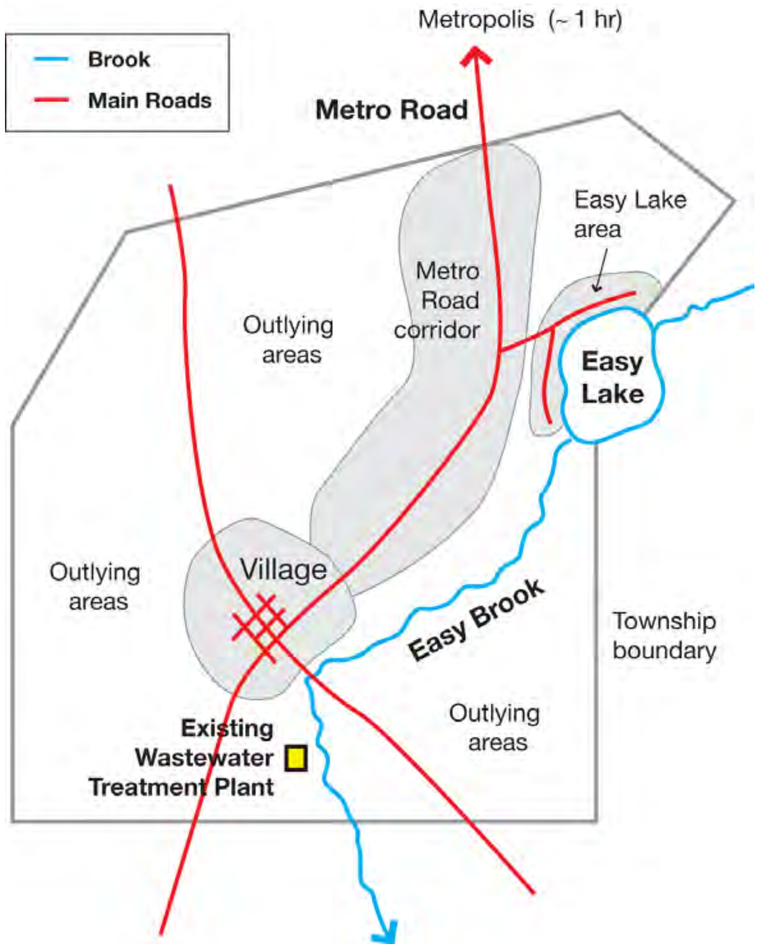
National Decentralized Water Resources Capacity Development Project



Case Studies of Economic Analysis and Community Decision Making for Decentralized Wastewater Systems

Rocky Mountain Institute
Snowmass, Colorado

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Case Studies of Economic Analysis and Community Decision Making for Decentralized Wastewater Systems

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ABSTRACT

This report examines how communities consider and value the benefits and costs of different scale wastewater facility options (onsite, cluster, and centralized options) in monetary or other terms, and examines the driving issues, motivations, thought processes, and decision-making methods of stakeholders relative to choices of wastewater system scale. Case studies of eight US communities cover seven topics that have received little attention in the literature to date:

- Financial benefits of incremental capacity expansion through implementation of decentralized systems
- Impacts of wastewater system choices on community growth, development, and autonomy
- Implications for fairness and equity within communities
- How communities evaluate the performance and reliability of wastewater systems
- How wastewater system planning affects relationships in a community and how relationships and trust affect wastewater decision making
- Hydrologic impacts of wastewater systems
- The value of decentralized systems to sanitation utilities that already manage large centralized systems

The case study communities are:

- Mobile, AL
- Paradise, CA
- Charlotte County, FL
- Johnson County, KS
- Metropolitan Boston, MA
- Lake Elmo, MN
- Broadtop Township and Coaldale Borough, PA
- Washington Island, WI

The case studies examine how each community evaluated the topical issue in the wastewater facility decision making process, or in some cases how the issue came up after wastewater facility decisions were made. The report also includes an analysis for a hypothetical community of the financial benefits of incremental capacity expansion using decentralized systems compared to periodic large-scale investments in centralized capacity.

EXECUTIVE SUMMARY

Project Purpose

This study is based on the premise that communities engaged in wastewater facility planning processes can make better choices if they understand how other communities have wrestled with wastewater infrastructure decisions. It presents case studies that focus on the decision processes of a variety of communities. Specifically, the case studies:

- Investigate how communities consider and value different scale wastewater options (onsite, cluster, centralized, and regionalized systems) in monetary and other terms
- Examine the driving issues, motivations, and decision-making methods of stakeholders relative to choices of wastewater system scale

The report focuses on seven topics that have received little attention in the literature to date:

- Financial benefits of incremental capacity expansion through implementation of decentralized systems
- Impacts of wastewater system choices on community growth, development, and autonomy
- Implications for fairness and equity within communities
- How communities evaluate the performance and reliability of wastewater systems
- How wastewater system planning affects relationships in a community and how relationships and trust affect wastewater decision making
- Hydrologic impacts of wastewater systems
- The value of decentralized systems to sanitation utilities that already manage large centralized systems

The case studies in this report can help communities facing wastewater system choices to: a) better understand the implications of different options so they can make better evaluations; and b) see how the decision process has played out in other communities, so that the process pitfalls encountered in some communities can be avoided and the process successes of other communities emulated.

Readers can review the results at various levels of detail, according to their particular needs. Part I reviews the concepts and methods of the study, provides summaries of the case studies, presents a financial analysis of wastewater scale choices for a hypothetical community, and synthesizes the study results into topical and overall recommendations. Part II provides the detailed case studies.

Methods

The research began with the generation of a list of potential case study communities. The researchers sought communities where two or more wastewater scale options had been considered and where one or more of the seven research topics had been part of the decision process. Inquiries to six listserves and four web-based bulletin boards in the wastewater management field yielded many suggestions for candidate communities, as did inquiries distributed through the professional networks of the National Decentralized Water Resources Capacity Development Project (NDWRCDP), the National Onsite Wastewater Recycling Association (NOWRA), and the Consortium of Institutes for Decentralized Wastewater Treatment (CIDWT).

Ultimately, more than 80 candidate communities were considered. Selection of the eight research communities was based on judgments of the likely richness of a community's experience in relation to the research topics; a desire to present a diversity of community types, wastewater problems, infrastructure proposals, and outcomes; and geographic distribution. Based on these criteria, the following communities were chosen:

- Mobile, AL
- Paradise, CA
- Charlotte County, FL
- Johnson County, KS
- Metropolitan Boston, MA
- Lake Elmo, MN
- Broad Top/Coaldale, PA
- Washington Island, WI

The researchers conducted interviews with officials and stakeholders in each community and reviewed facility plans, comprehensive plans, local codes, local government resolutions, and meeting minutes, and many other documents. In four communities—Paradise, CA; Charlotte County, FL; Lake Elmo, MN; and Washington Island, WI—the researchers conducted field visits and personal interviews, plus additional phone interviews. These case studies address four or five of the research topics. The other four case studies focus on one or two topics. Interviews in these communities were conducted by phone. Case study drafts were sent to every person interviewed in each community and the case studies were revised based on the comments received.

An additional analysis was developed for a hypothetical community given the name "Smallside, USA." The community's situation was constructed to enable a clear comparison of the financial cost differences between centralized and decentralized approaches to provision of wastewater system capacity. A water/wastewater utility finance and rate consultant prepared the financial analysis.

Case Study Synopses

The following statements indicate the key wastewater issues and actions for each case study.

- ***Mobile, AL:*** The water and wastewater utility for this city of more than 200,000 has chosen to develop, own, and operate cluster wastewater systems in the rapidly growing exurban area beyond its traditional sewer service area. This approach meets many of the strategic objectives of the utility. A demonstration "sewer mining" project is also underway in the urban core of Mobile. It will remove wastewater from an interceptor sewer, treat it with cluster-scale treatment units, and use the reclaimed water to irrigate a new city park.
- ***Paradise, CA:*** A proposed sewer and centralized treatment project for the commercial district of this unsewered community of 27,000 caused a public uproar due to public process mistakes, fairness and equity issues in cost allocation, and concerns over impacts of the proposed system on community growth and character. The public rejected the proposal, and an Onsite Wastewater Management Zone became the vehicle for management of all onsite systems in the town. Cluster systems are now under consideration to provide capacity for some commercial areas.
- ***Charlotte County, FL:*** A water and sewer master plan proposed a massive sewer project in this county, where the availability of more than 200,000 platted lots was contributing to explosive growth. Residents, many of them on low, fixed incomes, objected to the cost per household. After years of rancorous debate, the plan was rejected by the county commissioners. An ordinance requiring advanced onsite systems or lot combinations for small lots and lots on the waterfront or canals has met with success, as has a much smaller sewer expansion program.
- ***Johnson County, KS:*** A policy allowing cluster development and cluster-scale wastewater systems in unincorporated areas of this rapidly growing county just outside Kansas City, Missouri was proposed as a way to ease the transition to urban land use and eventual regional sewer service. The county chose not to enact the policy because of concerns that it would allow too much urban-style growth in rural areas and because of risks that absorption fields could experience hydraulic overloading due to infiltration to gravity sewers. (Some outside wastewater experts believe the choice of gravity sewers for the cluster systems was unwise.)
- ***Boston, MA:*** The regionalized sewer system of this large metropolitan area results in substantial transfers of local groundwater (for instance, water that infiltrates to sewer lines) out of local watersheds. This has contributed to declines in groundwater tables and reductions in the base flows of some local rivers and streams. The role of decentralized wastewater systems in recharging groundwater is receiving significant attention in the region.

- ***Lake Elmo, MN:*** Large-lot zoning in this community of about 7,000 located just nine miles east of St. Paul failed to achieve the community's objective of maintaining a rural atmosphere. An ordinance allowing cluster development with 50 percent open space preservation and cluster wastewater systems has been highly successful, and the community has rejected regional sewer service. This decision has been challenged by the regional planning authority, which believes Lake Elmo is not accepting its fair share of regional growth.
- ***Broad Top/Coaldale, PA:*** This low-income community of 10 villages and less than 2,000 people has historically used "straight pipes" to discharge household wastewater directly to local streams. The solution has been development of village-scale cluster systems and conventional and advanced onsite treatment systems, along with township management of onsite systems (including ownership in many cases).
- ***Washington Island, WA:*** This island's permanent population of about 700, and second home owners alike, objected to the high cost of a centralized treatment system proposed by the town's hired consultant. A second consultant developed a facility plan based on advanced onsite treatment systems and public management. This plan was accepted by the state after a successful demonstration of the proposed onsite technology. The plan was considerably less expensive and has given the town flexibility to adapt to regulatory and technological changes.

Topical Results and Recommendations

The seven research topics are introduced briefly in the following section, along with recommendations to other communities engaged in wastewater facility planning. The topical analyses in each case study provide the experiential substance behind these recommendations. The recommendations are explained further in Chapter 5, *Synthesis and Conclusions*.

Incremental Capacity Provision

Wastewater system scale affects the size and cost of capacity additions to a system. Centralized systems typically are built in a few large phases, with extra capacity in treatment and/or collection systems available to accommodate future growth. Onsite and cluster systems typically allow smaller, more frequent increments of capacity, built to accommodate immediate or near-future needs. Three case studies examine how communities perceive and value these differences. The Smallside, USA analysis further addressed the potential financial advantages of an incremental, decentralized approach. Recommendations derived from the case studies include:

- Focus infrastructure investments
- Recognize that conventional engineering typically emphasizes "staying ahead of the growth curve," often at substantial expense
- Consider demand management as one approach to capacity provision
- Realize that a "single solution" may be no solution
- Include financing considerations in the facility planning process
- Be aware that a finely phased approach may have higher "transaction costs"

- Be aware of economic dynamics that can undermine the financial viability of a large-scale system
- In a time of change and flux, consider the reduced financial risk of a more finely phased solution
- After implementing a plan, keep an eye on the future, but do not act prematurely

Community Growth, Development, and Autonomy

The impact of wastewater infrastructure in promoting or directing growth is a key issue in many communities, but how wastewater infrastructure issues influence decision making is not well understood. Arguments are often made for and against both sewers and onsite/cluster systems—that one or the other increases growth or encourages sprawl. Centralization or regionalization of wastewater systems may offer cost savings to communities or be resisted as a loss of local autonomy. Five case studies show how these issues have played out in various communities. The lessons of these case studies include:

- Recognize the relationship of system architecture to growth
- Address land-use planning before wastewater planning
- Work with consultants to critically evaluate assumptions
- Get the growth projections right
- Use infrastructure policy carefully as a growth-management tool

Fairness and Equity

The costs and benefits of centralized and decentralized systems affect citizens in very different ways. In general, centralization spreads costs widely across a community while decentralization focuses costs on individual or clustered residents, each according to the resident's specific situation. Four case studies address how various stakeholders perceive these differences. Recommendations include:

- Remember both the benefit and the liability that big systems create by distributing costs
- Take care in distributing the costs of system design
- Determine whether the community is fundamentally guided by a user-pays or a cost-sharing ethic
- When adopting a user-pays scheme, address financial hardships that may be created for some users
- When adopting a cost-sharing scheme, explain carefully why cost sharing is appropriate
- In addition to intra-community equity, carefully consider the inter-community or regional equity implications of wastewater systems

Performance and Reliability

Performance refers to required or desired results of wastewater treatment systems: levels of nutrient removal, pathogen neutralization, and other desired results. Reliability is the rate or probability over time of attaining a performance level. This study examines how communities (or in most cases, their consultants) choose performance levels and evaluate the performance and reliability of different wastewater systems. Five case studies reveal the following lessons:

- Carefully and clearly define the problem; for instance, whether existing onsite systems are really an environmental or health threat, and if so, whether that is due to technology, lack of management, or other factors
- Consider onsite or cluster system management carefully before rushing to a centralized solution
- Be sure that the needs analysis is sound
- Strive for a holistic approach to water quality issues
- Find out if flexible regulatory structures are available
- Endeavor to reach a consensus on performance and reliability issues that reaches across political lines
- Realize that decentralized wastewater systems, properly designed and managed, are potentially permanent systems, even within the urban fringe
- Thoroughly address performance and reliability concerns around decentralized systems
- Consider whether cluster development served by cluster-scale wastewater systems could help the community meet performance and reliability goals
- Consider how an incremental decentralized capacity approach can help address performance and reliability
- Consider the relative health and environmental risks posed by failures of centralized systems versus failures of decentralized systems serving the same population
- Ensure accountability, both financial and environmental
- Develop the necessary information infrastructure to ensure proper management
- Educate homeowners about the importance of proper practices in the use of wastewater treatment systems

Stakeholder Relationships and Trust

Community decision-making processes are strongly affected by the types, timing, and methods of presentation of key information, as well as the structure of decision processes. Wastewater system planning affects relationships in a community, and relationships affect debate and decision making. This interplay is examined in five case studies, which support the following recommendations:

- Realize that good technical work alone does not ensure success
- Provide for substantial, genuine public participation
- Develop a process that engages all segments of the community and encompasses all key issues
- Enlist the community in the search for solutions
- Include citizens' input when drafting requests for proposals (RFPs)
- Be sure consultants and community assistance providers attend carefully to the values of the community
- Make sure the public turns out; they have a responsibility to get involved sooner rather than later
- Never let consultants get ahead of or replace community leadership in the public's eye
- Identify and assist leaders interested in the issue and process
- Consider professional and unbiased facilitation
- Work closely with regulatory officials from the beginning
- If your community is breaking new ground for your state, be prepared for a long effort
- Take care to avoid making participatory bodies into "rubber stamp" groups
- Communicate public policies and the intent of leadership honestly and clearly
- Anticipate opposing perspectives and positions
- Respect and involve all perspectives and positions
- Be prepared to respond to the belief that any cost is too much
- Study all options
- Be prepared to correct misinformation about technical matters
- Ensure that citizens understand the need to undergo wastewater facility planning
- Take care to "prove" the case for new infrastructure or increased regulation and management by developing the best supporting information that is affordable
- Beware of using studies as a way to put off making decisions
- Spend the money required to package scientific information so that the public can understand it
- Keep the public informed throughout the planning process
- Note that outreach is essential not just in planning and policy-making, but also in implementation
- Avoid management structures that create conflicts of interest

Hydrologic Impacts

Wastewater systems can affect the water balance of watersheds. For instance, large-scale sewer systems can move significant amounts of locally supplied groundwater out-of-basin or to distant downstream treatment and release points. Sewers with high rates of infiltration can reduce groundwater recharge and stream base flow. A case study of the Boston metropolitan area shows the impacts of these processes and supports the following recommendations for communities considering centralization or regionalization of infrastructure:

- Study demand-side management and other wastewater flow reduction measures
- When considering a regional system architecture, evaluate how it transfers wastewater between basins
- Maintain stream base flow support through distributed, soil-based wastewater treatment and low-impact development practices wherever possible; surface water discharges of centrally treated wastewater to mitigate low instream flows are not environmentally equivalent
- Accurately account for interbasin transfers of water and wastewater when calculating watershed water budgets
- Take advantage of a local watershed’s ability to assimilate stormwater and recharge groundwater
- Reduce impervious surfaces that increase runoff and contribute heavily to peak flows
- Take care that policies addressing one problem do not exacerbate other problems
- Foster a holistic approach to watershed management; address both water quantity (hydrologic impacts) and water quality (ground and surface water contamination)

Value of Decentralized Systems to Large Wastewater Entities

Some wastewater system managers believe decentralized wastewater systems have an important role to play in major wastewater utilities. They believe a mixed architecture that includes centralized and decentralized systems may be the best way to serve large, diverse communities. A case study of the Mobile Area Water & Sewer System shows how decentralized systems (in this case, cluster systems) help serve the needs of a major wastewater service provider, both on the growing urban fringe and in the urban core of Mobile. Other large systems would do well to follow Mobile’s lead in these ways:

- Learn the options
- Identify the values decentralized systems can provide for particular situations
- Find a “champion” within the utility
- Try one or more demonstration projects to investigate the feasibility of decentralized systems for the community
- Experiment with different technologies
- Carefully consider cost structure when selecting technology

- Be clear with partners (developers) and users (homeowners) regarding the responsibilities of each
- Develop a service strategy and cost and revenue structures that minimize risks
- Be open-minded

Summary Conclusions: Top “Tips” for Communities Engaged in Wastewater Planning

The preceding sections present a large number of recommendations for communities engaged in wastewater facility planning. The following “top ten” list is one way to summarize the results of the case study research into the most important themes and recommendations. This list is particularly designed to aid communities that are just beginning a wastewater planning process, but will provide helpful reminders to other communities as well. The tips are presented in a rough chronological order of when the subjects might come up in a facility planning process; however, this does not mean that subjects noted in the later tips should not be given some consideration early in the process.

1. ***Address land-use planning before wastewater planning:*** If growth and community character concerns have not been adequately addressed in previous general planning processes, they will inevitably come up in the facility planning process. Citizens recognize the relationship of system architecture to growth. For instance, they know that sewers allow for and sometimes even require growth and higher development density. This is fine if such growth is widely desired. Citizens will reject wastewater proposals that they see as incompatible with their vision for the community. Shape wastewater system architecture around land-use decisions, rather than allowing infrastructure decisions to dictate land-use. On a related note, beware of “zoning by septic,” as is done in many communities unwilling to directly face growth issues. This practice is a blunt and often ineffective instrument, particularly since the availability of advanced onsite treatment technologies reduces the technical and perhaps the legal legitimacy of basing large-lot requirements on loadings from septic system effluent.

2. ***Work closely with regulatory officials from the beginning:*** This can help avoid enforcement actions while wastewater solutions are crafted. Constructive engagement is necessary to avoid costly confusion. Especially if innovative or alternative solutions are of interest, developing positive relationships with regulators will help them see that the community is genuinely interested in doing the right thing, rather than trying to “get away with something.” Solid relationships with regulatory officials also make the community more attractive to potential providers of financial assistance.

3. ***Provide for substantial, genuine public participation in the wastewater planning process:*** Remember that good technical work is not enough to guarantee success. Citizens must feel they have been adequately consulted and heard. Public hearings are not enough. Citizen work groups, committees, and other means of involvement are necessary. Be sure to develop a process that engages all segments of the community and encompasses all key issues. As part of that process, ask a broad cross-section of community members for their ideas, opinions, and values relative to wastewater issues and potential solutions.

Enlist the community in the search for solutions. Particularly in the problem scoping and option generation phases of the process, citizens can contribute useful ideas and at the very least the community will feel more ownership of the final plan. In the implementation phase, be sure the management system structure involves citizens in meaningful ways. Throughout, let citizens know that not only do they have opportunities to participate, but that they also have a responsibility to participate, in order to ensure that adequate information and perspectives are fed into goal-setting and system design processes. Explain why citizens should want to participate: they will benefit from reduced costs, improved quality of life, protection of property values, safer drinking water, and so on if they help shape the plan.

4. ***Be sure consultants and community assistance providers attend carefully to the values of the community:*** Too often consultants pay little attention to discerning and accommodating the values and qualitative concerns of local residents. A good consultant will help a community ask the right questions and articulate its values, goals, and issues relative to wastewater systems. Choose a consultant who will listen carefully to the community, and just as importantly, will help your community understand how its concerns, values, and goals will be impacted by different wastewater options. Also, choose a consultant with demonstrated experience with decentralized systems, to be sure that a full range of options are brought to the community's attention.

5. ***Carefully and clearly define and measure the problem:*** Pursuing higher performance goals and basing large wastewater system expenditures on anecdotal evidence or inconclusive studies is financially and politically risky. Studies must be carefully designed to determine the impacts and risks of onsite systems. Differences between existing and new systems, and between unmanaged and managed ones must be carefully noted. Further, wastewater is rarely the only anthropogenic source of nutrients or pathogens in a watershed. Ultimately the most cost-effective approach to pollution reduction is a risk-based approach that encompasses all pollutant sources and the relative costs and efficacy of various technologies and management options for controlling pollutants. Failure to integrate policies and solutions across sources or to "prove" that onsite systems pose significant risks leaves facility planners open to the charge that money and effort are being unwisely or unnecessarily spent in the wrong place. At the same time, this recommendation must be tempered by the realization that conclusive linkage of water quality findings to suspected sources is difficult. A "weight of evidence" approach may be required, but it must be carefully and fairly explained to the public.

6. ***Consider onsite system management before rushing to a centralized solution:*** In particular, determine whether observed or predicted onsite system failures are unavoidable or simply the result of poor operation and maintenance practices that could be remedied through appropriate management. Factors to consider in evaluating the failure risks of existing onsite systems include inappropriate soil conditions or inadequate designs allowed under onsite wastewater codes in place some years ago. Even if these risks are high, centralized solutions may still not be the most cost-effective approach—system replacement followed by effective management may be the way to go. Also consider whether appropriately designed and managed cluster systems can help the community meet higher performance and reliability goals.

7. ***Consider how wastewater systems affect local watershed water budgets.*** That is, evaluate how wastewater systems affect flows between groundwater and surface water, stream base flows, and flows between human and natural water systems. For instance, centralized or regionalized sewer systems often transport significant quantities of water from its point of origin (for example, water supply wells or infiltration of groundwater into gravity sewer lines) to distant downstream or out-of-basin treatment plants and outfalls. This can reduce groundwater tables and base flows in local streams. Onsite and cluster systems using soil absorption systems for dispersal of effluent may play a useful role in recharge of local groundwater and support of stream base flows. At present, these relationships are not recognized in many places, but are of significant concern in others. It appears that the role of wastewater systems in altering natural hydrologic conditions will become a greater environmental—and perhaps regulatory—concern in more places in coming years.

8. ***Investigate options that integrate centralized and decentralized approaches.*** In many communities it will be appropriate to use centralized wastewater service for some areas and management of onsite and cluster systems in others. Also, if the community already has a centralized system, do not extend sewers without carefully evaluating decentralized options to service the area(s) in question. A centralized utility can manage or even own and operate onsite and cluster systems to ensure or provide adequate wastewater service throughout a community in the most cost-effective and environmentally efficacious manner. If the community is unsewered but in or near a municipality or metropolitan area with a centralized or regionalized system, explore possibilities for that utility to provide management of (or to own and operate) decentralized systems in the community. At this point in time, few urban or suburban wastewater utilities include decentralized systems as a service offering, but more are likely to in the future. It is also worth identifying and approaching other utilities—for instance, rural electric cooperatives—that have the technical, managerial, and financial capacity to effectively manage decentralized wastewater systems. Some are doing so already.

9. ***Be aware that different wastewater system architectures distribute costs in different ways.*** In general, centralization spreads costs while decentralization focuses costs on individual or clustered wastewater system customers, each according to the specific situation. Thus, the equity and fairness implications of the choice of wastewater system scale will vary in ways that may affect public acceptance of the proposed solution. For instance, centralized systems are often promoted as achieving economies of scale. But they also raise concerns that some customers (for instance, those in more dense areas) will subsidize other customers (those in less dense areas). Another dynamic that often comes up with centralized options is the claim that residents are subsidizing businesses. Whether subsidization is actually occurring may or may not be true, but perceptions of unfair support of others may be decisive, along with attitudes about whether subsidies are justifiable or desirable. On the other hand, placing situation-specific costs directly on particular wastewater customers by using onsite or cluster systems without any type of cost-sharing across the community or any financial assistance for hardship cases may seem unfair and unaffordable to some or many community members.

