new approaches can be tried without penalties (SEP);
 - Explore new enforcement points and standards, such as mandated water use and reuse "efficiencies" and reduced discharges;
 - Explore ways to coordinate and integrate enforcement actions in surface water quality, source water protection, drinking water, groundwater, sediment and flood control, coastal zone management, estuary protection and endangered species, and streamline the processes by which local communities can meet the requirements;
 - Develop models for state and local design codes, as well as for oversight of pricing and service by new design-build-operate companies, so that expanding

- private markets are equitable and consistent with broader water resource plans;
- Appoint a new Water Commission to study and recommend to the Congress better mechanisms for promoting sustainable infrastructure development programs across a wide variety of agencies and Committees, including natural resources, environmental protection, public infrastructure, science, housing, and economic development.

Looming Water Crises and the Arguments for Soft Path Water Research and Activism

Success in harnessing the resources of the federal government will probably only be accomplished when there is either a stronger articulation of a looming water crisis, or a realization that the U.S. will suffer in a competitive global economy if it does not do more to shake up its infrastructure paradigm. There are beginning conversations in federal agencies and the Congress about the need for more long-range planning in the water sector to deal with such concerns as spread of drought conditions into the Northeast and South, increasing conflicts over human and ecosystem needs for clean water, stresses on the infrastructure from climate-change weather extremes, emerging contaminants of concern, and rising energy costs and energy-water interactions. Few of these conversations include the consideration that soft path water infrastructure systems could be significant elements in addressing these concerns, but they clearly should.

Further, without a focused effort to develop alternatives to the hard path infrastructure paradigm, the U.S. could well drift into a sub-optimal steady state relative to other countries. As earlier critics of the hard path approach had warned, either too much money would be spent on continuing repairs to outmoded technologies, or too little money would be spent and the infrastructure would continue to deteriorate.

Unnecessary and growing costs would be imposed on the natural environment. Opportunities for “greening” the cities and reusing wastewater nutrients and energy would be foregone. And, finally, the U.S. would also cede high-skill jobs and products to overseas workers and companies.

A deeper and more diversified alliance of advocates will need to be mobilized to make these arguments. The workshops and research for this project are a first step in that multi-year strategy.

TABLE OF CONTENTS

Acknowledgements	2
Executive Summary	3
Chapter 1: Introduction	12
Chapter 2: A Primer on the Soft Path Water Infrastructure Paradigm	17
Chapter 3: National Innovation Models and Strategies	30
Chapter 4: Targets and Dimensions of a Soft Path Water Paradigm Shift	36
Chapter 5: Mobilizing the “Support Role” of the Federal Government in the Short-Term	42
Chapter 6: Federal Leadership in Research and Project Financing in the Medium-Term	48
Chapter 7: Federal Leadership in Regulatory Reform in the Long-Term	59
Chapter 8: “New Strategies and New Alliances”: Recommendations of a Workshop of Experts and Advocates	69
Chapter 9: Summary and Conclusions	82
Footnotes	85
Bibliography	87
Appendix A: Workshop Participants	95
Appendix B: New Alliance Activities	97

Chapter I: Introduction

In recent years, a number of national organizations have urged the Congress to use federal legislation and funding incentives to promote the development and use of soft path approaches. Success in these efforts has been modest at best. While a provision for favorable zero-interest loans for soft path projects in the Clean Water State Revolving Fund (CWSRF) has been included in appropriations bills for several years, this provision is voluntary on the part of states and has had little impact on their funding allocations to traditional hard path projects. Several research and demonstration programs were funded in EPA appropriations for almost a decade, but were not included in recent bills. Efforts to secure funding for distributed stormwater projects in the 2005 Highway Bill were also blocked by the Senate.

An interesting diversity of constituencies had made the case for each of these measures. The Natural Resources Defense Council (NRDC), American Rivers, Clean Water Action, Coalition for Alternative Wastewater Treatment (CAWWT), and numerous groups in the Clean Water Network have supported the zero-interest incentive for distributed and nonstructural projects in the CWSRF. American Rivers had led a broad coalition in urging a set-aside for stormwater projects in the Highway Bill. CAWWT, the National Rural Electric Cooperative Association (NRECA), Water Environment Research Foundation (WERF), Electric Power Research Institute (EPRI), and Consortium of Institutes for Decentralized Wastewater Treatment

have also collaborated in a Congressionally-initiated research project, the National Decentralized Water Resources Capacity Development Project. The Congress also funded the National Community Decentralized Wastewater Demonstration Project, and 25 communities were designated for construction and planning grants over a period of several years.

A number of other organizations have also unsuccessfully urged the federal government to pay more attention to the development of distributed and nonstructural approaches in the water sector. The National Association of Home Builders (NAHB) has articulated for over a decade the need for research on low impact development stormwater BMPs that would be used in subdivision development.¹ More recently the NAHB Research Center (NAHBRC) conducted a broad stakeholder review of unmet research needs in the water field and identified a range of research questions on the performance and impacts of distributed water, wastewater, and reuse systems on water quality.² Taxpayers for Common Sense, American Rivers, NRDC, and the Progressive Policy Institute have also issued reports urging greater use of soft path water infrastructure.³

In spite of these reports and advocacy positions, the commitment of the federal government to exploring the soft path water agenda has been minimal. EPA has issued a series of guidance manuals in separate fields, such as decentralized wastewater and low impact development in non-urban areas, and has recently been funding the development of a water-efficiency labeling program called WaterSense.⁴ Minimally-funded

training and outreach projects have also been coordinated with stakeholder groups.⁵ But large-scale research, funding, or regulatory initiatives that would dramatically jump-start the soft path field have not been considered.

Purpose and Objectives of This Project

The purpose of this project has been to explore the potential for a significantly more effective federal role in shifting the nation's water resource infrastructure to a more sustainable, soft path paradigm. There were three specific objectives in this project: first, to research programs and policies in a host of federal agencies involved in one segment or another of the water sector; second, to create a new and stronger alliance of constituencies interested in various aspects of the soft path water sector; and third, to develop recommendations for a portfolio of high-priority federal policy initiatives to advance the soft path field in both the short and the long-term.

Research for the Project

An initial objective of this project was to explore a broad range of programs in EPA and other federal agencies and departments for potential support of soft path water approaches. Through website searches and interviews, a number of initiatives in departments such as the Department of Energy (DOE), US Department of Agriculture (USDA), and others were identified that are exemplary of how to expand federal involvement in the soft-path water field. Results of this research are presented in the Catalogue of Federal Water-Related Programs and Organizations: Support for Decentralized and Integrated Water

Research and Infrastructure, which accompanies this report.

It also became clear over the course of the project that it was important to research various theories on how innovation occurs in public-private markets and the basic tools that national governments have to promote innovation. This literature helped place the current Administration and Congressional philosophies and principles of governance in a broader historical and international context.

Creation of a New Soft Path Water Alliance

A key premise of this project was that constituencies interested in soft path water approaches had failed to work in partnership for a variety of historical and cultural reasons that could be overcome. In the past, a few "ecological engineers" developing natural treatment systems would occasionally speak at environmental conferences.⁶ But in general, environmental advocates and engineering and utility experts rarely communicated or worked on common projects. Much of this siloing was based on unexamined assumptions that their goals would be different. Homebuilding and environmental constituencies also never took the time to explore their common interests in any useful depth. What this siloing prevented was the development of a richer, multi-faceted understanding of what was happening in the field and of priorities for federal policy reform. Lost also was the development of a diverse constituency that would be taken seriously by federal departments or Congressional committees.

In this project, it soon became clear that many groups share a desire for a strengthening of soft path approaches and, over time, of more widespread adoption. Curiously, both progressive and conservative groups believe that the best and most creative solutions are developed by diverse stakeholders at the grassroots level where options and impacts are directly experienced, but they recognize that the federal government often has to permit these efforts, and can help to provide the proper tools and incentives for their work.

A key objective of the project was to identify policy initiatives that a majority of constituencies could support, and this was not difficult. Evidence that such a consensus-building effort might succeed could be seen in other environmental fields, such as the Green Building collaboration of architects, business, and environmentalists, in a new alliance of progressive farmers and fiscal conservatives taking on farm subsidies, and the Apollo Alliance of unions and environmental groups urging a range of sustainable energy initiatives.

The representatives of organizations that agreed to participate in the project and, specifically, in a series of four workshops, were the following:

Valerie Nelson, Coalition for Alternative Wastewater Treatment (CAWWT)

Nancy Stoner, Natural Resources Defense Council (NRDC)

Betsy Otto, American Rivers

Paul Schwartz, Clean Water Action

Mike Luzier, National Association of Home Builders Research Center (NAHBRC)

Steve Ellis and **Autumn Hanna**, Taxpayers for Common Sense

Jim Kreissl, Water Environment Federation (WEF)

Ray Ehrhard, Electric Power Research Institute (EPRI)

Scott Drake, National Rural Electric Cooperative Association (NRECA)

Matt Byers and **Linda Bonner**, National Onsite Wastewater Recycling Association (NOWRA)

Chris Kloss, Low Impact Development Center

Tracy Mehan, Cadmus Group

Steve Moddemeyer, City of Seattle

Rod Frederick, EPA

Robert Goo, EPA

A variety of other individuals and representatives of federal agencies, universities, non-profit organizations, public utilities, and engineering firms interested in the soft path field participated in one or more of four workshops held between November, 2005 and January, 2006, and their names are included in Appendix A. The greatest familiarity of workshop participants was in the decentralized wastewater and stormwater fields and in water quality programs at EPA, but drinking water quantity, energy, and land development expertise was also represented.

It was recognized that participants in this project would have different perspectives on the needs and opportunities for adoption of soft path approaches, and different capabilities and levels of interest in advocacy and research, and this was viewed as both a strength and a challenge for the project.

It was also recognized that there are other organizations and constituencies interested in a soft path water approach, but a decision was made to keep attendance in the workshops fairly small so as to facilitate the discussions and development of recommendations. In the future, the alliance will be expanded.

Recommended Portfolio of Federal Policy Initiatives

The third objective of the project was the articulation of a set of recommendations for federal policy to advance the soft path water paradigm. A workshop of the new alliance members was convened on January 19, 2006 in Washington, D.C. to develop an agenda for action. The goal of the discussions was to identify short-term initiatives that would meet three criteria: 1) high impact in advancing the soft path approach; 2) high likelihood of success in getting underway; 3) willingness of organizations to spend time in promoting or developing. Long-term strategies for more significant policy changes were also discussed, but it was recognized that these costly proposals that run contrary to current governing philosophies and policies, would be more difficult to achieve. Long-term recommendations presented in this report are therefore primarily by the author.

This Report

In the chapters that follow, the results of the research for the project are presented, followed by the recommendations of the new alliance of organizations. Chapter 2, a “primer” on soft path water, describes the evolution and prospects for the field. Recent experiences are showing, contrary to

earlier hopes and expectations, that mainstream utilities and communities have been very slow to adopt soft path approaches, even on an experimental basis, and that the agenda for scattered soft path projects across the country is instead being advanced by local community activists and leading-edge companies on the margins of the water field.

Chapter 3 describes a useful convergence between the needs of these change agents for technical and financial assistance, and a prevailing innovation strategy that sees the federal role as one of “support” to local communities and the private sector. Chapter 4 lays out a matrix of specific goals for such an innovation “support” strategy. Chapter 5 lists a sampling of agency-related research, pilot and demonstration projects, labeling programs, guidance manuals, small business assistance, conferences, and information dissemination initiatives in a wide range of federal agencies that have already funded isolated soft path projects in the past or that could fund such projects in the future. Coordination across programs and higher levels of funding would be desirable.

Chapters 6 and 7 return to the importance of more substantial structural changes in how the federal government approaches the water resource sector. If soft path approaches are to move from the occasional pilot project at the margins of infrastructure into mainstream practice throughout the country, the federal government will need to reinvigorate a national basic and applied research program in water resource infrastructure, and remove funding and regulatory barriers against

soft path approaches that date back to passage of hard path funding and regulations under the 1972 Clean Water Act.

Chapter 8 presents the results of the January 19th priority-setting exercise, which identifies the most significant initiatives that should be pursued by EPA and other agencies, and by Congressional committees. Chapter 9 summarizes the key findings of the report.

Chapter 2: A Primer on the Soft Path Water Infrastructure Paradigm

The term “soft path” is best-known as it is applied to demand management or to use of more efficient technologies in the energy sector, both strategies which have been promoted extensively by Amory Lovins and others at the Rocky Mountain Institute.⁷ Peter Gleick of the Pacific Institute has also used the term soft path to include water conservation appliances and metering or differential pricing incentives to reduce the demand for water.⁸ An “integrated resource plan” has meant the consideration of these energy or water “demand side” strategies in tandem with the historic approach to expand “supplies”.⁹

In this report, the term “soft path” is broadened to incorporate a broad set of distributed or decentralized water, wastewater, stormwater, and reuse technologies and approaches that have a “lighter footprint” on the environment than hard path underground piping systems and central treatment plants. The term “integrated” refers to a blending in planning and system design of all the various sectors of water supply, use, treatment, and reuse or disposal, and, to some degree as well, an exploration of synergies with distributed energy, transportation, and related infrastructure.

Definition of a Soft Path Water Approach

Soft path water infrastructure systems rely on managing and protecting water resources near the point of use by the consumer. To varying degrees, they also

protect and make use of the environment’s own natural processes and assimilative and treatment capacity. Hard path systems, in contrast, involve centralized distribution or collection and biological and chemical treatment in central plants.

Distributed and decentralized water infrastructure systems include:

- *onsite and cluster wastewater technologies that provide higher levels of treatment than conventional septic systems, such as nutrient removal where drinking water supplies or sensitive surface waters are threatened*
- *professional management (vs. homeowner maintenance) to extend the life and improve the reliability of onsite and cluster systems*
- *stormwater retention and filtration, such as in rain gardens, and reuse in buildings*
- *low impact development designs*
- *stream buffers, land conservation, and farming methods protective of water quality*
- *water conservation fixtures and demand side management*
- *point-of-use water treatment devices*
- *dual-piping to separate potable from non-potable water and reuse*
- *reuse of graywater (sinks and showers) and blackwater (toilets), such as for irrigation or toilet flushing, even in retrofits or infill development in cities*

- *distributed recharge of aquifers*
- *telemetry and monitoring of technologies and ecosystems*
- *public-private collaboration and market innovations*
- *reuse of wastewater nutrients in landscaping and agriculture*
- *reuse of wastewater in energy production (bio-gas) or heat recovery*

Definition of Integrated Water Resource Management

The water resource management field currently has many “sectors” or “disciplines”, including wastewater, drinking water, stormwater, land use development, non-structural flood control, reuse, and others. Each of these has a separate set of regulations, bureaucracies, engineering specialties, and contractors. Integrated water resource management means that planning and system design for each of these sectors is conducted within the context of all other sectors. Too often, facility planning fails to take account of all the direct and indirect impacts on other sectors. In this context, soft path approaches will often have distinct advantages over centralized infrastructure, since there is less impact on natural hydrologic processes and better assimilative and treatment capacity. Multiple, expensive piping networks can also be avoided. For example, water lines to homes, sewers away from homes, and treated wastewater back to homes for reuse can all be avoided by localized source, treatment, and reuse systems.

More recently, there has been interest in the benefits of integrating water resource planning and systems with energy,

transportation, agriculture, and other sectors of public infrastructure and the economy. One motivation is the significant use of energy by water and wastewater treatment plants, and conversely, the use of water by power plants. A key benefit of urban rain gardens, for example, is the reduction in the heat island effect. Cities can also achieve substantial savings by coordinating infrastructure capital projects street by street or neighborhood by neighborhood. More broadly, decentralized water and wastewater systems could underpin more sustainable development patterns, and create a broad range of economic, social, and aesthetic benefits.

A related term, “closing the loop”, has been used for manufacturing processes that reduce the input of raw materials and the production of “waste”, and that maximize recycling and creation of valuable products from this waste stream.¹⁰ In the water sector, the concept would be to reduce the use of water, particularly from off-site drinking water sources, maximize the reuse of stormwater and wastewater, and capture the value of nutrients and other constituents in the wastewater stream, prior to release of water back into the local environment. The emerging “clean tech” industry and venture capitalists define the term as “technologies developed by biological, computational, and physical scientists and engineers that enable more valuable use of natural resources and greatly reduce ecological impact.”¹¹

Dominance of the Hard Path Engineering Paradigm

In the mid 1800's, according to Joel Tarr of Carnegie Mellon University, there was an extended debate over whether dispersed private cesspools in urban areas should be replaced by public sewer systems.¹² This issue had arisen unexpectedly after water lines were built to bring clean water to residents. People started to use the water in toilets, and cesspools were as a result overflowing. The sewer or "water carriage" approach (water was used to dilute and "carry" human waste away) won the debate, in spite of reservations by some engineers, and by the 1940's, sewer service was provided for half of American homes. Untreated sewage was typically released into surface waters. A major achievement of the 1972 Clean Water Act was the accelerated construction of treatment plants, as well as sewers. By the turn of the 21st Century, 75% of homes in the U.S. were served by sewers.

While this choice of the hard path approach in the 1800's brought dramatically improved public health conditions to the cities, fears about the adverse public health and economic impacts of central sewers which were voiced by critics at the time are now eerily familiar. They included:

- *lost opportunities for reuse of septage as fertilizer on farms;*
- *leaking sewer pipes and degraded water quality for communities downstream from where sewers released untreated effluent;*
- *high costs for future generations of this capital-intensive method.*¹³

In recent years, advocates of decentralized approaches have taken note of similar problems in the hard path approach, which include missed opportunities for wastewater reuse; of leaking sewer pipes that are degrading groundwater; of contamination of surface waters when treatment plants periodically fail and as emerging "contaminants of concern" pass through conventional treatment plants; and the high capital costs projected for replacing and maintaining the aging infrastructure.