10. ***Consider the impacts of the size and timing of capacity investments on financing costs and the relative risks of different wastewater options.*** Engineers usually address the time value of money for capital, operations and maintenance (O&M), and management costs. But too few facility planners examine how the distribution of costs over time affects the amount of debt a community will carry and the resulting financing costs. In general, decentralized systems allow finer matching of total infrastructure capacity to growth in demand over time, while centralized systems front-load capacity, which a community must grow into. The latter approach typically requires more debt. In contrast, wastewater options that spread capital investments over time lower the net present value of financing costs, reduce the size of principal payments, and are more likely to be affordable for communities. Incremental provision of capacity exposes a community to less financial risk, including the risk of rate increases if less growth occurs than was originally projected. Incremental approaches also provide a community with more flexibility to adopt new technologies or react to other changes.

Report Organization

This report is divided into two parts:

- Part I of the report explains the research and presents its key findings (Chapters 1–5)
- Part II of the report provides detailed treatments of how eight communities have managed wastewater planning issues (Chapters 6–13). Each of these case studies follows a consistent structure and contains the same six major sections:
  - The Community
  - Wastewater Issues:
  - Historical Overview:
  - Analysis
  - Conclusions
  - Sources
- At the end of Part II are
  - A list of abbreviations
  - Key parameters of the engineering and financial analysis performed on a hypothetical community called Smallside, USA
  - Links to Excel workbooks used in the analysis of the financial benefits of incremental capacity provision for Smallside. The workbooks are available electronically with this report on the CD and online at www.ndwrcdp.org

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PART I – OVERVIEW

Part I of the report explains the research and presents its key findings. Chapters include:

- **Chapter 1, *Introduction*:** This chapter explains the purposes of the report, the concept of wastewater system architecture, and the research topics. It also identifies the case study communities.
- **Chapter 2, *Methodology:*** Here the selection of the case study communities, the methods of research, and the structure of the case study write-ups are described.
- **Chapter 3, *Case Study Summaries:*** This chapter presents one-page summaries of each case study.
- **Chapter 4, *Smallside, USA: A Hypothetical Analysis of the Financial Benefits of Incremental Capacity Provision:*** This chapter presents a financial analysis for a hypothetical community. The community was designed in a way that allowed isolation of the financing differences between centralized and onsite options.
- **Chapter 5, *Synthesis and Conclusions:*** Here the results of the case study research and the financial analysis are synthesized into topical and overall findings and recommendations.

1 INTRODUCTION

Wastewater infrastructure choices can be momentous decisions for communities. These decisions are often framed by questions like:

- Should we place requirements on the operation and maintenance of onsite systems such as septic tanks and leach fields to ensure they function properly?
- Should we require advanced onsite systems under certain conditions?
- Should we create a sewer system and build a treatment plant to serve multiple users, or continue using onsite systems?
- Should we extend sewers into a newly developing area or one previously served by onsite systems?
- Should we consider cluster systems as an alternative to onsite or centralized approaches?
- Should we incorporate wastewater reuse into our wastewater system, and how?
- Should we expand the capacity of a wastewater treatment plant?
- Should we close one or more smaller plants and consolidate treatment at one facility?
- Should we join a regional sewer system and send our sewage to a treatment facility outside our borders?

These questions represent significant decision points because a community's wastewater infrastructure choices have substantial and long-term impacts. The capital costs of the available options can vary significantly. So too can operating and maintenance costs. The distribution of costs across the community and over time may raise issues of affordability and equity. Wastewater system options vary in the quantity, quality, and location of effluent releases to the environment. Different systems may vary in reliability. Thus, system choices can present real and perceived differences in impacts and risks to the environment and public health. Systems also differ in their demands on users for proper operation and maintenance, and the degree and intrusiveness of inspection and action on private property by officials of the local government or other entity responsible for management. Also, wastewater system choices can affect patterns of growth in a community. For instance, sewers typically allow for higher density development than do onsite systems, which may be desirable or undesirable. Large-lot zoning for onsite systems can result in sprawl. Once a community decides to adopt sewers or large lots served by onsite systems, it is difficult if not impossible to go back and switch systems once an area is developed. These are just a few of the implications of wastewater infrastructure choices.

Many textbooks and manuals aim to provide guidance on wastewater technologies and decision factors to communities and wastewater professionals (for example, Crites and Tchobanoglous 1998, section 2-11) variety of frameworks and public and proprietary models that help quantify the costs and environmental and public health impacts of wastewater systems are available. Most of these documents and tools are intended to help communities to make good choices. There are also thousands of reports and articles that describe analytical tools as well as technologies and management systems chosen by various communities.

In spite of a wealth of materials of the types mentioned previously, there is little material available that describes how communities *actually go about making decisions* on questions like those that opened this report. For instance, while the literature often alludes to the politics of wastewater decisions, rarely is a community's political process described in detail. Seldom does the literature analyze the origins and manifestations of the particular issues on which a community decision has been made.

This study is designed to fill this gap. It is based on the premise that communities can make better choices if they understand how other communities have wrestled with wastewater infrastructure decisions. It presents case studies that focus on the decision processes of a variety of communities. Specifically, the case studies:

- Investigate how communities consider and value different scale wastewater system options in economic and other terms
- Examine the driving issues, motivations, and decision-making methods of stakeholders relative to choices of wastewater system scale

The objectives of the report are to help communities facing wastewater system choices to:

- Better understand the implications of different options, so that communities can make better evaluations
- See how the decision process has played out in other communities, so that the process pitfalls encountered in some communities can be avoided, and the process successes of other communities emulated

The report presents the wastewater-system decision stories of eight distinct communities across the United States. Each case study describes the overall history of the community's decision process, analyzes the community's experience with one or more of seven specific topics (introduced in the next section), and presents the lessons learned in the form of recommendations to other communities. These lessons are also synthesized into overall conclusion.

Scope of the Research

This section describes:

- Wastewater system architectures
- Wastewater system economics
- Research topics

Wastewater System Architectures

The case studies in this report address how communities perceive and choose between various wastewater infrastructure configurations, or *system architectures.* System architecture refers to both treatment plant scale and the number of connections served by a wastewater system. Treatment plants vary in capacity (scale) and in the number of wastewater generating connections served. Different architectures also typically vary in their mode of dispersing treated effluent. Four types of wastewater system architectures are frequently identified in the literature:

- ***Onsite:*** Onsite systems serve an individual house, business, or other facility. Usually onsite systems disperse treated effluent via a wastewater soil absorption system (such as a leach field). This dispersal mode contributes to recharge of the local groundwater.
- ***Cluster:*** Cluster systems serve a group of buildings, with a low-cost sewer system linking the various wastewater generation points to a shared treatment and effluent dispersal system. Cluster systems typically serve between two and several hundred homes (or equivalent units of wastewater flow), but may serve more. Some people refer to cluster systems as *communal* or *community* systems (where "community" refers to a neighborhood rather than an entire town or city). All three terms (cluster, communal, and community) are used in the case studies depending on local parlance. Cluster systems typically disperse their effluent via a wastewater soil absorption system (thereby recharging groundwater) or reuse the effluent via spray or drip irrigation lines or other means. Rarely, cluster systems discharge to surface water. Cluster systems should not be confused with the conventional sewer package plant systems that have historically caused many problems.
- ***Central:*** Centralized systems involve extensive sewer systems that link hundreds or thousands of homes and businesses to a large treatment plant. The demarcation between large cluster systems and small centralized systems is situational rather than absolute. A useful distinction, used in this report, is that centralized systems serve entire villages or municipalities, or large portions thereof, while cluster systems serve neighborhoods or small portions of municipalities. Centralized systems typically route treated effluent to surface water. Some centralized systems send treated effluent to industrial facilities, large landscapes, and in rare instances to individual homes and businesses for non-potable reuse.
- ***Regional:*** Regionalized systems serve multiple communities. Such systems usually use surface water effluent discharge. In some cases they provide water for non-potable reuse.

Onsite and cluster systems are often categorized together as *decentralized* systems. Treatment and dispersal or reuse of wastewater at or near its point of generation are common features of a decentralized wastewater system (Crites and Tchobanoglous 1998). Central and regional systems are often both referred to as *centralized* systems, and are typified by treatment and dispersal/reuse at considerable distance, sometimes many miles, from all or a significant portion of the wastewater service area.

It is important to note that the definition of a decentralized system is not purely physical. To truly constitute a *system*, onsite and cluster technologies must be appropriately managed. It is taken for granted that centralized facilities and sewers should be managed to ensure proper performance and reliability. Oversight of decentralized treatment units and any small-scale sewers associated with them must occur to ensure they are properly operated, maintained, and repaired when necessary. Thus, a decentralized system can and should be defined as a group of onsite and/or cluster systems under common management.

The main focus of this report is how communities perceive and evaluate differences between decentralized and centralized options. In some of the cases, communities evaluated different decentralized options or different centralized options (for example, differences between onsite and cluster options, or between central and regional approaches).

Wastewater System Economics

The case studies include basic information on the capital and operation and maintenance (O&M) costs of the wastewater systems considered or implemented by the case study communities. The economics of wastewater choices encompass much more than direct monetary costs, however. A full accounting of all costs and benefits created by wastewater systems would address externalized monetary costs such as water treatment costs required when water supplies are contaminated, externalized monetary benefits such as improvements in adjacent property values when better wastewater systems improve water quality in surface waters, non-monetary costs such as odors, and non-monetary benefits such as habitat creation at wastewater treatment wetlands. A companion project to this case study research provides a comprehensive “catalog” of the relative costs and benefits of centralized and decentralized wastewater systems. This project is a literature review prepared by Rocky Mountain Institute (RMI) and funded by the United States Environmental Protection Agency (US EPA) and partially by the National Decentralized Water Resources Capacity Development Project (NDWRCDP) as well. Various aspects of the case studies in this case study report are used to illustrate topics in the economics catalog. The report will be published in December 2004 and will be downloadable from the RMI website (www.rmi.org; in the water section of the online library). The report may also be available from the US EPA’s decentralized wastewater systems (septic systems) website (located at http://cfpub.epa.gov/owm/septic/home.cfm, as of November 14, 2004). Communities may benefit from consulting the economics catalog as they try to understand the full implications of their wastewater system options.

Research Topics

This project examines community experiences with wastewater system planning both generally and topically. The project focuses special attention on seven topics that have received scant attention to date in the literature of wastewater system planning. These topics and the types of questions each addresses are:

- ***Incremental capacity provision:*** Wastewater system scale affects the size and cost of capacity additions to a system. Centralized systems typically are built in a few large phases, with extra capacity in treatment and/or collection systems available to accommodate future growth. Onsite and cluster systems typically allow smaller, more frequent increments of capacity, built to accommodate immediate or near-future needs. What advantages and disadvantages do communities and wastewater planners see in more finely phased development of wastewater system capacity? Do communities perceive and pursue the potential benefits of approaches that use smaller capacity increments, such as reducing debt load, avoiding the financial risk of overbuilding capacity, buying time to adopt changing technologies and adjust to new regulatory requirements, and other benefits? How do communities and planners perceive and portray economies and diseconomies of scale presented by different wastewater system options?
- ***Growth, development, and autonomy:*** The impact of wastewater infrastructure in promoting or directing growth is a key concern in many communities, but how that concern influences wastewater system decision making is not well understood. Arguments are often made for and against both sewers and onsite/cluster systems—that one or the other increases growth or encourages sprawl. How have these arguments affected wastewater system decisions in particular communities? What impacts on community character do citizens and public leaders believe will result from different types of wastewater systems? Have communities seen wastewater system choices as important to maintaining community autonomy, particularly in growing metropolitan regions? What is the interplay between infrastructure planning and planning for other aspects of the community?
- ***Fairness and equity:*** The costs and benefits of centralized and decentralized systems fall on citizens in very different ways. How do communities perceive these differences? Under what conditions do fairness and equity become important factors in the choice of wastewater system scale? What relationships are seen (and not seen) between affordability and fairness? How are connection fees, wastewater service rates, and other costs structured to address equity and fairness issues between current users of a proposed wastewater system and between current and future users?
- ***Performance and reliability:*** *Performance* refers to required or desired results of wastewater treatment systems: a level of nutrient removal, pathogen reduction or elimination, and other desired results. *Reliability* is the rate or probability over time of attaining a performance level. How do communities choose performance levels and evaluate the performance and reliability characteristics of different wastewater systems? In particular, how do they perceive differences between centralized and decentralized systems in these regards? How do they address related issues such as vulnerability of systems to exogenous disruptions (such as floods) or to endogenous risks (such as what gets put down the drain)? When is the resilience of systems (the ability to recover from disruptions) an important consideration?

What design, use, and management actions do regulators require and communities' consultants recommend to ensure wastewater system reliability, and how does the public respond to those proposed or implemented actions?

- ***Stakeholder relationships and trust:*** Community decision-making processes are strongly affected by the types, timing, and methods of presentation of key information, as well as the structure of decision processes. How does wastewater system planning affect relationships in a community, and how do relationships affect debate and decision making? In the wastewater system planning context, what creates trust among stakeholders and facilitates smooth decision making? What erodes trust?
- ***Hydrologic impacts:*** Wastewater systems can affect the water balance of watersheds. For instance, large-scale sewer systems can move significant amounts of locally supplied groundwater out-of-basin or to distant downstream treatment and release points. Sewers with high rates of infiltration can reduce groundwater recharge and stream base flow. Where these issues have been identified, how have they been handled in the wastewater system planning process? How have hydrologic impacts become clear after a wastewater system was built? What role do stakeholders see decentralized systems playing in addressing or redressing hydrologic impacts of sewers?
- ***Value of decentralized systems to large utilities:*** Some wastewater system managers believe decentralized wastewater systems have an important role to play in major wastewater utilities. They believe a mixed architecture including centralized and decentralized systems may be the best way to serve the diverse needs of large service areas. What are some examples of this emerging diversity? Why have some urban utilities chosen decentralized systems as part of their wastewater service toolkit?

In addition to these specific topics, this study addresses more general aspects of community leadership and public involvement that produced successful or unsuccessful planning processes—success being defined as a result that appears to provide a functional and widely supported solution to wastewater problems. These aspects of community process are variously highlighted in the history, analysis, and conclusions sections of the case studies. In some cases, the final result is not yet clear but a number of intermediate outcomes are clear, including events and patterns that are likely to facilitate or hinder a final resolution.

The Case Study Communities

In choosing communities for this study RMI sought diversity in:

- Topical coverage
- Type of community
- Wastewater problems
- Proposed infrastructure choices
- Outcomes
- Geography

Chapter 2, *Methodology*, details how the case study communities were selected. Figure 1-1 shows the locations of the case study communities.

Figure 1-1: Location of Case Study Communities

Table 1-1 shows the final topics RMI investigated in each community. The topics covered in each case are also mentioned in a text box at the beginning of each case study. The reader may also find useful a community/topic cross-reference table located just after this report's table of contents.

Table 1-1: Topical Coverage of the Case Study Communities

Topics: / Community	Incremental Capacity Provision	Growth, Development, and Autonomy	Fairness and Equity	Performance and Reliability	Stakeholder Relationships and Trust	Hydrologic Impacts	Value to Large Utilities
Mobile, AL							6-12
Paradise, CA	7-12	7-16	7-25	7-20	7-29		
Charlotte County, FL	8-24	8-33	8-30	8-16	8-39		
Johnson County, KS		9-9		9-15			
Metropolitan Boston, MA						10-6	
Lake Elmo, MN		11-24	11-34	11-15	11-38		
Broad Top/Coaldale, PA					12-10		
Washington Island, WI	13-11	13-21	13-26	13-15	13-30		
Smallside, USA	4-1						

Table 1-2 describes various aspects of each community. This table summarizes each case study in terms of the selection factors mentioned above and explained in the next chapter.

Table 1-2: Community and Infrastructure Planning Characteristics

	Type of Community*	Primary Drivers for Wastewater Planning	Infrastructure Decision	Outcome
Mobile, AL	Urban & Exurban	New development; sewer capacity problems	Cluster systems (exurban); cluster-scale "sewer mining" (urban)	Exurban cluster systems are widely viewed positively. Demonstration sewer mining project now under construction.
Paradise, CA	Small Town & Suburban	Failing or inadequate onsite systems; new development	Centralized system proposed; rejected by public. Onsite wastewater management zone established; included new design and management requirements. Cluster systems now under consideration.	Improved management of onsite systems. Town considers onsite systems inadequate for commercial development, is reviewing cluster system options. Some vocal citizens question efficacy of the onsite management zone.
Charlotte County, FL	Mixed	New development; failing or inadequate onsite systems and package plants	Large sewer expansion proposed; rejected by public. County initiated mini-expansions of sewer and established new onsite system design standards.	Public views sewer mini-expansions favorably. Some members of the development community believe the new onsite standards are unnecessary and too costly.
Johnson County, KS	Suburban & Exurban	New development	Onsite systems with dry sewers. Cluster system policy proposed for unincorporated areas; not adopted.	Current policies for annexation and sewer extensions are considered successful and will remain in place, as will requirements for dry sewers for development in unincorporated areas.
Boston, MA	Mixed	New development; failing onsite systems; inadequate small WWTPs	Regionalization of wastewater treatment; expansion of sewer system. Some communities now promote decentralized systems.	Substantial improvement of Boston Harbor water quality. Concerns over sewers' roles in disrupting natural hydrology are substantial in several watersheds.

Table 1–2: Community and Infrastructure Planning Characteristics (Cont.)

	Type of Community*	Primary Drivers for Wastewater Planning	Infrastructure Decision	Outcome
Lake Elmo, MN	Small Town & Exurban	New development	Cluster systems favored by city government; regional planning agency prefers regional sewer connection for portions of city.	Developers and city consider cluster wastewater systems successful. Administrative law judge and appeals court have affirmed regional planning agency's authority to require city to increase areas of high-density development served by regional wastewater system.
Broad Top & Coaldale, PA	Rural & Small Town	Inadequate onsite systems	Cluster/semi-centralized systems; improved onsite systems and management for some areas.	Proposal is implemented as grant funding becomes available. Public is satisfied with new systems and increased management.
Washington Island, WI	Rural	Failing or inadequate onsite systems; new development	"Pump & haul" system with centralized treatment proposed; rejected by public. Onsite wastewater management program established; included inspections and upgrades of inadequate systems.	Broadly inclusive public process created wide support for onsite management program. Some discontinuities and controversy have occurred in implementation. A small centralized treatment system has helped manage septage in winter.

*See Chapter 2, *Methodology*, for more details.

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2 METHODOLOGY

Selection of the Case Study Communities

Rocky Mountain Institute's (RMI) research began in March 2002 with the generation of a list of potential case study communities. The researchers sought communities:

- Where wastewater facility decisions had already been made, though communities still in the decision-making process were also of interest
- Where two or more wastewater scale options have been considered (for example, centralized versus decentralized, onsite versus cluster, central versus regional)
- Where the community's experience touched on one or more of the seven focal topics

RMI used the following methods to compile a list of candidate communities:

- Posted inquiries asking for community nominations to six US and international listserves and four web-based bulletin boards
- Forwarded the same inquiry to the National Decentralized Water Resources Capacity Development Project (NDWRCDP), the National Onsite Wastewater Recycling Association (NOWRA), and the Consortium of Institutes for Decentralized Wastewater Treatment (CIDWT), with a request that the inquiry be distributed to the networks of these organizations
- Reviewed issues of the *Small Flows Quarterly* and its predecessor, *Small Flows*, back to January 1993, for articles regarding communities meeting the criteria noted above
- Reviewed RMI's files of other literature from the wastewater field

More than 40 individuals responded to RMI's inquiries. RMI entered all suggestions and additional communities identified from the literature review into a database that included fields for:

- Community name and location
- Type of community
- Situation that led to consideration of wastewater options
- Type of system chosen
- Type of management system
- Information pertinent to each of the seven topics

- An initial qualitative rating of relevance of the community to each topic
- Contact information
- Notes
- Other information

RMI conducted brief literature searches and phone research to complete the database for each of the potential case study communities.

The eight communities studied in this volume were chosen in consultation with the NDWRCDP subcommittees (Management and Economics, Training and Education) that oversaw the RMI project. Selection factors were as follows:

- Likely number of the seven topics covered and likely richness of a community's experience in relation to a topic. In general, communities that would shed light on multiple topics were favored. However, two communities were chosen based only on their potential to illuminate one topic: Mobile, Alabama (for the topic "value of decentralized systems to large utilities") and Metropolitan Boston, Massachusetts (for "hydrologic impacts").
- Diversity of community types. The final selections should reflect a mix of urban, suburban, exurban, small-town, rural, and mixed communities.
- Diversity of wastewater problems. The chosen communities should reflect a variety of drivers for wastewater planning: new development, failing or inadequate onsite systems, failing or inadequate package plants or small wastewater treatment plants.
- Diversity of infrastructure proposals. The final selections should include communities facing choices across the spectrum of system scale (onsite versus cluster versus central versus regional; not necessarily all options in each case). Area-specific facility plans and large-area master plans should both be represented.
- Diversity of outcomes. The final selections should include communities where wastewater infrastructure choices have been accepted and communities where the decisions have been challenged.

Community Types Addressed by This Study

Urban: High-density residential neighborhoods and substantial areas of high-density commercial development

Suburban: Low to high-density residential areas and areas of concentrated commercial development

Exurban: Once or still-rural areas outside urban centers experiencing rapid development

Small town: Concentrated "villages" with surrounding rural or suburban areas

Rural: Agricultural, open space, and low-density residential areas

Mixed: Characterized by three or more of the above types

- Geographic diversity. RMI and the NDWRCDP wanted the final selections to reflect a variety of physical conditions and to be drawn from across the county while ensuring the other criteria were met.

Based on these factors (see Table 1-1 and Table 1-2 for summaries), the following eight communities were chosen for this study:

- Mobile, AL
- Paradise, CA
- Charlotte County, FL
- Johnson County, KS
- Metropolitan Boston, MA
- Lake Elmo, MN
- Broad Top Township/Coaldale Borough, PA
- Washington Island, WI

Budgetary considerations did not allow personal visits by the RMI researchers to all communities. The communities where RMI conducted field research were:

- Paradise, CA
- Charlotte County, FL
- Lake Elmo, MN
- Washington Island, WI

RMI chose to visit those communities because each appeared to touch on several of the seven study topics. Four additional communities were chosen for phone-based interviews. These communities were chosen in part to round out the topical coverage of the case study set. RMI focused on only one or two topics in these communities. They were[1]:

- Mobile, AL
- Johnson County, KS
- Metropolitan Boston, MA
- Broad Top Township/Coaldale Borough, PA

[1] While these communities did not receive field visits for this study, lead author Richard Pinkham had experience in two of them. He previously completed water quality projects in the Boston metropolitan area and previously visited decentralized wastewater sites and met with wastewater officials in Mobile, Alabama.

Case Research

Following selection of the case studies, RMI conducted detailed primary and secondary research in each community. In communities where RMI made field visits, the researchers identified and personally interviewed key individuals. These included local elected officials, staff in government agencies (local, county, regional, state, and federal, depending on the details of the case study), utility officials, representatives of stakeholder groups (such as home builders associations and environmental groups), and in some cases ordinary citizens. Most of the interviews were conducted individually and lasted about an hour. A few were shorter and some were considerably longer. The interview procedure followed an evolutionary qualitative research approach, with RMI determining the questions based on the role(s) of the individual(s) being interviewed and the information acquired previously. RMI interviewed 10 to 19 people in the four communities the researchers visited. The field visits took place in September and October 2002. RMI also conducted three to six phone interviews with additional individuals in these communities.

The researchers also visited typical and notable decentralized wastewater facilities. They drove around each of the communities and attempted to get a feel for the local geography and development conditions. The field visits lasted from two to three days.

For the four additional communities, RMI identified key individuals, then conducted phone interviews. The number of phone interviews ranged from four to 25, depending on the complexity of the case. For instance, the Johnson County, Kansas case study focused on a proposed policy that was developed by county staff but never taken to the public or implemented. Thus, the project team deemed it sufficient to interview key county staff and one city official. On the other hand, the case study of the Boston, Massachusetts metropolitan area encompassed several watersheds and dozens of communities, and involved decisions and policies made over a 30-year period. For this case study the researchers interviewed 25 individuals.

For all of the communities, RMI obtained and reviewed a variety of documents relevant to wastewater decision making. These included:

- Wastewater facility plans
- Wastewater master plans
- Community comprehensive plans
- Local sanitation codes
- Special studies of
    - Soils
    - Water quality
    - Other environmental conditions

- Environmental assessments
- Environmental impact statements
- Other documents

As needed, RMI also obtained resolutions and ordinances of local governments, local government and utility board meeting minutes, court decisions, budget data, operational data, and other information in printed or electronic format. A number of people in each community volunteered documents or provided documents requested by RMI.

Drafting and Verification of the Case Study Write-ups

After conducting interviews and reviewing documents for each community, RMI began an initial draft of each case study. The drafting process revealed many additional questions and illuminated details requiring fact checks. Thus the team made additional calls to previously interviewed individuals as needed during the writing and rewriting process.

RMI submitted two initial case study drafts to the NDWRCDP project oversight committees. The NDWRCDP requested changes in the structure and style of the case write-ups. RMI prepared and submitted to the NDWRCDP a revised draft of one case study. The NDWRCDP oversight committees approved the revised structure and style. This sample case study then served as a template for all other case studies. The standard structure of the case study write-ups is described as follows.

Subsequent review, revision, and editing of the case studies took place as follows:

- The three authors reviewed each other's work following initial drafts.
- The authors submitted draft case studies to the NDWRCDP and to an RMI manager.
- The authors revised each case study based on comments and questions from the NDWRCDP project oversight committees and the RMI manager.
- RMI mailed the revised draft to each person interviewed in the case study community,[2] along with background information on the overall project and a cover letter asking interviewees to identify factual mistakes, misleading statements, or any other inaccuracies or misrepresentations, and to make any other comments or suggestions.
- RMI revised each case study based on the feedback from the interviewees.
- The authors compiled the overall report. RMI's in-house editor reviewed the entire document.
- RMI submitted the draft final report to the NDWRCDP.
- RMI revised the report based on comments from the NDWRCDP and submitted the final report to the NDWRCDP.

[2] A few individuals in Lake Elmo were interviewed by phone after the review by other interviewees.

Structure of the Case Studies

The eight case studies are presented in alphabetical order by state. Each has the sections and subsections as described in the following sections.

Major Sections

All case studies follow a consistent structure. Each has six major sections, described as follows:

- ***The Community:*** This short section provides a basic description of the community, focusing on aspects most relevant to wastewater systems: land use, growth, nature of the economy, topography, climate, water supply, and other aspects.
- ***Wastewater Issues:*** Another short section identifies the key problems that led the community into a wastewater system planning process.
- ***Historical Overview:*** This section outlines the major studies, events, and developments that occurred as wastewater issues became evident and the community embarked on a wastewater system planning process. The process and results are described in general terms.
- ***Analysis:*** Here the discussion sorts through the history and provides additional details that illuminate what happened in the community and why. It notes the implications for the community of the planning steps taken and the decisions made, and highlights the positions and actions of key stakeholders. Subsections focus on one or more of the seven topics noted earlier.
- ***Conclusions:*** In this section the discussion steps back and reviews the key themes revealed by the community's experience. This section synthesizes the information developed in earlier sections into lessons for other communities.
- ***Sources:*** Sources are broken down into personal interviews, phone interviews, and documents reviewed.

Structure of the Analysis Subsections

After the historical overview, the analysis section addresses the significance of the case study to one or more of the seven topics identified earlier. Each case study based on a field visit addresses four or five topics. Each case study based on phone interviews focuses on one or two of the topics.

Each topic is treated in a separate subsection. For each topic, the text addresses three questions and provides a status report:

- How was system architecture relevant to this issue?
- How was the issue addressed?
- Did the issue resonate with the community?
- Results/Status

At the beginning of each topical subsection, a text box provides summary answers to the four analytical concerns. Four sub-subsections then provide detailed discussion. While the content of the discussions varies from community to community according to the nature of the wastewater system planning process in each, the general content and the types of additional questions addressed by each sub-subsection are as follows:

- ***How was system architecture relevant to this issue?*** Do there appear to be important differences between centralized and decentralized options with respect to the issue? Sometimes these differences were identified in studies or discussions prior to the wastewater system decision. Often, such differences were only vaguely characterized or not identified at all. However, with the benefit of hindsight, it is often possible to suggest differences.
- ***How was the issue addressed?*** This sub-subsection characterizes how a community and its consultants handled the issue. Where did the issue emerge in the planning process? Was systematic evaluation attempted once the issue emerged? In particular, were the differences between centralized and decentralized choices with respect to the issue rigorously analyzed in facilities plans or other documents? If these differences were not analyzed systematically, would such an analysis likely have been useful?
- ***Did the issue resonate with the community?*** This question explores the impact of the issue on the public or key subsets of the public. What was the nature of community discussion of the issue? How did the issue and public reaction affect the decision making process? Did consensus emerge in the community regarding the issue? If not, why not?
- ***Results/Status:*** What impact did the issue have on the decision (if this is not already clear from the preceding discussions)? Is the issue still a concern in the community in relation to current wastewater systems? If the facility planning process and decision did not fully resolve the issue, what other solutions have been suggested or implemented?

Longer discussions have key points highlighted to begin one or more paragraphs addressing each point.

As noted at the outset, the seven topics have received little or inadequate attention in the professional literature. Therefore, it is not surprising that in some case studies, certain issues were not studied carefully by government staff or consultants. Often issues came out instead in the political process, when the public reacted to proposed projects. In some instances, the importance of a topic became evident only in hindsight, after implementation of a wastewater system.

Documentation

Sources used in each case study are provided at the end of each write-up. Sources are broken down into personal interviews, phone interviews, and documents reviewed. Only major documents are itemized. For most case studies, the team reviewed many additional minor documents, such as municipal government resolutions, minutes of municipal and utility board meetings, newspaper clippings, written correspondence, and other documents.

All dollar amounts are taken directly from documents and are not inflated to current dollars. The figures are provided to illuminate the decision process within each community—for instance, by showing the relative costs of various wastewater management options. Figures should not be compared between case studies due to the wide range of years involved and the attendant effects of inflation.

Smallside, USA Financial Analysis

To show how incremental investment in decentralized systems can produce financial advantages over investments in typical centralized systems, the NDWRCDP commissioned a financial analysis along with the case study research. The methodology for this analysis is discussed in detail in Chapter 4, *Smallside, USA: A Hypothetical Analysis of the Financial Benefits of Incremental Capacity Provision.*

3 CASE STUDY SUMMARIES

This section presents summaries of each case study. These synopses describe the community, identify the wastewater issues that drove the wastewater facility planning process or that are focused on in this study, describe the solution(s) chosen by the community, and briefly discuss the results.

Mobile, Alabama

The Community: The City of Mobile is located on Mobile Bay, on the gulf coast of Alabama. Roughly half of Mobile County's population of 400,000 lives in the city. The Mobile Area Water and Sewer System (MAWSS) provides water and wastewater services to the city and some of the surrounding area.

Wastewater Issues: New development outside the city and sewer capacity problems within the city were the driving forces for the wastewater decisions considered in this case study. MAWSS had to decide whether and how to provide wastewater service to suburban-style subdivisions that are being built outside the city limits (some at considerable distance) and on the opposite side of a topographic ridge that divides the Mobile Bay watershed from the rest of the county. Initially, the utility serviced the developing area by building force mains to bring sewage back to the Mobile Bay gravity sewer shed and MAWSS's three centralized wastewater treatment plants. Additional force mains would be expensive. In addition, as in many older American cities, Mobile's wastewater system includes miles of aging sewer lines that suffer from infiltration and inflow (I/I) in wet weather. Adding more flows from new development outside the city would exacerbate sewer capacity problems. Building extensive sewers and a new treatment plant in the developing watershed would be politically difficult.

Solutions: MAWSS made a strategic decision in the late 1990s to begin serving development outside its existing sewer service area with cluster systems. Four systems have been built to date, using septic tank effluent pump (STEP) collection systems and ranging in initial treatment capacity from 20,000 to 60,000 gallons per day (GPD). The largest will eventually treat up to 240,000 GPD, serving a school and over 1,000 homes. In addition, MAWSS is currently building a demonstration project in the urban core of Mobile that will "mine" sewage from an interceptor sewer, treat the sewage with four different technologies (to determine performance and operational requirements), and use the treated effluent to irrigate a park the city is developing.

In the exurban area, developers build all onsite tanks, filters, pumps, and collection lines, all to MAWSS specifications. MAWSS builds the treatment system on land donated by the developer. MAWSS operates and maintains all components of each system. Homeowners sign an operation and maintenance agreement and pay a monthly fee to MAWSS.

Results: The exurban cluster systems are widely viewed positively by developers and homeowners. MAWSS found that the systems are a good match with its strategic objectives of:

- Avoiding large capital expenditures for new force mains or a new treatment plant
- Avoiding political battles over a new treatment plant
- Avoiding new flows in its already capacity-limited gravity sewers
- Providing cost-effective service to developing areas around the city
- Providing environmental stewardship through higher levels of treatment than septic system alternatives
- Generating new customers and a positive image for the utility
- Using wastewater service as a tool to compete with other local water providers for lucrative water service to new development

The urban demonstration project will help MAWSS determine if carefully located sewer mining cluster systems can reduce capacity problems in sewers, will show how local wastewater reuse can be accomplished, and will provide operational and cost data helpful to the development of additional cluster systems.

Paradise, California

The Community: Paradise is a community of roughly 27,000 people located in the northern California foothills of the Sierra Nevada Mountains. The town grew rapidly during the 1960s and 1970s, incorporated in 1979, and continued to grow in the 1980s. The population is dispersed across 18 square miles, industry is negligible, and commercial development is fairly limited, all of which contributes to a rural atmosphere cherished by many residents.

Wastewater Issues: All homes and businesses in Paradise, until very recently, have utilized onsite wastewater treatment systems, mostly septic systems. In the late 1970s and into the 1980s, many onsite system failures were noted. High bacteria counts were found in streams and some drinking water wells near the town’s two commercial strips. Meanwhile, small lot sizes and strained soil capacity in the commercial district often precluded commercial development or building renovations that would increase wastewater generation.

Solutions: Studies in the late 1980s proposed a sewer system that would serve well over 1,000 acres along the town’s commercial strips. In 1990 the town council created a town-wide Wastewater Design Assessment District (WDAD) to raise $4 million to design a sewer system and treatment plant, and to develop an Onsite Wastewater Management Zone to oversee onsite systems in non-sewered areas. Many residents became upset with how the WDAD was formed, how the assessment units were assigned to properties, the implications of sewers for the growth and character of the town, and the projected construction cost of the sewer system, which was pegged at $20.7 million in mid-1992. Voters recalled four of five council members and replaced them with an anti-sewer majority. Finally, voters rejected the proposed sewer system outright on the November 1992 ballot.

Once the sewer plan was defeated, the onsite zone became the means for Paradise to manage all wastewater systems in town. Through the zone, the town required operating permits for all new and existing systems; adopted design criteria, including special regulations for large systems and innovative systems; set up variance and enforcement procedures; and established a monitoring program. Paradise also established a program for initial and periodic operational evaluation of all onsite systems by private evaluators.

Results: The sewer proposal divided the community. New residents and young families tended to support the proposal because they wanted additional services in Paradise. Older residents and others who liked the town's rural atmosphere feared changes to the community's character. The town failed to genuinely involve the public in development of the plan, serious environmental or health risks from onsite systems were not proven, and cluster systems for businesses and management of all systems in town got little attention in the evaluation of wastewater options.

The onsite zone helps ensure that systems are properly maintained and failing systems are quickly repaired or replaced. Conflicts of interest in the private evaluator system are an issue for many citizens, while some others believe the zone supports a pro-growth agenda. Commercial development using onsite systems slowed, but did not stop altogether. Now the town is investigating cluster system options to provide additional treatment capacity in commercial areas.

Charlotte County, Florida

The Community: Charlotte County is located on the gulf coast of Florida, south of Sarasota. Spurred by the availability of more than 200,000 quarter-acre lots platted by several large development companies, the county's population boomed from 27,559 in 1970 to nearly 140,000 in 2000. The population is skewed toward older, retired persons, many of whom are on fixed incomes.

Wastewater Issues: Roughly half the lots in Charlotte County have access to water distribution lines, but the original developers provided sewer service to a much more limited area. Most lots experience high seasonal water tables and have other soil characteristics that limit the efficacy of onsite septic systems. Following the state's 1988 rejection of the county's comprehensive plan, the county committed to preparing a water and sewer service study and using the results to guide infrastructure expansion. When the largest development company went bankrupt in 1990, the county acquired its water and wastewater subsidiary to gain control of infrastructure expansion.

Solutions: The county's 1993 water and sewer master plan provided phasing recommendations for water and sewer projects through 2015. Estimated costs totaled $462 million for wastewater service by the new county utility and $148 million for water service. Estimates for the first 22,000 lot sewer-only project put costs at $8,700 per lot. Public reaction was overwhelmingly negative. Reasons included the high per unit cost relative to the low fixed incomes of many residents, the fact that many residents had already paid for a septic system, and a belief that environmental and public health risks posed by septic systems had not been substantiated.

Despite having spent over $15 million for engineering, the Board of County Commissioners, reacting to substantial public uproar, stopped the sewer expansion project in 1996.

In its 1997 comprehensive plan, the county took an alternative approach. It enacted a variety of growth management policies. Regarding wastewater, it committed to limiting extension of water lines without concurrent provision of sewer service, developing “mini” sewer expansions in certain areas, establishing a water quality monitoring program, developing an ordinance to require advanced treatment (aerobic treatment units or ATUs) or density-reducing lot combinations for small and waterfront lots, and creating a septic system management program. Under the new ordinance, operating permits and service contracts with licensed maintenance companies are required for ATUs. The septic system management program is now under development—the county put off this initiative pending the results of a septic systems study, which was completed in late 2003.

Results: The 1988 comprehensive plan and 1993 water and sewer master plan did not adequately manage growth. A massive sewer expansion predicated on rapid, extensive growth had high per unit costs and did not give adequate consideration to the role and management of onsite wastewater systems. The ATU ordinance met with opposition from realtors and builders who feared its costs would hurt their business, but is now largely accepted. The small-scale sewer expansions have been extremely successful because they are targeted to areas where sewers are most cost-effective. Management of septic systems remains largely unaddressed, but the county is now turning its attention in this direction—an important development given the large number of systems in the county, including many along canals that were built prior to the state’s 1983 update of siting and design regulations.

Johnson County, Kansas

The Community: Johnson County includes the southwestern sector of the Kansas City, Missouri metropolitan area. Over the past 20 years the county has sustained an average net population growth of approximately 10,000 persons per year. The vast majority of county residents live in incorporated areas with densities of three to four dwelling units per acre. Farms interspersed with residential developments characterize the unincorporated area.

Wastewater Issues: Sewer service has been expanded in roughly concentric bands as urbanization spreads south and west from Kansas City. Use of onsite wastewater systems has resulted in lower density development (two-acre minimum lot size) in portions of the county that are now or will soon be surrounded by urban-density development. This creates obstacles to the provision of cost-effective sewer service. In addition, soils in much of the county have limiting conditions that require alternatives to conventional septic tank and leach field systems.

Solutions: To ease the transition to sewer service, in 2002 the Board of County Commissioners (BOCC) adopted a “Dry Sewers Policy” that requires installation of dry, low-pressure sewer mains in subdivisions that are not in proximity to existing sewers, in addition to installation of appropriate onsite systems. This policy did not address the problem of low-density growth, so the county also considered a policy that would allow developers in unincorporated areas to increase density by utilizing cluster wastewater systems.

Under the "Community Septic System Program," a developer would build gravity sewers connected to a central aerated septic tank and subsurface wastewater absorption system. The county wastewater utility would be responsible for overall operation and maintenance (O&M), while the environmental department would operate the septic tank and soil absorption system. Once sewer service is extended to the area, the subdivision sewer lines would be connected to traditional sanitary sewers and the community septic tank and absorption system would be decommissioned.

Results: The proposal was initially of interest to the county because cluster systems would allow lot sizes smaller than two acres and thus growth in the unincorporated area would be more compatible with eventual urban land use. However, county staff eventually recommended against adoption of the policy, and the BOCC has not reconsidered this decision, so the policy is effectively dead. Two major concerns, based on local conditions that might not pertain elsewhere, resulted in the staff rejecting the policy. First, because developers face significant excise taxes in incorporated areas but not in unincorporated areas, officials feared that the policy would create incentives for large-scale, urban-density growth in unincorporated areas, in turn requiring the county to provide other urban services beyond its fiscal capability. Second, because county commissioners and the county wastewater utility preferred gravity sewers to low-pressure sewers, the community septic system design was based on gravity sewers.

This required oversizing the soil absorption field to allow for gravity sewer infiltration and inflow. However, concerns about hydraulic overloading of community systems remained, contributing to the recommendation against the cluster system policy. Using low-pressure sewers instead would have negated this concern, but this was not Johnson County's choice. The county has instead chosen to maintain large-lot requirements for unincorporated area development and to rely on existing annexation mechanisms to encourage development within incorporated areas.

Metropolitan Boston, Massachusetts

The Community: The greater Boston metropolitan area is home to more than three million people. It is characterized by intense urban development tapering to suburban and semi-rural development on the fringe. Many streams and rivers flow through its communities.

Wastewater Issues: This case study focuses on the hydrologic impacts of large sewer systems. The Massachusetts Water Resources Authority (MWRA) provides wastewater collection and treatment service to 43 communities in the region and water service from reservoirs outside the service area to 48 communities. It treats all sewage at one regional plant (Deer Island) and disposes of effluent through an ocean outfall. The MWRA sewer collection system encompasses 240 miles of MWRA-owned interceptors, 5,400 miles of publicly-owned community sewers, and over 5,000 miles of private sewer service connections. The configuration of sewer and water systems results in substantial transfers of water within and between the various watersheds of the region. The mechanisms of these transfers include drinking water imports, which add to local watershed water budgets in 18 communities that use non-MWRA onsite, community, or sub-regional wastewater systems; groundwater withdrawals in 13 communities that have their own water supplies but dispose of wastewater through MWRA sewers; and infiltration and inflow (I/I) to the MWRA collection system, which accounts for up to 60 percent of total flows at the Deer Island treatment plant and moves water from local watersheds directly to the ocean. The latter two types of transfers deplete groundwater and contribute to reduced base flows in a number of local rivers, including complete loss of flow on some occasions.

Solutions: In the 1970s, prior to the decision to consolidate treatment at the Deer Island plant, a number of alternatives were considered that used several satellite treatment plants, in part to augment flows in certain rivers. Given treatment technologies available at the time, flow augmentation from satellite plants would have unacceptably compromised river water quality. For this and other reasons, the Deer Island option was chosen.

Results: Since completion of the Deer Island plant and ocean outfall, water and sediment quality in Boston Harbor has increased dramatically. At the same time, reduced groundwater levels have contributed to water supply concerns in several communities, and low flow problems in several rivers have remained and even increased as growth has continued. These conditions have sparked a variety of actions. The state enacted an Interbasin Transfer Act in 1984 that applies to wastewater as well as water supplies. In 1996 the Massachusetts Department of Environmental Protection developed new guidelines for wastewater facility planning that require consideration of onsite and cluster system alternatives. The state has essentially taken the position that recharge of groundwater with decentralized systems is preferable to surface water flow augmentation from wastewater plants. A number of communities have given serious consideration to—and some have chosen—decentralized systems in part to recharge groundwater and support stream base flows. MWRA has developed a wastewater rate methodology and an I/I remediation plan designed to decrease sewer flows. Ways to increase groundwater recharge and thereby support stream flows through reduction in impervious surfaces are also receiving substantial attention.

Lake Elmo, Minnesota

The Community: Lake Elmo is an incorporated municipality encompassing 24 square miles in the Minneapolis-St. Paul metropolitan area. While only nine miles from downtown St. Paul, the community retains large open spaces and a substantially rural character. In the 20 years following 1980 it increased in population by only a little over 1,500 persons, to a population of 6,863 in 2000.

Wastewater Issues: For many years, Lake Elmo relied on large-lot zoning (2.5 acres or more per home, with each home using onsite wastewater treatment) as its primary means to retain rural quality of life. However, this style of development often resulted in “prairie palaces”—large homes surrounded by huge bluegrass lawns that provided little sense of the prairie and agricultural past and failed to create neighborhoods. In 1995, the city enacted an 18-month building moratorium to reconsider its zoning and wastewater policies.

Solutions: In 1996, Lake Elmo adopted a cluster development ordinance. It maintains density at 16 units per 40 acres, but houses can be clustered as long as 50 percent of the total buildable area is permanently preserved as open space. Cluster wastewater systems are used to treat wastewater at each development site. The city requires an O&M plan and a monitoring plan for each wastewater system. Homeowners’ associations (HOAs) are charged with carrying out the plans. Lake Elmo previously adopted a mandatory two-year pumpout schedule for individual septic systems and has a custom database in place to send reminders to homeowners and to track compliance. In its draft 2000 – 2020 comprehensive plan, Lake Elmo rejected regional sewer service as incompatible with the city's semi-rural development goals.

Results: Developers and homeowners have responded positively to the cluster system ordinance. To date, eight such developments with a total of 365 homes have been approved. One development also includes office space. Several developers believe that clustering houses offers advantages in development design, and providing a communal wastewater treatment system is attractive to homeowners since they are absolved of the responsibilities of maintaining a septic system. Home prices in several Lake Elmo cluster developments are well above regional norms.

Some HOAs were initially lax in managing their wastewater systems—lapses in maintenance and performance occurred. The city now oversees the systems more closely and requires each HOA to have a three-year contract with a qualified firm for regular O&M and monitoring.

Meanwhile, in the fall of 2002, the Metropolitan Council, the Twin Cities' regional planning authority and regional wastewater service provider, declared that Lake Elmo's draft comprehensive plan, including its reliance on cluster development, did not conform to regional development and infrastructure goals.

Essentially, the council found that Lake Elmo was not planning for its fair share of regional growth, and by rejecting the council's development allocation and the regional sewer service required by that allocation, Lake Elmo would force development to go elsewhere in the region, causing increased costs for regional sewers and other infrastructure. The council required Lake Elmo to modify its plan. Lake Elmo appealed the decision to an administrative law judge, lost, appealed that finding to an appeals court, lost, and appealed to the Minnesota Supreme Court, where a decision is pending.

Broad Top Township and Coaldale Borough, Pennsylvania

The Community: Broad Top Township and Coaldale Borough are situated in south central Pennsylvania. Thick forest cover and steep, mountainous topography carved by many creeks and streams characterize the area. About 70 percent of the population of 1,953 in 2000 (down from more than 4,000 in 1940) resides in and around nine villages and Coaldale Borough. The township has a board of supervisors while the borough has its own governing council and mayor. Since the decline of the coal mining industry, the area has depended on timber cutting and agriculture as its main industries. A majority of residents earn below-average incomes.

Wastewater Issues: The direct discharge of wastewater to streams and storm drains was widespread well into the 1990s. In spite of environmental laws, the discharges were not stopped because lots were too small to support septic systems, because of the prohibitive cost of a centralized system, and because stream quality was already significantly degraded from acid mine drainage. A 1981 study identified water quality as a key problem for the region, and the communities began to discuss the need for wastewater treatment. It was clear from the start that solutions would have to be low-cost.

Solutions: The two municipalities formed a joint Sewage Advisory Committee (SAC) in 1991. The SAC spent considerable time crafting a wastewater facility plan request for proposals that would accurately reflect the needs of residents, including a requirement that O&M costs be capped at ten dollars per household per month. The selected engineers found that the most cost-effective option would be five community-scale cluster systems serving roughly 600 households in the villages, plus improved onsite systems and a management program for the remaining 220 outlying households.

Property owners who voluntarily participated in the onsite management program would turn over ownership and control of their systems to Broad Top Township in return for free repair or replacement of the systems. All inspections, pumpouts, and maintenance of the systems would be the responsibility of the township. Those not participating would be required to have their systems inspected annually and would be responsible for the costs of all required maintenance, repairs, or replacements.

Results: An extraordinary degree of public participation and buy-in to the planning effort and solution helped the township secure substantial grant funding. This has enabled the township to meet its monthly cost objective. However, the cost requirement also limits the eligibility of the township for some grant programs, so funding and implementation of the community systems has been slower than expected. Currently about half of the planned households are connected.

To date, 120 of the eligible households have chosen to join the publicly-funded onsite management program. More are expected to join over time. Forty-three individual onsite systems have been reconstructed, and six small cluster systems have been built. Seven newly constructed homes have also joined, as required by a town ordinance. The community-scale systems and the onsite system management program have helped the town make significant strides in correcting pollution of local streams by “straight pipes” and inadequate treatment systems.

Washington Island, Wisconsin

The Community: Washington Island is 22 square miles in size and is located between Green Bay and Lake Michigan, 90 miles northeast of the city of Green Bay. It has a year-round population of approximately 700. In the short summers, the island becomes a vacation hub and the population swells considerably. The island is rural in character, with farms and permanent residences in the interior and inns and vacation homes along the shore.

Wastewater Issues: Shallow soils and fissured limestone bedrock characterize the island. Many interior homes have long been served by septic tank soil absorption systems, while shoreline homes built in recent decades relied on holding tanks due to the shallow soils. The proliferation of homes built with holding tanks in the 1970s and 1980s created concerns about the long-term capacity of fields on the island where holding tank wastes were spread. In addition, it became apparent that many onsite soil absorption systems were not compliant with state codes.

Solutions: In 1986 the town board hired an engineering firm to prepare a wastewater facility plan. Construction of a sewer system proved infeasible because of the shallow bedrock. The engineers instead proposed a “pump and haul” system using pumper trucks and a centralized treatment facility. The cost of the system was estimated at $5 million. Residents were extremely concerned by the cost. In addition, potential discharge sites, including spray irrigation fields, wetlands, and the lake were ruled out for environmental, public health, or aesthetic reasons.

In 1990 the town board appointed a citizen wastewater committee to research alternatives. The town also hired a new consultant who was especially familiar with decentralized wastewater treatment. After Washington Island completed a multi-year demonstration project that showed that onsite recirculating sand filter (RSF) systems could meet a 10 milligram per liter nitrate standard, the new engineer prepared a new facility plan based on widespread use of the RSF technology and public management of onsite systems. The management program included the creation of a utility district, initial inspections of all systems, periodic re-inspections, septic tank pumpout schedules, and tracking of all inspections and pumpouts of all holding tanks and onsite treatment systems.