But other concerns about the cumulative impacts of central system approaches, and the inability of the environment to continue to absorb the externalities of hard path infrastructure, are starting to be discussed, including:

- *adverse environmental impacts of introducing nutrients, endocrine disrupters, and pharmaceuticals into sensitive estuaries, lakes, and fish/wildlife habitats;*
- *disruptions of hydrologic regimes and groundwater replenishment, with resulting reductions in stream flows and water supplies and saltwater intrusion in coastal aquifers and saltwater intrusion in coastal aquifers;*
- *channeled flood waters affecting downstream communities and disrupting ecosystems;*
- *loss of control over development patterns and increased contributions to stormwater runoff that usually follow the construction of water and sewer lines.*

Benefits of Soft Paths

Typically, comparisons of the construction and maintenance costs of water and wastewater infrastructure are at the forefront of investment decisions. Often, for new development, calculations will show distributed and nonstructural system approaches, such as low impact development or cluster wastewater systems, to be less costly to install than central collection and treatment systems. For existing communities, the impacts of distributed systems, such as rain gardens, are less well understood and may appear to be more costly than new stormwater collection and storage systems (separated from conventional sewers). But soft path infrastructure can also produce other benefits for communities, including:

- *avoidance of the need to expand water supplies, by capturing and reusing stormwater or wastewater instead;*
- *reduced peak flows and enhanced capacity of existing sewer and stormwater pipes to handle storm events;*
- *energy savings from reduced demand for air conditioning when trees are providing shade or green roofs are cooling buildings;*
- *financial savings by spreading investments out over time (avoiding loans for large construction projects), and by integrating projects into road, park, and building budgets;*
- *ability to target wastewater and stormwater solutions at localized pollution problems that currently exist, without creating the infrastructure that promotes*

rampant, uncontrolled growth wherever the water and sewer lines run;

- *creation of local jobs in installation and long-term maintenance;*
- *restoration and preservation of open space (used for treatment), recreation areas, fish habitat, stream daylighting;*
- *improved public health and increased property values for those who live near this “green” infrastructure;*
- *reuse of nutrients in agriculture;*
- *recapture of heat and energy in the organic wastes;*
- *removal of toxics at the source, rather than contamination of the entire waste stream in sewers.*

Hard Path Engineering on Auto Pilot

In spite of the growing realization that hard path water infrastructure has been a very costly and disruptive approach and that soft path systems have many benefits, the water sector continues down the hard path. As recently as EPA’s Clean Water Needs survey in 2000, the assumption by state and local officials was that the percentage of homes connected to sewers should eventually increase from 75% to 88%.¹⁴ Studies of the “gap” in funding for water and wastewater also assume that existing piping systems will be repaired, rather than displaced or complemented by new soft path approaches.¹⁵

At a high-level WERF workshop in 1998, this practice of meeting new societal demands with incremental improvements in the existing hard path paradigm, rather than through a

fundamental rethinking of the paradigm, was discussed.¹⁶ Over time, stricter water quality standards for effluent going into surface waters were met at the treatment plant through higher levels of treatment, first by primary (settling of solids), then, secondary (removal or organic contaminants), and eventually, tertiary (removal of nutrients) treatment. Arguments for greater water sector integration and reuse were met with other central system adaptations, such as reuse of some treatment plant sludge in fertilizer pellets.

The latest short-term “fix” to the hard path is the drive to develop large desalination plants to increase the supply of water, rather than to reduce the demand for water through water conservation appliances or stormwater capture and reuse at individual homes. A second example is the current EPA research focus on new piping materials and designs, rather than research on decentralized systems. Participants in the 1998 workshop agreed that localized treatment, advanced bio-technology, and reuse would be the key improvements in a paradigm shift, but recognized the barriers to introducing these innovations into the mainstream practice.¹⁷ Their hope was that constituencies other than engineers and municipal utilities would step forward to promote the paradigm shift.

Possible Scenarios for the Expansion of a Soft Path Paradigm

In February, 2002, a CAWWT-sponsored “futures” workshop on integrated soft path water infrastructure identified five possible scenarios in which soft path water approaches could

be put to use in the U.S.¹⁸ These scenarios are summarized below, in part to highlight what experts have believed to be the potential applications of decentralized and integrated approaches, and in part to demonstrate how resistant existing institutions have continued to be to exploring the soft path. Each of these scenarios describes a different set of institutions that it was hoped in 2002 would develop and incorporate soft path approaches, including small communities, urban utilities, designers and manufacturers, federal and state governments, or environmental activists.

Scenario A: “Pragmatic Integration in Small Communities”

The first potential soft path forward would lie in the inventiveness and pragmatism of small town America trying to solve its problems without the expectation of much outside financial help. In Scenario A, individual communities would lead the charge to soft path water resource management, in part to avoid large capital projects that are beyond the reach of the local tax base, and in part as a tool to stimulate development consistent with preserving community character and protecting natural resources. Specific problems requiring attention would be: increased number of contaminated wells, failing septic systems, polluted streams, lakes, or beaches, depleted water supplies, and problems attracting new industry.

Small communities do not have the economic resources to build large centralized transport and treatment systems for water, wastewater, storm water, and flood control. Under Scenario A, they would deploy solutions

that 1) build on the existing infrastructure of individual septic systems; and 2) solve more than one problem at a time, such as simultaneously addressing both storm water and wastewater. These communities would make use of decentralized wastewater systems, artificial wetlands to provide treatment for parking lot runoff, green strips to reduce agricultural impacts on water bodies, and they may even explore water reclamation for irrigation of recreational lands or in small areas where the population is relatively concentrated. Wetlands, existing or constructed, could play an important role in flood control as well.

Prior to the workshop, this scenario was ranked as the most likely to emerge, but by the end of the workshop it was ranked next to last.

Scenario B: “Restoring the Urban Mass Balance”

Another school of thought suggests that the most pressing needs for integrated water resource management exist in major metropolitan areas, with tightening water supplies and increasing water and wastewater infrastructure replacement costs. Under Scenario B, major metropolitan utilities would have learned to adapt, refit, and modify their water and wastewater systems to fit better within the natural hydrologic regime and to restore/preserve the natural “mass balance” of water in the local geography. Precipitation that falls within their boundaries would be captured, and wastewater would be reused, thereby meeting much of current and future water demand. Groundwater

recharge with stormwater and treated wastewater would be commonplace.

Much of this integration can be achieved with inherited “hard path” infrastructure, but additional benefits can be achieved by introducing soft path solutions as well. Satellite wastewater treatment facilities, for example, can be built to provide water for reuse in various districts and neighborhoods. Stormwater would be regularly captured, treated, and reused as irrigation water (or other uses) at many points throughout the urban and suburban grid. Non-potable reuse could include firefighting, car washing, toilet flushing, and irrigation of lawns, crops, golf courses, parks, median strips, and other vegetation, and reuse could be significantly cheaper than desalination. Artificial and natural wetlands can play an important role in treating runoff.

Many of these new installations can enhance the aesthetics of the city and the health and well-being of residents. This scenario relies heavily on new business, pricing, and market models. Customers would be divided into different market segments, with higher rates for higher quality, potable water, and lower rates for non-potable water.

Scenario B was ranked third most likely prior to the workshop, but the first most likely after extended discussions in the workshop.

Scenario C: “Keep the Water On the Site”

Scenario C’s philosophy of “Keep the Water on the Site” would emerge if a comprehensive and widely accepted understanding of micro-scale wastewater and stormwater treatment and

management had led to the development of safe and reliable systems, in particular for potable and non-potable reuse at the home or subdivision scale. Wherever and whenever possible, builders, engineers, and technology manufacturers would push for the tightest, shortest, closed loop systems possible. This means that water would be both drawn from local available resources and be returned to the environment as near to its point of use as possible. Any individual neighborhood, town, county, or watershed would be a patchwork of very innovative, integrated, and locally customized water treatment and traditional practices. Advanced onsite treatment systems would be carefully tailored to work with the local soils and hydrology to provide treatment (not just subsurface disposal) and reuse of stormwater and wastewater. In some cases even point-of-use drinking water purification would be done at the individual home.

“Micro-scale” technologies include: rainwater capture and use for irrigation, toilet flushing, etc.; graywater and wastewater reuse; optimum assimilation of rainwater in the landscape; multifunctional, multi-benefit technologies; water conservation and waterless toilets; alternative disinfection technologies; and remote monitoring and telemetry. These innovative equipment and systems design concepts would be backed by stringent, well-established operation and management (O&M) requirements to ensure that they are continually effective. Either utilities or private maintenance companies could perform these services, under public regulatory oversight.

Scenario C was ranked the second most likely future, both before and after the workshop discussions.

Scenario D: “Integrated Planning and Regulations”

A fourth view of the future suggests that there would be a growing awareness and movement among the regulatory and policy community to provide a more holistic framework for water quality management. Under an overarching framework of “sustainability”, a wide range of currently separable fields would be merged, including water quality, water quantity, habitat protection, landscape and community character, economic well-being, and social/cultural health. Integrated water resource management plans would be developed around the natural water hydrology of the region, and actions of various agencies would be coordinated under this one plan. Regulations would still be required, but there would be a shift towards performance goals, so that maximum flexibility would be provided for cost-effective and innovative technologies and methods.

Scenario D was considered the least likely prior to the workshop, and third most likely after the workshop.

Scenario E: Preservation and Reliance on Natural Systems

A final scenario would rely upon the power of the public and the environmental community to act as catalysts for change. Under Scenario E, the public has come to recognize that there is no better way to ensure clean, safe, and plentiful water than to rely on, and work within the carrying capacity of

natural systems. Environmental groups would be much more aware of the details and design trade-offs associated with alternative approaches to integrated water management than they have been in the past.

Under Scenario E, the concept of green infrastructure would be widely accepted. There would be more setback and set-aside requirements of areas where there are natural hydrologic functions. Flood plain and coastal building problems would be well under control. Long-term planning based on an understanding of how flood plains and coastlines change would ensure that we do not build in places that are likely to be destroyed by storm events and erosion. Urban streams would be valued as precious assets in the life of a city and rain gardens and green parks would be major elements in movements for healthy cities, exercise trails, and increased attention to aesthetic values. Wetlands would be particularly valuable given their broad role and multiple uses. They would be protected wherever they exist, restored wherever possible, and often constructed to provide natural treatment of stormwater and wastewater while simultaneously creating new habitat.

Scenario E was ranked next to last in likelihood prior to the workshop, and least likely after the workshop.

2006 Update – Only Modest Progress in the U.S.

Since 2002, there has been less progress in the soft path water field than participants in the workshop had hoped. In several of the siloed sectors of the soft path field there have been modest advances. But there has not been much

incorporation of soft path approaches by established utilities or engineers, and little by way of integration across the siloed sectors of water, wastewater, stormwater, and reuse.

The scattered advances in separate sectors of the soft path field include:

- *new, advanced onsite alternatives to septic systems are being permitted in more and more states—for use in sensitive areas or on non-complying sites;*¹⁹
- *mandatory requirements for professional management of onsite systems are being established in scattered communities;*²⁰
- *cluster wastewater systems, in particular, have been advancing in Greenfield developments, and new private utilities have been formed to install and maintain these systems in unsewered areas;*²¹
- *Phase 2 stormwater regulations have created increasing demands for low-impact development approaches;*
- *in arid parts of the country, reuse of wastewater for golf course irrigation is becoming fairly common, along with water conservation incentives for homeowners.*

However, the legitimacy of soft path systems as a permanent part of the infrastructure has not been widely accepted. Rain gardens and other distributed stormwater systems, for example, are rarely looked at as long-term components of urban runoff or combined sewer overflow remediation

plans or as alternatives to construction of new water supply systems. Localized reuse, particularly wastewater reuse for toilet flushing or recapture of nutrients in landscaping or agriculture (eco-sanitation), have been very slow to develop in the U.S. Sewers continue to be constructed in unsewered areas.

It was thought that water shortages would begin to force urban utilities to develop new water-efficiency and reuse programs as large-scale strategies (Scenario B). Water conservation programs in the arid Southwest are becoming fairly common. But other elements of an integrated soft path approach are still relatively rare. While cities such as Los Angeles and Seattle have begun to install rain gardens and cisterns, these are still on a pilot basis.²² Only a few waterless urinals or wastewater recycling systems have been installed in places such as NRDC headquarters in California, and most recently in New York City office and residential buildings.

Other than work in several national demonstration projects, there has been minimal effort to integrate technologies at the site or “micro” level (Scenario C). Wastewater planning and engineering is still largely done separately from stormwater engineering, whether at the individual home or subdivision level. Only a few university facilities are exploring the reuse of wastewater for biogas production or in growing of crops.²³ Manufacturers of “siloe” equipment have not been major drivers toward integrated systems.

Pragmatic integration of infrastructure at the small community level (Scenario A) has also not typically occurred. Low-

income rural communities are constrained in their choices by the hard path requirements of federal funding or by enforcement actions. Middle-income communities, with less access to federal subsidies, focus on the economic costs of systems and are told by engineers that soft path approaches are both more costly and more risky. They rarely consider the full range of soft path benefits.²⁴

Ironically, it is in the natural systems scenario (Scenario E), considered least likely by the 2002 workshop participants, that the greatest push for integrated soft path water approaches has occurred. The broader “sustainability” and environmental justice movements have successfully organized for the introduction of roof gardens, cisterns, tree planting, and other soft path or “green infrastructure” approaches into a number of cities, in particular Los Angeles, Seattle, Chicago, Portland, and Philadelphia.²⁵

In the private sector as well, the green building collaborative of environmental groups and builders has begun to incorporate sustainable, soft path water solutions into new “green” subdivision development scattered across the country. Green building ratings and guidelines have been oriented primarily to energy efficiencies and safe building materials, but more recently the US Green Building Council and other groups have begun to focus on water conservation and reducing stormwater runoff.²⁶ The full water “chain” from source to disposal has not yet been addressed.

Lessons from Recent Trends – New Entrants and Advocates are the Drivers

Probably the most significant insight from this four-year history is that existing institutions are unlikely to branch out or explore soft path approaches on their own. Mainstream urban water and wastewater utilities that already have substantial hard path water infrastructure systems in the ground have not, with few exceptions, recognized the benefits of incorporating soft path systems, such as rain gardens or reuse systems, into their portfolios. Small communities needing new infrastructure will almost always still look to conventional hard path solutions. Finally, even the long-time practitioners in each of the siloed soft path sectors have also hesitated to branch out into more integrated approaches, or apparently, to recognize significant market potential in doing so. For example, onsite wastewater companies and engineers are slow to explore synergies with stormwater design, reuse, or landscaping. Indeed, researchers in one of the national demonstration programs could find no examples of holistic water management or design even being studied at the individual site level.²⁷

In general, adoption of soft path approaches is coming from new private industry entrants or from political leadership or grassroots advocacy. For example, in New York City, it is a leading-edge engineer, Ed Clerico, who is designing wastewater recycling systems in an infill redevelopment at the Solaire and Battery Park, rather than the municipal utilities.²⁸ Installation and maintenance of cluster systems are being

implemented in many parts of the country by newly-formed private utilities, such as the Pickney Brothers.²⁹ In urban areas, soft path projects are being championed by political leaders, such as Mayor Richard Daley of Chicago, or by community advocacy organizations, such as Tree People in Los Angeles.³⁰

The lack of interest by existing institutions will likely be a continuing problem. Utilities can justify a certain amount of skepticism about soft path systems, since technologies are still evolving and performance data is poor. Utilities familiar with big engineered systems in public rights-of-way are nervous about relying on individual homeowners to maintain their systems and are hesitant to take on the management of thousands of dispersed systems on private property. Avoidance of risk and concerns about liability permeate decisionmaking.

Another systemic problem that the U.S. will need to address, however, is the short-term preoccupation with the deterioration of the existing hard path infrastructure. Economists point out that it is inappropriate to take “sunk costs” into account when planning for the future. Utilities should not be assuming that spending all available resources on repair and replacement of aging pipes is their only or most cost-effective solution for the long-term, but that is the strong tendency. Utilities are also not usually required to take into account the multiple benefits, such as reduced energy costs or improved aesthetics in neighborhoods, that typically would favor the soft path approach, but instead just focus on the immediate capital and maintenance costs

of providing water and wastewater services.

There are several other trends of note since 2002.

Budding Critique of the Hard Path Paradigm in Academic Circles

To date, national leadership continues to focus primarily on incremental, short-term improvements to the hard path water paradigm. EPA's strategy to address the looming "gap" in resources to deal with the aging hard path infrastructure is oriented around asset management efficiencies, full-cost pricing to raise local rates, or watershed approaches that could shift spending to the most cost-effective projects, including trading among treatment plants or with agricultural Best Management Practices (BMP's).³¹ Modest new research funds are being directed to improvements to piping systems, rather than a more radical restructuring of the infrastructure around decentralized or other approaches.³²

However, a number of academics have begun to focus on the adverse impacts of the hard path approach in ecosystems. These faculty members are often not well-trained or interested in promoting specific soft path water technologies per se, but rather are looking conceptually to decentralized approaches to lighten the infrastructure footprint in the environment. Examples of this budding academic interest are two Harvard School of Design conferences, the first, "Ecological Engineering for Integrated Water Management: Designing Industrial and Urban Watersheds", in 2003, and the second, "Green

Infrastructures for Water in the City", in 2005.³³

In the summer of 2006, the National Science Foundation and International Water Association also sponsored a conference, "Cities of the Future: Blue Water in Green Cities".³⁴ Conference organizers stated that "experts had realized that large and even middle size urban areas have reached their limits of ecological and hydrological balance and resilience to human pressures on water and groundwater resource, and had become vulnerable and unsustainable." A goal was to develop a new vision and paradigm for sustainable urban water resources, ecology, and infrastructure, and soft path water approaches were a key focus of panel discussions.

Energy/Water/Agriculture/Transportation Nexus

Since 2002, interest has been developing in the integration of water sector planning and engineering with distributed energy, agricultural reuse, and other sectors. In part this interest is a result of the exploration of integrated designs emerging overseas, and in part because environmental advocates and energy experts are increasingly discovering the synergies and interrelationships of these sectors.

At the national level, the DOE and research organizations such as EPRI have begun to map out long-term options for the "energy-water nexus" of large power plants and water systems.³⁵ Decentralized approaches are also being considered.

The National Academy of Sciences, in conjunction with the University of

California-Berkeley and other partners, has created an “Urban Sustainability Initiative”, which will research urban development practices across a broad infrastructure spectrum. Pilot cities will be in China and Africa.³⁶

Beginning Awareness of International Innovations

Few American engineers or utility managers have ventured overseas for international water conferences, but those that have are reporting back a significant movement to develop integrated soft path solutions in both developed and developing countries. In the past, US water and wastewater hard path engineering was viewed as the “gold standard” for modern sanitation. For years, American engineers and aid organizations focused on identifying cheaper versions of hard path solutions for poor countries and providing technical assistance to those countries.

A new picture of America’s declining role in the international world of drinking water and sanitation is emerging, however. First, the U.S. has become a net importer of innovative water and wastewater technologies and approaches; very little R&D is occurring in either the public or private sectors in the U.S.³⁷ Second, the sophistication of engineers in developing countries is increasing, and their relationships with European and American engineers are becoming more “collaborative”.³⁸

A significant portion of innovation in the water and wastewater sector overseas is in integrated and decentralized systems. A variety of these overseas initiatives will be highlighted in a March, 2007

conference in the U.S.³⁹ Sessions will include such topics as:

- *eco-sanitation, or “closed loop” reuse of nutrients in treated wastewater*
- *rainwater “harvesting” for reuse, rather than stormwater disposal*
- *Green Building with “off-the-grid” water infrastructure*
- *Decentralized technologies in the urban setting*
- *Watershed perspectives and soft path technologies for environmental restoration*
- *Water as a multiple-benefit resource in “Cities of the Future”*
- *Biotechnology research for new treatment methods*
- *Redesign of institutional structures for management of an integrated infrastructure*
- *Privatization of modular units*

A Harvard Business School professor, Clayton Christiansen, has written extensively about the pattern of new products developed overseas quickly capturing U.S. markets and displacing even the most successful of American corporations.⁴⁰ Similarly, in countries such as China that lack the necessary water infrastructure, there are huge opportunities for “leapfrog” technologies and institutions to be developed that exceed current hard path approaches in their long-term economic and environmental sustainability. The U.S. can choose to begin its own efforts at reform, or wait for its comparative disadvantages in the water sector to become more and more painfully evident.