Results: Initial inspections will be completed two years ahead of schedule. Systems that are not compliant with the state code or are failing hydraulically are upgraded or replaced as required at the owner's expense. Due to changes in the state groundwater code, RSFs are no longer required, so conventional or mounded soil absorption fields are used. Holding tanks are still used, but new holding tanks are discouraged. Most of the island's highly independent residents as well as second home owners have accepted public oversight of their onsite systems as a reasonable trade-off for the cost savings achieved by avoiding a large centralized treatment system. Careful attention to public participation during the facility planning process ensured this result. The decentralized facility plan allows for flexibility in adapting to new technologies and situations. As one example, the town built a 2,000 gallon per day Fixed Activated-sludge Treatment (FAST) system to accept holding tank waste in the winter, a greatly scaled-down version of the original centralized treatment idea. This allowed cessation of all field spreading of holding tank waste during winter months. One challenge the town has faced is maintaining proactive leadership of the wastewater program as the membership of the town board changes over time.

Smallside, USA

The Community: Smallside is a hypothetical community designed for this study to show how periodic, small investments in decentralized wastewater system capacity can provide financial benefits compared to larger, infrequent investments in centralized wastewater system capacity. Smallside's population of nearly 2,500 enjoys the rural character of the community and the attendant high quality of life. Given these desirable qualities and its location within commuting distance of Metropolis, a building boomlet has recently occurred in Smallside. The population is expected to swell to nearly 6,000 by build-out in 30 years.

Wastewater Issues: The village area is served by a small activated-sludge wastewater treatment plant, and a key issue facing the town is whether to expand the plant and provide sewer service to areas outside the village where the most growth is expected. Failures of some existing onsite systems, high seasonal groundwater tables, and nutrient enrichment of a lake in town have raised questions about the viability of onsite systems in the town's future.

Solutions: The town's engineers have identified several options that successfully address the town's needs at what appears to be the same cost. One is expansion of the treatment plant, installation of sewer trunk lines, and construction of sewer mains and laterals on an occasional basis as new subdivisions are created. The other is a decentralized approach that involves gradual replacement of conventional onsite systems as they fail, the use of mounded soil absorption systems in most parts of town, and the use of special nutrient-reducing systems near the lake. The town could provide management for privately owned onsite systems, or could take over ownership, operation, and maintenance of onsite systems. The net present value of the capital, O&M, and management costs of all three options (centralized, resident-owned onsite, and town-owned onsite) is equal. However, the distribution of costs over time is dramatically different between the centralized and onsite alternatives. The centralized option's capital costs are highly front-loaded, while its O&M costs are fairly low over time. The decentralized alternatives have capital costs that are spread much more evenly over the 30-year build-out period and total O&M costs that are greater over the planning period.

Results: A financial analyst prepared scenarios for how each alternative would be financed and estimated the lifecycle costs and the average annual homeowner payments required to support the *total costs*—capital, O&M, management, *and financing*—of each alternative. The centralized option would require a higher debt load, which incurs interest and other debt service charges and raises the total cost considerably. Using reasonable financial assumptions, the net present value of the centralized option, when financing costs are included, is 29 percent greater than that of either decentralized option. Average annual homeowner payments also were substantially less for the decentralized options, with the resident-owned onsite somewhat less costly than city-owned onsite. Sensitivity analysis confirmed these results. Lower-than-expected growth would result in costs being spread across fewer residents. Average annual payments for the particular low-growth scenario considered would increase four to five percent for the onsite options versus the base case and 12 percent for the centralized option. Increasing the interest rate spread between town debt and homeowner debt by 1.5 percent did not appreciably change the percentage difference between average annual payments for the centralized and decentralized options. Adding inflation to the analysis did not change the rank order of the alternatives.

4 SMALLSIDE, USA: A HYPOTHETICAL ANALYSIS OF THE FINANCIAL BENEFITS OF INCREMENTAL CAPACITY PROVISION

Three of the community case studies discuss how those communities viewed differences in how centralized and decentralized system architectures provide capacity over time. This chapter delves further into this topic.

Decentralized systems serve customers individually or in small clusters as growth occurs or as existing onsite systems are replaced or upgraded. This pattern differs substantially from the typical pattern of centralized system capacity provision in which a large amount of treatment capacity is generally built up-front, and demand “grows into” the capacity. Centralized sewers are typically sized for build-out, which may not occur for decades. Some phasing of capacity occurs in centralized systems as sewer lines are extended and treatment plants are expanded. On the other hand, a decentralized system architecture results in finer increments of capacity being built as needed over an extended period, in a “just-in-time” fashion.

This pattern of closer matching of capacity to demand can affect how a community pays for wastewater capacity. It may allow a community to reduce its project financing costs, which include interest paid on debt, issuance costs on bonds or other debt, costs to maintain debt service coverage ratios and operating reserve ratios, and other financing costs. To show how incremental investment in decentralized systems can produce financial advantages over investments in typical centralized systems, the National Decentralized Water Resources Capacity Development Project (NDWRCDP) commissioned a financial analysis along with the case study research. This chapter presents the methodology and results of that analysis.

Methodology

To illustrate the financial benefits that decentralized systems can offer, the project team developed and analyzed wastewater alternatives for a hypothetical community named Smallside. The goal was to isolate differences in financing costs between centralized and decentralized systems from related-but-separate differences in capital costs, operation and maintenance (O&M) costs, and management and administration costs.[3]

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[3] This distinction between financial costs and other costs is important. In the common lexicon the term financial is sometimes used as a catch-all for all types of costs. Here the more precise notion of “financial” as referring to the parameters and costs of financing investments is used. Total costs include capital, O&M, management, and financing costs.

The project team for this financial study included:

- Rocky Mountain Institute (RMI), the organization responsible for the entire case study project
- Hazen and Sawyer, an engineering firm with substantial experience in designing and costing both centralized and decentralized wastewater systems
- Rick Giardina and Associates (RGA), a utility finance and rate-making consulting firm that has worked with small and large water and wastewater systems across the country

To develop the analysis presented in this chapter, the team used the following approach:

- RMI "roughed-out" the characteristics of Smallside—its approximate population and population growth pattern, its different land areas, its existing wastewater systems, and other characteristics. The community was "designed" to be a typical American community located in a rural area experiencing growth.
- Engineers at Hazen and Sawyer developed estimates of capital, O&M, and management and administration costs over a 30-year period for centralized and decentralized wastewater alternatives. For simplicity, the alternatives were a) to serve all homes in the Smallside study area with a centralized system, or b) to serve all homes with onsite systems. Cluster systems and hybrid centralized/decentralized options for the study area were not considered. The estimates were based on unit costs for the recommended technologies drawn from actual studies done in Florida by Hazen and Sawyer.
- Financial analysts at RGA developed a net present value model for the capital, O&M, and management costs developed by Hazen and Sawyer. This model included a 30-year "extension period," thus encompassing a total of 60 years of data, to enable a full 30 years of operations for systems put in place in year 30 to be included in the analysis.
- RMI, in collaboration with Hazen and Sawyer and RGA, adjusted the mix of onsite wastewater technologies assumed in the onsite alternative in order to equalize the net present value of capital, O&M, and management and administration costs of the onsite and centralized alternatives. This step made isolation of financing costs possible.
- RGA developed a financial model that incorporated the annual capital, O&M, and management and administration costs from previous steps, along with such factors as mortgage and bond interest rates, debt service coverage ratios, operating reserve ratios, and other financial factors. The model made possible the calculation of total system costs, including financing costs, and thereby allowed comparison of the alternatives in terms of the present value of lifecycle costs and average annual payments facing Smallside homeowners under each of the scenarios analyzed.
- RGA conducted sensitivity tests to determine if changes to several key assumptions in the base case had a substantial impact on the results. Three sensitivity cases were run: lower growth rate, inflation, and higher mortgage interest rate.

This methodology and its rationale are explained in further detail in the following sections of this chapter. A number of key assumptions are identified prior to discussion of the results. Other more subtle assumptions, their influence on the analysis, and caveats to interpretation or application of the results are discussed in the final section of this chapter. Appendix A of this report summarizes some of the key engineering and financial parameters assumed or calculated as part of this study. Appendices B, C, D, E and F, provide the spreadsheets used in the engineering cost models and financial models. These spreadsheets are available electronically with this report on the CD and online at www.ndwrcdp.org. Further information about these spreadsheets is provided on the final page of this report.

It is important to note here that this is a “first order” analysis designed to clearly illustrate how decentralized approaches can have reduced financial and total costs compared to centralized systems. The objective was not to design and select the best wastewater system for a town like Smallside, but rather to develop an example that would isolate and reveal differences in financing costs between decentralized and centralized alternatives. With the logic of the difference made clear, real communities will be better able to imagine and perhaps to analyze how that logic applies to their specific physical and financial conditions. Few communities will find that the net present value of combined capital, O&M, and management costs—the metric most commonly used to determine the most economic choice—is the same for the two best alternatives. The greater significance of the findings in this chapter is this: in some cases, a decentralized system that appears more expensive than a centralized system in terms of capital, O&M, and management costs may actually be less expensive when financing costs are also considered, and may present less financial risk should key assumptions for future year conditions prove incorrect.

Characteristics of Smallside

Smallside is a township in Anystate, USA. Its population of nearly 2,500 enjoys the rural character of the community and the attendant high quality of life. Farms and farm-family homes are scattered throughout the township, while most non-farm homes are clustered around the village center, along the road to Metropolis (about an hour away) and along the shore of Easy Lake. Given its desirable quality of life, its location within commuting distance of Metropolis, and the potential of lakefront second home development, a building “boomlet” has recently begun in Smallside. New homes are being built on lots around Easy Lake and around the village center. The first substantial suburban-style development, fifty homes on one-third-acre lots, was recently built along Metro Road. Similar developments are being planned, and the building of individual homes along Metro Road and throughout the rest of town is picking up.

The state Department of Community Development has told the Smallside Board of Supervisors that Smallside will likely double in population within 20 years. This means the town will grow by more than 50 new housing units and about 130 individuals per year. Smallside expects growth to occur in the retail and service sectors along with the residential growth.

According to the state, growth will continue beyond 20 years as well, albeit at a somewhat slower rate as growth shifts to other parts of the region. Smallside will probably be built-out in about thirty years, and boast a population of nearly 6,000. Table 4-1 shows the current and projected housing population of Smallside.

Table 4-1: Current and Projected Housing and Population of Smallside, USA

	Current Conditions			10 Years Out		20 Years Out		30 Years Out	
	Homes	**Pop/HH**	**Pop**	**Homes**	**Pop**	**Homes**	**Pop**	**Homes**	**Pop**
Village Center	300	2.54	762	350	889	400	1,016	425	1,080
Easy Lake	100	2.54	254	200	508	250	635	250	635
Metro Road Corridor	400	2.54	1,016	700	1,778	1,100	2,794	1,350	3,429
Outlying Areas	175	2.54	445	225	572	275	699	325	826
Township Total	*975*	*2.54*	*2,477*	*1,475*	*3,747*	*2,025*	*5,144*	*2,350*	*5,969*
Increase over decade				500	1,270	550	1,397	325	826
Total for Wastewater Study Area (Easy Lake and Metro Road)	*500*	*2.54*	*1,270*	*900*	*2,286*	*1,350*	*3,429*	*1,600*	*4,064*

The town is currently wrestling with a variety of community planning issues. A key question is whether or not to provide sewer service to the areas expected to receive most of the growth. That some existing septic systems are failing adds considerable weight to this issue. Most of the town experiences high seasonal groundwater tables. Many older onsite systems do not meet current codes. The town is particularly concerned about additional onsite systems introducing excessive nutrients to sensitive environmental areas, including Easy Lake and some wetlands. These environmental and aesthetic amenities must be protected if the town is to maintain its character. Finally, the town needs an affordable wastewater system because in the coming years it anticipates having to improve roads, build schools, expand fire and police services, and serve other community needs.

Subareas of Smallside

Existing development and anticipated growth in Smallside is expected to occur differentially in different geographical areas, as a result of development constraints and efforts by the town to focus growth in some places while preserving the rural character of other places. Table 4-1 shows current and projected housing and population for the town's four distinct areas, each of which is described in the following sections. Figure 4-1 shows the different areas of Smallside.

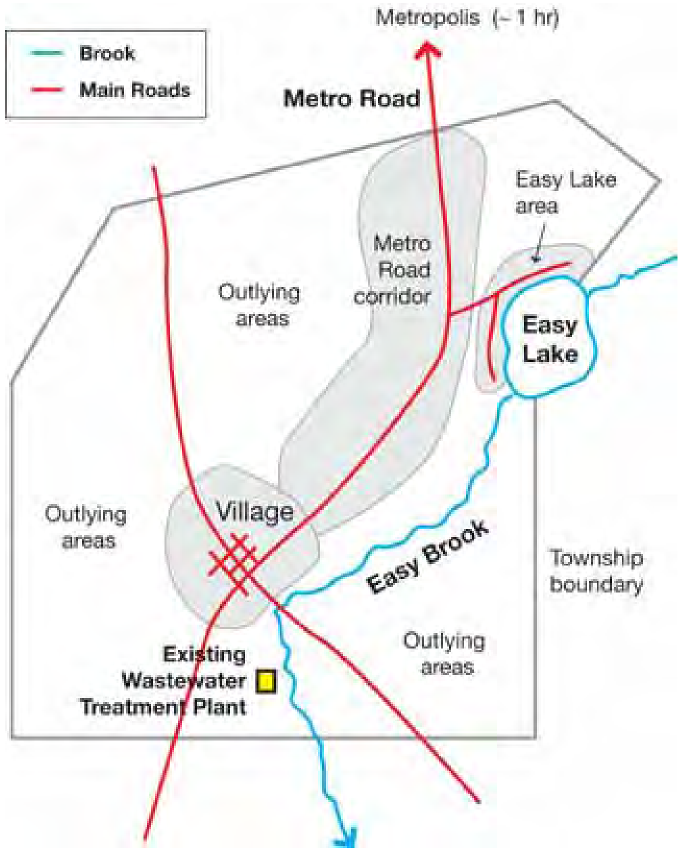


Figure 4-1: Map of Smallside, USA

Village Area

Smallside's central village consists of commercial, community, and residential properties along Main Street and in a few surrounding blocks. The village currently has 300 homes. At build-out the town expects the village to have 425 homes. Space for additional commercial development is available in the village.

The village is currently served by a single wastewater treatment plant. When the plant was built several years ago, its capacity of 150,000 gallons per day was chosen to accommodate all wastewater flows from the village through build-out. The facility is located a considerable distance from the village and has land to expand so that it can accept flows from other parts of town.

Easy Lake Area

Easy Lake is a beautiful, 300-acre lake that Smallside shares with another town. Its water has historically been very clear. Recently clarity has gone down somewhat, raising concerns that nutrient enrichment from septic systems along the lake and surrounding farms could be increasing algal growth and otherwise impacting the lake. A number of the existing septic tank and leach field systems along the lake are failing, and more are expected to develop problems in coming years. Soils along much of the lakeshore are shallow and sit atop bedrock.

Currently there are 100 homes located along Easy Lake in Smallside, on either side of a road that parallels the lakeshore. Some are inhabited seasonally, but most are lived in year-round. The average lot size is one-half acre.

This area is attractive for additional year-round and seasonal residents. At current densities, another 150 homes could be built in Smallside along the shore of and near Easy Lake.

Metro Road Corridor

Metro Road runs by the village, passes Easy Lake (located on a spur road), and continues on to Metropolis, roughly one hour from the village. Currently, many individual homes and small groups of homes are scattered along Metro Road. At present, this area has 400 homes.

A suburban-type subdivision of one-half acre lots was recently built just off Metro Road. Considerable growth is expected along and adjacent to this corridor over the next several decades. Most growth is expected to take place in suburban-style developments. This could result in 950 new homes in this area, for a total of 1,350 homes at build-out.

Outlying Areas

Another 175 homes are scattered throughout the rest of the township, most at significant distances from each other. Many are farms. The town is trying to discourage high-density development of these outlying areas through large-lot zoning. Development of additional homes on large lots throughout the outlying area is expected to occur slowly but continuously, amounting to another 100 homes over the next 20 years. The overall density of development in the outlying areas is expected to remain too low into the foreseeable future for sewers to be considered economically feasible. Onsite systems will continue to serve all homes.

Wastewater Treatment Options Studied for Smallside

Given the characteristics of Smallside, the project team defined the study area for this analysis as the Metro Road and Easy Lake areas. The plan for serving the village area and outlying rural areas would be the same regardless of the option chosen for Metro Road and Easy Lake and would include:

- Using the existing capacity at the wastewater treatment plant to serve growth in the village through build-out
- Using onsite systems to serve outlying areas

Two simplified wastewater system options for the study area were defined:

- ***Decentralized option—onsite wastewater treatment systems (OWTS):*** This option would utilize onsite systems for both the Metro Road and Easy Lake areas. Most systems in the Metro Road area would have a conventional septic tank and a mounded wastewater soil absorption field, and are referred to as "mound systems." For the Easy Lake area, with its nutrient enrichment issues, the assumed technology is an Onsite Wastewater Nutrient Reduction System (OWNRS) utilizing a multi-compartment tank with aerobic and anoxic zones and process control to achieve biological nitrogen removal, followed by a subsurface drip irrigation effluent dispersal system. OWNRS would also be used for some homes located close to streams or wetlands in the Metro Road area. The assumed technologies would be installed at all new homes. For existing homes, it is assumed that existing onsite systems would be replaced as those systems fail or homes are sold. The assumed replacement rate is 10 percent per year, meaning that all existing onsite systems would be replaced with the recommended technologies within the first ten years of the study period.
- ***Centralized option—centralized wastewater treatment system (CWTS):*** Under this option the township would install sewers to serve the Metro Road and Easy Lake areas, and expand the existing wastewater treatment plant to accommodate existing and new homes in these areas. Low-cost sewers (compared to conventional gravity sewers) would be used. This study assumes vacuum sewers would be used in the Metro Road area, where they would work well for the flat topography and large number of homes anticipated for this area. For Easy Lake, low-pressure sewers are assumed because of a slight topographic rise between the lake and the Metro Road corridor. A force main would connect the two areas to the treatment plant. Under this centralized treatment scenario, with the amount of growth assumed, the wastewater treatment plant would be expanded by 250,000 gallons per day (gpd) in the first year, and again by 150,000 gpd in year 15, to a total build-out capacity of 550,000 gpd. A major sewering effort for existing homes and near-term growth would be made in year 1, and smaller sewer projects to serve new subdivisions would begin in year 9 and occur every three to four years thereafter.

Capital, O&M, and Management Cost of the Alternatives

In a typical wastewater facility planning effort, the most economic alternative would be defined as the alternative with the lowest net present value of anticipated cost streams over time. A discount rate, reflecting the "time value of money," would be used to equalize the value of costs today and costs in later years—for instance, one-time capital costs versus ongoing O&M costs.[4]

The pattern of costs for each alternative typically varies significantly over time; net present value compares costs on an equalized basis. An alternative with the lowest net present value cost is usually considered the most economic choice. Typically this choice is made before financing

[4] The "time value of money" means that a dollar today is worth more than a dollar at some point in the future, not because of inflation, but because a rational person would rather have an amount of money today than an equal amount at some point in the future. The discount rate reflects this difference as a compound yearly rate of decline in the value of money over time.

costs are considered and is generally based on an engineer’s assessment of the net present value of capital, O&M, and management and administration costs.

For the Smallside analysis only the overall framework and results of the engineering cost analysis are noted here in order to move the discussion quickly to its focus: financial differences between the alternatives. Certain estimated and assumed costs and other parameters of the engineering cost analysis are summarized in Appendix A. Detailed annual capital, O&M, and management and administration costs of the OWTS and CWTS base-case alternatives, and the net present value of those costs using a three percent discount rate, are provided in tables in Appendix B. All costs in this chapter and the appendices are in 2002 dollars.

The engineering analysis begins with an assessment of wastewater needs created by the type of users and growth patterns of the study area. The population of Smallside, the number of homes included in the wastewater study area, and annual wastewater flows are shown in This analysis assumes that only homes are served in the study area (all commercial development would occur in the village), and that they generate wastewater at a rate of 200 gallons per home per day, or 73,000 gallons per year. Note that 40 new homes are connected each year through year 10, and then forty-five homes per year until year 20 when growth slows to 25 homes per year. A total of 1,600 homes are involved in the new wastewater treatment system by year 30. For the decentralized alternative, a detailed breakdown of residents that would install each type of system—mound or OWNRS—is provided in Appendix B of this report.

Table 4-2: Smallside Residents Included in Wastewater Study Service Area

Year	Population Served	Homes Included in Project	Annual Wastewater Flows (kgal)
0	1,270	500	36,500
1	1,372	540	39,420
2	1,473	580	42,340
3	1,575	620	45,260
4	1,676	660	48,180
5	1,778	700	51,100
6	1,880	740	54,020
7	1,981	780	56,940
8	2,083	820	59,860
9	2,184	860	62,780
10	2,286	900	65,700
11	2,400	945	68,985
12	2,515	990	72,270

Table 4-2: Smallside Residents Include in Wastewater Study Service Area (Cont.)

Year	Population Served	Homes Included in Project	Annual Wastewater Flows (kgal)
13	2,629	1,035	75,555
14	2,743	1,080	78,840
15	2,858	1,125	82,125
16	2,972	1,170	85,410
17	3,086	1,215	88,695
18	3,200	1,260	91,980
19	3,315	1,305	95,265
20	3,429	1,350	98,550
21	3,493	1,375	100,375
22	3,556	1,400	102,200
23	3,620	1,425	104,025
24	3,683	1,450	105,850
25	3,747	1,475	107,675
26	3,810	1,500	109,500
27	3,874	1,525	111,325
28	3,937	1,550	113,150
29	4,001	1,575	114,975
30	4,064	1,600	116,800

For both the centralized and decentralized wastewater treatment approaches, 500 existing septic systems would be replaced with a new wastewater system and an additional 1,100 connections would be completed over 30 years. Of the 1,100 new residential properties developed, 950 of those would be located in the Metro Road area, and 150 would be located in the Easy Lake area. The last connections would occur in year 30 of the study period. Thus, the system annual operational costs stabilize in year 30 and are used to calculate costs over a 30-year extension period. Because some of the customers would arrive in year 30, an extension period is used to capture the system costs for a period long enough to account for all costs associated with the 1,600 customers included in the study. This extension period enables a fair comparison of the CWTS costs with the OWTS costs, which also stabilize in year 30.[5]

[5] Capital renewal is discussed in the final section of this chapter.

The construction of the CWTS would occur in year 0, and new connections would begin service in year 1. In the OWTS alternative, the conversions of existing homes to the OWTS would begin in year 0. Therefore, the financing of each wastewater treatment technology begins in year 0.

The costs of constructing the two types of systems, centralized and decentralized, require different amounts of capital investments each year (see Figure 4-2). The primary central system would be constructed in year 0 and expanded in increments as new neighborhoods are developed, thus requiring large capital outlays in the years that construction occurs. In contrast, the onsite systems would be added annually as the new homes are constructed or existing onsite systems need to be replaced (the analysis assumes all onsite systems existing in year 0 are replaced over a 10-year period). Thus, the annual capital outlays for construction result in different financing requirements for the centralized and decentralized systems.

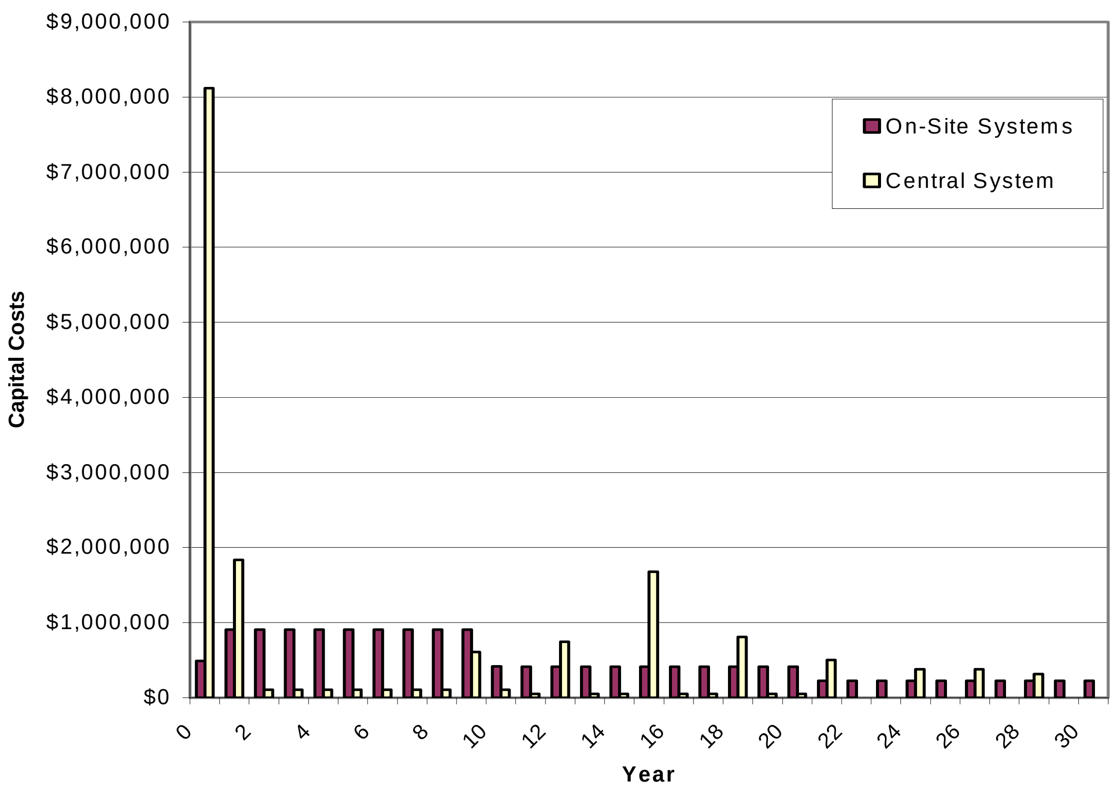


Figure 4-2: Comparison of Capital Outlays Over Time for Wastewater Treatment Technologies in Smallside

In addition to differences in the amount and timing of capital costs, the O&M costs associated with each technology are significantly different. The O&M costs for the onsite systems include:

- Power (which is low for the mound system pump but a fairly substantial cost for the OWNRS systems because of the blower used in the aerobic treatment unit)
- Permit fees

- Labor for performance checks and maintenance visits
- Replacement of the pump (mounds and OWNRS) and blower (OWNRS) every ten years
- Residual pump-outs every five years for mounds and every three years for OWNRS

The O&M costs for the centralized option include:

- Power for the vacuum station, the low-pressure pump units, and the treatment plant
- Labor to operate and maintain each of these systems
- Periodic replacement of pumps, valves, controllers, and other parts

Given the particular technologies assumed in this study, O&M costs for the decentralized approach are estimated to be somewhat higher than for a centralized approach. However, under a decentralized option, O&M is essentially directly proportional to the number of connections, so unit costs are relatively constant. For the centralized option, O&M is partially proportional to connections, while some fixed O&M costs are proportional to size, resulting in higher unit O&M costs in early years until more connections reduce the average unit cost.