Fresh Ideas from Outside of the Mainstream

It is often said that the best ideas come from new collaborations at the intersection of widely-different fields. Breakthroughs occur, for example, when biologists and engineers, with dramatically different ways of understanding natural systems, work on common problems in manufacturing and design. The fact that environmental advocates, new companies, landscape architects, agricultural experts, biologists, and energy and transportation engineers are beginning to take an interest in water infrastructure issues, and in particular more decentralized and integrated solutions, bodes well for creative solutions in the future. Financial support and concerted opening of new markets is needed, however, to create the conditions for these synergies to develop.

Chapter 3: National Innovation Models and Strategies

In the prior chapter, the discouraging lack of interest in soft path approaches by small communities and municipal utilities and engineers was discussed, along with the finding that new entrants in the field, including local environmental advocates and small private companies, are the primary agents of reform in scattered sites across the country. In this chapter, several innovation theories are presented that describe the use of “market push” and “market pull” strategies to assist change agents and promote diffusion more broadly, and in the following chapter, various targets and dimensions of reform are outlined.

The Challenges of a Soft Path Paradigm Shift

It is important to recognize at the outset how difficult innovation at the local level is for soft path advocates and the private sector, and therefore how critical federal assistance can be to their success. The water resource infrastructure sector is a well-entrenched, tradition-bound field, where decisions are made with the participation of a multiplicity of actors at the local level. Incorporation of distributed and nonstructural solutions integrated into a holistic water plan, would constitute a major “disruptive innovation” in this system, with impacts and demands on all of these actors.

Private markets can be quickly transformed by “winds of creative destruction”, as an entrepreneur with a new product first captures a niche

market and then penetrates the market widely as the advantages of the newer product become known. But there is no easy parallel in the water resource sector. Innovative companies have trouble opening markets for their products and services in a regulatory regime that won’t permit new designs. The role that industry can ordinarily play in lobbying for regulatory changes emerges only slowly if at all, because companies remain in an “infant industry” state without the resources or wherewithal to advocate their interests in the political arena. Finally, most urban water or wastewater providers are local monopolies without competitors drawing attention to cheaper or better alternatives.

“Social entrepreneurs” or local non-profit advocates for soft path technologies also face enormous difficulties in taking on entrenched bureaucracies or conventional engineering “experts” who pronounce that soft path approaches won’t work. Even if advocates succeed in one community through what some have called “super-hero” efforts, the task of reform is not made much easier elsewhere in the country. Without good examples of how soft path can work in neighboring communities with similar soils, climate, and institutions, it is difficult to make a convincing case for a community to try something new. It becomes a bit of a Catch-22. Because there are no good case studies, no new examples will emerge, and on and on. Fellow citizens are also usually leery of becoming “guinea pigs” for trying out new approaches.

Most discussion of federal innovation policies is about how private markets

can be influenced. The public interest in cutting vehicle emissions, for example, may require the federal government to intervene with research, taxes and subsidies, and regulations in the essentially private market transactions of auto production by private companies and sales to private consumers. In contrast, water and wastewater utilities are by and large public entities regulated in a complex local political and regulatory environment, where engineering choices are buffeted by traditional federal, state, and local regulations, land use ramifications, equity concerns, etc. The challenge for federal policies to promote a shift to smaller-scale or closed-loop systems is all the greater, because there are so many parties and interests involved in infrastructure decisions.

An important insight is that any one party in water infrastructure is typically able to block impulses for innovation or change brought to the table by any other parties in the process. And, underlying all these decisions is a desire to avoid the risks of failure in trying something new. It's easy to question the reliability of new technologies or to argue that skills of the local workforce are lacking. And because public health can be affected by infrastructure decisions, the argument could be that it is "better to be safe than sorry".

In general, the soft path field is still at the margins, or "off the radar screen", of the hard path water resource infrastructure sector. In most instances, the installed systems are serving only as "complements" to the existing hard path. For example, roof gardens installed on City Halls or tree planting in urban neighborhoods may attract little attention

from municipal utilities, and advanced onsite or cluster wastewater systems may be in isolated areas, off-the-grid of municipal sewers. However, if soft path systems started to compete directly with soft path systems as "substitutes" for solving the nation's core water and wastewater problems, then the reactions of entrenched interests will become increasingly more problematic.

As Michael Porter of the Harvard Business School has pointed out, "threatened entities will respond" to market challenges.⁴¹ In the case of water resource infrastructure, soft path innovators have to deal with powerful groups that would stand to lose from the emergence of soft path approaches, including: cities that have used sewer extensions to annex new taxpayers in outlying areas; engineers who believe they make more money off larger hard path projects; developers who can build more homes when sewers are built; construction companies and unions that only do sewer and not soft path construction; and bureaucrats who are risk-averse and resistant to the challenges of managing change. Each of these constituencies can stall innovation. In the late 1970's, for example, federal research on onsite wastewater approaches was ended when central system lobbies approached Congressional committees with their competitive concerns.

The short-term strategies and programs discussed as part of a short-term "support" role are unlikely to be enough to lead to a paradigm shift in the water resource sector toward the soft path, particularly if hard path interests mount a challenge that highlights the occasional early failures and higher costs of the

nascent soft path field.⁴² At some future point, the federal government will need to restructure and rebuild its major levers of research, financial incentives, and regulations if a fundamental shift in thinking is to occur. Nevertheless, in the short-term, local change agents can be helped substantially in exploring and demonstrating the necessary new approaches to technology, management, financing, local ordinances, and other innovative aspects of the soft path paradigm. They can also demonstrate and document the multiple benefits of soft path infrastructure, in particular if integrated with energy, agriculture, land use, and other infrastructure concerns. These rigorous and proven models at the local level will be instrumental to making the case for the longer-term policy reforms that are needed, and which are described in Chapters 6 and 7. The private sector can also be encouraged to invest in innovative approaches.

There are a number of basic models for how public policies can encourage innovation:

- *National innovation strategies*
- *Adoption-diffusion models*
- *Market transformation portfolios*
- *“Tipping point” and other social change models*

National Innovation Strategies

Nicholas Ashford of M.I.T., who in the early 1990’s chaired EPA’s National Advisory Council for Environmental Policy and Technology, has been one of the leading researchers on “National Innovation” strategies from an international perspective. Ashford writes that large-scale national innovation strategies are comprised of

either “market push” or “market pull” strategies.⁴³ On the one hand, a new product is invented by the science and technology sector and put out into the market. On the other hand, regulations or customer tastes change what the market wants and companies respond with new or altered products.

Government market push (or supply side) strategies support the development of new concepts in the laboratory (basic research) and new technologies (applied research), or the testing of new products in pilot and demonstration projects in the field. Market pull strategies shape the demand for products or services, through such levers as regulatory requirements, funding incentives, information dissemination, and education of the buying public.

A key conclusion of Ashford’s work is that regulations are the most powerful intervention in a market, but are only implemented after long periods of building public support for imposing mandates on companies and consumers.⁴⁴ The European Union and Japan are examples of governments that have adopted these traditional strategies in the water sector, with both significant public investments in research and with new decentralized wastewater standards recently being adopted by the Europe Union. It is important to note that a significant portion of research overseas is in decentralized technologies.

Adoption-Diffusion Models

Hilary Brown of New Civic Works outlined in a 2005 Harvard University conference on urban green water infrastructure how a classic private market adoption-diffusion curve (which

tracks market penetration from a small niche to widespread use) could be influenced through public action.⁴⁵ In this talk, she described how government could transform a sector through the following sequence of policies and initiatives: financing laboratory research, building pilot and demonstration projects in public facilities or subsidized private facilities, providing financial and other incentives for wider adoption in the market, and finally, instituting regulatory requirements. This model was followed in the last five years, with City and EPA support for green building pilots in New York City.⁴⁶ A green building ordinance for large commercial buildings was adopted last fall, and the City has begun to turn its attention to wastewater recycling in housing projects in Battery Park. The City is exploring incentives, such as lower sewer rates when such recycling occurs.

The NAHB Research Center also uses an adoption-diffusion model to organize its work.⁴⁷ Home builders recognize that in their highly-competitive market with thousands of small companies, federally-sponsored research is a necessity. Individual companies lack the resources or incentives to support research on their own. NAHBRC works on programs such as Zero-Energy Homes for the Department of Energy, where it is recognized that government subsidies or tax incentives are needed to induce homebuyers to install expensive energy-efficiency or renewables such as solar or wind power that lack a short-term payback. The expectation is that, over time, costs of new technologies will fall dramatically as demand increases. In New York City, for example, green building costs fell from 20% to only 2-

5% above conventional costs in just five years.

A key part of this literature is that “early adopters” tend to have different values from the mainstream. Clayton Christensen has also described how “disruptive” innovations are usually invented by entrepreneurs outside the established field. Even the best companies with high-quality products and good customer ratings can be blindsided by upstarts, often from other countries.⁴⁸

Market Transformation Portfolios

In 1992, sustainable energy advocates developed the theory behind a “market transformation” strategy of federal and state policies.⁴⁹ The fundamental goal was to increase the adoption of energy-efficient products, services and/or practices by creating lasting changes in the structure of energy markets. Market barriers or “failures”, such as asymmetric information, distorted market power, uncertainty, and others, would be addressed simultaneously by a variety of players and activities. Coordination among the players and strategies would be necessary.

For example, a strategy to promote a specific piece of energy-efficient equipment might involve preliminary Energy Star product ratings, training of contractors, promotion to customers, public incentives such as rebates, and eventually codes and standards. Michael Porter has also highlighted the central role of national “standards” for new products, both in streamlining markets and in raising the comfort level of consumers.⁵⁰

A 2003 review of 28 projects found that the most successful were for products with low incremental cost and short payback, with substantial other benefits besides energy savings, and with modifications of existing technologies rather than new technologies.⁵¹ Product markets were easier to shift than service markets, and the initiatives with the greatest coordinated efforts were the most likely to succeed.

"Tipping Point" and other Social Change Models

Malcolm Gladwell, in his widely-read book, "Tipping Point", argues that in a complex and open society there are key individuals who, by virtue of their large social networks and leadership roles, can transform markets.⁵² This concept was discussed at a 2005 Palo Alto conference on long-term management of soft path infrastructure, where it was agreed that educating a broad range of market participants was probably less effective than reaching a few key leaders in the field.⁵³

A range of other ideas about how change happens were discussed in the CAWWT workshops. Donella Meadows has written about how policies and markets can reach turning points where one set of ideas and institutions replaces another, similar to how paradigms shift suddenly in science.⁵⁴ Meadows argues for an innovation strategy that both critiques the existing paradigm and supports a variety of innovators, because the forces that eventually tip a field into a new paradigm are not predictable. David Johnston of "What's Working" has described the power behind the Green Building movement, where diverse stakeholders came together to identify

where their interests were in alignment, and developed a rating system and supporting institutions that reflected those commonalities.⁵⁵ Craig Lindell of Aqua-Point has spoken of the significance of reducing risks for all parties in an evolving market and identifying the pivot points in the field where there is the greatest resistance to change.⁵⁶

Conclusions:

While the political-social-economic model of how change occurs may differ from one theorist to another, as described above, there are clear commonalities in the basic categories of federal policy that they recommend be considered to create the conditions for reform. Differences may arise in which of these tools are posited as more important, or which combination is most powerful at any given time. All would agree that a "portfolio" of simultaneous measures will be more effective than any single tool, in part because change is not perfectly predictable and in part because market push and market pull strategies work best when influencing market players simultaneously.

The list of federal innovation policy tools includes:

Market Push Strategies

- *Basic and applied research – inventing new approaches*
- *Pilots and models -- testing new approaches*
- *Demonstrations in a commercial or real-world setting*
- *Evaluations of new products or designs*

Market Pull Strategies

- *Market information – studies and guidance manuals*
- *Outreach – conferences, newsletters, training*
- *Labeling and standard-setting projects*
- *Funding incentives*
- *Regulatory requirements*
- *Public education and social marketing*

CHAPTER 4: TARGETS AND DIMENSIONS OF A SOFT PATH WATER PARADIGM SHIFT

In Chapter 3, several federal innovation strategies were described, including market “push” approaches, such as support of research, and market “pull” approaches, such as education and financial incentives. In this Chapter, a framework of targets for soft path innovation and a shift in the water paradigm are described.

Targets of Federal Innovation Strategies

Target 1: Integrating the Water “Chain”

Human intervention into the natural water system entails a sequence of distinct steps or elements:

- *source of water (groundwater, surface water, stormwater)*
- *treatment of water (point-of-use or distant treatment plant)*
- *use of water – potable and non-potable*
- *treatment of polluted water (removal of pollutants from wastewater, gray water, stormwater)*
- *reuse of treated stormwater or wastewater (landscape irrigation, toilet flushing, car washing)*
- *disposal of water, wastewater, and stormwater (onsite in soils or off-site)*

Currently, progress in advancing a decentralized approach is being made in isolated elements of this “chain”. In particular new technologies are

emerging in on-site and cluster wastewater treatment systems, and rain gardens and green roofs for stormwater retention are increasingly popular in urban areas and new subdivisions. Water-efficient appliances and point-of-use water treatment devices are also being developed.

There is value in continued development of each of these elements separately. However, the long-term vision for sustainable water resource management also includes an integration of several or all of these elements. In some cases integrated technologies and designs can “close the loop” for water use, treatment, and reuse at the individual site or at the cluster system level. In other cases, integration would be achieved through a water management plan that considered the entire water “chain”, but which centralized some of the infrastructure and decentralized other parts, as described below.

Target 2: Exploring Solutions at Multiple “Scales”

Modern sanitation has been defined by centralized, big pipe infrastructure, with onsite wells and septic systems as a “temporary” solution. Recently, cluster systems at the subdivision level have emerged as an attractive new point on the spectrum between these two extremes. In reality, there are a host of scales for dealing with elements of the water “chain”, including:

- *the individual home*
- *several homes on a common system*
- *the large commercial or apartment building*
- *the subdivision or neighborhood*
- *the city or town*

- *the natural watershed or region*

A common refrain in the industry is that technologies can be decentralized, but management must be assured. The most popular approaches with the public appear to be a decentralization of wastewater technology and management at the individual home level (the homeowner hires their own contractor), with centralized utility management of cluster systems. All wastewater systems, in particular, should be periodically inspected. In terms of assessment and planning, the advantages of the watershed-scale are increasingly clear, and EPA is promoting watershed management and trading.

Target 3: Blending Centralized and Decentralized Systems – Integrating the Water “Chain” at Multiple “Scales”

The basic, long-term goal for the nation is sustainable water resource infrastructure, which both has the lightest possible footprint on the environment, and which supports the economic, social, and cultural development of communities. Soft path water advocates believe that decentralized and integrated solutions have many unrecognized benefits, but also acknowledge that centralized and siloed technologies can still be more appropriate in a wide variety of instances.

Because the barriers to utilization of soft path approaches are currently so severe, however, advocates argue that soft path solutions are dramatically underdeveloped, and they urge a strong federal role in advancing their invention, demonstration, and adoption.

Ultimately, however, the challenge will be to understand the proper use and benefits of both decentralized and centralized approaches.

Part of the issue is one of scale, whether it be at the individual building, subdivision or neighborhood, community, or watershed level. Water resource planning can be integrated at each of these levels, but the actual technology installations can be either decentralized or centralized. A water system could be through centralized distribution pipes, while wastewater treatment could be onsite. Wastewater treatment in urban areas could be centralized, while stormwater collection and reuse could be kept at each high-rise building. New subdivisions could cluster wastewater and reuse systems, while leaving private wells and rain gardens at the individual home. One of the major long-term challenges, then, for both engineers and community stakeholders, will be to understand the decentralized and centralized options in each of the water, wastewater, stormwater, and reuse sectors, and how and when to blend them at each scale.

Target 4: Understanding the Multiple Benefits of Water Infrastructure

Another challenge is to link water infrastructure to a much broader set of societal concerns. In the last several hundred years, professional disciplines and bureaucracies have been created to deal with particular problems with specialized solutions. As discussed earlier, water and wastewater infrastructure designed for a narrow purpose of bringing clean water to homes and then removing the wastewater from these homes produces a

host of unintended externalities in the environment and the community.

Increasingly and in a wide variety of fields, the mechanistic view of breaking down natural and social systems into component parts is being challenged, because the sum of the parts is no longer sustainable. More holistic, systems-thinking is required, but is much more difficult. A research goal should be the development of clear new models for how water resource infrastructure can be better integrated into the larger health and well-being of communities and natural environment. The challenge for communities across the country would be the adaptation of these new models to their local circumstances.

Target 5: Innovation Needed in Technology, Management, Markets, Regulations, Financing, Private Behavior

While the tendency of soft path advocates is to focus on the technologies, such as rain gardens, advanced onsite wastewater systems, and low impact development practices, these technologies cannot be advanced without complementary innovation in a host of other aspects of the field. Construction and maintenance functions, which have been developed for underground pipes and big treatment plants, must be adapted to small treatment units on potentially thousands or hundreds of thousands of individual properties. New businesses and new skills are required in the transition, since private property owners tend to prefer dealing with their own contractor rather than municipal utility staff, and engineers need to learn about soils and landscapes as well as pipes and pumps.

Ordinances and codes need to be revised to protect public health in use of these systems. Homeowners and commercial building managers will have to absorb a greater degree of responsibility for systems on their property, at a minimum not to turn off controls or otherwise disrupt the operation and maintenance of the systems. A host of planning, financing, and other institutional functions will need to be reformed.

Target 6: Multiple Players in Innovation Strategies

Many of the innovation strategies discussed earlier are directed at mainstream companies and large private markets of individual customers. For example, the goal is to see existing large automakers invent and sell fuel-efficient vehicles to millions of American drivers. Other environmental technology programs focus on helping new, small companies develop products for niche market early adopters, as a precursor to more widespread diffusion. Federal facilities can be significant early adopters in this regard, in particular because they can absorb the higher costs expected in the early use of new technologies.

In the soft path water field, some of the targets of innovation strategies are similarly in the private sector. There are significant opportunities to attract more “cleantech” investment into research and commercialization, by establishing voluntary national standards that can have the effect of creating larger markets nationwide. Government can help individual companies develop new wastewater or reuse systems by supporting academic research in biology and other fields, and can provide

incentives and education to homeowners to purchase these. Training of contractors to install and maintain systems can help expand these private markets as well. Housing and commercial developers are also a key target for introducing innovative systems into a new private market niche, such as is occurring with the Green Building movement in Greenfield subdivisions and downtown office buildings.

But the target of soft path innovation strategies is also at the community level, where the private sector alone lacks the standing or capabilities to promote the necessary changes. For the full potential of the soft path paradigm to emerge, local non-profit advocates and political leaders need to become more engaged and can be helped by financial support and technical assistance as well. Only they have the confidence of fellow citizens and the motivation to take the broad approach to sustainability that can force a discussion of the multiple benefits of soft path approaches, including energy savings for residents, aesthetic benefits, local jobs, etc. These multiple benefit arguments are not as credible coming from mainstream utilities and engineers, and of new private companies alike. Only political and civil society leadership have the capability to force public bureaucracies to invest resources in reforming regulations and practices. As earlier chapters have described, the easiest challenge is to install pilot systems, such as rain gardens, at scattered sites in the community, while the larger challenge is to introduce soft path approaches as comprehensive complements or substitutes for conventional, hard path solutions at the community or watershed level.

Some of the earlier national community wastewater demonstration projects are good examples of how federal financial support can help local multi-stakeholder groups of non-profit civic organizations, local officials, academics, and other experts in envisioning and promoting change. These change agents, as has been described, face near-insurmountable obstacles in trying to shift the water infrastructure paradigm, but with financial support for their time and other costs, and a sufficient level of flexibility from federal and state officials, there have been successes in reforming practice. In these scattered instances, the demonstration projects have functioned as R&D centers for the invention of new technology, planning, management, regulatory, and financing “systems” in decentralized wastewater. Similar efforts in stormwater, reuse, and integrated water management, more generally, should be mounted.

Target 7: Supporting Multiple Soft Paths

In Chapter 2, the 2002 future scenario-building exercise for soft path water development was described. The scenarios where both a significant need and motivated stakeholders could lead to adoption of a soft path approach included:

- *small community pragmatism*
- *urban mass balance calculations*
- *onsite technology development*
- *integrated planning and regulations*
- *natural systems or “green infrastructure” advocacy*

While progress in these scenarios has been much slower than hoped, they still

offer major arenas or settings for new approaches and benefits of a soft path to emerge.

A Murky Path Forward – Summary Guidelines for an Innovation Strategy

The inability of national soft path leaders in the 2002 workshop to see clearly into the forces and opportunities for the adoption of soft path approaches should also provide a cautionary note for innovation strategies in the future. In general, history is replete with both failed idealistic projects and with government strategies that didn't produce the desired results in public and private behavior. Michael Porter of the Harvard Business School has also stated that there is nothing inevitable or predictable about the emergence or stalling of new markets. Much depends on "the luck of the draw and the relative skills of the participants".

The implication of this history is that it would be a mistake to focus federal initiatives on just one vision of a soft path future or just one innovation strategy to realize that vision. Rather, the key to a successful shift in the water paradigm is to support a variety of qualified local change agents, researchers, and the private sector in testing their often diverse visions of the soft path, and then to disseminate more broadly the lessons of the most successful pilots. In summary, a soft path innovation strategy should be built on the following general principles or guidelines:

- *Establish a comprehensive goal of long-run environmental, economic, and social*

sustainability through the development and adoption of decentralized and integrated water resource approaches, where appropriate, and at multiple scales;

- *Recognize that the soft path water paradigm is at an early stage of development, and that robust models for comprehensive technology and institutional reform are still evolving;*
- *Acknowledge that viable models will only emerge through trial and error, so there is value in supporting a multiplicity of approaches;*
- *Support research into innovative technologies and designs in separate sectors of decentralized water, wastewater, stormwater, and reuse, as well as integrated and "closed loop" solutions, and give priority to approaches that have multiple benefits;*
- *Support innovation at multiple scales (e.g. building, subdivision, community, and watershed);*
- *Support innovation in technology, management, regulations, and financing;*
- *Support research into water applications from emerging fields of science;*
- *Support the development of voluntary national standards for technology and practice as a means to expand markets and stimulate private sector investments in research;*
- *Support complex and difficult research and demonstration projects that integrate both technical and institutional reform, and that demonstrate*

- multiple benefits and long-term sustainability at multiple scales;*
- *Track the successes and failures of all these projects and continuously refine the lessons learned;*
 - *Create vehicles for these models and insights to be widely disseminated, initially to soft path change agents, and eventually, to mainstream institutions;*
 - *Remove federal financial and regulatory barriers to widespread adoption of soft path infrastructure at the local level.*

Realistically, a federal soft path innovation strategy has to take advantage of the available resources and reflect the political constraints in the executive and legislative branches. In the next chapter, short-term initiatives to advance the development and demonstration of the soft path paradigm are matched with existing policies and approaches at the federal level. In the following chapters, longer-term initiatives are discussed which can help the soft path water field in a subsequent, more widespread “diffusion” phase. In Chapter 8, the particular recommendations for high-priority initiatives made by the “new alliance” in its January 19th workshop are presented.

Chapter 5: Mobilizing the “Support Role” of the Federal Government in the Short-Term

Chapter 3 described current models for a government role in promoting innovation in public-private “markets”, and Chapter 4 presented a number of goals and suggestions for an innovation strategy in the soft path water sector. In this Chapter, the short-term opportunities for mobilizing federal agencies to assist in soft path water development and adoption are described.

In broad terms, the federal government has developed an approach for “supporting” local community, private sector, and other “change agents” that is compatible with recent patterns of early adoption of soft path water systems. However, the level of federal funding for project assistance should be increased, and, in some cases, new programs should be created. The EPA should also take the lead in coordinating an inter-agency working group and strategy that can target priority projects and goals more efficiently and effectively.

Federal Support for a “Quiet Revolution” in Environmental Protection

James Connaughton, Chairman of the White House Council on Environmental Quality, described the Bush Administration approach to environmental innovation and reform in a 2003 speech, “Tapping the Power of the Quiet Revolution: Productive Harmony Through Integrated Environmental Policy”.⁵⁷ In this speech he outlined the main elements of the Administration’s vision for how the

country would tackle environmental problems in a different, and they asserted, better way than under past “command-and-control” regulations at the federal level.

Connaughton posited that environmental reform is embedded in a “Quiet Revolution” of millions of people, including academics, business, citizens, and government at the local level. These innovators are starting to collaborate to find new solutions that would “harmoniously balance environmental, social, and economic needs for future generations”. The main elements of this new environmental approach are:

- *a focus on results;*
- *a strengthening of personal and corporate “stewardship” of the environment;*
- *reliance on private market mechanisms, such as performance standards and incentives;*
- *innovative technologies;*
- *science-based decisionmaking based on identification of highest risks;*
- *a shift from federal to local responsibility or “ownership” of environmental solutions;*
- *a shift from enforcement to “voluntary” compliance.*

These themes of private stewardship and local control are being implemented in a variety of programs across federal departments and agencies. As such, they serve as the backdrop for EPA’s national innovation strategy,⁵⁸ the Department of Interior’s Water 2025,⁵⁹ and the Administration-wide support for “cooperative conservation” partnerships.⁶⁰

Opportunities for Support of Soft Path Water Projects

As part of this project, a Catalogue of Federal Water-Related Programs and Organizations was prepared.⁶¹ This Catalogue describes federal department and agency missions and programs related to the water sector or research, as well as detailed examples of projects and recipients of federal support in the soft path arena. The Catalogue should be consulted by anyone interested in learning more about the activities of particular agencies, or in seeking funding from a variety of sources. In this Chapter, the broad patterns of federal activity are described.

Areas of Support for Soft Path Water Projects

Research on federal programs for the Catalogue has identified a surprising number of efforts in the key “market transformation” categories described in Chapter 3. These include:

- *applied research and development related to the mission of the department or agency*
- *pilots and models in federal facilities and programs*
- *labeling and standards projects*
- *studies and guidance manuals*
- *conferences, newsletters, networking, and other outreach*
- *coordination initiatives*

Some of these are competitive grant programs in the agencies; others are funded by Congressional designations for specific projects in appropriations bills.

It is fair to say that soft path industry and environmental advocates have been unaware of the full extent of involvement by agencies other than EPA. Nevertheless, researchers and advocates at the local level often search out and combine grants from multiple agencies. For example, the University of Rhode Island, a leader in the soft path water field, has secured funding for decentralized wastewater research, education, and demonstration projects from EPA, US Department of Agriculture (USDA), National Oceanic and Atmospheric Administration (NOAA) in the Department of Commerce, and the National Science Foundation.

Illustrative Projects Funded by Federal Departments and Agencies

Each of the federal departments and agencies has a different core mission, but that core mission can intersect with the soft path water field in useful ways. Examples of how agency missions can support soft path projects include the following. More details on these projects, as well as descriptions of agency programs and missions can be found in the Catalogue.

U.S. Department of Agriculture (USDA)

USDA has been charged to promote rural development, as well as agriculture, and since the mid-1800’s has funded research, education, and extension or outreach services in land-grant universities. The U.S. Forest Service has also been developing an urban forestry program related to water

quality. Examples of projects funded in recent years include:

- *a New England Onsite Wastewater Training Program at the University of Rhode Island*
- *stormwater and low impact development guidance documents developed by the National NEMO (Nonpoint Education for Municipal Officials) Network based in Connecticut*
- *a Revitalizing Baltimore project to involve citizens in restoring green space and protecting the urban watershed.*

Department of Commerce

The Department of Commerce sponsors research in NOAA coastal and Sea Grant university programs, funds a National Estuarine Research Reserve network, and supports technology research in the National Institute of Standards and Technology. Examples of soft path projects include:

- *research on nutrient removal in onsite systems in the Waquoit Bay National Estuarine Research Reserve watershed on Cape Cod*
- *grants for soft path technology development from the Cooperative Institute for Coastal and Estuarine Environmental Technology in New Hampshire*
- *a workshop on sources of water quality impairment, including septic systems, in Santa Monica Bay, California*

Department of Defense (DOD)

DOD sponsors the Federal Network for Sustainability and pilots environmental

technologies on military bases.

Examples of soft path projects include:

- *a Fort Lewis sustainability program, including a goal for zero discharge of wastewater into Puget Sound and 75% reduction of water use by 2025*
- *a Congressional line-item appropriation for research on dual-flush toilets*

Department of Energy (DOE)

DOE is exploring the energy-water nexus and is collaborating with EPA on water-efficiency and reuse standards. An example of a soft path water project is:

- *guidance on best management practices (BMP's) in water reuse and reclamation in buildings*

Department of Health and Human Services (HHS)

HHS's Centers for Disease Control investigates health hazards associated with water quality. Examples of research includes:

- *studies of water treatment devices and of the public health impacts of septic systems.*

Department of Housing and Urban Department (HUD)

HUD supports pilot-testing and guidance on housing technology in its Partnership for Advancing Technology in Housing. Examples of its investigations of water-related technologies include:

- *guidance on low impact development practices, piloting of aerobic treatment units, and web-based newsletter and technical information services*

provided by the National Association of Home Builders Research Center in Maryland

Department of Interior

The Department of Interior supports reuse studies in the Bureau of Reclamation, and a host of watershed and water quality research projects in the US Geological Service (USGS). The Interior Department also funds the National Institutes for Water Resources, with institutes in each of the fifty states. Examples of funded projects include:

- *a National Xeriscape Demonstration Program in Texas, Arizona, Nevada, Colorado, and North Dakota*
- *USGS studies of onsite system impacts on the sole-source aquifer in Deschutes County, Oregon*
- *Studies of stormwater technologies and low impact development practices at the North Carolina Water Resources Research Institute*

Department of Transportation (DOT)

DOT funds projects in stormwater runoff and “green highways” mitigation. An example of a soft path project includes:

- *Federal Highway Administration collaboration with stakeholders to consider trading systems from highway runoff with low impact development subdivisions.*

Environmental Protection Agency

EPA has created program areas and initiatives in green building, sustainable technology, nonpoint source remediation, decentralized wastewater

management, research, and demonstration projects. Examples of funded projects include:

- *P3 (People, Prosperity, Planet), a university competition for sustainable technology and policy, including stormwater, energy efficiency, and green building designs*
- *Environmental Technology Verification (ETV) projects on nutrient removal in onsite systems*
- *Region 2 support of Green Building programs in New York City*
- *Region 4 support of studies on land development in North Carolina*
- *a Sustainable Infrastructure initiative which has sponsored the development of a water-efficiency program of labels and standards called Water Sense*
- *management of National Community Wastewater Demonstration Projects designated by the Congress*
- *sponsorship of workshops, conferences, and information clearinghouses in such fields as low impact development, nonpoint source pollution, watershed management, and decentralized wastewater management and regulations*

National Academy of Sciences (NAS)

The NAS sponsors studies in water science and engineering, and in urban sustainability. Examples of imminent projects include:

- *studies of the effectiveness of stormwater Phase 2 BMP’s and*

international infrastructure innovations, including in water

National Science Foundation (NSF)

NSF supports a variety of ecosystem monitoring programs, science and technology centers, and engineering projects. Examples of projects funded include:

- *sponsorship of a conference on water systems in cities of the future*
- *a grant to the University of Rhode Island Coastal Institute to integrate graduate education and research in nonpoint source pollution*
- *Science and Technology Center support for the University of Arizona, which has been researching semi-arid hydrology and riparian areas*

The White House

The White House has issued executive orders for “greening” government buildings and management practices, and the President’s Office of Science and Technology Policy is reviewing the activities of federal agencies in the broad “water availability and quality” arena

Small Business Innovation Research

The SBIR program, as an inter-agency effort, supports innovative technology development and commercialization.

Inter-Agency Coordination

The plethora of agency missions and programs provides the opportunity for expanded support of a research and development and early adoption phase

for the soft path water field. A challenge is to achieve greater impact and save time and money through coordination of the efforts of the separate agencies.

Several suggestions, from those that are achievable in the short-term to those that are possible once the “case” for change has been made, are:

- *appointment of staff in EPA’s Office of Water to coordinate soft path water-related programs within EPA*
- *prioritization of water infrastructure issues in EPA’s Sustainable Research Strategy*
- *organization of a conference of research and development programs (and recipients of grants) in departments and agencies that fund water projects, including EPA’s Office of Research and Development, USDA’s CREES program for land-grant universities, DOE’s energy-water nexus, the Commerce Department’s National Estuarine Research Reserve Program, Sea Grant, and CICEET; the Interior Department’s USGS and Bureau of Reclamation research; HUD’s PATH program, DOD’s sustainability research, and NSF*
- *reinvigoration of OMB’s inter-agency group on federal funding of local water-related infrastructure across a wide variety of agencies (EPA, USDA, Commerce, HUD, FEMA, Army Corps)*

Limitations to the “Support Role”

To the degree that the nation relies on state and local governments and the private sector to provide the leadership in innovative practices and approaches, then the diverse programs described above across a wide variety of federal agencies can help these activists and entrepreneurs. However, the next chapters describe more fundamental and costly approaches that will be needed at the federal level if a widespread soft path paradigm shift is to occur. These include: supporting research that local communities or firms will not otherwise fund; removing financial barriers to local initiative and creativity; and opening up federal regulatory and enforcement programs to the use of soft paths.

Chapter 6: Federal Leadership in Water Infrastructure Research and Project Financing in the Medium-Term

In the prior chapter, a wide range of innovation “support” strategies and projects in the federal government have been described as they can help local change agents and the private sector develop innovative approaches. In this chapter, the need for a more forceful federal role in advancing the soft path agenda through funding of basic research, financial incentives for soft path approaches, and reform of the regulatory structure over the long-term is described. As the National Academy of Public Administration has pointed out in the past, federally-supported “pilot” projects have not been able to overcome a structure of federal regulations and funding that preclude their widespread use.⁶² Achieving these larger changes in policy will be more difficult than mobilizing the “support” role, for the following political reasons:

- *The Bush Administration has been drastically cutting federal funding for the primary vehicle of federal support for water and wastewater capital projects, the Clean Water and Drinking Water State Revolving Funds (SRF’s). As a result, requests for new financial incentives for soft path projects are pitted against the need for repairing and replacing existing conventional sewer projects;*
- *The Administration is unwilling to impose new federal mandates for state actions, such as requirements that a portion of*

federal funds be spent for soft path projects in each state;

- *Water-related federal research funding has been in decline since the 1980’s, when the Reagan Administration proposed that the funding burden be shifted to states and the private sector;⁶³*
- *The Administration and the Congress are unwilling to develop strong new regulatory frameworks to take on complex water-related problems, such as non-point source pollution or land development;*
- *The Administration is disinclined to take on the work of integrating funding programs or regulations across diverse federal departments and agencies;⁶⁴*
- *There is no perceived crisis or public outcry in the water infrastructure sector that would warrant stronger action and collaboration.*

Over time, however, these barriers to reform can potentially be overcome with concerted advocacy and demonstration of robust and high-value alternatives needing assistance and reform from the federal government.

The Context for Federal Reform

The 1972 Clean Water Act established a framework of water quality standards for the nation’s surface waters and required installation of best management practices (BMP’s) for point-source effluent under a federal regulatory systems, the National Pollutant Discharge Elimination System (NPDES). Large federal subsidies (75% of capital costs) were also provided for

sewer collection and treatment plant projects, under a construction grants program. This framework strengthened the central “hard path” engineering paradigm of sewer systems and treatment plants, where the general idea from a public health standpoint was to remove wastewater far from the source.

Innovation was built into the Clean Water Act, however, first through the primary vehicles of research and development programs authorized in 1972 at \$100 million per year (over \$300 million in current dollars) and, subsequently in 1977 Amendments, through incorporation of an additional subsidy and federal guarantee (15% more) for innovative and alternative systems. Many of these were decentralized cluster systems or constructed wetlands in small communities.⁶⁵ Numerous new technologies were streamed into the construction projects built with federal grants, and a lot of ideas are said to have emerged from federally-funded research carried out in universities, often by graduate students, who later developed technologies and carried them into production by setting up their own companies.⁶⁶

In the 1980s, these innovation strategies in the Clean Water Act were largely phased out. Two concepts took hold: first, that federal subsidies for wastewater systems promoted overly-expensive systems and displacement of local spending, and should be phased out; and second, that research was more properly the role of the private sector and the states.⁶⁷ In 1987, the federal construction grants program was replaced by a revolving loan system, the Clean Water State Revolving Fund

(CWSRF), which dramatically reduced the federal share to national capital expenditures (from 75% of capital costs to the equivalent of about 25% of combined capital and interest repayments) and the innovative and alternative provision was dropped. Research funding in water and wastewater also declined precipitously from the late 1970's to the early 1990's.⁶⁸ The Reagan Administration assumed that the states and the private sector would pick up the slack in declining federal investments, but this has not been the case.