Management and administrative costs are also higher for the OWTS than the CWTS. This assumption is based on the need for inspections and management of dispersed treatment systems. The OWNRS systems in particular would need close and frequent oversight. The O&M costs and management costs for each technology are shown in Appendix B.

Under the OWTS approach, the OWNRS system is more expensive than the mound system for both capital and O&M costs. The project team adjusted the mix of mound and OWNRS systems in the OWTS alternative in order to produce an OWTS scenario in which the total net present value of OWTS capital, O&M, and management costs was equal to the total net present value of the same types of costs for a CWTS scenario. While this manipulation may seem artificial—rarely does the net present value of the two main alternatives come out the same in the real world—it was done in order to focus attention on differences in financing costs that result from the different patterns over time of capital, O&M, and management costs between the two alternatives.

In other words, ignoring how the centralized and decentralized systems are financed, the capital outlays and operational costs are the same on a present value basis over a 60-year period. When financing costs are considered, the total system costs change, and these changes are the focus of this study. A summary of the present value of the base costs for each alternative is provided in Appendix B.

Financial Analysis

The financial analysis is the focus of this hypothetical community study. The objective was to provide comparisons of the financing costs associated with centralized and decentralized approaches and the general user-fee levels needed to fund each approach. In particular, this analysis focuses on the financing implications of each system architecture, how costs to the homeowners differ under township and residential ownership, and the financial risks of centralized wastewater treatment systems compared to decentralized wastewater treatment when growth in the community is less or slower than initially projected. The methods and assumptions used in the financial analysis are provided in the following section, followed by a discussion of the analysis and the results.

Financial Analysis Scenarios

In addition to the two physical alternatives—centralized (CWTS) and decentralized (OWTS)—this study also examined the financial differences between homeowner and township ownership of onsite wastewater treatment systems. A municipality might consider owning onsite systems in order to ensure the systems are properly maintained and managed. Thus, the study examined three wastewater system options:

- ***OWTS Resident-Owned:*** Resident ownership, operation, and maintenance; township management of all decentralized (OWTS) units
- ***OWTS Township-Owned:*** Township ownership, operation, maintenance and management of all decentralized (OWTS) units
- ***CWTS Township-Owned:*** Township ownership, operation, maintenance and management of the entire centralized system (CWTS)

Two scenarios involve OWTS, with ownership by the township in one scenario and ownership by the resident (homeowner) in another. For simplicity, the costs of O&M and management were assumed to be the same in these two OWTS scenarios. The third scenario involves the construction and operation of a CWTS owned by the township. The purpose of evaluating these three scenarios is to compare the ultimate costs to the homeowner under each scenario.

For the two scenarios in which the township owns the systems, the township provides all O&M and management services for the systems. For the scenario in which the homeowner owns the OWTS, the township would provide overall management by monitoring the systems for performance and compliance with environmental regulations, but it would not operate or maintain the OWTS units. Specific O&M costs for each technology are provided in Appendix F of this report.

Financial assumptions applied to all three alternatives are shown in Table 4-3. Financial assumptions specific to each of the alternatives are discussed in the following sections. Details of the financial analysis are provided in the appendices.

Table 4-3: Financial Assumptions

Description	Data
Bond Interest Rate	6.00%
Real Bond Interest Rate	3.00%
Real Discount Rate	3.00%
Issuance Costs as % of Bond Issue	1.00%
Bond Term	20 years
Debt Service Coverage Ratio	1.20 x annual debt service
Operating Reserve Ratio	15%
Interest Earned on Cash Balances	1.5%
Homeowner Interest Rate	7.00%
Homeowner Real Interest Rate	4.00%
Homeowner Real Discount Rate	3.00%
Tax Rate for Interest Deduction	27.00%
Homeowner Debt Issuance Costs as % of Debt	1.00%
Homeowner Debt Term	30 years
Township Growth Period	30 years
Analysis Extension Period	30 years
Total Analysis Period	60 years

OWTS Resident-Owned

For the scenario in which the homeowner owns the OWTS, a monthly user fee covers management and system administrative costs of the OWTS as incurred by the township. These costs involve ensuring that each system meets environmental regulations. Maintenance costs are paid by the homeowner and are assumed the same as if the township, or a privately owned firm, were to provide the maintenance services.

For this scenario, in which homeowners finance and own the OWTS, the township does not incur any debt because the homeowner pays for the installation of the system. It is assumed that the homeowner includes the capital cost of an OWTS in his or her primary mortgage (new system) or a second mortgage (replacement system). The amount the homeowner pays through his or her mortgage has been calculated for inclusion in the total costs paid by the homeowner. The interest amount has been adjusted in this study to account for the tax deduction for interest payments using a 27 percent marginal tax rate. The table showing these annual costs is in Appendix B.

OWTS Township-Owned

For the scenario in which the township owns the OWTS, all costs are essentially the same as in the homeowner ownership case, but the homeowner would not pay directly for the system via his or her mortgage payment. Instead, the homeowner would be charged a monthly fee that would include the cost of constructing the system in addition to all operational, maintenance, and management costs. As such, the financing and maintenance of the OWTS in this scenario is differs from the scenario in which the homeowner owns the OWTS. In this township-owned OWTS scenario, the township finances the OWTS and takes responsibility for all maintenance and environmental monitoring. This eliminates the inclusion of the construction cost in the homeowner's mortgage payment, but increases the monthly customer charge to the homeowner for recovery of O&M, capital, and financing costs.

CWTS Township-Owned

Under the scenario in which the township constructs the centralized system, fees consist of a monthly customer charge for maintenance and administration of the system and an impact fee that is assessed to cover construction of the CWTS. As is common with publicly-owned central wastewater collection and treatment systems, the township of Smallside would own and manage the wastewater treatment system and incur debt to finance the construction and expansion of the system as the township grows. An impact fee was calculated so the township could recover the construction and financing costs of the CWTS.

It was also assumed that the township would obtain a loan or issue a bond in certain years as necessary to finance the construction and expansion of the CWTS (treatment plant expansion or expansion of the collection system) in anticipation of collecting impact fees to repay construction-related debt.

For the CWTS alternative, user fees are calculated over the thirty-year study period to recover operation and maintenance costs, to provide operating reserves, and to meet debt service coverage requirements. The detailed annual capital cost and debt repayment schedules for the CWTS scenario are provided in Appendix B. The user fees are shown in the table in this appendix on a $/kgal (1,000 gallons = one kgal), or cost-per-volume, basis; however, in practice they would likely consist of a monthly customer charge and a volume rate. The impact fee calculation is also shown in this appendix.

Financial Analysis Results

Two different cost perspectives were developed to illustrate the results for the three scenarios in this analysis, and they are summarized in Table 4-4 and Table 4-5 one perspective is for the total lifecycle cost in which the present value of all costs (capital, O&M, management and administration, and financing) is calculated for a 60-year period. Including at least 30 years of costs for each connection, which requires a 60-year period, allows an equal basis comparison of all alternatives. These costs are shown in Table 4-4. Since no inflation rate was used to increase costs from year to year, a discount rate of three percent was used and is the assumed real cost of capital. No distinction has been made between the discount rate for a homeowner and the township in this study because comparisons of alternatives need to be made using the same discount rate, in order to reflect a viewpoint from one decision maker.

Table 4-4: Present Value of Lifecycle Costs

	OWTS Resident-Owned	OWTS Township-Owned	CWTS Township-Owned
Present Value	$25,471,365	$25,559,427	$32,916,104

Notice in Table 4-4 that the lowest cost alternative is the resident-owned OWTS. There is little difference between this alternative and the township-owned OWTS, but the CWTS has significantly higher costs due to the financing costs associated with the central system. The financing costs include debt service associated with the capital construction costs as financed through the township, and mortgage interest paid by the homeowner as a result of the township-imposed impact fee that is assumed to be included in the homeowner's mortgage.

One key component of the township-owned CWTS, therefore, is the assumed inclusion of the impact fee in the homeowners' mortgage payments, which results in interest charges that increase the total cost of the alternative shown in Table 4-4. Because constructing the CWTS requires considerably more borrowing by the community in early years than does the OWTS approach (in which borrowing is spread across the full 30 years to build-out), interest on township debt and debt passed on to homeowners through incorporation of the impact fee in their mortgages results in considerably higher interest costs to the community under the CWTS approach. Homeowner interest charges have been adjusted for taxes by using a 27 percent tax rate to calculate the mortgage interest tax deduction. These calculations are shown in Appendix B of this report.

A summary of the differences between the township-owned CWTS costs and township-owned OWTS costs is shown in Figure 4-3. As noted earlier, the OWTS options assumed in this study have higher O&M and management costs than for the CWTS option. However, this cost difference is more than offset by the higher capital and financing costs of the OWTS option. The cost components of the total present value amounts in Table 4-4 are shown in Appendix B.

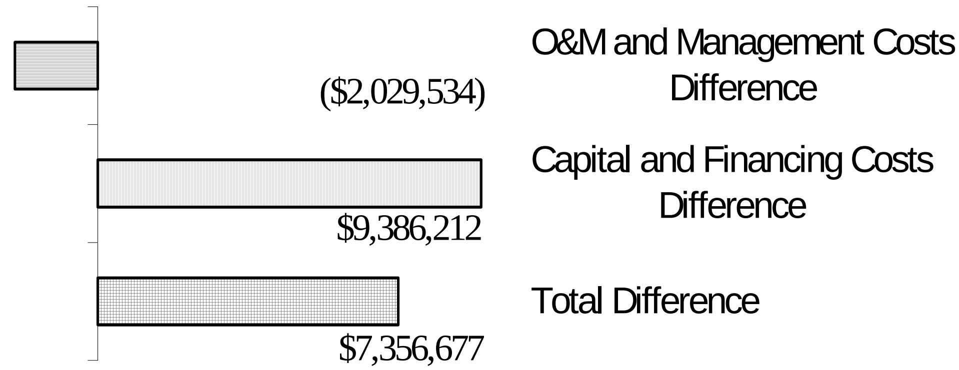


Figure 4-3: Differences in Total Lifecycle Costs for Township-Owned Options—Central System Costs Minus Onsite System Costs

The second cost perspective considered in this study is based on the homeowner's annual outlays and consists of calculating the average annual payment a homeowner would make for a 30-year period, excluding the effects of inflation. This perspective provides a frame of reference for a homeowner, so they can quickly see the difference in annual payments (which would likely be paid in monthly rates) when considering the alternative wastewater treatment approaches. The results for this cost perspective are shown in Table 4-5.

Table 4-5: Homeowner Average Annual Payments

	OWTS Resident-Owned	OWTS Township-Owned	CWTS Township-Owned
Annual Amount	$614	$682	$844

The homeowner average annual costs in Table 4-5 are consistent with the ranking of results shown in Table 4-4, and primarily reflect the difference in financing costs for the three alternatives. The financing costs for the township under the two township-owned scenarios include funds required to meet the township's debt service coverage and operating reserve requirements, which are needed for the township to demonstrate financial viability and meet daily cash needs for operations, respectively. The amounts in Table 4-4 do not include funds for meeting the township's debt service coverage and operating reserve requirements because these funds are never spent and can be considered similar to a deposit that is refundable if the utility terminated all operations. However, they are reflected in the Table 4-5 annual payments because they are included in the fees the homeowner pays, which were used to calculate the average annual payments in Table 4-5.

Under the two OWTS scenarios there is no impact fee, so the homeowner either pays financing costs through mortgage payments (OWTS Resident-Owned) or through a monthly fee to the township for the construction, operation, and maintenance of the onsite systems (OWTS Township-Owned). In both cases, those charges only begin when an existing home onsite system is replaced (occurring over a 10-year period) or a new home requires a new system (occurring over a 30-year period). Under the CWTS scenario, in contrast, payments of up-front impact fees by all 500 existing homeowners whose systems are replaced by a sewer in year 0 create sizeable interest payments over time (the impact fees are assumed to be incorporated into homeowners' mortgages). Those interest charges, combined with the high capital construction costs of a CWTS that requires the township to carry and pay interest on debt for many years (until impact fees for new connections recover the remaining costs of the township's debt), create higher financing costs for the CWTS than the OWTS. This accounts for much of the difference in total costs between the two different approaches to wastewater treatment.

The average annual payments in Table 4-5 therefore reflect amounts paid each year by the homeowner to the township for its relevant wastewater system costs and the amount of additional interest the homeowner pays through a mortgage payment for the wastewater treatment system. In comparison, the present values shown in Table 4-4 reflect an expenditure perspective that covers 60 years instead of an annual payment requirement perspective as depicted in Table 4-5. Nonetheless, both perspectives indicate that the homeowner would pay less for wastewater treatment using an onsite, resident-owned treatment system than a centralized system. The homeowner would pay more for a township-owned onsite system, but still less than for a centralized system.

Sensitivity Analysis

A sensitivity analysis was completed in order to assess whether assumptions made in the study would bias the results in favor of any of the alternatives. The assumptions that are most influential in a study such as this typically involve growth rates, inflation, and financing factors such as interest rates. Therefore, three cases were developed to assess the influence these factors may have on the alternatives. The tables containing the detailed calculations for each of the sensitivity cases are in Appendices C, D, and E.

The first sensitivity case assumes that less growth occurs than had originally been anticipated. This results in a longer period of underutilization of the CWTS or construction of fewer OWTS than originally planned. The low growth scenario is depicted in Figure 4-4, which compares the original growth projection to the "actual" growth experienced in this sensitivity case.

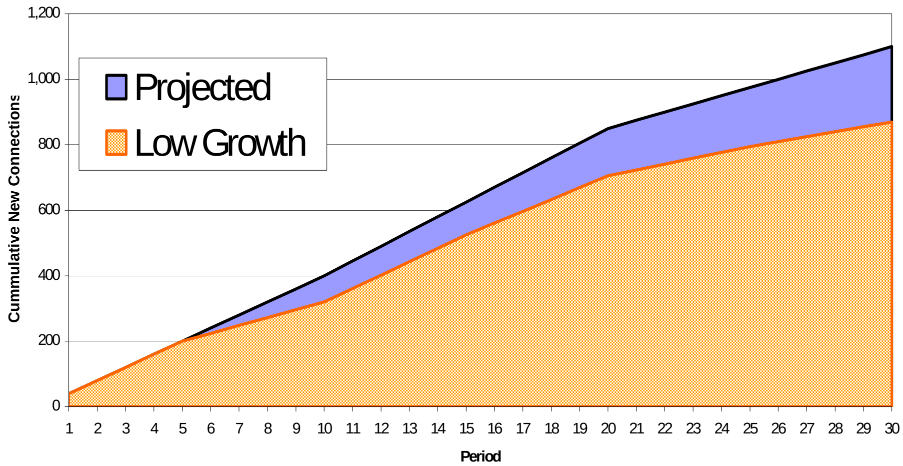


Figure 4-4: Base Growth Compared to Low Growth

Under this case, the assumptions about how the CWTS expansion plans are modified by the township as the lower-than-expected growth is realized are important to the financial outcome for the CWTS scenario. More specifically, as the township grows the CWTS would typically be expanded in anticipation of serving each neighborhood. The initial treatment plant expansion and collection system expansion is the same in both the base-case and low-growth scenario. In the low-growth scenario, it is assumed that some learning occurs as slower growth is observed. Therefore, the out-year expansion of the treatment plant is delayed and downsized, and collection system expansions are also somewhat delayed and downsized compared to the base-case scenario.

The results for the low-growth scenario from the homeowner perspective are shown in Table 4-6. The average annual payments change somewhat for the OWTS due to a slightly different mix in the two types of systems, mounds and OWNRS, but generally are at the same level as in the base-growth case. The average payments increase four to five percent, depending on ownership, over the base case.

Table 4-6: Homeowner Average Annual Payments, Low-Growth Scenario

	OWTS Resident-Owned	OWTS Township-Owned	CWTS Township-Owned
Annual Amount	$643	$706	$945

In the CWTS scenario, due to the need to anticipate growth and construct a system in advance under the CWTS approach, there is some underutilization of the system. The underutilization results in higher average annual costs for the smaller number of residents who meet debt obligations of a CWTS that has excess capacity. The increase in the average annual payments for the CWTS, about 12 percent, reflects the increased risks of financing a CWTS compared to the OWTS approach.

The second sensitivity case involves the influence inflation could have on the annual payments. A three percent annual inflation rate was used to depict the impact of inflation for the three alternatives; the resulting annual payments are shown in Table 4-7.

Table 4-7: Homeowner Average Annual Payments, Three Percent Inflation Scenario

	OWTS Resident-Owned	OWTS Township-Owned	CWTS Township-Owned
Annual Amount	$1,082	$1,198	$1,374

In conjunction with including inflation, it was also necessary to adjust the mortgage rate for inflation. Therefore, instead of using a four percent real mortgage rate as was done in the main study, a seven percent mortgage rate was used in this inflation sensitivity case.

Figure 4-5 shows the differences between the annual average payments for the non-inflation base case and the inflation case for each alternative. As illustrated, inflation does not change the relative ranking of the alternatives. Rather, Figure 4-5 shows that the differences between the non-inflation and inflation results are greater for the CWTS, and in general, greater for the higher-cost alternatives. Thus, with inflation, one can expect the benefits to be greater for the OWTS Resident-Owned alternative.

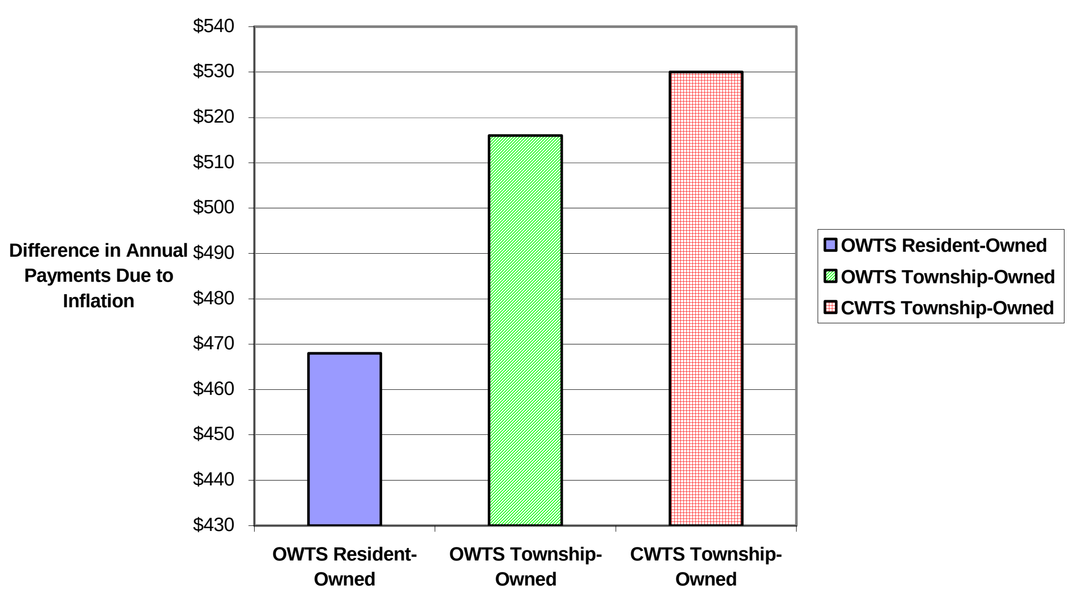


Figure 4-5: Impact of Inflation On Annual Payments

The third sensitivity case involved looking at the difference between the township's cost of borrowing and a homeowner's cost of borrowing, or mortgage rate. Since a change in the mortgage rate would not influence the OWTS Township-Owned alternative because there is no mortgage component for that alternative, only the OWTS Resident-Owned and the CWTS alternatives are included in this case. An additional 1.5 percent was added to the mortgage rate for this sensitivity case to evaluate the influence the mortgage rate has on the results. This makes the spread between the township's borrowing rate and the homeowner mortgage rate 2.5 percent (adding 1.5 percent to the one percent difference in borrowing costs used in the main study). Because there are a variety of mortgages available to homeowners that include fixed and adjustable rates, with different terms and rates, a 2.5 percent difference in borrowing costs was assumed sufficient for reflecting the potential influence the cost of borrowing could have on the results.

Table 4-8 shows the annual payments that would result under the higher mortgage rate for homeowners. Note that the increase in the average annual payment is different under each alternative, with the OWTS payments increasing by $50 per year (to $664 from $614; or an 8.1 percent increase) and the CWTS payments increasing by $75 per year (to $919 from $844; or an 8.9 percent increase). This difference occurs because the average capital cost per connection is slightly higher for the CWTS.

Table 4-8: Homeowner Average Annual Payments, High Mortgage Rate Scenario

Mortgage Rate Spread Above Township Borrowing Rate	OWTS Resident-Owned	CWTS Township-Owned
High Case, 2.5%	$664	$919
Base Case, 1%	$614	$844

Summary

Smallside, a hypothetical township with a wastewater service area of 500 homes initially, and growing to 1,600 homes over 30 years, was the focus of this analysis. An extension period of 30 years was added in order to reflect the lifecycle costs of all systems built in the first 30-year period, thus allowing a comparison over a period (60 years) in which the specified wastewater technologies could be fully implemented and financed.

The financial evaluation of decentralized and centralized wastewater treatment alternatives made in this study consisted of comparing the financing characteristics of the two wastewater system architectures. To isolate these differences, the capital, O&M, and management and administration costs over the 60-year analysis period for the two approaches in the hypothetical community of Smallside were made equivalent prior to including financing costs. The decentralized approach consisted of two types of onsite treatment systems, the mound and OWNRS. Since the two onsite systems have different costs, a combination of the two was developed so that the net present value of costs for the decentralized system (OWTS) were approximately the same over a 60-year period as the costs of a centralized system (CWTS) serving the same number of connections.

With the capital, O&M, and management costs of each wastewater option the same on a present value basis, a cash flow projection was developed to estimate the financing costs for each approach across the 60-year analysis period. Key financing aspects modeled in the cash flow projections included debt financing and service rates (that is, user fees and impact fees).

In addition, two onsite scenarios were modeled: one involved ownership, operation, maintenance, and financing of the systems by the homeowner, and the other scenario involved ownership, operation, maintenance, and financing of the onsite systems by the township. Under both of these scenarios, the township would monitor the onsite systems to ensure environmental regulations were met. These two OWTS scenarios were compared with the CWTS scenario in which the township was assumed to own, operate, maintain, and finance the centralized system in a conventional manner. The total lifecycle costs including financing were compared on a present value basis for all of the 1,600 residential connections, and they were also compared on the basis of the average annual payment necessary per residential connection. In order to further evaluate the three alternatives, three sensitivity cases were established in which inflation, low growth, and an increased mortgage interest rate were modeled to evaluate whether the assumptions about these factors would influence the ranking of alternatives.

The results indicate that for this community—for which the costs of a decentralized system architecture (onsite systems) and a centralized systems architecture at first appear to be the same—the decentralized option costs less than the centralized system, once financing costs are taken into account. This is true regardless of whether the township or homeowners own the onsite systems. Between the two onsite-system scenarios, ownership by the homeowner resulted in a lower cost for all cases considered.

The point of the analysis has little to do with determining the exact capital, operations, maintenance, and management costs of onsite systems versus a centralized system for Smallside. The focus is on how differences in the general pattern of those expenses over time (up-front and periodic large-scale centralized investments versus frequent but incremental decentralized investments) affect financing and total costs.

This analysis shows that in real-world cases in which the costs addressed in a typical engineering analysis—capital, operations, maintenance, and management costs—are the same or very close for centralized and decentralized options, the decentralized option is likely to be less expensive on a total cost basis when financing is considered. A key factor leading to this result is lower debt-financing cost due to the incremental pattern of construction of decentralized systems.[6]

In some cases a decentralized option may at first appear more expensive in an engineering cost analysis. However, given the financial dynamics illustrated by this analysis—in particular, less

[6] While this study only looked at an all-onsite option as the decentralized option, to the extent that multiple cluster systems allow finer matching of capacity to demand than does a centralized alternative, a decentralized approach using cluster systems or a mix of cluster and onsite systems should enjoy some of the same financial advantages noted in this study.

need for debt and its attendant financing costs due to the incremental pattern of construction of decentralized systems—a decentralized option could be less expensive or equal in total cost when financing is considered. In addition, as the sensitivity cases show, a decentralized approach can be less risky under conditions such as slower-than-expected growth.