FEDERAL FUNDING FOR WATER-RELATED RESEARCH

The National Academy of Sciences has issued several reports in recent years which describe the per capita decline since the 1980's in water-related R&D funding by the federal government.⁶⁹ Funding has also shifted substantially from support of basic, long-term research to support of agency mission-related and short-term research projects.⁷⁰ In particular, there has been a decline in assistance for technology-related research and development, and most of the remaining funding for water-related technology innovation is in the Department of Defense.⁷¹

As a follow-up to these NAS reports, the White House Office of Science and Technology Policy has established an inter-agency subcommittee on water quality and availability.⁷² This subcommittee has been identifying national needs for future research and developing recommendations for greater coordination and revitalization of federally-funded research across multiple agencies. One report on water

availability research needs has already been released, and a second on water quality will follow. In general, there has not been much recognition in this process of the role that soft path technologies can play in addressing long-term needs and problems.

How Soft Path Change Agents See the Need for Research

The importance of a reinvigorated federal research program can be understood through the needs that soft path advocates have for a more comprehensive suite of high-performance technologies and institutional models. Current concerns are:

- *Restricted choices* -- advocates have fewer soft path technologies to choose from than they would if public funding were generating more laboratory research. A recent example is the need to address nutrient input from septic systems into coastal ponds. Even advanced treatment units can't meet the stringent standards required in many areas. Research at the University of Waterloo in Canada to mimic natural riparian zone functions in a wood-chip-based onsite system has led to superior nutrient removal, but more research of this type is needed.⁷³
- *Lack of performance data* -- Data on the performance and reliability of decentralized technologies across the water "chain" (supply, use, treatment, reuse, disposal) is also sparse, since so few have been

permitted or installed, even on an experimental basis. In a Catch-22, systems are then viewed by regulators, engineers, and local officials as higher-risk than they would be if more monitoring studies had been conducted;

- *Unclear benefits and costs* -- The multiple benefits and costs of various soft and hard path approaches are not well-articulated or documented, in particular the externalities of water resource infrastructure for the ecosystem, public health, and community aesthetics and well-being.
- *Absence of a toolkit of technical, institutional, and regulatory options* -- Because so little research has been done across the "water chain" and at "multiple scales", communities lack the knowledge for picking optimal technologies and regulatory approaches.

There are several structural problems that explain why the private sector has not filled in the gap in public funding, as the Reagan Administration had hoped when it began cutting back on research funding:

- *Fragmentation* -- because local codes and ordinances vary so dramatically from one state, county, or town to the next, markets for new technologies are extraordinarily "fragmented" and large corporations and venture capitalists with ample research budgets stay out of the field;⁷⁴
- *Non-proprietary designs* -- because many soft path

technologies are soil-based designs that are non-proprietary, private companies cannot exclusively capture the benefits of any research. For example, research results on landscaping for stormwater retention, shallow trenches for wastewater treatment in soils, low impact development systems, etc. could be used by any designer and are not embedded in specific pieces of equipment that a manufacturer would produce. Thus, there are no strong incentives for private firms to invest in this research;

- *Basic research* – the private sector under-invests in basic research that could lead to fundamental redesigns in soft path water infrastructures, because such research is expensive and high-risk and an individual company cannot usually capture all the benefits of the research through exclusive patents. Such research is appropriately conducted in non-profit universities, research institutes, or government laboratories, where public benefits and costs are properly aligned,⁷⁵
- *Institutional and socio-economic research* – private companies do not invest in research on essential components of a transition to a soft path in water, such as long-range assessments of water quality futures or regulatory, management, or financial reform at all levels of government.

If the federal government supported the development of national standards for technologies, then the concern for

“fragmentation” could be overcome. Larger companies with significant research budgets might then enter the field and substantially increase the quality of proprietary “blackbox” technologies. Publicly-funded research would still be needed on natural systems, institutional reforms, and basic micro- and macro-scale models and insights.

States have also not mounted substantial research programs in water infrastructure-related topics. California is an exception, with new research programs in energy and water, intended both to address energy and water shortages and to promote new companies and job development for both domestic and international markets.⁷⁶ Seattle is a large city that has also been investing resources in piloting stormwater retention systems and studying how they can be utilized as alternatives to big pipe solutions.⁷⁷ But these and scattered other research projects in states and cities across the country are insufficient to the need.

The decline in water infrastructure-related science has created a glaring gap in the U.S. in comparison to other countries, and was highlighted in 2006 by the announcement of an agreement between Singapore and the Massachusetts Institute of Technology to partner in water infrastructure and other areas of research over the five years.⁷⁸ This will be M.I.T.’s first research facility outside of Cambridge, Massachusetts, and their shift of research overseas can be seen as an indication of the lack of adequate funds in the US.

Numerous reports in the last twenty years have recommended a resumption of federal funding of research and

demonstration projects in water and wastewater.⁷⁹ The Congressional Budget Office, in particular, was asked by the Congress in 2002 to examine the funding “gap” for water and wastewater.⁸⁰ CBO recommended that R&D was only one of two classic justifications for federal investment, the second being subsidies to keep rates affordable for particularly hard-hit communities. CBO also sharply questioned whether unrestricted subsidies to local communities were appropriate, given the tendency of cities to over-invest in technology and to shift their own monies to other city services once they had a federal subsidy in hand.

A Soft Path Water Research Agenda

Several U.S. workshops have highlighted the potential for science and technology research to upgrade and alter the basic modes of water and wastewater treatment. The 1998 WERF workshop discussed the potential, for example, of gene sequencing to introduce new micro-organisms into treatment units to provide better performance.⁸¹ More recently, a CAWT 2005 workshop discussed the role of bio-mimicry approaches, or studies of how natural systems may be solving water purification, capture, and recycling in better way than manmade, engineered systems. Typically, new ideas emerge from collaboration among biologists and engineers.⁸² Bio-mimicry research on natural membranes that are superior to current technologies is underway in Europe and Asia, but not yet in the U.S.⁸³

Other soft path water research and development topics identified in the 2002 workshop include: demonstration

that soft path technologies and management work reliably at the site level and to protect water quality; cost comparisons between hard and soft paths; community decisionmaking tools; model integrated regulations, codes, and plans; and tools to enhance public awareness and education.⁸⁴

Recommended Research Reform:

- Fund comprehensive surveys of emerging research and new applications of integrated and decentralized infrastructure in developed countries, such as in Europe, Australia and Japan, and in developing “leap frog” economies, such as China and India;
- Fund the formation of several Centers of Excellence at universities or research institutes, for the purposes of coordinating basic and applied research in soft path water infrastructure;
- Initiate research in water, wastewater, and reuse applications of bio-mimicry, biotechnology, nano-technology and other leading edges of science;
- Study a broad range of potential institutional reforms, including integrated water management, privatized system management and financing structures, and local performance-based codes and ordinances;
- Research infrastructure options that integrate some or all systems across the “water chain” (source, use, treatment, reuse, disposal), at “multiple scales” (individual site, neighborhood, city, watershed), and in diverse settings (rural Greenfield

- development, suburban areas, and cities);
- Stimulate private investments in technology-related research, by helping to create large national markets based on voluntary national standards and by signaling a long-term commitment to greater efficiencies and a lighter footprint in the infrastructure;
 - Develop 50-year projections on water supply and quality, and explore the likely impact of alternative infrastructure paths, including the use of soft path infrastructure both to complement and substitute for hard path projects.

FEDERAL FINANCING OF LOCAL INFRASTRUCTURE

Federal subsidies for local water and wastewater projects in a wide range of agencies were initiated when the standard for modern sanitation was the installation of centralized water distribution and sewer collection pipes and treatment plants. Failure to reform these programs since the 1970's has created serious obstacles for soft path advocates at the local level.

Innovation strategies, as described in Chapter 3, highlight the significant role that funding incentives can play in promoting market reforms. Particularly in a well-entrenched public-private market, such as in water resource infrastructure, extra incentives are needed for major actors to do the additional work entailed in developing new solutions, creating new institutions, etc. Innovative technologies are often much more expensive at the outset, and

the risk of failure is a major deterrent to innovation throughout the system.

How Soft Path Water Advocates See the Need for Funding Reform

The following patterns in federal financing programs are problematic for soft path water change agents:

- *Eligibilities only for publicly-owned systems* – other than the Clean Water SRF program, federal programs do not allow funds to be used for systems owned by private individuals. Most soft path infrastructure technologies are installed on private property, and while in theory public utilities could own these systems, homeowners generally prefer to retain ownership and control of their systems;⁸⁵
- *Rigorous alternatives analysis not required* -- engineers in federal and state agencies are generally not knowledgeable about soft path approaches and do not require a serious analysis of the alternatives as a condition of funding;
- *Integrated assessments not required* –there is no significant requirement in funding applications for a full analysis of the externalities of individual projects, such as disruptions of regional hydrologies, saltwater intrusion into aquifers, land use development and subsequent runoff, etc.;
- *Siloed missions* -- agencies that fund water or wastewater projects for low-income housing

- or economic development are typically opposed to supporting innovative environmental technologies or approaches;
- *Multiple benefits analysis not required* – the energy, aesthetic, and other benefits of soft path approaches will not be counted in choosing which water or wastewater infrastructure projects to fund.

Soft path advocates have great difficulty in asking local citizens to support soft path approaches when federal funding is only available for hard path projects that emerge in siloed and incomplete analysis. TREE People in Los Angeles is an isolated example of a non-profit organization that has recently succeeded in coordinating federal funding from a variety of agencies for installation of stormwater retention and reuse systems in a pilot neighborhood, but this took years of effort.⁸⁶ Volunteers in smaller communities typically lack the resources to overcome the bias in federal agencies. The requirement for public ownership of water and wastewater installations in rural development programs, such as in USDA, appears to be inviolate.

The ideal federal role, in terms of promoting soft path approaches, would be explicit additional subsidies and loan guarantees for soft path projects, as was the approach of the I&A provision for an additional 15% subsidy in the CWA construction grants programs. A second requirement would be that local projects would only be approved for funding if they had been identified as part of an integrated planning process. The current federal funding role in water resource infrastructure is virtually the opposite of this ideal.

Organizations examining the federal role in the water supply side of infrastructure have developed similar concerns about federal funding patterns. During 2005 hearings about the future of the Bureau of Reclamation, testimony was submitted describing findings of a 2005 National Water Policy Forum, which was funded by nine separate federal agencies, including the Departments of Agriculture, Defense, Interior, Commerce, and EPA.⁸⁷ One of four major findings of this forum was the need “to address the Nation’s water issues in an integrated manner, focusing not on single isolated projects but on programs that present watershed-level solutions”.

In later testimony, Commissioner Keys of the Bureau cited several times the current reality that water supply projects for constructing miles of new water lines were being funded, even though localized desalination of brackish water might be significantly cheaper.

Existing Funding Programs

A full description of federal financing of local infrastructure is provided in the Catalogue of Federal Water-Related Programs and Organizations. A brief summary of key programs is provided as follows:

CWSRF – The CWSRF is the most friendly to soft path approaches of all the federal funding programs studied. A 1996 agreement between EPA and the States set in motion a process by which innovative approaches became eligible for funding over time. These include decentralized wastewater projects, smart growth initiatives, LID systems, water

conservation, and others. Secondly, as a result of this agreement, a system was created whereby organizations receiving loans could in turn lend money to private homeowners for systems on their property. Parts of this expansion in eligibilities required a ruling by the U.S. Treasury that public monies could be used on private property if there was an easement to inspect the treatment system during the life of the loan.

However, in spite of innovations in this program, the CWSRF has been a particular target of OMB budget-cutters, falling from a high of \$1.35 Billion several years ago to a recent \$850 million. This is in contrast to relatively level funding for rural water/wastewater projects in such departments as USDA. In addition, while EPA has ruled that soft path projects are eligible, and has allowed for innovative funding mechanisms such as linked-deposit programs, few states have gone along with these provisions. American Rivers has examined these difficulties in the Great Lakes States and is working to promote changes at the state level.

DWSRF -- Congress began several years ago to allow increasing percentages of the SDWSRF to be utilized for source water protection, which could include decentralized stormwater and wastewater projects. A key barrier to this use of funds and the reason why funding has been lagging, is that projects on private property are specifically disallowed.

EPA Section 319 NonPoint Source Implementation Grants -- This program does cover funding for decentralized system projects. However, recently EPA has set-aside half of the budget (about

\$100 million) for watershed planning studies, and monies are not available for construction projects.

Construction grants in EPA appropriations. A list of local projects is designated each year by the Appropriations. Committees, based on requests from Congressmen and Senators, reached a peak of several hundred million in the FY2006 bill.

The 1972 CWA federal construction grants program, which is used as authorization for these projects, had been available only to publicly-owned treatment works (POTW's). However, a ruling was made that the national community demonstration projects included in the line-item list for a number of years could cover costs of construction of onsite wastewater systems on private property (with a requirement for a public easement). In the recent bill there has been an occasional listing for what appear to be decentralized systems. This funding stream continues to be for conventionally-engineered projects, however.

Rural Utilities Service -- The RUS water/wastewater funding is directed at low-income rural communities, most of which do have not centralized water, sewer or stormwater systems and would be ideal candidates for soft path approaches. However, the RUS has a long history of supporting public (or non-profit community) facilities and is particularly averse to assisting privately-owned systems. RUS is attempting to absorb soft path technologies into its program by supporting construction of small cluster systems, including constructed wetlands, in a few states

such as Minnesota. Secondly, RUS points out that grants are available to homeowners directly for treatment systems on their property through the modest low-income grant and loan program available to low-income homeowners.

HUD -- CDBG Grants and loans are available for low-income community water and wastewater projects, where infrastructure is argued as necessary for economic development and revitalization. CDBG funds are also only available for POTW's.

Department of Commerce – EDA grants for water and wastewater projects to assist in economic revitalization are also only for publicly-owned treatment works.

Bureau of Reclamation – Rural water projects have been funded for years as line-items in Congressional legislation. Rural Water Supply Act legislation has recently been introduced in the Congress which would create a new funding program with a more rational approach to project selection.⁸⁸ As stated above, this legislation would require inter-agency coordination and would allow watershed planning to be a factor in award of grants. The Commissioner of the Bureau also suggested in testimony that allowance of federal development of the engineering plan could introduce innovative soft path approaches, such as local desalination of brackish groundwater, rather than a local preference for conventional water piping systems.

Army Corps of Engineers – Numerous water and wastewater projects have been authorized in recent water resource bills,

but few have actually been funded in appropriations bills. A brief review of listed projects suggests that all are for conventionally-engineered publicly-owned treatment works.

Inter-Agency Coordination of Funding – The Office of Management and Budget (OMB) convened an inter-agency task force several years ago, to discuss water and wastewater infrastructure financing. Several concerns had emerged about the tendency of federal funding programs to require and reinforce conventional engineering solutions, and to support individual projects without an examination of externalities and impacts in the larger watershed. OMB has concluded, for the time being, that the time and effort in building a collaborative funding approach across agencies appears to outweigh the benefits of integration, and the Task Force has not met in over a year.

The new Senate bill to create a Rural Water funding program (replacing Congressional line-items with a more rational process) does include a provision requiring the Secretary of Interior to develop a coordinated approach to funding rural projects and also includes a factor to be considered (not a mandatory criteria) that proposed projects be part of a broader watershed plan.

Potential Tax Incentives for Soft Path Water Projects

In the last few years, a number of states have passed tax credit incentives for energy-efficiency systems and energy renewables. Massachusetts is one of the states that provides a tax credit for upgrades to home septic systems.

The federal Energy Policy Act of 2005 instituted a similar tax incentive approach at the federal level. Tax credits are currently available for individuals and businesses for energy-efficient appliances, materials and designs. Any federal Green Building legislation that incorporates federal tax credits as incentives should also include soft path water technologies in the list of eligible activities.

Sustainability in Private Financing

The federal government can provide guidance to developers and homebuilders on soft path approaches that are cost-effective and attractive to homebuyers. There are also recent efforts internationally to develop valuation tools for “sustainability” in bank loans, insurance, and mortgages. Under such an approach, projects would be measured under a “Triple Bottom Line” basis, which includes economic, social, and environmental factors. The U.S. could participate in these efforts, which have been stimulated in part by a “Freshfields” report for the United Nations Environment Programme that described future liabilities of corporations for un-sustainable practices and suggested that investors could legally take environmental, social, and governance factors into account.⁸⁹ The U.S. could also support the Vancouver Valuation Accord developed at an international conference of progressive developers, bankers, and professional valuation standards organizations.⁹⁰

Recommendations for Financing Reform:

- Shift some of the policy and budget discussions away from the current preoccupation with how much the federal government should contribute to fixing the aging hard path water and wastewater infrastructure and focus on how to rebuild an ethic and practice of innovation in the sector;
- Create financial incentives for use of soft path approaches in all federal subsidy programs, including EPA’s Clean Water and Drinking Water State Revolving Funds, and USDA, HUD, Commerce, and other grant or loan programs;
- Expand eligibilities for federal funding to include support for systems on homeowners’ private property, including water conservation technologies, advanced onsite wastewater treatment, rain gardens and other stormwater retention designs, and graywater and wastewater reuse;
- Prohibit use of federal funds for infrastructure projects that promote land development in water-sensitive areas;
- Incorporate soft path water systems in any new federal tax incentive programs for green buildings;
- Collaborate with progressive financing institutions, such as the World Bank, insurance companies, real estate mortgage companies and others, in setting standards for investments in sustainable infrastructure and Green Building projects;
- Implement an integrated water resource planning requirement for all recipients of federal water

infrastructure subsidies,
including both water supply and
water quality projects from a
variety of agencies.

Chapter 7: Federal Leadership in Regulatory Reform in the Long-Term

The soft path water field is currently severely hamstrung by a variety of regulatory impediments and biases that are not being addressed at the federal level. The federal government does not directly regulate most nonpoint sources of water pollution, including soft path installations. This reality causes three interrelated problems for soft path advocates. First, weak and widely-divergent local regulations across the country fail to create large new “markets” or demand for the development and adoption of high-performance technologies and approaches. Second, the strong federal enforcement of point source effluents, in contrast to weak involvement in nonpoint source management, pushes communities to solve water quality problems through conventional hard path approaches. Finally, a variety of federal laws are not well-integrated, in particular to deal with both water quantity and water quality concerns simultaneously.

The imbalance between strong federal point-source permitting and weak federal involvement in nonpoint-source regulations is the backdrop for much current policy debate. In particular, agricultural nonpoint pollution sources are a significant portion of water quality degradation across the country and are still inadequately controlled. Rapid ex-urban land development is also expected to create increasingly severe stormwater and wastewater-related problems over time, but similarly is not currently regulated in a coherent fashion at the federal level. These impacts include surface and groundwater quality

degradation and habitat destruction, as well as disruptions to water hydrologies and exacerbations of drought conditions.

As suggested in the prior chapter, there is a pervasive reticence in the current Administration and Congress to extend the reach of the Clean Water Act into direct federal regulation of nonpoint sources, and indeed, recent Supreme Court cases suggest that a rollback of federal jurisdiction in “non-navigable waters” may have begun. This political reality suggests a major reform of federal regulations is unlikely in the short-term. The burden is thus put either on devising voluntary, incentive-based solutions to dealing with nonpoint source pollution and soft path technologies, or alternatively, on incremental adaptation of existing water quality regulations and NPDES permits, so that soft path solutions and water quantity concerns can be incorporated.

How Soft Path Advocates See the Need for State/Local Regulatory Reform

For those who seek expanded use of decentralized and integrated soft path technologies at the individual site, subdivision, or community level, there is a long list of state and local regulatory barriers and concerns:

- *Minimal requirements* -- Local regulations do not typically require that emerging soft path technologies such as rain gardens, advanced onsite wastewater treatment, or reuse systems be installed at homes, commercial buildings, subdivisions etc – if there were such mandates across the

- country, huge new markets would be opened to soft path system innovators and manufacturers;
- *Limited options* -- Where decentralized treatment IS required, as in conventional septic systems for individual homes, newly-emerging technologies are generally not permitted – local regulators tend to be very risk-averse and persist with traditional prescriptive codes specifying a few standard designs, rather than performance-based approaches that would provide more flexibility to system designers in their use of new technologies and soil-based designs for treatment;⁹¹
 - *Inconsistencies* -- Even if some states or counties permit or require newly-emerging technologies for non-conforming sites or in response to special needs -- the overall national market is still small and sends inconsistent signals about what standards need to be met by new systems;⁹²
 - *Lack of maintenance* -- Long-term operation and maintenance requirements are generally not in place – as a result, failure rates of high-tech mechanical systems are unnecessarily high and the reputation of decentralized approaches can suffer;
 - *Siloed permitting* -- Water, wastewater, and stormwater systems are separately regulated and there is minimal integration of designs or permits – those innovators who would seek to develop integrated solutions would not be encouraged and in most cases not even allowed to install them. Just one siloed regulation can prevent installation of an integrated system.
 - *Difficulties for builders* -- Developers avoid low impact development approaches that entail time-consuming and expensive negotiations with local regulators to allow innovative systems to be installed.
- There are various reasons why local or state regulations have not been reformed to require, or at the very least allow, innovative soft path systems to be installed. Entrenched interests block change. For example, plumbers unions often oppose use of waterless urinals, out of concern that they will lose plumbing work. As earlier stated, local regulators hesitate to permit new technologies because they have minimal time to research new technologies and are concerned about potential failures.
- The most potent underlying barrier to local soft path mandates is the resistance by homeowners and businesses to any new requirements that they install expensive systems, or submit to new maintenance fees and periodic inspection requirements. Contributing to this public resistance is the continued failure to articulate the long-term benefits of decentralized and integrated infrastructure to the public. Advocates of these more expensive and intrusive requirements for the homeowner have struggled in persuading the public, when there is still insufficient research documenting how new soft path mandates would improve property values, water quality, local economies, and quality of life. There has also been

insufficient marketing research linking the values and preferences of homeowners and the public to the benefits of soft path approaches.

Scattered Reforms

There are scattered successes across the country in modernizing state and local regulations for decentralized systems in the separate silos of the water chain. With much effort, onsite manufacturers have persuaded a number of states to permit their systems. Newly-permitted technologies include graveless trenches, pre-treatment textile filters, and aerobic treatment units that can be used to remediate failing systems or to accommodate new homebuilding on lots that do not meet the requirements for conventional septic system designs. In environmentally-sensitive areas, such as around coastal ponds in Rhode Island or sole-source aquifers in Oregon, advanced onsite treatment is actually being mandated by local regulators, and residents have come to accept these requirements that protect valuable local resources.⁹³ Cities such as Philadelphia are beginning to permit waterless urinals in commercial buildings, and New York City is exploring commercial and residential reuse systems. Perhaps the most widespread mandates are for water-efficient appliances in arid parts of the country. While there has been no comprehensive documentation of state and local regulatory reform across all soft path sectors, anecdotal evidence suggests that it is still only on the margins of the water field.

Potential Federal Measures

While strict new federal mandates requiring soft path infrastructure all

across the country would be the single greatest engine for technology improvements and widespread adoption that could be devised, the current political climate is not receptive to preempting traditional state and local authorities. In 1992, a consensus recommendation of “Water Quality 2000”, a stakeholder group assembled by the Water Environment Federation, for imposition of national onsite system regulations was never adopted.⁹⁴ Early discussions within EPA about extending the Underground Injection Control program to individual home septic systems were also dropped, and the requirements for state programs for larger cluster systems are also minimal so far (states need to have UIC programs, but specific measures are not yet prescribed by the federal government). New Phase 2 stormwater regulations also leave the designation of specific BMP’s up to the states. This lack of specificity and rigor in federal approaches is part of a larger pattern of deference to the states.

There are other reasons beyond political tensions for questioning whether a strict federal regulatory role is advisable. Most soft path water systems rely to some degree on treatment and drainage in soils, which are highly variable across the country and which are affected by local climate conditions. As a result, it would be much more difficult to design a uniform, national approach for onsite systems than it has been for mechanical treatment plants. Water quality protection needs and opportunities would also vary from one watershed and ecosystem to the next.

There are, however, a number of steps that the federal government could take to promote reform of local regulations.

1. Model Public Health, Environmental and Building Codes

Good model codes need to be developed for state and local regulations that integrate across water sectors and that promote the use of innovative decentralized technologies, and these need then to be disseminated to state governments and local communities. EPA has recently funded groups such as the Center for Watershed Protection and the National Onsite Wastewater Recycling Association, to develop model performance codes and ordinances in low impact development and onsite wastewater systems, respectively. These efforts could be replicated for integrated soft path system oversight more generally, followed by projects to disseminate the models broadly across states and communities.

2. Model Watershed Approaches with Nested Soft Paths

Good examples also need to be developed of how soft path technology installations in water supply and treatment, stormwater retention, wastewater treatment, reuse and disposal, can nest to best effect into broader watershed protection plans. EPA and other federal agencies can fund local watershed projects to research such approaches, including regulatory standards for complete “off-the-grid” systems for new subdivisions or infill development.

There have been a number of state initiatives to promote integrated water

system planning at the watershed level, including in Massachusetts, Texas, Pennsylvania, and California. In general, it has been difficult to develop cooperation among siloed agencies, such as water supply and water quality. Most of the work has also continued to focus on conventional hard path solutions.

3. Model Public Utility Oversight

One private sector innovation that has begun to emerge in recent years is a design-build-operate model for cluster wastewater systems, particularly in new subdivisions. Discussions at a 2005 workshop in Palo Alto suggested that these systems tend to be for more affluent homeowners, and they are not usually built as part of a comprehensive water resource planning and review process. While the current need is to “expand” these markets, in the future there will need to be greater oversight to assure that they are serving the broader public interest. Model frameworks for state public utility oversight would be helpful.

4. Federal Incentives for Local Regulatory Reform

The federal government could also utilize a variety of incentive measures that fall short of direct regulation of all systems across the country. NOAA Coastal Grants, for example, require that states have approved septic system regulations in place as a condition of federal funding. Substantial increases in piloting and funding innovative TMDL and trading approaches have the potential to encourage states to reform onsite regulations, as a cheaper and better alternative to ever more expensive treatment plant upgrades. Pressures on

states to implement new nutrient criteria for environmentally-sensitive water bodies would also be a strong incentive for stricter local standards.

Federal Enforcement Bias Favoring Hard Path Solutions

The federal National Pollutant Discharge Elimination System (NPDES) system for point-source discharges has encouraged hard path infrastructure solutions to water quality impairments, even if soft path alternatives might be preferable from a multiple benefits standpoint.

Reasons for this traditional reliance by federal and state enforcement offices on hard path solutions are:

- *Sewer bias* – Under the NPDES, EPA cannot directly enforce repairs or upgrades of onsite septic systems that discharge into soils, so they have typically pushed cities and towns to extend sewer lines into unsewered neighborhoods. The way to force construction of a sewer might be a threat of fines against the existing central treatment plant that is not in compliance, or the imposition of a growth moratorium by the state until the sewer is constructed. Alternatively, federal and state enforcement officials concerned about water quality violations in streams or lakes will identify several small, illegal point source discharges and require the town to install sewers throughout the neighborhood to remedy those violations. If a local advocacy group urges septic system upgrades as an alternative, the regulatory authority can

unilaterally block consideration of that approach in the settlement agreement;

- *Storm sewer bias* -- Similarly, since federal regulations do not mandate rain gardens to retain stormwater at individual homes, enforcement officers will typically force municipalities to solve wet weather runoff and overflow problems through upgrades to storm drainage systems, separation of stormwater from old combined sewers, installation of underground stormwater storage tunnels, and expansion of treatment plant capacity.
- *Short timeframes* -- Once an enforcement program targets a municipality for water quality violations, there is minimal time allowed for the community to consider innovative or alternative approaches. Conventional engineering designs are usually the ones on the shelf, rather than innovative soft path ideas. Enforcement authorities usually want a fairly quick facilities planning process leading to the signing of a consent decree. Further, the expectation is for an agreement that dictates the comprehensive solution, typically hard path engineering, rather than an adaptive management approach which allows a community to experiment with soft path alternatives over time.
- *Siloed actions* -- Current permitting and enforcement authorities do not take adequate account of adverse effects of infrastructure projects that are

built in isolation. Soft path approaches are likely to emerge as superior alternatives if a comprehensive analysis has been undertaken. Instead, sewers get built to take care of the immediate problem and the externalities, such as falling groundwater levels or stormwater runoff from new development, are only seen later or in other parts of the watershed;

- *Financial risks for innovation* -- The risks and liabilities that engineers and communities assume when they design and build infrastructure deter innovation – EPA will impose fines if treatment is not achieved as planned.

From the perspective of soft path advocates, the NPDES permitting and enforcement framework, as it is currently being practiced, is severely retarding soft path innovation across the country. Enforcement is a potent and apparently necessary part of the solution, since communities all across the country are failing voluntarily to take action to clean up water pollution. However, at the point when the attention of the local community is finally caught by the threat of substantial fines for water quality violations, soft path solutions do not receive serious consideration.

Lawyers in enforcement agencies use public sector engineers to assess the facilities plans submitted by communities, and these engineers have historically expressed strong concerns and doubts about the reliability of soft path solutions. But, enforcement officials also have their own motivations

for pushing as much as possible the point source solution of the central sewer collectors and treatment plant. They have no direct control over local soft path regulations, lack independent knowledge of the performance of soft path technologies and management, and can't envision a system by which thousands of individual onsite systems would each receive federal permits.

There are several recent indications that the NPDES permit system could be adapted, if federal officials were willing. The same enforcement strategy of holding up approval of a comprehensive long term control plan or NPDES permit until communities extended sewer lines, could be used to require soft path upgrades instead. A recent court ruling in Minnesota stated that new sewer lines that would increase treatment plant releases into impaired waters would not be allowed if decentralized alternatives could be built in outlying areas. EPA has also developed guidance on how distributed stormwater systems in urban areas can reduce combined sewer and sanitary sewer overflows, and is looking to pilot these approaches into NPDES permits in several communities.

Lack of Integration of Federal Water Legislation

A related set of concerns for advancing soft path solutions is the siloing of water quantity, water quality, and other legislative and regulatory programs. Watershed groups typically find that local actions affecting a stream segment or lake are affected by Clean Water Act requirements for wastewater systems and stormwater systems, Safe Drinking Water Act requirements for source water protection, Army Corps of Engineers

permitting for flood and sediment control, water right allocations, and the Endangered Species Act. Coastal protection efforts are also guided by Coastal Zone Management and National Estuary programs. These separate requirements can often be at cross-purposes, for example if water withdrawals or sewers do not take account of the associated runoff from new development. The most critical lack of coordination is between water quantity and water quality concerns.

The 2005 National Water Policy Dialogue urged more integrated approaches and a “harmonizing and reconciling” of national water policy. Participants stated that “there is a need to reconcile the myriad laws, executive orders, and Congressional guidance that have created the current disjointed ad hoc national water policy and clearly define the 21st century goals and values that should be met”, and criticized the multiple, often conflicting, agency mandates.⁹⁵ Proposals for the establishment of a Water Commission that would be tasked with examining these issues have been discussed in recent Hearings in the Congress.⁹⁶

In the Southwest, water supply allocations and public lands boundaries have largely determined growth and development patterns, which in turn have had substantial water quality impacts on rivers.⁹⁷ Recently, the majority of Bureau of Reclamation projects, according to Congressional staff, are in “mitigation” efforts to deal with hydrological disruptions and water quality impairment created by earlier infrastructure projects. In the future, integrated water resource planning should be a condition of water

withdrawal projects, so that all regional water quantity and quality impacts are taken into account.

In the East, where until recently, water supply has been more than adequate, water quality under the Clean Water Act and flood control under Army Corps of Engineers permits have been the predominant concerns. Here as well, there has been minimal coordination of efforts from the federal perspective, and local communities fail to take account of the integrated nature of the water resource. The Eastern Massachusetts example of a large central wastewater system and ocean outfall pipe drastically depleting drinking water wells and streamflows is a prime example of the costs of this splintered decisionmaking.

Local watershed collaborative efforts can include assessments and implementation plans across multiple water policy and regulatory “silos”. However, in practice, one particular regulatory requirement can unfortunately drive the selection of remedial solutions, because there are not the regulatory “teeth” to implement other, more beneficial, approaches. For example, environmental groups have backed big-pipe solutions to combined sewer and sanitary sewer overflows, even though soft path solutions would arguably provide higher, multiple benefits. The big pipe project could be enforced under the federal law, but the rain gardens regulated under local authorities, could not.

The Complex Thicket: Siloed Incrementalism vs. Leapfrog Integration

Of all the challenges for redesigning federal policies and approaches, regulatory reform is the most difficult and the understanding of the problems and options is the least advanced. Various federal programs have recently begun to explore options to bring more responsible regulatory approaches to decentralized systems that have been under state and local jurisdiction. Key EPA programs that are looking at individual home or neighborhood septic systems as targets for stiffened federal requirements include:

- *the Underground Injection Control (UIC) program to protect groundwater from soil disposal systems;*
- *sourcewater protection programs for drinking water;*
- *nutrient standards development that would focus on onsite system contributions and lead communities to require advanced treatment;*
- *Phase II stormwater regulations (minimal controls) that could eventually deal with wet weather runoff from onsite systems;*
- *TMDL's that would allow for some trading between decentralized system management and municipal treatment plants.*

Similarly, decentralized systems for stormwater retention and treatment, such as roof or rain gardens, are being looked at through:

- *Phase II stormwater regulations and minimal controls (greater clarity on cluster system*

practices and expansion to include individual homes);

- *Army Corps permits for sediments;*
- *Combined Sewer Overflow (CSO) plans that would encourage distributed retention, so wet weather flows do not enter drainage or sewer systems.*

In terms of drinking water quality:

- *Source water protection plans have included land protection, septic system upgrades, and buffers around farmlands as substitutes for water treatment plant upgrades, such as in the New York City watershed and later in the Boston-area watershed.*

In terms of water supply, the Senate Water Supply Act of 2005 included:

- *Required alternatives analysis, including consideration of decentralized water sources, such as localized desalination of brackish groundwater, as options to piping freshwater from miles away.*

Because decentralized systems continue to be under local authorities, this approach is designed to work in stages: first, demonstrate how decentralized systems of one sort or another can solve some water quality problems better than hard path solutions; second, allow these decentralized solutions to be integrated into NPDES long term control plans and consent decrees; third, provide education to, and if at all possible, financial incentives for communities to institute decentralized system ordinances and plans; and fourth, hope for the

widespread adoption of the soft path approach nationally. This approach assumes that a host of other barriers at the local level are surmounted, including opposition from entrenched and threatened interests. An improvement in the approach would be the imposition of the “portfolio” approach, which would have EPA eventually mandate that a certain minimum percentage of funding or of stormwater and wastewater flows are addressed by soft path, decentralized systems and reuse.

An additional flaw in the “incrementalist” approach that is emerging at EPA is that the broad water system and community benefits are not taken into account in each of these siloed efforts. For example, septic system experts worry that stringent and costly UIC requirements under consideration for cluster systems (disinfection prior to disposal in soils, whether needed or not) will drive developers to use cheaper individual home systems that do not have to meet these standards. They question whether disinfection is needed, but also point out that the multiple benefits of cluster systems, such as preservation of open space through cluster development of the housing would be lost.

It would be far better to require existing and new developments to have an integrated water management plan, that both entailed a “lighter footprint” on the ecosystem and that created maximum community benefits and values. Unfortunately, an understanding of the variable impacts of alternative systems across the “water chain” and at “multiple scales” is very thin. The tools, technologies, and impacts are severely under-researched. Because of that lack

of knowledge, the development of “integrated regulatory frameworks” is also challenging.

The unwillingness of the current Administration and Congress to promote or require watershed approaches that entail serious regional land use planning is also a significant block to integrated water infrastructure planning. A shift from farmlands or forests to new subdivisions will have great impacts on water hydrologies and surface and groundwater quality, but governments of all levels are moving slowly and cautiously, if at all, to constrain or “control” new development.

A final problem is in reaching agreement with multiple constituencies on how to introduce more flexible regulations and enforcement to balance multiple benefits and costs. In the recent past, a simplistic version of a “flexible and balanced” concept was, unfortunately, used to argue that environmental protection was often not worth the cost in dollars. Environmental and water quality advocates are, therefore, justifiably suspicious of potential “Trojan horse” shifts from existing regulatory approaches into uncharted integration.

Recommendations for Regulatory Reform

- Fund a study group to identify problems in the current regulatory structure, which is based in hard path approaches and which divides authorities into separate spheres of water quality, water quantity, surface water and groundwater, flood control, endangered species, etc. This group should consider

- alternatives for both incremental reform and significant new federal legislation;
- Develop mechanisms for incorporating soft path technologies into municipal point-source wastewater and stormwater permits, through such requirements as “soft path portfolios” similar to renewable energy portfolios;
 - Incorporate “adaptive management” and “performance-based” approaches into the federal permit process so that higher-risk new approaches can be tried without penalties;
 - Explore new enforcement points and standards, such as mandated water use and reuse “efficiencies” and reduced discharges;
 - Explore ways to coordinate and integrate enforcement actions in surface water quality, source water protection, drinking water, groundwater, sediment and flood control, coastal zone management, estuary protection and endangered species, and streamline the processes by which local communities can meet the requirements;
 - Develop models for state and local design codes, as well as for oversight of pricing and service by new design-build-operate companies, so that expanding private markets are equitable and consistent with broader water resource plans;
 - Appoint a new Water Commission to study and recommend to the Congress better mechanisms for promoting sustainable infrastructure

development programs across a wide variety of agencies and Committees, including natural resources, environmental protection, public infrastructure, science, housing, and economic development.

Long-Term Infrastructure Sustainability

In the end, communities across the country should be looking across the board to more sustainable infrastructure in water, energy, transportation, and housing. For synergies and multiple benefits to emerge, the federal financial disincentives and regulatory barriers need to be replaced by sustainable infrastructure incentives and, potentially by a minimum floor of regulatory mandates. In the short-term, at least those projects on federal property and using federal funds should be required to implement sustainable infrastructure plans. For example, public housing projects using federal funds should be required to install sustainable water infrastructure, which would typically include rain or roof gardens, water-efficient fixtures, and reuse. Similar requirements should be made for energy-efficiency and renewables.