Recommendations

Based on this analysis, the following recommendations should be useful to wastewater facility planners:

- Remember that the application of a discount rate in an engineering analysis does not account for differences in financing costs between options.
- When the costs typically evaluated in an engineering analysis (capital, O&M, and management costs) of decentralized and centralized alternatives appear to be similar on a net present value basis, be sure to project and analyze the likely financing costs of each alternative. These financing costs should be included when final cost comparisons between the alternatives are made.
- Be sure to incorporate the proper interest rates for each option, key differences in the parameters of debt (issuance costs, operating and reserve margin requirements, and other differences), the effects of tax considerations (the deductibility of interest charges on wastewater system costs that are rolled into mortgages), and other financial factors.
- Include sensitivity testing of key assumptions as part of the analysis. In most cases, this does not need to be an elaborate and exhaustive analysis. Determine what the key assumptions are and modify them in basic ways. For growing communities, it is particularly important to test the impact on ratepayers of changes to the growth patterns assumed in the financial analysis.

Additional Points and Caveats

Several key assumptions and findings of the financial analysis are detailed in the following sections. These points may respond to some of the questions that a reader may have after reading the material presented in the previous section. Some of the points discuss how changing some assumptions would not markedly change the results. Some of the points also indicate ways in which some of the assumptions are conservative; that is, more precise assumptions would tend to accentuate the apparent financial advantages of frequent, small investments in capacity versus less frequent, larger investments. In some cases, more precise assumptions could reduce some of those advantages.

Regarding the Engineering Cost Analysis

In the engineering analysis for the two decentralized scenarios, the 500 existing onsite systems were assumed to be 480 mounds and 20 OWNRS. Using the same two types of systems as assumed for new systems simplified calculation of O&M costs. A more likely situation is that existing systems would be additional types, probably conventional septic/leach field systems with lower O&M costs.

In the decentralized scenarios, existing system replacements are 100 percent replacements. In reality, septic tanks and other components would in some cases be retained, reducing capital costs.

The two onsite scenarios assume there is no difference in total or component costs between resident-owned versus township-owned onsite systems. In reality, the township-owned approach might achieve savings through economies of scale in purchasing, installation, and O&M.

The simplifying assumptions noted above are, in fact, not germane to the point of the analysis. The entire exercise was designed to focus on differences in financing costs by equalizing the net present value of capital, operations, maintenance, and management costs. One could complicate the analysis to address these considerations, but the methodology for this study would still have been to equalize the net present value of costs considered in the engineering analysis. Complicating the analysis would not substantially change the result. This is because differences in the year-to-year the pattern of costs between centralized and decentralized systems would not change substantially.

The 30-year extension period was included mainly to capture the net present value of financing costs for 20- to 30-year financial obligations incurred through the initial 30-year growth period. O&M and management costs are also extended (years 31 to 60 at the same rates as year 30), but no renewal of substantial capital items is assumed during the extension period. In reality, various major components of both centralized and decentralized systems would be replaced in years 31 to 60. The analysis assumes that the net present value of those replacements would be equal for centralized and decentralized systems. However, replacement of minor components such as pumps, filters, and other components is included in the analysis, by incorporation into the annual O&M costs. Note that the 60-year analysis period makes the net present value of any capital replacement expenses in the extension period quite low. For example, with a three percent per year discount rate, $1,000 in year 30 is worth only $412 when discounted back to year 0, and $1,000 in year 60 is worth only $168 when discounted to year 0. Cost differences in the extension years would have to be truly substantial to significantly narrow the gap between the net present value of total costs (financing included) between the centralized and onsite options.

Two specific decentralized technologies were used for comparison with a centralized wastewater treatment system. The number of installations of each decentralized technology was chosen specifically to balance total construction and O&M costs so they equated to the total construction and O&M costs of the centralized system on a present value basis. Setting these costs equal on a present value basis enabled a “fair” comparison of financing costs in terms of the magnitude of interest charges and the timing of capital expenditures.

In reality, it is very unlikely that a community would experience the situation in which construction and O&M costs of the centralized and decentralized wastewater treatment options are equivalent on a present value basis. Thus, other engineering configurations and environmental and operational considerations could change the results. This study does not conclude that decentralized wastewater treatment technologies are generally more economic than centralized wastewater systems. Rather, it shows that when conventional engineering analysis costs are close between centralized and decentralized alternatives, decentralized systems could turn out to be cheaper once financing costs are considered. It also suggests that decentralized systems that at first appear to be somewhat more expensive could in fact be less expensive once financing is taken into account.

This study also shows that underutilization of a centralized system resulting from a reduction in projected growth can lead to significantly higher costs for customers. To the extent that a centralized system can be expanded in smaller increments than assumed in this analysis, risks can be mitigated and the financial advantages of a decentralized approach would be reduced.

Regarding the Financial Analysis

The project team generously assumed that in the centralized scenario new subdivisions (new sewer connections) are only built when the new lots are needed. This assumes that existing subdivisions are almost completely built out before new subdivisions are built and sewers are provided to those new subdivisions. In reality, new subdivisions would be built before existing subdivisions are nearly built out. This would exacerbate the mismatch in centralized systems between construction and actual demand, thereby increasing the advantage of decentralized systems in avoiding financing costs.

In both the base-case and slow-growth scenarios for a centralized approach, the team assumed that developers in the Easy Lake area have complete understanding of the market and are thus able to build only as many connections each year as are needed. In reality, even in this small of a development there would be some building ahead and some overshoot as growth slows. Again, accounting for more realistic knowledge of the market would accentuate the financing cost advantage of decentralized systems.

In the low-growth scenario, the team assumed the township would delay the wastewater treatment plant expansion. The team also assumed that expansion would be smaller because by year 18 the township has realized that build-out will not be as great as expected. These may or may not be generous assumptions depending on the planning capabilities and savvy of the community.

In the low-growth scenario, the team also assumed additional collection system connections are delayed somewhat. This scenario also assumed a reduction in the size (number of connections) of the increments of new sewer capacity, assuming developers will within a year or two recognize changes to the growth rate and will reduce risk by downsizing somewhat. Again, this may or may not be generous.

The financing costs of the centralized system were higher than financing costs for the decentralized system in this case study. The higher costs are a result of the high initial construction costs associated with the centralized system and the need for the utility to borrow money to build the centralized system. The interest charges associated with residents including the impact fee in their mortgages were included in the total costs for the centralized system. Similarly, interest charges associated with including the cost of onsite systems in home mortgages were included in the total costs of the decentralized system. Both technologies therefore include the assumption of a direct pass-through of the impact fee for the CWTS and the construction cost of the OWTS to the resident. In reality, in both cases the amount of the pass-through costs could be influenced by contractors and their desired profit margins, homeowner financial resources, and local and national economic conditions. It is also possible that there would not be an impact fee, and that all construction costs would be recovered through monthly user charges. This case was not considered in the analysis, but could result in lower financing charges for the centralized system.

The impact fee for the CWTS was calculated for the entire 30-year growth period to simplify calculations. Typically only seven to ten years of capital expenses are used and the fee is updated periodically as needed based on an estimate of future capital expenditures.

Using a shorter period for calculating impact fees may increase the impact fees in the early years during which the highest construction costs are incurred, thereby increasing the financing costs of the centralized system.

Annual user fees were calculated to meet annual revenue requirements, including debt service coverage and operating reserves. No attempts were made to smooth rates to avoid annual increases and decreases due to cash flow variations. This should have no significant influence on the ranking of alternatives.

Inflation was omitted from the base case, and considered in a sensitivity case. The main influence of inflation in the sensitivity case is on the annual level of fees, and on mortgage rates. It does not influence the ranking of alternatives from lowest to highest cost unless specific reasons are found to inflate some components of the alternatives at different rates than other components. For example, the annual inspection and maintenance costs of the decentralized systems might increase more rapidly than the maintenance costs of the centralized system, thereby creating a reason to include inflation rates that differ for the different cost components of each technology. A sensitivity analysis on separate cost components of the technologies was not part of the scope of the financial analysis.

The financing costs were based on township debt being financed over 20 years and all residential mortgages having 30-year terms. In addition, the average residential mortgage interest rate was set one percent higher than the township's interest rate on debt. There are various factors that could affect these interest rates, either increasing or decreasing the difference, such as credit ratings and national interest rates. One sensitivity case was developed to demonstrate the influence the difference between the township's cost of debt and the average residential mortgage interest rate has on the results, and it included the same 20- and 30-year terms as the base case. This resulted in slightly higher total present value costs for the centralized system due to the up-front capital construction costs that would be financed at a higher rate through impact fees assumed to be included in residential mortgages.

5 SYNTHESIS AND CONCLUSIONS

The case studies in this report describe eight stories of communities working hard to make choices about wastewater infrastructure. Each community addressed one or more of the seven focal topics of this research, as shown in Table 5-1. Some communities achieved broad support for their chosen approaches. Others did not. Some are still struggling to determine what wastewater system architecture suits them best. Together, these case studies offer a rich repository of community experiences. Other communities can learn from the successes and mistakes of these communities.

Table 5-1: Topical Coverage of the Case Study Communities

Topics: / Community	Incremental Capacity Provision	Growth, Development, and Autonomy	Fairness and Equity	Performance and Reliability	Stakeholder Relationships and Trust	Hydrologic Impacts	Value to Large Utilities
Mobile, AL							6-12
Paradise, CA	7-12	7-16	7-25	7-20	7-29		
Charlotte County, FL	8-24	8-33	8-30	8-16	8-39		
Johnson County, KS		9-9		9-15			
Metropolitan Boston, MA						10-6	
Lake Elmo, MN		11-24	11-34	11-15	11-38		
Broad Top/Coaldale, PA					12-10		
Washington Island, WI	13-11	13-21	13-26	13-15	13-30		
Smallside, USA	4-1						

The following sections summarize the lessons learned from each community with regard to the seven research topics. Each section lists the case studies that address the topic, then briefly compares the communities and summarizes how the topic came up in each. Then a synthesis of the lessons revealed by each group of case studies is presented in the form of recommendations to other communities.

Incremental Capacity Provision

Communities:

- Paradise, CA
- Charlotte County, FL
- Washington Island, WI
- Smallside, USA

These case studies address community impacts resulting from the size and timing of investments in wastewater system capacity. In general, decentralized systems allow finer matching of total infrastructure capacity to total demand over time. These case studies corroborate observations of many wastewater experts that facility plans often fail to consider the differences between centralized and decentralized systems in this respect.

In Paradise, California, planners failed to look at targeting decentralized systems at specific trouble spots as an alternative to a sewer plan for the entire commercial district. A huge citizen revolt against the plan ensued. A similar pattern occurred in Charlotte County, Florida over an even larger sewer proposal. In both communities, replacing onsite systems over time (as they failed, for instance) and building capacity for new growth incrementally with decentralized systems probably could have reduced costs and certainly would have prompted less controversy than a very large sewering scheme.

On Washington Island, Wisconsin, an initial consultant did not pay much attention to project phasing. A second consultant who specialized in decentralized systems outlined the financial advantages of incremental decentralized system investments versus large up-front centralized system investments. He also noted that the incremental approach would enable the community to adopt improved technologies as they become available over time.

The analysis of the hypothetical community of Smallside, USA clarified the potential financial advantages of using decentralized systems to match capacity to need. The example was structured to equalize the net present value of costs conventionally evaluated in an engineering study—capital, O&M, and management. A cash-flow projection estimated the difference in financing costs between centralized and decentralized options for the example. The advantage for a decentralized approach in terms of *total costs*—capital, O&M, management, *and financing*—were significant from both a net present value and an annual payment requirements perspective. Further, the decentralized approach presented less risk associated with population growth unpredictability.

While the Lake Elmo, Minnesota case study did not directly address incremental capacity provision, it raises some points that are pertinent here. The town’s adopted policy of using cluster systems and rejecting regional sewer results in capacity being provided only as each development is built. However, its refusal to accept urbanization and regional sewer service, according to the Metropolitan Council, would result in increased sewer and other infrastructure costs to other communities. This could include changes in the timing, placement, and sizing of sewer infrastructure outside of Lake Elmo. A community's choices can have a substantial impact on how infrastructure is provided in other communities.

Some lessons from these communities are:

- ***Focus infrastructure investments:*** In Charlotte County, widespread sewering was indefensible except under very optimistic population growth projections, and it was not always defensible on that basis—build-out percentages were too low within the planning period to justify sewering. The sewer plan proposed too much infrastructure too soon. The resulting high costs created substantial citizen outrage and distrust. Focusing smaller investments based on a proactive growth-management policy would have made more sense, and that is essentially what eventually happened when the county adopted a sewer "mini-expansion" program.
- ***Recognize that conventional engineering often emphasizes "staying ahead of the growth curve":*** While the cost of carrying underutilized capacity is recognized, and typically dealt with by a phasing plan, an engineer's goal is often—though not stated—to avoid the risk of building too little capacity, resulting in expensive capacity increases at a later date. If sewers are to be installed, it is prudent to design them for full build-out because the life of pipe in the ground is very long and the added cost of increasing their capacity is small compared to increasing that capacity later. But build-out may be a half-century or more in the future. Thus constructing for build-out can lead to long periods of over-capacity in certain portions of the infrastructure. If too much over-capacity is planned, project expense mounts and citizen revolts may occur, as Charlotte County's experience shows. What is needed in many communities is an approach to infrastructure that allows a more incremental approach to capacity. Decentralized systems offer "just-in-time" capacity, whereas the capacity of a sewer line cannot be phased once a decision to install it has been made. So decisions must be made as to a) where sewers are appropriate in the long-term, which is a community character issue, and b) in sewer-appropriate areas, the timing of replacement of onsite and cluster systems by a sewer, which is a cost-optimization issue. Both require close coordination between engineers, planners, developers, and elected officials, to appropriately select the type of service and to stage growth across sub-areas of the service area.
- ***Consider demand management as one approach to capacity provision:*** Retrofits and new installations of water-efficient fixtures, appliances, and commercial equipment reduce infrastructure capacity requirements. Increased water use efficiency is known to extend the life of wastewater soil absorption fields and to help defer, downsize, or avoid altogether proposed expansions of centralized wastewater treatment plants. Increased efficiency is perhaps the most finely incremental approach to capacity. Suites of efficiency measures can provide small to large increments of freed or avoided capacity.
- ***Realize that a single solution may be no solution:*** Be willing to accept that incremental improvement is better than proposing a system that is too big to be accepted by the public. Paradise could have designed onsite and cluster solutions to address some capacity

constraints in the commercial district, even if not all of the constraints could have been addressed this way.

- ***Include financing considerations in the facility planning process:*** Wastewater facility planners often suggest where funds might come from. Engineering economics addresses the time value of money for capital, O&M, and sometimes management costs. But too few facility planners examine how the distribution of costs over time affects the amount of interest and other financing costs a community will pay. Large upfront costs are difficult for a community because they generate large financing costs. The Smallside analysis showed how debt service costs paid by a municipality for a large capital investment and by homeowners (by financing of impact fees through a home mortgage) increased total costs relative to a decentralized option. Wastewater options that spread investments over time lower the net present value of financing costs, reduce the size of principal payments, and are more likely to be acceptable to communities.
- ***Be aware that a finely phased approach may have higher transaction costs:*** For instance, the total amount of financing fees (financing costs other than interest) may increase as the number of borrowing transactions increases. Moreover, some funding agencies may dislike the increased paperwork and other transaction costs of a larger number of smaller projects, phased over time, compared to a single large loan and project. Advocates of decentralized systems are searching for ways to address this problem and other transaction cost obstacles.
- ***Be aware of economic dynamics that can undermine the financial viability of a large-scale system****:* On Washington Island, the first plan did not account for a dynamic identified in the second plan: high operational costs for a scheme that involved trucking holding tank wastes to a centralized treatment facility, which would create incentives for users to replace holding tanks with onsite systems (due to their lower operational costs), thereby undermining the customer base for the proposed central treatment plant.
- ***In a time of change and flux, consider the financial risk reduction value of a more finely phased solution:*** In the case of Paradise, a bit more foresight might have anticipated useful improvements in onsite technologies or identified how cluster systems could help address the town's growing need for water reuse. A decentralized approach, which the town adopted when the sewer plan was rejected, allows adaptation to new technologies and changing conditions. This reduces the financial risk of foregoing cheaper or more appropriate technology choices in the future. On Washington Island, going with a decentralized approach allowed the community to later adopt, because of new regulations, a centralized system sized just for the winter-time holding tank waste stream—a much smaller and less costly system than the original centralized treatment proposal. The Smallside case shows how a decentralized approach carries less financial risk should service area growth turn out to be less than projected.
- ***After implementing a plan, keep an eye on the future, but do not act prematurely:*** For instance, as Washington Island continues to develop, field spreading of summertime wastes from remaining holding tanks may become problematic. Some islanders are calling for construction of additional units of centralized treatment capacity. However, high costs may prompt more holding tank owners to adopt onsite treatment systems, which could make new centralized capacity unnecessary. The key is to identify the future point at which certain decisions must be made, and beyond which certain options will no longer be available.

Community Growth, Development, and Autonomy

Communities:

- Paradise, CA
- Charlotte County, FL
- Johnson County, KS
- Lake Elmo, MN
- Washington Island, WI

The impact of wastewater infrastructure in promoting or directing growth is a key issue in many communities, but how these concerns influence wastewater system decision making is not well understood. Arguments are often made for and against both sewers and onsite/cluster systems, with proponents and opponents arguing that one or the other increases growth and encourages sprawl. Centralization or regionalization of wastewater systems may offer cost savings to communities or be resisted as a loss of local autonomy.

In Paradise, California many citizens objected to increased growth and changes in community character (such as more apartment buildings and strip center development) that they believed a centralized sewer system would bring. Washington Island, Wisconsin residents feared that a centralized treatment system, because of its expense, would force the island to accept more development to pay for the system's cost.

A plan for widespread sewering in Charlotte County, Florida offered little growth-management leverage to the county. When the plan failed, the county was able develop a comprehensive suite of tools designed to direct high-density growth to certain areas and reduce density or improve onsite treatment in others. The tools included policies on sewer extensions, requirements for advanced onsite systems for certain lots in unsewered areas, land acquisition programs, lot swaps, and a number of other general planning tools.

The stories of Johnson County, Kansas and Lake Elmo, Minnesota reveal the sometimes complicated interplay between wastewater system choices and growth-related policies in rapidly urbanizing areas. In Johnson County, a proposal to allow cluster systems was initially investigated to determine if such systems would ease the transition to sewer service once regional sewers were extended. Because of county policies regarding provision of other services (roads, fire protection, schools, and other services.) and differences between county and city tax policies, the county eventually decided to not allow cluster systems and stuck with its policies for dry sewers and early annexation by local cities. In Lake Elmo, the community developed a cluster approach to development, with each development served by a cluster wastewater system. This approach helps the community maintain its rural character. However, the Metropolitan

Council, which coordinates planning across the Twin Cities region, objects to Lake Elmo's land use plan.

It says cluster development cannot accommodate Lake Elmo's share of regional growth, and it demands that the city utilize a regional sewer service as the agency had planned for Lake Elmo. The two parties are still locked in a legal battle.

These experiences suggest the following recommendations for other communities:

- ***Recognize the relationship of system architecture to growth:*** Centralized sewer systems create the opportunity for increased growth and may even require growth to pay back system costs. Conversely, land-use plans calling for high-density development, as in the Metropolitan Council's plans for Lake Elmo, require sewers to support such growth. Citizens recognize these relationships and will turn down sewer proposals they see as incompatible with their vision for the community.
- ***Address land-use planning before wastewater planning:*** Shape wastewater system architecture around land-use decisions. If growth issues have not been adequately addressed in previous general planning processes, they will inevitably come up in the facility planning process. The Paradise, Charlotte County, and Washington Island stories show how growth and community character concerns contributed to rejection of central sewer plans in which large expenditures on planning and design had already been made. It may in some instances be possible to address general planning concerns simultaneously with the facility planning process—Washington Island did so successfully in its second attempt at wastewater system planning—but this is probably the exception rather than the norm. Washington Island residents did not have widely divergent visions for the future of the community.
- ***Work with consultants to critically evaluate assumptions:*** In the Charlotte County Water and Sewer Master Plan, consultants made two mistakes regarding growth. First, they took full build-out of all platted lots in the county as a given. This was not the direction the community needed to go—full build-out at platted densities would have generated unsupportable demands on other infrastructure and services. A good consultant can help a community ask the right questions. For example, is there a widely supported community vision in place? If not, are the full implications of implicit growth assumptions realized?
- ***Get the growth projections right:*** The second major mistake of the Charlotte County master plan consultants was to base their small-area population projections on a faulty methodology. Extrapolation of change over a recent high-growth period was not sound, and summation of optimistic small-area forecasts across a large area yielded large-area figures that were much higher than other available population projections. Beware of this "fallacy of composition." In cases where acceptable large-area forecasts are available, take great care in the allocation of growth projections to sub-areas. Facility planners in Paradise probably made a mistake in not finely tuning capacity allocations; owners of properties with little development potential objected when they were asked to pay the same amount as owners of same-sized parcels located in prime development areas.
- ***Use infrastructure policy carefully as a growth management tool:*** "Zoning by septic" alone, as is done by many communities unwilling to directly face growth issues, should be avoided because it is a blunt and often ineffective instrument. But using onsite wastewater policy in

the context of a comprehensive approach to growth may be quite appropriate. Charlotte County's policy to reduce the density of septic systems or require advanced systems makes sense considering the small size of platted lots in the county, and because this policy works in tandem with other policies designed to attract higher-density development to areas served by sewer. Interestingly, the frequently heard canard of opponents of advanced onsite systems—that they "are bad because they enable growth anywhere"—was irrelevant in Charlotte County because existing septic policies and historic land development practices already allowed high-density residential growth almost anywhere. As noted previously, the best method is to develop a broadly supported vision of the community's future and couple that with appropriate zoning and other non-wastewater growth-management tools before planning wastewater facilities.

Fairness and Equity

Communities:

- Paradise, CA
- Charlotte County, FL
- Lake Elmo, MN
- Washington Island, WI

Different wastewater system architectures distribute costs in different ways. In general, centralization spreads costs while decentralization focuses costs on individual or clustered wastewater system customers, each according to the specific situation.

In Paradise, California, centralization, including a multi-million-dollar design study, was expensive and raised questions about how benefits and costs would be spread across a large and diverse service area. Fairness in cost allocation, particularly for the design study assessment district, was a topic of considerable concern and uncertainty. It is interesting that the town now sees placing costs directly on failing systems or those with high-capacity needs as one of the advantages of cluster systems.

Washington Island, Wisconsin chose a decentralized approach in part because it matched residents' ethic of individual responsibility. Islanders with onsite systems would pay for their own upgrades if necessary, while those on holding tanks would pay user fees for community treatment (field spreading) sites. This approach enabled the town to avoid equity issues arising from the diversity of treatment needs among property owners. Serving holding tank users had been the impetus for a centralized treatment system proposal, and the financial viability of that system had demanded that costs be spread across all property owners.

Concerns about the fairness and affordability of paying twice—once for onsite systems and then again for a proposed sewer system—came up in several case studies. When Charlotte County, Florida developed a plan for widespread sewering, many citizens protested the idea of paying for a sewer when their septic systems, most believed, worked just fine. Charlotte County's demographics heightened affordability and fairness issues. Retirees felt their fixed incomes could not support the cost of sewers, and many feared that appreciation of their low-priced homes would not recover the high cost of a sewer connection in a timely fashion.

The Lake Elmo, Minnesota case study shows that equity issues can also arise at the inter-community, regional scale. Regional equity and regional versus local control have been polarizing topics for Lake Elmo, neighboring communities, and the Metropolitan Council (the regional planning agency and regional wastewater service provider). Lake Elmo's decision to limit urbanization and not utilize regional sewer service (it plans to use cluster systems instead) may increase infrastructure and other costs across the region and place an unfair burden on other communities. The Metropolitan Council argues that Lake Elmo has long been identified as a location for urban growth, and that Lake Elmo is receiving regional benefits but is unwilling to accept increased development in return. An administrative law judge has ruled that Lake Elmo's plan "may have a substantial impact on or contains a substantial departure from metropolitan system plans," including a plan for regional wastewater service to Lake Elmo. The city may have to accept regional sewers. It has appealed the council's decision to the state supreme court.

These cases suggest the following lessons for other communities to consider:

- ***Remember both the benefit and the liability that big systems create by distributing costs:*** Big systems are often promoted as achieving economies of scale. But they also often raise equity issues in how benefits and costs are spread.
- ***Take care in distributing the costs of system design:*** The Paradise case shows that equity issues may come up not just in relation to construction costs, but also in connection to large costs necessary to design large systems. The scheme the city developed to allocate the costs of the $4 million Wastewater Design Assessment District caused a community furor. Among many concerns, residents who would remain on onsite systems objected to being assessed for costs of sewer design.
- ***Determine whether your community is fundamentally guided by a user-pays or a cost-sharing ethic:*** User-pays refers to, for instance, fee structures or architecture choices that place the costs of specific systems or services on the specific households or businesses using them. Cost-sharing refers to rate structures or architecture choices that spread costs of multiple systems or services across a geographic area. The philosophical difference between these approaches is central to development of financing schemes that will be supported by the community. More fundamentally, knowing the community's tendency in this regard may help determine what type of architecture is most appropriate, as happened on Washington Island when a strong user-pays ethic contributed to selection of a decentralized approach. Note, however, that adopting a user-pays approach should not be used as a way to avoid management. Proper oversight of decentralized systems is still required to ensure proper performance and guard against system failures. Otherwise, compliant system owners may ultimately be penalized because their neighbors fail to maintain their systems, resulting in problems that lead to the installation of sewers.
- ***When adopting a user-pays scheme, address financial hardships it may create for some users:*** Even if most people in a community support a user-pays ethic, not all persons will

agree with this approach, and some may face financial hardships because of it. Develop ways to mitigate those hardships, and be sure to follow-through on promises to do so. Interviewees for the Washington Island case study said the community could have done a better job in finding financial assistance for low-income residents who needed to upgrade their onsite systems.