Ultimately, as the externalities of existing settlements on the nation become more apparent, and the benefits of “lighter footprint” decentralization and integration emerge, minimum standards for long-term sustainability of public infrastructure should be required by new federal legislation.

Chapter 8: Development of a Federal Policy Portfolio of Initiatives: Recommendations of a Workshop of Experts and Advocates

On January 19, 2006, in Washington, D.C., a workshop of potential “new alliance” members was convened for the purposes of developing an action plan or set of strategies for a more effective federal role in advancing the development of soft path water resource management. The goal of the workshop was to identify initiatives that would meet all three of the following criteria:

- Areas of effort and activities that will have the greatest impact in increasing the adoption and use of soft path technologies;
- Areas of effort and activities that a new alliance could succeed in completing;
- Projects that people want to work on individually, with their organization and/or collectively, going forward.

The process used to develop a list of strategies was to list potential projects and then to carry out two “bullet voting” exercises: first, to identify priority projects, and second, to identify projects that individuals and organizations would be motivated to spend time and resources in advancing. The high-priority projects were by and large the topics that received the most interest in working on as well. There was a general recognition that the best action plan would be one that would achieve the greatest results with the least amount of time and resources needed by the

participating organizations. It was also recognized that an action plan could include projects that only one or several organizations were willing to work on, as long as other organizations supported the initiatives in principal.

Overall, the strategies that received the greatest support as both important priorities and as initiatives organizations were willing to work on were in the research area. 46 of 94 bullet votes for “priority projects” were in the research area and 57 of 104 votes for “interest in working on” were in the research area. Structural changes such as regulatory, policy, funding or market reform received 19 and 23 points respectively; and outreach projects received 29 and 24 points respectively.

Highest-priority projects were:

Research and development

- Demonstration and pilot projects
- Research on the value of water, pricing, externalities, equity

Structural Change: Policies, Regulations, Markets

- Green Building – developing ties and links
- Integrated water resource planning and funding requirements

Outreach

- Support and networking with local organizations
- Enlisting “champions”, including in the federal government

Overarching Themes:

- A. *Agreement about National Innovation Strategies*

Workshop participants accepted the general framework that “national innovation strategies” fall into the categories of “market push” in science, research, and demonstrations, and “market pull” structural changes in the market or in consumer preferences.

B. A “Diversified Portfolio” of Projects

There was a recognition that one outcome of the workshop could be the articulation of a single strategy based on a point of view about one important barrier or another or about the best way for change to occur. This approach was rejected, because it was recognized that such single-purpose, “silver bullet”, strategies often fail, and that groups with different political philosophies were also unlikely to agree on a single best method. Further, it is too complex a matter to predict exactly what will work, and a sensible strategy is to bank on several possible approaches that could show surprisingly good results.

It was decided, therefore, to develop a “diversified portfolio” of federal policy initiatives.

C. “Adaptive” and Phased Strategies

There was a strong and clear agreement coming out of the fall WERF-sponsored workshops that, while scattered projects in integrated soft path water resource management have been developing at the local

level, nevertheless the picture is murky as to how the various elements will come together, costs, etc. Therefore, these priority projects represent an initial set of strategies to enrich and deepen the field. It would be expected that later phases could involve more fundamental strategies such as public outreach and regulatory reform. A clear concern was expressed that too heavy promotion of concepts, before all the arguments and tools had been worked out, could lead to failures and a backlash against soft path approaches, similar to what had occurred in the late 1970’s. This reality created a certain amount of tension, recognizing that the two key issues in water infrastructure, the impacts of land development on water quantity and quality, and how to repair aging urban infrastructure that is reaching the end of its useful life (aging sewer and water pipes and treatment plants) could both potentially benefit a great deal from consideration of alternatives to conventional hard path solutions. Nevertheless, it is premature to develop a full-blown case for soft path approaches in these two great issues areas.

A compromise position emerged to the effect that we know enough now to articulate arguments and there are case studies to report. There was no support, however, for articulating a comprehensive document or action plan or massive outreach effort until more research and pilot projects had been completed and evaluated. Three general phases were laid out: pilots, evaluation, and, in time, information out to the country.

D. Support for Local Initiatives

There was an understanding that the primary energy and creativity at this point is at the local level, and that an overarching goal is for the federal government to support these efforts rather than develop new federal mandates in the short-term. In this regard, earlier workshop discussions about the federal role suggested:

- The federal government can provide “visionary” leadership
- The federal government can coordinate among agencies
- The federal government can support locals through financial assistance, and technical assistance

E. Multiple Benefits/Multiple Stakeholders

It was clear in the workshops that the value of soft path water approaches was often in the externalities or indirect benefits, such as aesthetics, energy-savings, open space, increased property values, etc. For this reason and because this paradigm shift requires substantial work by a variety of institutions, many constituencies need to be involved in projects.

F. Tension between advocates for voluntary approaches and strict regulatory approaches was put off for the time being (earlier chapters in this report represent the views of the author only).

While it was clear in the fall workshops that “siloes” regulations in water, wastewater and stormwater were creating serious problems across the country, the challenge of sorting through how the regulatory structure should be reformed was beyond the capabilities of this group at this time. Once more is known about the benefits and tools of the integrated soft path, regulatory issues can be addressed more knowledgeably.

G. Both new development and urban areas

Soft path water approaches can be put to use in cities, suburbs, and rural communities, and in new development.

H. No perceived crisis in the public.

It is premature to raise an alarm to the public. More research needs to be done on long-range (50-100 year) water supply and water quality futures. Also, it is important to develop a more sophisticated understanding of what values the public supports that can be mobilized in support of integrated soft path approaches. Again, the set of strategies articulated in the January 19th workshop reflect an agreement that it is important to deepen and enrich the knowledge base before going out to the public in a sustained manner.

Market Push Research and Pilot/Demonstration Projects

The following priority projects were identified in the research and development area of innovation strategies.

High priority projects (10 or more dot votes)

- Support for pilot and demonstration projects in federal facilities and in local communities
- Research on benefits and costs of soft and hard path approaches, and pricing or other mechanisms to better align local decisions with long-run environmental and economic sustainability

Medium priority projects (3-5 dot votes)

- Basic, long-term research
- Developing a multi-faced business case
- Documenting limitations of hard path water infrastructure
- Research on marketing and public values
- Defining the “value proposition” for soft path water

Low priority projects (2 or fewer dot votes)

- Technology performance evaluations
- National Center or Laboratory of Excellence
- Domestic and international research review
- Political analysis of players and interests
- Research on leverage points, including government funding cycles, current vs. future development, new

regulatory requirements, infrastructure repairs

- Water/energy nexus
- Research on regulatory barriers and obstacles at local, state and federal level
- Watershed planning tools

Research topics received the highest levels of support in the January workshop, both as important federal strategies and as projects organizations expressed an interest in working on in a new alliance. This ranking can be traced to the general reasoning that it is still early in the development of the soft path field and that it is vital to have solid demonstrations and research documenting tools, benefits, etc. This reasoning was developed in the earlier WERF-sponsored workshops, where research and demonstrations were seen as pivotal in advancing the field. These topics also interrelate with priorities in the areas of market push structural reform and outreach. For example, research on markets and public values would be helpful in integrating the soft path water into the Green Building movement, which was one of the priorities in the structural reform strategy area.

High-Priority Projects

The high-priority projects described in detail were:

I. Demonstration and pilot projects (chosen carefully, with respect to scale)

The value of demonstration projects and pilots surfaced repeatedly in the 2005 WERF-supported and January 19th

workshops. Several key points in the discussions were:

1. Decisionmakers, such as elected officials and the public, need to see concrete examples of innovative approaches.
2. Risk aversion pervades the water resource infrastructure sector and engineers and utility managers, in particular, need to develop greater comfort with innovation approaches.
3. While most of the creativity and innovation in integrated soft path water infrastructure is occurring at local levels, the barriers to innovation are severe – an engineering bias against soft path systems, siloing of local agencies, siloing and narrow, mission-driven agendas of federal and state programs affecting local government, indifference of most of the public, restrictive local ordinances, and others – incentive funding of soft path projects is needed to help in overcoming these barriers.
4. Scale issues – more is known about the performance of distributed systems (rain gardens, onsite wastewater systems) at the individual lot level than at the subdivision or community-wide level. Demonstration projects should provide data on multiple levels.
5. Pilot projects are needed to demonstrate the efficacy of innovative technologies or projects in controlled settings. Demonstration projects generally explore the feasibility of these approaches in real communities and markets.
6. Demonstration projects (and pilot projects) are needed that integrate soft path water with sustainable energy, agricultural reuse, and other infrastructure fields more generally (this broad view of infrastructure is developing overseas).
7. The best demonstration projects will be in communities where there is interest and support, rather than a response to an enforcement/compliance remedy. Nevertheless, fines for non-compliance in treatment plants could be used as a pool of funds for demonstration projects in states.

Possible Actions to Promote Pilot and Demonstration Projects

The federal government can promote pilot and demonstration projects through technical assistance and outreach to communities with the interest and resources to work on soft path water resource projects on their own. However, the primary impact of the federal government will be in pilots in federal facilities and in financial assistance to local projects. Research conducted for this project has identified the following opportunities for funding of pilot and demonstration projects:

- National Community Decentralized Wastewater Demonstration Project (revive

- funding, which lapsed in the 2005 budget)
- Water Quality Cooperative Agreements (revive funding, which lapsed in the 2006 budget)
 - Work with the Federal Facilities Center and in particular with the Department of Defense and National Park Service to implement soft path water approaches in federal buildings, military bases, park visitors' centers, etc.
 - Watershed Grants at EPA (increase funding beyond the current \$15 million)
 - Explore research and pilot programs in other federal agencies, such as DOE (coordinate with energy/water nexus), Bureau of Reclamation (Title XVI programs), Water 2025 in DOI.

II. Research on benefits and costs of soft and hard path approaches, and pricing or other mechanisms to better align local decisions with long-run environmental and economic sustainability

This research topic emerged for a number of reasons:

1. It was suggested in earlier workshops that a significant reform in the system would come from forcing "siloed" hard path infrastructure beneficiaries to absorb the full costs of the disruptions these systems were causing in the regional watershed. If residents had to pay water rates that reflected the damage to streams and aquifers that came from the construction of public water systems, they

would likely purchase water conservation appliances and otherwise seek to reduce water consumption. Their communities might install soft path solutions, because under a full-cost calculation, the advantages of soft path water approaches would be clearly evident.

2. The role of federal subsidies in shielding water, wastewater, and stormwater customers from the full cost of infrastructure was also discussed. As had been discussed in the 1980's, when the shift was made from grants to loans, the suspicion is that hard path infrastructure is installed because federal and state subsidies make it affordable.
3. While in general, full-cost pricing will tend to lead to more sustainable choices being made, there are the twin problems of equity and access that must be resolved. If subsidies are withdrawn or rates are raised, water and wastewater services will be a major strain on the budgets of low-income ratepayers. Further, small, rural communities with higher per capita costs of infrastructure might not implement either soft path or hard path infrastructure improvements.
4. Approaches, such as low-income heating subsidies and targeted federal grants, should be considered as means to deal with these issues of equity and access.

5. While full-cost analysis is a desirable goal, little is understood about the types and actual levels of monetary and non-monetary benefits and costs of hard path vs. soft path water choices. A key area to be researched would be the cumulative impact of various solutions at either the neighborhood or subdivision level or the watershed level. How much do alternatives differentially impact drought conditions, groundwater depletion, streamflows, water quality, etc?

Medium and low priority research projects identified

While thirteen other topics received less support in the bullet-voting, they are nevertheless important to several alliance members that are intending to move forward on implementation. These projects are:

Long-term research and domestic/international research review

The November 10th WERF-sponsored workshop highlighted the precipitous decline in water-related infrastructure research in the U.S., in stark contrast to substantial funding for research and technology development in Asia and Europe. It was generally agreed that the U.S. has become a net importer of innovative water sector technologies. Opportunities were highlighted for technology breakthroughs in soft path water technologies, through such fields as bio-mimicry, nanotechnology, bio-engineering, and others. The suggestion was made in the January 19th meeting that it was vital in securing a substantial

revitalization of a federal research program to learn more about and document more fully this picture of a declining standing of U.S. water infrastructure relative to other countries.

Three short-term opportunities exist to follow-up on these issues and questions:

- Support NOWRA's international conference on decentralized and integrated water resource management in March, 2007 in Baltimore, Maryland
- Collaborate with EPA sustainability and international water groups in the Office of Water
- Work with the National Academy of Sciences panel examining international infrastructure innovations and explore lessons for the future of US water and wastewater solutions.

Energy/water nexus

The Electric Power Research Institute, which is a member of the National Decentralized Water Resources Capacity Development Project, has been invited to participate in the energy/water nexus research road-mapping exercise for DOE.

Defining the "value proposition"

This topic is right at the center of what participants in the January 19th workshop believe is most necessary to successfully advance the soft path water agenda, e.g. strengthening the capability of the field to make a solid case for significant federal policy proposals and other outreach. In general, participants suggested that the field is still too murky to be able to make a clear and

compelling statement for the values of a new soft path water paradigm, particularly when the hard path paradigm may question the scattered evidence that exists to date and point to failures that have occurred in recent years. Further research and demonstration projects will help to strengthen the basic case.

In the short-term, nevertheless, at least the outlines of a value proposition are needed. The new alliance should work on framing the arguments through the following efforts:

- reconsideration of better terms than “integrated soft path water resource infrastructure”, which were considered neither clear nor compelling to the uninitiated;
- assembling of various value statements, such as in EPA, RCAP, or other documents developed by participants;
- funding for a project to “frame” the field in language that will both educate and interest experts and the public.

Multi-faceted business case

There was substantial discussion in the WERF-sponsored sessions about the efficiencies and innovations that a robust private sector could bring to the emerging soft path water field, particularly if environmental and public utility regulations were developed to protect the public interest. One of the most dynamic parts of the decentralized wastewater field is the forming of new companies collaborating with developers to install and maintain cluster wastewater and stormwater systems in new subdivision developments. These

private firms are utilizing some of the latest technologies, are handling the thorny question of ongoing operation and maintenance functions that central system utilities are struggling with, and are working right at the center of creative community design. Decentralized technologies can facilitate building patterns that bring communities the wide range of economic, environmental, social, and aesthetic benefits that they desire.

The business case for how some of these more innovative companies operate and research on areas of the water resource sector where they could be expanded would be productive. Research topics would be:

- Soft path water products and how businesses could emerge to provide them
- Whether integrated water, wastewater, stormwater, and reuse technologies can be integrated at the site, neighborhood, and community and installed and maintained by the same company or utility
- How questions of equity and access can be addressed, for example through traditional public utility rate and other service area requirements
- Asset management and how GASB relates to soft path vs hard path water infrastructure

Market Pull Structural Reforms: Regulations, Funding, Markets

The following priorities were identified in the market pull or structural reform area of innovation strategies.

High-priority projects (7 or more dot votes):

- Linking the soft path water field to the “green building” movement and development of similar “standards” and “ratings”
- Exploration of how to tie federal grant and loan awards to an integrated water supply and water quality plan in a watershed

Medium priority projects (3 votes):

- Public health links explored

Low priority projects (1 or fewer dots):

- Federal regulatory changes
- State performance standards (less prescriptive)
- Model, flexible local codes

Major significant structural reforms in water resource “markets”, such as an expansion in the role of the private sector (see prior chapter discussing the need for research on the “business case”), regulatory reform, or a major shift in federal funding programs, were determined to be out of reach in the short-term. The current climate of federal policy which is opposed to new federal mandates, the undeveloped case for soft path approaches, and the absence of a robust advocacy alliance all mitigate against such measures, at least for now. The two high-priority federal policy recommendations were therefore those that were considered to be at least possible to achieve.

High-Priority Projects

III. Linking the soft path water field to the “green building” movement and development of similar “standards” and “ratings”

In the four workshops, there was substantial discussion about the success of the green building movement, which was bringing more sustainable building materials and energy-efficiencies into the commercial and home building construction markets, was encouraging the education and certification of architects, and was leading to new courses being developed in universities. In about a decade, the idea has catapulted from a fringe concept to a mainstream concept. While only several hundreds of commercial buildings have been certified under formal U.S. Green Building ratings, the number of conferences, guidance materials, local ordinances is increasing dramatically.

Several strengths of the green building model were discussed:

- the green building movement is a successful example of how to bring together architects, manufacturers, builders, homebuyers, and energy-efficiency and sustainable building advocates in collaborative efforts;
- green building has started as a voluntary program, only recently being adopted into local ordinances. That improves the quality of participation by partners and allows for innovative approaches to be tested before they are brought under regulation;
- green building designs are not always the cheapest, and this is a reminder that customers are willing to pay more if the case is made for higher value in the product;
- purchasers of green building (and hybrids) have turned out to be

politically and culturally in the mainstream, rather than from a narrow environmental movement;

- water has been a minimal part of green building so far. Only recently has water conservation been considered, but rarely stormwater, wastewater, or reuse.

The proposal from the January 19th workshop is to create linkages to the Green Building movement, and potentially to develop a parallel system for sustainable soft path water systems.

Possible actions include

- collaboration with the draft LEED neighborhood rating system (a collaborative of US Green Building Council, NRDC, and Congress of New Urbanism, and funded by EPA)
- collaboration with the new US Green Building Council projects for individual home construction
- networking with other green building initiatives, including with NAHB, conferences, publications, etc.
- approaching the green building network in the federal government
- discussing with EPA potential sponsorship of a separate project to develop a soft path water rating and certification system

IV. Exploration of how to tie federal grant and loan awards to an integrated water supply and water quality plan in a watershed

Workshop discussions highlighted the dangers of building siloed hard path water projects without taking account of major impacts on surface and

groundwater supplies and water quality in the wider watershed. Federal funding programs contribute to this problem by not requiring an examination of these impacts prior to awarding grants or loans. One solution to this problem would be a requirement for an integrated water supply and water quality plan to have been developed and evidence that the particular project is consistent with that plan.

One version of how this requirement could be implemented is in a provision in the proposed Rural Water Supply Act of 2005. In addition, California has recently tied an integrated water resource planning requirement to a new grants program for communities.⁹⁸ Ohio has also developed a coordinated funding program that requires communities to consider water projects in the context of broader growth and development issues.

A final example is the requirement that electric utilities submit a full-cost analysis of the impacts of new power plant construction or rate increases, prior to approval by the state Public Utilities Commission.

Possible actions:

- OMB had convened an inter-agency group to examine the problems of lack of collaboration among federal funding programs, but decided not to pursue any remedies. The case needs to be much stronger that this is having severe impacts on watersheds. Combining with groups such as the National Water Policy Forum on the water supply side could buttress this argument.

- Consider how asset management GASB 34 requirements for life-cycle analysis might help force integrated planning
 - Examine whether integrated planning could be incorporated into already existing NEPA requirements
 - Suggest to EPA that they promote the concept of integrated planning with state funding agencies and use California and Ohio as models
 - Incorporate issues of integrated water planning into discussions about the mission of a potential Water Commission
- packing existing case studies from different organizations
 - Link unusual allies
 - Acknowledge and build public awareness of a looming water crisis
 - Implement broad social marketing
 - Link soft path arguments to the “gap” analysis for repairing the nation’s hard path infrastructure

Market Pull Outreach Strategies

The following priorities were identified in the market pull outreach area (influencing consumer demand through innovation) of innovation strategies.

High priority projects (8 dot votes):

- Support for a network of local advocates and experts
- Work with federal leadership to provide guidance on the benefits of soft path approaches to federal agencies and to the nation.

Medium priority projects (4 votes):

- Send a clear and compelling soft path message and value proposition to key audiences

Low priority projects (2 or fewer votes):

- Conferences and workshops
- Translation of complicated tools into useable tools for small communities
- Case studies – translate techniques to useable stories,

Participants in the January 19th workshop listed a broad range of outreach projects that could be undertaken, ranging from broad social marketing and value messages taken to key audiences. Again, because of the early, nascent nature of the field, priority strategies were those that help with development of the soft path approach. Serious public outreach efforts, directly to utilities and homeowners would follow at a later time.

High-Priority Projects

V. Support for a network of local advocates and experts

The current federal environmental innovation strategy relies heavily on local reform efforts. If this strategy is to work in advancing soft path solutions, local advocates need a great deal of information and many tools to assess and implement soft vs. hard path alternatives. The first recommendation to fund demonstration projects is designed to help those few local innovators with the capabilities and interests in developing new approaches in technology, management, financing systems, ordinances, etc. with the financial resources needed to do so. The corollary federal strategy is for

replication of these models and successes in other communities. Support for a network of local advocates and experts is a critical and cost-effective means to achieve this knowledge-transfer.

Reform agents are, in particular, the voluntary sector of non-governmental organizations or NGO's. Ideally, these volunteers would join with engineering and other experts at the local and national level, as was achieved preliminarily in the workshops. Currently, there is no support system or network for soft path innovation. Other than an industry-led association in decentralized wastewater (NOWRA) and a national conference on LID that was convened last year, there is not yet a serious networking project for integrated soft path approaches at the national level.

The needs of local organizations were discussed extensively in the workshop. Because so few citizens are aware of the complex issues surrounding community choices of hard path vs soft path infrastructure, they are currently ill-prepared to take on this role. Existing information and tools are not adequate, even if groups take an interest in the question. For example, demonstration case studies are few and far between, so advocates can't point to neighboring towns. Performance data on systems is sparse. Models to estimate the cumulative economic and water quality impacts of various approaches are not adequately developed. And, volunteer activists do not know who in the private sector or utility fields to seek out for these answers, or how to establish stronger, more diverse alliances.

An effort should be made to map out the range of stakeholders and advocacy groups that should be involved. For example, it was recognized in the workshops that some local NGO's have worked to promote isolated soft path systems, such as rain gardens, distributed reuse, point of use water treatment, recycling of nutrients into agriculture, low impact development practices, and other nonstructural and distributed infrastructure. But these advocates are not coordinated under a common soft path framework. Similarly, there are various "foci" of activism around sprawl land development, pollution prevention, greening the cities, toxics campaigns, and others. A key question to address is how each of these concerns is affected by the choice of hard path vs. soft path water resource infrastructure.

A national network can serve the following purposes: bring soft path advocates together to share lessons learned about the implementation of soft path approaches; seek to provide them over time with information and tools generated through a wide variety of projects; seek their continued input on priority research topics; and help them develop collaborations with other local stakeholders and experts.

Possible actions:

- the NOWRA 2007 international conference is a possible venue for creating a technical and professional network
- Edens Lost and Found could be approached for a collaborative technical effort

- EPA could offer support for conferences and workshop, newsletters, etc.

VI. Work with federal leadership to provide guidance on the benefits of soft path approaches to federal agencies and to the nation.

As EPA has recognized, it is vital for federal leadership to articulate new directions in federal policy and goals for the nation. This leadership both motivates agencies and provides inspiration and ideas to local communities across the country. Workshop participants discussed the value in communicating with potential “champions” for soft path water approaches in the federal government.

Possible champions to be approached:

- White House Office of Science and Technology Policy, which has been conducting a review of water-related research across agencies
- Leaders in Congress who are offering legislation in response to international competition in science and technology
- Leaders in Congress who are concerned with the establishment of a Water Commission
- Leaders in Congress who have supported soft path research and demonstration projects in the past
- DOE Energy/Water Nexus group, which is expressing an interest in decentralized systems
- EPA Office of Water groups concerned with Innovation Policies, Sustainability, Smart Growth, Sustainable Infrastructure, International

issues, Watershed Strategies, and others

- EPA Office of Research and Development
- CEQ and OMB, who should be informed of the need to allow private property stormwater, wastewater, and reuse systems to eligible for federal funding, since that is consistent with one of the most important elements in the current “support” role of this Administration
- Work with federal leadership to provide guidance on the benefits of soft path approaches to federal agencies and to the nation.

Chapter 9: Key Findings and Conclusions

The objectives of this report were to research water-related initiatives and programs in the federal government, and to engage a diverse group of constituencies in a discussion about how the federal government could provide assistance in the development and adoption of integrated and decentralized water resource approaches. Key findings of the report were:

History and Potential for Soft Path Water Management

1. Siloed, hard path engineering, with miles of pipes and large, central treatment plants became the norm for water, wastewater, and stormwater management, beginning in the mid-1800's. Recently, the disruptions and high costs of maintaining this approach have become evident.
2. Decentralized and integrated approaches offer great promise for a lighter footprint in the environment and for lower costs, particularly when wastewater and stormwater are viewed as resources rather than wastes to be transported away and dumped somewhere else into the ecosystem.
3. The soft path approach has multiple benefits and synergies with other sectors, including energy savings, aesthetics, local economic development, and sustainable agriculture.

Impediments to the Soft Path

4. Soft path approaches are in an underdeveloped, or "infant industry", state, because the barriers to introducing systems into homes, subdivisions, and communities are severe.
5. These barriers include interlocking traditions and interests of municipal utilities, local regulators, developers, engineers, unions, and federal funding and regulatory structures.

Change Agents – Local Advocates and Leading-Edge Companies

6. In spite of the difficulties, local advocates and leading-edge companies are introducing soft path approaches in scattered sites across the country. These tend to be in siloed sectors of the soft path, such as in stormwater retention or on-site wastewater treatment, rather than a fully-integrated approach, and they are still at the margins of the dominant hard path institutions.
7. Because of this scattered nature of the current soft path field, the full potential of an integrated and decentralized approach is not yet demonstrated. This makes it hard for advocates to defend a substantial shift in federal policy at this time.

Federal Support for Change Agents

8. In the short-term, the federal government has an array of low-cost programs for supporting local communities and the private sector that can be of help in assisting

change agents in implementing soft path projects.

9. Demonstration projects, in particular, can help local advocates develop comprehensive, community-wide solutions. These projects can develop models for all the institutional changes required in shifting to a soft path, including new planning, management, regulatory, financing, and market approaches.
10. As these projects are implemented, the multiple benefits of the soft path and synergies with other infrastructure approaches can be explored and documented at both the metropolitan and the watershed levels. Federal funding is essential for these projects to occur, since they entail large-scale restructuring of entrenched programs and interests.
11. Support for integration of soft path water approaches into the green building movement is a second major project. This alignment of industry, developer, and environmental perspectives and energies has already proven to be an effective jump-start to sustainable building materials, energy efficiency, and other aspects of sustainable development.

Federal Leadership for the Long Haul

12. While it may be premature for the federal government to require the hard path water field across the country to transition into the soft path, the case for at least nudging the field in that direction needs to be made in the coming years.

13. The key areas of federal leadership are in a reinvigoration of basic and applied research in the nation's universities, research institutes, and government laboratories; reform of federal subsidy programs and regulations to remove the bias against soft path projects; and the introduction of incentives for integrated and multiple-benefit approaches in the country's infrastructure management.

Concluding Comments

At the December 12, 2005 workshop, participants were asked to consider how the three great institutions in America -- government, the non-profit sector, and the private market -- could help open the entrenched hard path infrastructure field to innovative soft path approaches. Each sector has its strengths and allies. For those constituencies who work full-time in Washington, DC, the opportunities for the federal government to provide leadership and set standards for the country are primary. For others, the strength of America's "civil society" is manifest in the struggles of motivated citizens and volunteer organizations to introduce soft path approaches wherever they can. Advocates for the private sector point to the risk-taking and creativity that is evident in small start-up companies pushing to get their technologies permitted in one city or state after another.

Currently, none of the three engines of reform are fully in gear in the soft path water field, because too many obstacles are in their way. For an effective jump-start and transition into the mainstream, all three sectors will need to be involved

in a collaborative effort. The new alliance of groups that met for the four workshops in the fall and winter of 2005-2006 involved representatives for each of the sectors, and the consensus developed around objectives and recommendations should make it evident that there is much common ground to proceed down new soft paths in water.

Of all three institutions, however, it is the federal government that is positioned to take this agenda and provide funding and encouragement for coordinated efforts across the country. It is hoped that this report and the collective insights of a new alliance of committed constituencies constitute the first step in persuading the federal government to take on that leadership role.

¹ Conversation with Michael Luzier, President, National Association of Home Builders Research Center (NAHBRC).

² Conversation with Alex Duran, NAHBRC.

³ Taxpayers for Common Sense. 2005.; American Rivers. 2004.; Natural Resources Defense Council. 2006.; Mazurek, J. and T. Mirga. 2004..

⁴ EPA. 2004. Managing Onsite....; LID Center 2000. ; EPA. 2006.

⁵ EPA, 2005. Memorandum.

⁶ Several Bioneers conferences have featured John Todd, creator of "Living Machines" for plants and fish to treat wastewater.

⁷ Lovins, A. 2002.

⁸ Gleick, P. 2003.

⁹ Brooks, D. 2003.

¹⁰ McDonough, W. and M. Braungart. 2002.

¹¹ See definition at www.cleantech.com

¹² Tarr, J. 1996. p. 186

¹³ Ibid.

¹⁴ EPA, 1997, 1996 Clean Water Needs Survey... p C-5.

¹⁵ EPA. 2002. The Clean Water and Drinking.....

¹⁶ Water Environment Research Foundation. 1999,

¹⁷ Ibid.

¹⁸ Nelson, V. 2002.

¹⁹ See, for example, Joubert, L. 2004.

²⁰ Ibid.

²¹ Nelson, V. 2006. Viable Business....

²² Wiland, H. and D. Bell. 2006.

²³ See, for example, John Todd's research at the University of Vermont.

²⁴ Jones, K. 2005.

²⁵ Wiland, H. and D. Bell, op cit.

²⁶ See new neighborhood ratings at

www.usgbc.org.

²⁷ Conversation with Larry Coffman, Prince George's County, MD.

²⁸ Clerico, E. 2007.

²⁹ Nelson, V, op cit.

³⁰ Wiland, H. and D. Bell, op cit.

³¹ EPA. 2006. Sustaining Our Nation's....

³² EPA has created a new research program for sustainable infrastructure, with an initial appropriation of \$7 million.

³³ See www.ecological-engineering.org and <http://studentgroups.gsd.harvard.edu/ecology/bios.html>

³⁴ See www.bluewatergreencities.net

³⁵ See http://www.sandia.gov/energy-water/roadmap_process.htm

³⁶ See <http://bie.berkeley.edu/usi/index.htm>

³⁷ Conversations with numerous American engineers, who have observed that leading-edge technologies are usually imported from overseas. Ray Ehrhard, Washington University in St. Louis, Mo; Julian Sandino, CH2MHill; James Kreissl,; and others..

³⁸ Conversations with participants in the International Water Association Small Water and Wastewater Systems conference, Mexico City, March, 2006.

³⁹ See www.waterforalllife.org

⁴⁰ Christiansen, C. 1997.

⁴¹ Porter, M. 1980, p. 224.

⁴² In Minnesota, several cluster wastewater treatment systems have failed and the State legislature has had to appropriate funding for replacements.

⁴³ Ashford, N.

⁴⁴ Ibid.

⁴⁵ Brown, H.

⁴⁶ EPA

⁴⁷ Conversation with Michael Luzier, NAHBRC.

⁴⁸ Christensen, C. 1997.

⁴⁹ Nadel, S. et al, 2003.

⁵⁰ Porter, M. op. cit., p 222.

⁵¹ Nadel, S. op. cit.

⁵² Gladwell, M., 2000.

⁵³ Nelson, V. 2006. Viable Business Models

⁵⁴ Meadows, D. 1999.

⁵⁵ Johnston, D. 2005

⁵⁶ Lindell, C. 2005.

⁵⁷ Connaughton, J. 2003.

⁵⁸ EPA, 2004. Innovating for Better.....

⁵⁹ U.S. Department of Interior, 2003.

⁶⁰ U.S. Department of Interior, 2005.

⁶¹ CAWT, 2006, Catalogue.....

⁶² National Academy of Public Administration, 2000.

⁶³ National Research Council, 2004.

⁶⁴ The Office of Management and Budget convened a working group to examine federal funding of local water and wastewater projects, which has not met in recent years.

⁶⁵ EPA, 1989.

⁶⁶ Conversation with Julian Sandino, CH2MHill.

⁶⁷ CBO, National Research Council. 2004. p.50.

⁶⁸ U.S. General Accounting Office. 1994. p 33

⁶⁹ National Research Council, 2001 and 2004.

⁷⁰ National Research Council, 2004. p 10.

⁷¹ Ibid.

⁷² Office of Science and Technology Policy, 2004.

⁷³ Lombardo, 2006.

⁷⁴ Hoover, 1998.

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- ⁷⁵ Congressional Budget Office, 2002, Summary p 11.
- ⁷⁶ Burtis, P. 2004.
- ⁷⁷ Seattle Public Utilities. 2003.
- ⁷⁸ Tech Talk. 2006.
- ⁷⁹ For example, EPA and Office of Science and Technology Policy reports in 1994.
- ⁸⁰ CBO, 2002.
- ⁸¹ WERF. Op cit. p ES-2.
- ⁸² Benyus, J. 1997.
- ⁸³ Wilderer, P, 2006.
- ⁸⁴ Nelson, 2003.
- ⁸⁵ Nelson, 2006, Viable Business...
- ⁸⁶ Conversation with Andy Lipkis, TREE People.

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- ⁸⁷ Senate, 2005 hearings
- ⁸⁸ Ibid.
- ⁸⁹ www.freshfields.com
- ⁹⁰ www.vancouveraccord.org
- ⁹¹ NOWRA, 2006.
- ⁹² Hoover et al, 1998.
- ⁹³ Joubert, 2004.
- ⁹⁴ Water Quality 2000, 1994. p. 56.
- ⁹⁵ American Water Resources Association. 2005. p. 3
- ⁹⁶ House of Representatives, 2005.
- ⁹⁷ Babbitt, B. 2005.
- ⁹⁸ California Department of Water Resources, 2004.

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Appendix A: Workshop Participants

Four daylong workshops to develop new strategies and new alliances were held on November 10, 2005, December 12 and 13, 2006, and January 19, 2006. The four workshops were facilitated by Patrick Field of Consensus Building Institute.

Individuals who participated in one or more of the workshops include the following. Those who participated in the January 19th priority-setting exercise described in Chapter 7 are indicated by an asterisk.

Matt Byers, National Onsite
Wastewater Association
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Watershed Partners
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Alex Echols, Conrod Communications
*Ray Ehrhard, EPRI Community
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*Autumn Hanna, Taxpayers for
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David Johnston, What's Working
Ken Jones, Green Mountain Institute
Chris Kloss, Low Impact Development
Center
*James Kreissl, Water Environment
Federation Small Systems
Committee
Nancy Lee, Social Marketing Services
Craig Lindell, Aquapoint
Andrew Lipkis, Tree People
*Michael Luzier, NAHB Research
Center
*Tracy Mehan, The Cadmus Group
Steve Moddemeyer, Seattle Public
Utilities
Tracy Moir-McClean, University of
Tennessee
*John Murphy, EPRI Community
Environmental Center
*Valerie Nelson, Coalition for
Alternative Wastewater
Treatment
Howard Neukrug, City of Philadelphia,
Office of Watersheds
*Betsy Otto, American Rivers
Ron Pate, Sandia National Laboratory
Glenn Patterson, USGS
Sushama Pradhan, North Carolina
State University
Karl Rabago, Houston Advanced
Research Center
*Paul Schwartz, Clean Water Action
Peter Shelley, Conservation Law
Foundation
Frank Shephard, Woods Hole Data
Base, Inc.
Robert Siegrist, Colorado School
of Mines
Jim Stebbins, Project Design
Consultants

*Nancy Stoner, Natural Resources
Defense Council
Heather Whitlow, Casey Trees
Harry Wiland, Edens Lost and Found
Richard Wright, American Society
of Civil Engineers

Appendix B: New Alliance Activities

While the purpose of this report was to examine federal policies to promote the soft path water resource infrastructure sector, this chapter summarizes conclusions that were drawn as to how a new alliance of environmental, industry, engineering, home building, and public interest organizations might proceed in formulating and advancing this federal policy agenda. The following recommendations were made at the January 19th meeting:

- The alliance would not involve the formation of a new organization, but rather collaboration on various projects as participating organizations saw fit. In general, the high priority federal policy initiatives described in earlier chapters were also rated highest in terms of willingness of these diverse constituencies to work on
- Different organizations would step forward to take the lead on each of the priority areas, which would entail organizing conference calls and meetings, etc.
- The high-priority recommendations would involve formulation of a proposal and eventually a recommendation to federal agencies or Congressional committees to dedicate funding for these initiatives;
- Various members of the alliance might coordinate on research and other projects to advance the soft path field;
- Funding support for initiatives might also be sought from private foundations;
- A key benefit of beginning to work on each of these priority proposals and research projects is that the new alliance will begin to develop a richer understanding of the needs and opportunities of the field; other opportunities for collaboration may also emerge;
- It was recognized that the argument for soft path water resource infrastructure is not yet well made. Demonstration projects and research will help. A project to develop a better language and “value statement” that would be understandable and appeal to a broad range of constituencies would also be useful;
- The January 19th workshop was intended to include a small group of experts in the soft path field. In the future it will be important to invite a much broader range of constituencies to participate in workshops and projects, including soft path water conservation and reuse constituencies; representatives of community assistance organizations; governors’, cities’ and towns’ representatives; science advocacy groups; and others;
- A vehicle for communication, such as a newsletter, website, conferences and workshops would also be beneficial.