- ***When adopting a cost-sharing scheme, explain carefully why it is appropriate:*** Not everyone will agree that they should share in the costs of a wastewater system. In Paradise, some city officials now say the city could have done a better job of explaining how a proposed sewer system would benefit all residents. Many residents considered the plan a gift to developers, focused as it was on sewering the commercial district. Many did not see other benefits, both subtle and general: an increased tax base, improved water quality, and more shopping opportunities. (A decentralized approach would have generated some of these benefits too, but could not have supported the same amount of commercial development.)
- ***In addition to intra-community equity, carefully consider the inter-community or regional equity implications of wastewater systems:*** In the Lake Elmo case, the regional planning agency believes that in rejecting regional plans for its urbanization and rejecting additional regional sewer service, Lake Elmo is shifting costs of growth to other communities. The agency also claims that the community's rural lifestyle is being subsidized by other metro-area communities that disproportionately fund roads, parks, schools, sewers, and other services that benefit Lake Elmo. In Johnson County, Kansas, staff members were concerned that allowing cluster wastewater systems to serve developments in the unincorporated areas would prompt sentiments that city residents subsidize schools, roads, and other services and facilities for rural residents. In addition, the O&M costs for the proposed county-run wastewater systems were higher than the rates paid to the county wastewater utility by sewered residents, raising another subsidy issue.

Performance and Reliability

Communities:

- Paradise, CA
- Charlotte County, FL
- Johnson County, KS
- Lake Elmo, MN
- Washington Island, WI

Performance refers to required or desired capabilities of wastewater treatment systems: a level of nutrient removal, pathogen neutralization, and other capabilities. Reliability is the rate or probability over time of achieving a specified performance level.

Five communities in this study showed some commonalities and a number of differences in how they assessed and addressed wastewater system performance needs and regulated and managed systems to ensure reliability. Some of the cases address sewer reliability as well as treatment system performance and reliability.

In two communities—Paradise, California and Charlotte County, Florida—perceived environmental and public health risks from onsite systems were a key justification for major sewering proposals. On Washington Island, Wisconsin, similar concerns led to a centralization proposal, though in this case wastewater was to be conveyed to a central treatment plant by holding-tank pumper trucks rather than sewers.

In Paradise, numerous water quality studies and reviews of onsite system failures were inconclusive about the threat posed by onsite systems, but nonetheless wastewater system planners used them to justify sewering. In the wastewater needs analysis, application of a hydraulic loading regulation that was a surrogate for nitrogen loading was conceptually flawed. This approach led to dismissal of decentralized options. The potential benefits of water conservation and improved onsite management to reduce failures in the commercial district were outlined, but were not rigorously evaluated. After the sewer proposal was rejected, an onsite wastewater management zone (originally planned to cover only residential areas) became the regulatory means to address performance and reliability town-wide. The zone has a variety of regulations and oversight practices designed to ensure adequate performance and reliability of onsite and cluster systems. However, some critics believe zone policies are aimed more at allowing growth than protecting public health.

A wastewater master plan was developed for Charlotte County, Florida with the aim of eliminating most septic systems on the grounds that they were public and environmental health risks. Opponents of the resulting sewer plan, which did not address maintenance of existing sewers, believed leaking sewers were as great a problem. (This is known as “exfiltration,” as opposed to the opposite and better-known phenomenon of infiltration. Some wastewater experts believe that contamination of groundwater by sewer exfiltration should be considered a problem that is as serious as contamination from septic systems.) Both pro- and anti-sewer proponents used largely anecdotal evidence of failures. When the sewer plan was rejected by the public, officials began to view onsite wastewater systems as permanent—not temporary— in many areas. This required new approaches to ensure adequate performance and reliability. The health department conducted a surface water sampling program to document contamination. The county developed an ordinance that reduced the density of new septic systems or required increased performance through installation of aerobic treatment units (ATUs) under certain conditions. Some parties, however, question the reliability of ATUs, and say the emphasis should be on finding and fixing failing septic systems. After a much-delayed study, the county will soon develop a septic system inspection and maintenance program. A water-quality monitoring program designed to identify areas where wastewater systems are inadequate will begin soon.

On Washington Island, Wisconsin environmental and public health risks from onsite systems were a key justification for the centralization proposal. However, centralized discharge of treated wastewater raised a different performance issue: no suitable disposal point could be identified for treated effluent. Lack of adequate state regulation of advanced onsite systems precluded their inclusion in the initial consultant's discussion of alternatives. The town conducted a demonstration project to prove adequate technology existed. A second consultant developed a wastewater facilities plan based on the demonstrated technology and a public management program. Citizens eventually accepted public oversight of private onsite systems as a necessary and practical solution. The utility district has implemented a database tracking system to ensure that systems are properly maintained, holding tank wastes reach intended field spreading sites, and spreading sites are not overburdened.

In Johnson County, Kansas reliability was a key factor in the evaluation of wastewater collection and treatment technologies for a proposed cluster-system policy. County commissioners had shown reluctance to use low-pressure sewers (LPS), believing them unreliable. Johnson County Wastewater staff believed gravity sewers had lower maintenance requirements, and staff did not like having to access private property for LPS pump replacements or other repairs and maintenance. Thus, the wastewater task force selected gravity sewer systems early in the decision process. However, gravity sewers raised other reliability issues. Most notably, concerns about the ability of community treatment systems to withstand high rates of infiltration and inflow (I/I) to gravity sewers resulted in system designs with excess capacity and additional I/I reduction measures. This raised system costs somewhat. More importantly, because of the unpredictability of gravity sewer I/I, conservative design could not eliminate the potential for failures from system overload. For this reason and certain land-use planning concerns, county staff recommended against the proposed policy. Some outside reviewers of this case study have questioned the basis of Johnson County's preference for gravity sewers. They say county staff may not have gathered enough information about the reliability of LPS systems.

In Minnesota, cluster-scale engineered wetland treatment systems were new to both the City of Lake Elmo and the state. The city needed to address performance and reliability concerns before approving their use under an experimental state permit. Lake Elmo officials set performance standards and required that operation and maintenance plans be prepared for each system. Homeowners associations (HOAs) were charged with operation and maintenance, the idea being that HOAs would have a vested interest in system reliability. Application of the performance, O&M, and water monitoring standards has evolved as the city, state, and system operators have gained experience with these systems. Some lapses in HOA management and city oversight occurred. The city has improved its oversight of HOAs, but may opt for municipal ownership and management of cluster wastewater systems in the future. The city has also adopted more stringent septic system requirements than state law, and it has developed a system tracking database, in part because it wishes to remain rural and has rejected regional sewer service.

Based on these case studies, some recommendations regarding performance and reliability of wastewater systems are:

- ***Carefully and clearly define the problem****:* For instance, consider carefully whether existing onsite systems are really an environmental or health threat, and whether any risks are due to particular technologies or reflect a lack of adequate management. Also consider whether a problem, once clearly defined, is serious enough to warrant big expenditures. Paradise and Charlotte County pursued expensive systems based on inconclusive data about the risks of existing onsite systems, and without adequate consideration of improved management. Pursuing higher performance goals and basing a multi-million dollar investment on inconclusive studies is risky at best. At the same time, this recommendation must be tempered by the realization that conclusive linkage of water quality findings to suspected sources is difficult. A “weight of evidence” approach may be required, but it must be carefully and fairly explained.

- ***Consider onsite or cluster system management carefully before rushing to a centralized solution:*** In Paradise this was not done for the commercial area. Because of the momentum toward a centralized sewer, the town overlooked what now seems an obvious step: detailed consideration of whether onsite system failures were unavoidable or simply a result of poor O&M practices.
- ***Be sure that the needs analysis is sound:*** Poor concepts bias results, especially when the concepts support a direction that has official backing. In the Paradise studies, the hydraulic loading rate approach to service area delineation was flawed. This fact was likely overlooked because town leaders clearly wanted a sewer system.
- ***Strive for a holistic approach to water quality issues:*** Wastewater is rarely the only anthropogenic nutrient or pathogen source in a watershed. Ultimately the most cost-effective approach to pollutant reduction is a risk-based approach that encompasses all pollutant sources. Failure to integrate policies and solutions across sources leaves one open to the charge that money and effort are being unwisely or unnecessarily spent in the wrong place.
- ***Consider flexible regulatory structures:*** The high costs created by strict wastewater effluent standards in some states or sub-state regions have led to calls for relaxation of standards in specific locales that pose less risk. Depending on the situation, regulatory models such as nutrient trading schemes and geographically variable standards may be appropriate. This of course will likely require flexibility beyond the local/regional scale; for instance, on the part of state regulatory agencies.
- ***Strive to reach a consensus on performance and reliability issues that reaches across political lines:*** This becomes especially important when implementing an innovative or alternative solution. Broad political support is necessary to allow time to try out the technology. Lake Elmo initially developed this support through an 18-month building moratorium to prepare a cluster development ordinance and regulations for cluster wastewater systems. Providing management to ensure that operation and maintenance achieves a level of service that residents would receive with centralized sewerage can help to gain support. Lake Elmo ran into problems by not maintaining strong oversight of homeowner association O&M of wetlands treatment systems. Some minor system failures indicated the need for the city to do a better job of checking whether proper O&M was occurring.
- ***Realize that decentralized wastewater systems, properly designed and managed, are potentially permanent systems, even within the urban fringe:*** Thus management systems should be put in place to ensure that treatment systems provide adequate performance and are operated and maintained in a manner that ensures reliability and longevity. Charlotte County, Florida realized this, and is developing policies and programs to address concerns over nutrient and pathogen loading as a result of high densities of onsite systems and to reduce system failures.

- ***Thoroughly address performance and reliability concerns around decentralized systems:*** Many communities and many engineers do not understand the potential of decentralized systems, or their limitations. Find qualified experts to help the community understand technologies and their requirements. Lake Elmo could have used many different treatment technologies to serve cluster developments. It chose wetlands treatment because this technology offered low operating costs and compatible aesthetics with open-space preservation, and because an engineering firm thoroughly familiar with the technology was nearby. This firm has helped the city understand the performance of the systems and the necessity of proper O&M to ensure reliability.
- ***Consider whether cluster development served by cluster-scale wastewater systems could help the community meet performance and reliability goals:*** Clustering treatment can allow a community to cost-effectively add additional treatment technologies and thereby achieve higher performance levels than with individual septic systems. Cluster systems also reduce the transaction costs of management by reducing the number of treatment systems a municipality or other entity must track and manage.
- ***Consider how an incremental decentralized capacity approach can help address performance and reliability:*** The second facility planning consultant for Washington Island noted in the facility plan that the decentralized approach would allow the most current technologies to be adopted as onsite systems were upgraded over time, while a centralized approach would lock the entire community into a specific technology for a long period. Moreover, a decentralized approach allows continual improvements in management practices as the community or management entity gains experience. In the case of Paradise, a decentralized approach could take advantage of improvements in the nitrogen-reducing capabilities of decentralized technologies, making them more attractive options for solving the town's wastewater capacity issues.
- ***Consider the implications of system failures:*** An advantage of decentralized facilities is that each individual system (onsite or cluster) poses much reduced risks when compared to a centralized facility. When problems occur, they are limited in scope, typically easy and inexpensive to repair, and any direct discharges are small and do not create significant health problems or environmental harm. Assuming proper management, multiple decentralized systems may present reduced overall risks compared to a centralized system for the same service area.
- ***Ensure accountability, both financial and environmental:*** Consider and define how system failures will be addressed if they occur. If choosing to employ a decentralized architecture as Lake Elmo did, rather than to access regional infrastructure, accountability to regional and state authorities may be required. Likewise, accountability within the municipality should be articulated clearly. If HOAs are responsible for O&M, then financial and environmental assurances should be secured from them as well.
- ***Develop the necessary information infrastructure to ensure proper management:*** Washington Island has contracted for a database system that will assist the town in ensuring proper management of both onsite systems and field spreading sites. Lake Elmo developed its own system to track inspections and remind residents of septic tank pumping requirements.

- ***Educate homeowners about the importance of proper practices in the use of wastewater treatment systems:*** Alert homeowners to their own financial and environmental interests in doing their part to maintain the health of a system by not overloading it or disposing wastes that can harm it. This is particularly important if a cluster wastewater system is marketed as "having sewer service," as some have been in Lake Elmo and in Mobile, Alabama. Cluster systems in many ways seem to users like centralized sewerage systems, but require somewhat more user care.

Stakeholder Relationships and Trust

Communities:

- Paradise, CA
- Charlotte County, FL
- Lake Elmo, MN
- Broad Top and Coaldale, PA
- Washington Island, WI

These five case studies clearly indicate the importance of open and meticulous public processes in wastewater infrastructure decisions. First, some cases show what not to do and reveal the costs of losing trust between stakeholders.

For instance, in Paradise, California inadequate attention to trust-building appears to have occurred throughout the facility planning process. A lack of clarity on the need for replacing septic systems with a centralized system created confusion and suspicion about the agenda of town leaders. A town council vote to proceed with a sewer design assessment occurred without substantial public participation. Citizen committees were used in ways that gave an impression that the sewer planners had already decided what was important and that they were not interested in citizens' views. Information became politicized by pro- and anti-sewer forces.

The situation was much the same in Charlotte County, Florida. The county failed to adequately engage the public when planning a massive sewer system expansion. Its consultants appeared arrogant to citizens, and when they announced the per-household cost, the public was shocked. Tensions were exacerbated by water and wastewater rate increases after a public takeover of a private utility. Public hearings became shouting matches.

The results were similar in both communities. A number of elected officials were ousted and sewer plans were discarded. Charlotte County officials eventually regained substantial public trust. In Paradise, the situation has calmed, but some mistrust of public officials lingers to this day, including mistrust over the policies and actions of an onsite wastewater management zone.

Historically, sewering has been a divisive issue within Lake Elmo, Minnesota. Landowners in the past successfully sought annexation by another city in part because Lake Elmo officials refused to address their request for sewer service. More recently, sewer plans have strained relations between the city and a regional planning agency. The agency solicited input from Lake Elmo during planning of a regional sewer interceptor, but at some point communications failed. The agency and the city did not reach a clear agreement on the scale of sewering, resulting in a protracted political and legal battle.

Fortunately, some of the case studies indicate how to build and maintain trust. In Lake Elmo prior to the regional sewer dispute, the city did a good job of engaging diverse stakeholders within the community during formulation of cluster development and engineered wetlands treatment policies. This resulted in a number of highly successful cluster developments that will help achieve the community's vision of remaining semi-rural.

In Charlotte County, regaining trust after the sewer debacle took a long time. The public eventually responded to:

- The firm leadership of the board of county commissioners
- Much stronger public involvement in development of a new comprehensive plan
- Continual release of accurate, timely, and detailed information to the press and the public
- Sincere efforts by utility officials to address citizen concerns regarding mini-expansions of sewer
- Delivery of five years of rate reductions by the county water and wastewater utility

In Broad Top, Pennsylvania, municipal leaders recognized from the start that an effective solution would require the support of citizens and regulators. Officials involved citizens, regulatory authorities, and funding agencies early in the planning process. The creation of a Sewage Advisory Committee in which anyone could participate went a long way toward nurturing trust. Special attention was paid to drafting a request for proposal (RFP) and selecting a consultant that met the needs of the community for an innovative approach. Using a diversity of wastewater systems increased support by keeping costs low, and satisfied the different physical and social needs of the area. Achieving community consensus made the community attractive to outside funding that made the project financially possible.

On Washington Island, Wisconsin, adoption of a decentralized approach managed by the town required willing participants. Leaders of the facility planning process consistently sought out the views and ideas of the public. Community discussions and consistent, transparent information exchanges allowed a consensus to be built—in this case, in favor of decentralized systems. This process also eased the concerns of state regulators over the alternative approach that was being considered. Residents became willing participants in the municipal oversight of onsite systems. Residents are still willing participants in the program although there have been some troubling lapses in program implementation as the interest and understanding of town board members has fluctuated over time.

Other communities can benefit from the lessons these case studies reveal:

- ***Realize that good technical work alone does not ensure success:*** Attention to public process and politics is essential. Good technical work in Paradise and Charlotte County was not enough to guarantee success. Public process missteps in those communities led to rejection of the results of considerable engineering effort.
- ***Provide for substantial, genuine public participation:*** Public hearings are not enough. The public must feel that it has a genuine role in the planning process. In Charlotte County, the differences in public involvement in the 1993 master plan and the 1997 comprehensive plan were substantial, as were the results—outrage in the former case, widespread support in the latter. Participation, as Charlotte County Commissioner Adam Cummings said, requires vesting citizen bodies with some power and trusting their reasonableness. The county did this with the Charlotte Assembly, a deliberative body that set a tone for public discussion and established important directions for policy makers.
- ***Develop a process that engages all segments of the community and encompasses all key issues:*** As part of that process, ask a broad cross-section of community members for their ideas, opinions, and values. Do not assume answers. Issues of growth, fairness, and community character were all made part of the successful process on Washington Island. In Lake Elmo, the city engaged citizens and developers early in the cluster development ordinance decision process. However, a "geographic consensus" behind the city's plan was never reached. A number of owners of properties along an interstate highway had a different vision, and requested sewer service from the regional wastewater agency. If local officials had more actively sought to address these individuals' concerns, some intra-community problems may have been avoided, and possibly some regional issues as well.
- ***Enlist the community in the search for solutions:*** Clearly, while some aspects of the facility planning process can only be accomplished by technical experts, the problem scoping and idea generation steps will benefit from substantial public participation. Useful ideas may arise, and at the very least the community will feel more ownership of the final plan, as the Washington Island case study showed.
- ***Include citizens' input when drafting your request for proposals (RFPs):*** In Broad Top, citizen participation resulted in incorporation of an important social value—affordability—into the RFP, which specified that the system design must keep monthly service fees under ten dollars.
- ***Be sure consultants and community assistance providers attend carefully to the values of the community:*** On Washington Island, the first facility plan focused on facility options and regulatory considerations. It appears the plan was developed with little attention paid to discerning and accommodating qualitative concerns of local residents. The second facility plan is replete with qualitative discussion of environmental impacts, impacts on tourism, fiscal integrity, equity issues, concerns over management schemes, and so on. The second consultant apparently listened more carefully to the community, and more importantly, led the community to an understanding of how these matters could be impacted by centralized and decentralized approaches.

- ***Make sure the public turns out*:** Often, the public only participates once the cost of a proposed solution is announced, which is too late. Just as community leaders and consultants have a responsibility to seek public input, the public has a responsibility to provide it. An awareness campaign prior to the planning phase may help generate the necessary interest. Explain why citizens should want to participate: they will benefit from reduced costs, improved quality of life, protection of property values, safer drinking water, and so on if they help shape the plan. This sort of positive approach was used successfully on Washington Island.

- ***Never let consultants get ahead of or replace community leadership in the public's eye:*** Involving consultants in public participation is often very helpful—even necessary—but government or utility officials must maintain control over the process. In Charlotte County, consultants released cost estimates in a public meeting before elected officials had seen the figures. This created a belief that neither the consultants nor the county leaders really cared about costs.

- ***Identify and assist leaders interested in the issue and process:*** While broad public participation is important, it must be orchestrated by a small number of people with the requisite abilities. This could be an outside consultant. When this leadership comes from inside the community, as it did on Washington Island, so much the better. Long-term dedication is required to see the process to its conclusion. It helps to have one or more "champions" to keep the effort going. But remember that this person or persons must be genuinely open to the input of others, and that this individual or group must not try to ram through a particular vision. The champion(s) must focus on ends rather than particular technical or institutional means. Communities are diverse and their solutions should also be diverse.

- ***Consider professional and unbiased facilitation:*** Public process facilitation may need to come from individuals not connected to the technical outcome. In Paradise, the project engineer had conflicting roles as a facilitator and an advocate for a specific technical solution. This contributed to perceptions that the town was "on a track" and not really interested in public input.

- ***Work closely with regulatory officials from the beginning:*** This can help avoid enforcement actions while wastewater solutions are crafted. Constructive engagement in both directions is necessary to avoid costly confusion. Solid relationships with regulatory officials also make a community more attractive to potential providers of financial assistance, as shown in Broad Top. Washington Island developed positive relationships with state regulators, who came to see the town as genuinely interested in doing the right thing, rather than trying to "get away with something."

- ***If the community is breaking new ground at the state level, be prepared for a long effort:*** For instance, be prepared to demonstrate any new technologies, as Washington Island did. These days, this step should not often be necessary, but state onsite regulations are in flux. Regulators often want to see a technology proven in their state.

- ***Take care to avoid making participatory bodies into "rubber stamp" groups:*** In Charlotte County, some participants in an onsite systems work group felt the policy was already firmly established, as it mostly was. In Paradise, citizens came to believe that local leaders assembled an advisory committee only to have their chosen plans "approved." Perception of a "done deal" breeds cynicism. On the other hand, before they go to the public for input, elected leaders must also understand in their own minds what is required of certain policies given regulatory and other concerns. The trick is in knowing what control is appropriately placed in the public's hands and what control should remain with elected and appointed officials, with consultants, and with regulators.

- ***Communicate public policies and the intent of leadership honestly and clearly:*** In Charlotte County, some interest groups saw a hidden agenda—growth control—in the preparation and passing of the onsite systems ordinance. Local politicians now say that was certainly their intent (they prefer the less politically-charged term growth management), along with protection of environmental and public health. Somehow this dual intent was not effectively communicated to the interest groups, which felt threatened by the growth-management component.
- ***Anticipate opposing perspectives and positions:*** Several thoughtful residents interviewed for this study—some inside, some outside local government—offered this lesson: anticipate opposition. They believe local leaders should have anticipated opposition to wastewater projects in the early planning stages. Concerns that surfaced when the specific project was introduced might have been better dealt with through a more holistic planning process. For instance, growth concerns could have been addressed through policy-making in areas outside the wastewater planning effort.
- ***Respect and involve opposing perspectives and positions:*** These same interviewees advise that when dealing with organized opposition, reach out to its leadership, hear and understand the group's arguments, find answers to its concerns, and respond to group members directly. Also ask opponents to suggest ways in which their goals and community leadership goals could be achieved simultaneously.
- ***Be prepared to respond to the belief that any cost is too much:*** In many areas served by conventional septic systems, people are used to paying only the cost of occasional pumping of a septic tank, and many rarely or never pump. As decentralized wastewater management expert Lorraine Joubert puts it, "When you are used to paying nothing, anything is too much." Paying nothing often results from failure to enforce existing codes regarding pumpouts and other maintenance. (Therefore, the lack of enforcement is a major obstacle to improving management practices or building new facilities.) If a community is in the "used to paying nothing" situation, clearly articulate, within the particular context, why the expenditure is important. This can be articulated in two ways. One way is to explain that "nothing" is not acceptable (due, for instance, to changing codes) and to explain why the proposed costs are necessary and reasonable. Often it is better to put the argument in a positive tone. People are more willing to pay if they see value than if they are just told the costs are necessary. The potential benefits of a project could include improved quality of life, protection of property values, safe drinking water, and more. The values provided will be different for different communities.
- ***Study all options:*** Be sure all feasible types of sewers and treatment systems are considered, across a wide spectrum of infrastructure scale. According to one local official in Charlotte County, a major theme in the public opposition to the sewer plan was the belief that officials had not reviewed all available alternatives. Besides technical issues, thoroughly investigate

options to surmount cultural and institutional barriers. Johnson County officials were very concerned about preserving maintenance access to onsite tanks and pumps for low-pressure sewers (LPS). Many communities (including Mobile, Alabama) have developed effective ways to address this concern.

- ***Be prepared to correct misinformation about technical matters:*** In Johnson County, Kansas, the characterization of LPS as unreliable by parties with other agendas could have been counteracted with appropriate information. Broad citizen concerns—in this case, concerns about the costs and growth implications of LPS retrofits—may be valid issues for debate, but factual inaccuracies about technical matters such as LPS reliability should not be allowed to stand. Education of decision makers is particularly important.
- ***Ensure that citizens understand the need to undergo wastewater facility planning:*** Have outside public officials from state and county offices address the public on the need if necessary. Spend considerable time and effort to reach consensus on the need before going forward with alternatives analysis or design. The Broad Top and Washington Island experiences show that this pays off in terms of support for the final solution.
- ***Take care to prove the case for new infrastructure or increased regulation and management by developing the best supporting science affordable:*** If a wastewater solution costs much, someone will probably say the need for it has not been proven. What constitutes proof is always a sticky issue, especially when the costs of conclusive studies can be so high. The Charlotte County case study shows that, in some manner satisfactory to local opinion leaders, three questions must be addressed:

  1. Are the contaminants of concern clearly of human origin? (Just finding fecal coliforms is not conclusive.)

  2. Is the human source clearly what it is said to be? (Ribotyping to show human origin does not alone prove whether the source is septic systems or leaky sewers.)

  3. What is the relative importance and cost-effectiveness of addressing the pollution source proposed to be addressed versus other sources? (The public generally wants to know that a program generates a big bang for the buck.)

Remember that in many cases, what is tested may be less important than the design of the study (where and when testing occurs). If a major step is proposed, for which the costs will be high, be especially sure adequate science is in place. If not, expect significant resistance on the grounds that the goal is too ambitious, not justified, and could be achieved more cheaply another way.

- ***At the same time, beware of using studies as a way to put off making decisions:*** In Charlotte County politicians got off the hook for making onsite system management policies because a multi-year pilot study was underway. Often study is needed before policy is made. In this case, arguably enough was already known (and available in the national wastewater literature) about septic tank solids accumulations and other aspects of onsite system management that an ordinance could have been developed without the results of the study.

- ***Spend the money required to package scientific information so that the public can understand it:*** Otherwise, more money will be spent later dealing with the consequences of public ignorance. Design the package around some of the following questions:
  - Does the public see the problem? If so, how? If not, why not?
  - If the public sees the problem, are they willing to take action to address it (such as pay or meet new regulations)? If not, why not?
  - Does the public think their own wastewater systems are not part of the problem?
  - Can the public afford to pay? Are they holding out for someone else to pay?
  - Is the need tangible?
- ***Keep the public informed throughout the planning process:*** Planners on Washington Island recognized that informal discussions in the community shaped opinions and eventually decisions. Be sure these discussions are based on sound information. This requires a continual effort to inform citizens of all the issues, facts, problems, and opportunities identified in the facility planning process. This effort is also necessary in order to maintain the public's trust that the process is unfolding properly.
- ***Note that outreach is essential, not just in planning and policy-making, but also in implementation:*** Exemplary communication during the Charlotte County sewer mini-expansions helped rebuild trust broken by poor handling of the previous sewer expansion proposal. Utility personnel visited each neighborhood before sewer installation began. They not only answered questions, they made an effort to identify and follow-up with individuals who seemed most concerned about the project.
- ***Avoid management structures that create conflicts of interest:*** In Paradise, a system in which septic system service companies serve as inspectors creates an incentive for inspectors to recommend pumping and other maintenance. This has led to charges that some inspectors are defrauding residents and has created cynicism about the overall onsite wastewater management program.

Hydrologic Impacts

Communities:

- Metropolitan Boston, MA

The role of water supply systems in altering groundwater levels and surface water flows is widely recognized. Less well known are the ways centralized wastewater systems contribute to significant hydrologic changes:

- Wastewater collection systems often transport locally withdrawn water supplies—disposed to sanitary sewers—great distances to downstream or out-of-basin treatment plants.

- Collection systems experiencing significant infiltration intercept natural groundwater flows and transport that water to distant discharge points, often significantly reducing local groundwater recharge and stream base flow.
- Combined sewer systems also intercept runoff, by inflow through roof downspouts, street and parking lot drains, foundation drains, and other sources that would otherwise add to stream flows between the point of sewer inflow and the eventual treatment plant discharge, or they move the water out of basin.
- Even where I/I are minimal, collection systems may remove groundwater. Water may move along a gravity sewer line gradient, but outside of the pipes themselves, particularly if gravel pipe bedding or disturbed soil from trenching is more permeable than the surrounding soil and subsoil.
- Centralized systems also contribute to hydrologic change in an indirect but critical manner. Centralization of wastewater service beyond the cluster scale allows high-density development over large areas. Increased density results in increases in impervious surfaces. Included among the many impacts of high levels of impervious surfaces is a reduction in infiltration of rainwater and snowmelt into the soil, and attendant reductions in groundwater recharge. This can impact aquifers levels and base flows in streams. These impacts are well-documented and represent an increasing public policy concern.

The metropolitan Boston, Massachusetts case study focused on several of the above mechanisms of hydrologic impact. Regional water and sewer service in the Boston area is provided by the Massachusetts Water Resources Authority (MWRA), which serves a total of 43 communities. Thirteen of these communities receive regional sewer service but utilize their own local groundwater supplies for potable water. This configuration results in locally-withdrawn water being sent out of local watersheds to MWRA’s Deer Island Treatment Plant (DITP) and ultimately to an ocean outfall. In addition, I/I to sewer lines in the 30 MWRA sewer service communities removes water from local watersheds. I/I accounts for up to 60 percent of total flows received at the DITP. Impervious surfaces in Boston-area watersheds also rob the groundwater of natural recharge.

Some watersheds in the region, notably that of the Charles River, also receive imported water that is added to natural flows. This occurs because a number of MWRA communities use water from western Massachusetts reservoirs and then treat wastewater in onsite, community, or sub-regional systems, resulting in discharge of the imported water to local groundwater (through wastewater effluent soil absorption systems) or direct discharge to local surface waters.

The net balance appears to be negative. Portions of the Charles, Neponset, and Ipswich Rivers experience unnaturally low flows at times. Groundwater levels have been lowered in certain locations and at certain times of the year, resulting in reduced stream base flows.

During planning for improved wastewater treatment in the 1970s and 1980s, efforts to address water transfers through the sewer system from inland watersheds to Boston Harbor included evaluations of inland satellite treatment plants that could augment river flows. Technology limitations and siting concerns made such plants infeasible, but many lessons were learned in the facility planning process.

Today local, regional, state, and federal entities in Massachusetts recognize that water budgets in some basins have been detrimentally altered by development, and that wastewater systems play a significant role in this problem. Many entities have developed or are developing policies and plans to address hydrologic imbalances. Decentralized wastewater systems are seen as an important part of the solution in some communities.

Based on these experiences and initiatives, some recommendations to other communities, especially those considering regionalization of wastewater infrastructure, include:

- ***Study demand-side management and other wastewater flow reduction measures:*** Such efforts should include I/I remediation. Weigh the costs of increased treatment plant capacity versus the costs of flow reduction and the benefits of wastewater flow reduction to local watersheds. Explore the long-term cost of collection system maintenance, including increased treatment costs due to I/I, when deciding system architecture and scale. Decentralized systems may be more attractive when all the costs and benefits of different options are considered.
- ***If considering a regional system architecture, evaluate how it transfers wastewater between basins:*** Determine the degree to which the proposed system could reduce groundwater supplies and reduce groundwater support for stream flows. Consider the impacts of stream flow reductions on economic services that natural waterways provide, like fishing and recreation, flood control, industrial process cooling, and other services.
- ***Realize that surface water discharges of treated wastewater to maintain hydrologic regimes are problematic:*** The satellite plants studied for the Boston area were rejected in part due to the impacts of large point-source discharges of even highly treated wastewater. Maintain stream base flow support through distributed, soil-based wastewater treatment and low-impact development practices wherever possible; surface water discharges of centrally treated wastewater to mitigate low instream flows are not environmentally equivalent.
- ***Accurately account for interbasin transfers of water and wastewater when calculating watershed water budgets:*** Pay special attention to I/I and to outdoor water use. Lawn watering usually represents a significant percentage of water use during summer months, but much of the water is lost to evapotranspiration.
- ***Take advantage of a local watershed's ability to assimilate stormwater and recharge groundwater:*** This has the dual benefit of maintaining water within the basin while mitigating peak capacity requirements in combined sewer collection and treatment systems. Many best management practices (BMPs) are available to infiltrate stormwater to the soil and keep it out of sewers.
- ***Reduce impervious surfaces, which increase runoff and contribute heavily to peak flows:*** Work with planning departments and building code enforcement officers to mitigate unnecessary runoff from development. BMP options include pervious paving materials, rainwater collection and storage systems, bioretention (such as rain gardens), and improved detention and recharge.

- ***Ensure that policies addressing one problem do not exacerbate other problems:*** Massachusetts's Title 5 legislation took on water quality degradation from failing and substandard onsite systems, but created localized pressures for sewer service that could contribute to undesirable water transfers.
- ***Foster a holistic approach to watershed management:*** Bob Zimmerman of the Charles River Watershed Association maintains that the conventional engineering approach "that treats rainwater as a liability, disconnects rainwater from groundwater with impervious surfaces, and transports locally drawn potable water to distant locations for treatment and discharge" is the fundamental problem. He maintains that a fundamental transformation of thinking, a "paradigm shift" toward holistic water management, is necessary. Of course, a holistic approach must address both water quantity (hydrologic impacts) and water quality (ground and surface water contamination).

Value of Decentralized Systems to Large Wastewater Entities

Communities:

- Mobile, AL

Onsite and cluster wastewater systems are today mainly thought of as tools for rural and exurban communities. Few urban wastewater utilities have seriously considered how decentralized wastewater systems can be of benefit within their service areas. One that has is the Mobile Area Water & Sewer System (MAWSS).

MAWSS had to choose between providing centralized service, decentralized service, or no service to growing exurban areas of the county. This decision had substantial economic, political, and other implications for the utility. Extending centralized service would have been expensive because the developing areas were distant and on the opposite side of a watershed divide from the city of Mobile. Building a new centralized wastewater plant in the growing watershed to allow gravity sewer service was politically impractical; residents and environmental groups would have objected to surface water discharge. At the same time, the MAWSS board felt it was not in the best interest of the county to allow substantial suburban-style development to occur on conventional septic systems. Nor was it in the best interest of the utility. Providing wastewater service would build the case for providing MAWSS's water service, a highly profitable activity for the utility.

For these reasons, MAWSS began to explore decentralized wastewater systems. The utility leadership educated itself about decentralized options and then made a strategic decision to begin building them. The utility experimented with several technologies. It also developed design, management, service, and revenue strategies to reduce its costs and risks.

Developers have been very responsive to MAWSS's cluster systems, finding they offer reduced liability and increased marketability compared to individual septic systems. Homeowners are happy to have a utility managing their wastewater system.

Someday, as the exurban area around Mobile increases in density, MAWSS might connect together its decentralized systems to create a more centralized system—or it might not. MAWSS will not have to face that decision for decades. It will be clear whether this makes sense when the time comes. For now it is clear that decentralized systems are the best way for MAWSS to service the area. MAWSS plans to build no more interceptors beyond the watershed divide and to use decentralized systems instead. Proof of its success is the fact that other local utilities have adopted the concept and are competing with MAWSS for customers.

MAWSS has also begun to explore how decentralized systems could help address problems within its gravity-fed sewershed. The utility sought and obtained US EPA demonstration project funding to build a facility in the urban core of Mobile. This project will remove sewage from an overburdened interceptor and direct it to four different treatment systems. Solids will be returned to the interceptor. Treated effluent will be used to irrigate a city park on a redevelopment site. MAWSS will use the project to study additional treatment technologies, evaluate drip irrigation as an effluent dispersal technology, and assess how strategic location of decentralized systems around the city could provide sewer capacity relief and possibly help address total maximum daily load (TMDL) issues in the watershed.

Some other large wastewater systems—Seattle Public Utilities, for instance—are beginning to consider how decentralized systems could be a part of their service toolkit. The approach MAWSS took to entering the decentralized field and building its capabilities to manage small, alternative systems should be instructive for many urban wastewater system administrators. They would do well to follow MAWSS's lead and heed these recommendations:

- ***Learn the options:*** In the last ten years there have been many developments in the field of decentralized wastewater management. There are technologies and management models available for just about any situation.
- ***Identify the values decentralized systems can provide for a community's particular situation:*** Cost-effective service? Rapid response to a service problem or opportunity? Reduced financial risk? Reduced exposure to criticism on environmental, equity, or other grounds? Avoidance or reduction of capacity issues in an existing centralized system? A tool to gain new customers and compete with other utilities? Decentralized systems can provide positive responses to these and other concerns.
- ***Find a "champion":*** The Mobile story points out the substantial impact a few well-placed individuals with vision can have on wastewater planning. The technical expertise of University of South Alabama Professor Kevin White and the leadership of MAWSS Director Malcolm Steeves greatly facilitated the development and implementation of an alternative wastewater architecture for growing areas around Mobile. It is especially important that one or more senior managers in a utility support an alternative concept.

- ***Try one or more demonstration projects to investigate the feasibility of decentralized systems for the community:*** Testing decentralized wastewater management does not require a large investment, by the standards of an urban or a suburban utility. The decision need not be difficult. MAWSS did not need to intensively study its situation to know it made sense to try a decentralized approach. Formal master planning is appropriate and useful in many situations, but it is not necessary in order to justify testing the concept.
- ***Experiment with different technologies:*** Learn by doing, which is the surest way to find out what works best in a specific area and with particular management capabilities and constraints. MAWSS used two different treatment technologies in its first four exurban projects and is evaluating three more in its urban demonstration project. After trying different technologies, standardize on one or two that meet the requirements most closely, as MAWSS plans to do.
- ***Carefully consider cost structure when selecting technology:*** In MAWSS's case, given the remoteness of some of the developments it served, the utility felt it was best to pick low O&M technologies, and to design components of the system in ways that reduced O&M. This cut down on costly visits from utility personnel. Plenty of models for low O&M or low capital cost systems are available from around the country.
- ***Be clear with partners (developers) and users (homeowners) regarding the responsibilities of each:*** For instance, MAWSS developed detailed specifications for collection systems installed by developers, which the utility takes over. MAWSS also developed a standard contract for connected homeowners that prohibits garbage disposals, makes users liable for misuse of a system, guarantees utility access to system components on private property, sets out billing practices, and so on. In return, MAWSS provides all maintenance on the system and homeowners receive a level of worry-free wastewater service similar to an urban sewer system.
- ***Develop a service strategy and cost and revenue structures that minimize risks:*** For instance, MAWSS built three of its first four decentralized systems near schools, where housing development was likely to occur in the near future. MAWSS also developed conservative revenue structures to ensure its costs would be covered. Developers share the costs by donating land for a treatment/dispersal facility and building the collection system. Typically MAWSS pays 30 to 40 percent of the treatment facility cost, and recovers the remainder in up-front fees and connection fees paid by developers and homeowners. It calculates fees to capture the developer's portion of the facility cost within a reasonable time, based on estimates of how many homes are likely to connect to the system within that time. Because the cost of operating and maintaining decentralized systems would only become clear over time, MAWSS also set monthly service rates paid by homeowners at 140 percent of the rate within the conventional sewer service area.
- ***Be open-minded:*** Be ready for new ideas. Malcolm Steeves said one of the most significant outcomes of his utility's foray into decentralized wastewater management is that the experience has opened the minds of his staff members and broadened his board's thinking in ways that are helpful in many aspects of MAWSS's business.

Summary: Top Tips for Communities Engaged in Wastewater Planning

The preceding sections present a large number of recommendations for communities engaged in wastewater facility planning. Depending on a community's circumstances, some of the topics and some of the recommendations will be more pertinent than others. The following top ten list is one way to summarize the results of the case study research into the most important themes and recommendations. This list is particularly designed to aid communities that are just beginning a wastewater planning process, but will provide helpful reminders to other communities as well. The tips are presented in a rough chronological order of when their subjects might come up in a facility planning process; however, this does not mean that subjects noted in the later tips should not be given some consideration early in the process.

1. ***Address land-use planning before wastewater planning:*** If growth and community character concerns have not been adequately addressed in previous general planning processes, they will inevitably come up in the facility planning process. Citizens recognize the relationship of system architecture to growth. For instance, they know that sewers allow for and sometimes even require growth and higher development density. This is fine if such growth is widely desired. Citizens will reject wastewater proposals that they see as incompatible with their vision for the community. Shape wastewater system architecture around land-use decisions, rather than allowing infrastructure decisions to dictate land use. On a related note, beware of "zoning by septic," as is done in many communities unwilling to directly face growth issues. This practice is a blunt and often ineffective instrument, particularly since the availability of advanced onsite treatment technologies reduces the technical and perhaps the legal legitimacy of basing large-lot requirements on loadings from septic system effluent.

2. ***Work closely with regulatory officials from the beginning:*** This can help avoid enforcement actions while wastewater solutions are crafted. Constructive engagement is necessary to avoid costly confusion. Especially if a community is interested in innovative or alternative solutions, developing positive relationships with regulators will help them see that the community is genuinely interested in doing the right thing, rather than trying to "get away with something." Solid relationships with regulatory officials also make a community more attractive to potential providers of financial assistance.

3. ***Provide for substantial, genuine public participation in the wastewater planning process:*** Remember that good technical work is not enough to guarantee success. Citizens must feel they have been adequately consulted and heard. Public hearings are not enough. Citizen work groups, committees and other means of involvement are necessary. Be sure to develop a process that engages all segments of the community and encompasses all key issues. As part of that process, ask a broad cross-section of community members for their ideas, opinions, and values relative to wastewater issues and potential solutions. Enlist the community in the search for solutions. Particularly in the problem scoping and option generation phases of the process, citizens can contribute useful ideas and at the very least the community will feel more ownership of the final plan. In the implementation phase, be sure the management system structure involves citizens in meaningful ways.

Throughout, let citizens know that not only do they have opportunities to participate, but that they also have a responsibility to participate, in order to ensure that adequate information and perspectives are fed into goal-setting and system design processes. Explain why citizens should want to participate: they will benefit from reduced costs, improved quality of life, protection of property values, safer drinking water, and so on if they help shape the plan.

4. ***Be sure consultants and community assistance providers attend carefully to the values of the community:*** Too often consultants pay little attention to discerning and accommodating the values and qualitative concerns of local residents. A good consultant will help a community ask the right questions and articulate its values, goals, and issues relative to wastewater systems. Choose a consultant who will listen carefully to the community, and just as importantly, will help the community understand how its concerns, values, and goals will be impacted by different wastewater options. As well, choose a consultant with demonstrated experience with decentralized systems, to be sure that a full range of options are brought to the community's attention.

5. ***Carefully and clearly define and measure the problem:*** Pursuing higher performance goals and basing large wastewater system expenditures on anecdotal evidence or inconclusive studies is financially and politically risky. Studies must be very carefully designed to determine the impacts and risks of onsite systems. Differences between existing and new systems, and between unmanaged and managed ones must be carefully noted. Further, wastewater is rarely the only anthropogenic source of nutrients or pathogens in a watershed. Ultimately the most cost-effective approach to pollution reduction is a risk-based approach that encompasses all pollutant sources and the relative costs and efficacy of various technologies and management options for controlling pollutants. Failure to integrate policies and solutions across sources or to prove that onsite systems pose significant risks leaves facility planners open to the charge that money and effort are being unwisely or unnecessarily spent in the wrong place. At the same time, this recommendation must be tempered by the realization that conclusive linkage of water quality findings to suspected sources is difficult. A "weight of evidence" approach may be required, but it must be carefully and fairly explained to the public.

6. ***Consider onsite system management before rushing to a centralized solution:*** In particular, determine whether observed or predicted onsite system failures are unavoidable or simply the result of poor operation and maintenance practices that could be remedied through appropriate management. Factors to consider in evaluating the failure risks of existing onsite systems include inappropriate soil conditions or inadequate designs allowed under onsite wastewater codes in place some years ago. Even if these risks are high, centralized solutions may still not be the most cost-effective approach—system replacement followed by effective management may be the way to go. Also consider whether appropriately designed and managed cluster systems can help the community meet higher performance and reliability goals.

7. ***Consider how wastewater systems affect local watershed water budgets:*** That is, evaluate how wastewater systems affect flows between groundwater and surface water, stream base flows, and flows between human and natural water systems. For instance, centralized or regionalized sewer systems often transport significant quantities of water from its point of origin (such as water supply wells or infiltration of groundwater into gravity sewer lines) to distant downstream or out-of-basin treatment plants and outfalls. This can reduce groundwater tables and base flows in local streams. Onsite and cluster systems using soil absorption systems for dispersal of effluent may play a useful role in recharge of local groundwater and support of stream base flows. At present, these relationships are not recognized in many places, but are of significant concern in others. It appears that the role of wastewater systems in altering natural hydrologic conditions will become a greater environmental—and perhaps regulatory—concern in more places in coming years.

8. ***Investigate options that integrate centralized and decentralized approaches:*** In many communities it will be appropriate to use centralized wastewater service for some areas, and management of onsite and cluster systems in others. Also, if a community already has a centralized system, do not extend sewers without carefully evaluating decentralized options to service the area(s) in question. A centralized utility can manage or even own and operate onsite and cluster systems to ensure or provide adequate wastewater service throughout a community in the most cost-effective and environmentally efficacious manner. If a community is unsewered but in or near a municipality or metropolitan area with a centralized or regionalized system, explore possibilities for that utility to provide management of (or to own and operate) decentralized systems in the community. At this time, few urban or suburban wastewater utilities include decentralized systems as a service offering, but more are likely to in the future. It is also worth identifying and approaching other utilities—for instance, rural electric cooperatives—that have the technical, managerial, and financial capacity to effectively manage decentralized wastewater systems. Some are doing so already.

9. ***Be aware that different wastewater system architectures distribute costs in different ways:*** In general, centralization spreads costs while decentralization focuses costs on individual or clustered wastewater system customers, each according to the specific situation. Thus, the equity and fairness implications of the choice of wastewater system scale will vary in ways that may affect public acceptance of the proposed solution. For instance, centralized systems are often promoted as achieving economies of scale. But they also raise concerns that some customers (for instance, those in more dense areas) will subsidize other customers (those in less dense areas). Another dynamic that often comes up with centralized options is the claim that residents are subsidizing businesses. Whether subsidization is actually occurring may or may not be true, but perceptions of unfair support of others may be decisive, along with attitudes about whether subsidies are justifiable or desirable. On the other hand, placing situation-specific costs directly on particular wastewater customers by using onsite or cluster systems without any type of cost-sharing across the community or any financial assistance for hardship cases may seem unfair and unaffordable to some or many community members.

10. ***Consider the impacts of the size and timing of capacity investments on financing costs and the relative risks of different wastewater options***: Engineers usually address the time value of money for capital, O&M, and management costs. But too few facility planners examine how the distribution of costs over time affects the amount of debt a community will carry and the resulting financing costs. In general, decentralized systems allow finer matching of total infrastructure capacity to growth in demand over time, while centralized systems front-load capacity, which a community must grow into. The latter approach typically requires more debt. In contrast, wastewater options that spread capital investments over time lower the net present value of financing costs, reduce the size of principal payments, and are more likely to be affordable for communities. Incremental provision of capacity exposes a community to less financial risk, including the risk of rate increases if less growth occurs than was originally projected. Incremental approaches also provide a community with more flexibility to adopt new technologies or react to other changes.

PART II – CASE STUDIES

Following are detailed treatments of how eight communities have managed wastewater planning issues. All case studies follow a consistent structure. Each has six major sections:

- ***The Community:*** This short section provides a basic description of the community, focusing on aspects most relevant to wastewater systems: land use, growth, nature of the economy, topography, climate, water supply, and other aspects.
- ***Wastewater Issues:*** Another short section identifies the key problems that led the community into a wastewater system planning process.
- ***Historical Overview:*** This section outlines the major studies, events, and developments that occurred as wastewater issues became evident and the community embarked on a wastewater system planning process. The process and results are described in general terms.
- ***Analysis:*** Here the discussion sorts through the history and provides additional details that illuminate what happened in the community and why. It notes the implications for the community of the planning steps taken and the decisions made, and highlights the positions and actions of key stakeholders. Subsections focus on one or more of the seven topics noted earlier. Each analytical subsection considers how system architecture was relevant to the issue, how the issue was addressed, whether the issue resonated with the community, and results and present status.
- ***Conclusions:*** In this section the discussion steps back and reviews the key themes revealed by the community's experience. This section synthesizes the information developed in earlier sections into lessons for other communities.
- ***Sources:*** Sources are broken down into personal interviews, phone interviews, and documents reviewed.

6 MOBILE, ALABAMA

This case study addresses the topic:

- Value of decentralized systems to large utilities

The Community

The City of Mobile and Mobile County are located in the extreme south of Alabama, on the Gulf of Mexico. The county covers 1,200 square miles and is bounded on the east by Mobile Bay and the Mobile–Tensaw river delta and on the west by the Alabama–Mississippi state line. Its population totaled nearly 400,000 in 2000. The county has 10 incorporated municipalities.

Roughly half of the county's population lives in the City of Mobile. Mobile's Port of Alabama bustles with shipping of forest products (it leads the nation in wood pulp exports), coal, and other commodities and goods. The city is a regional center for medical and financial services, higher education, and government.

Small cities are located immediately north and south of Mobile. The growing unincorporated area to the west of the City of Mobile relies on the city for police, fire, planning, and other services.

The water and wastewater utility for Mobile and some of the surrounding area is the Mobile Area Water & Sewer System (MAWSS), formally titled the Board of Water and Sewer Commissioners of the City of Mobile. MAWSS is governed by five commissioners appointed by the city council. The utility provides water mainly from its 3,600-acre Converse Reservoir, located west of the city. It supplies some industrial customers from the Mobile River. The utility operates three wastewater treatment plants (WWTPs) on or close to Mobile Bay.

Figure 6-1: The Location of the City of Mobile and Mobile County in the State of Alabama

Wastewater Issues

MAWSS is a substantial urban water and wastewater utility that operates a large, centralized sewer system and three treatment plants. These plants are described in Table 6-1.

Table 6-1: Wastewater Treatment Plants of the MAWSS

Treatment Plant	Year Built	Most Recent Major Expansion	Capacity	Receiving Water
Wright Smith, Jr.	1947	1987	12.8 MGD	Three Mile Creek
Clifton C. Williams	1957	Late 1990s	28.0 MGD*	Mobile Bay
Bill Ziebach	1965	None	2.0 MGD	Mobile Bay

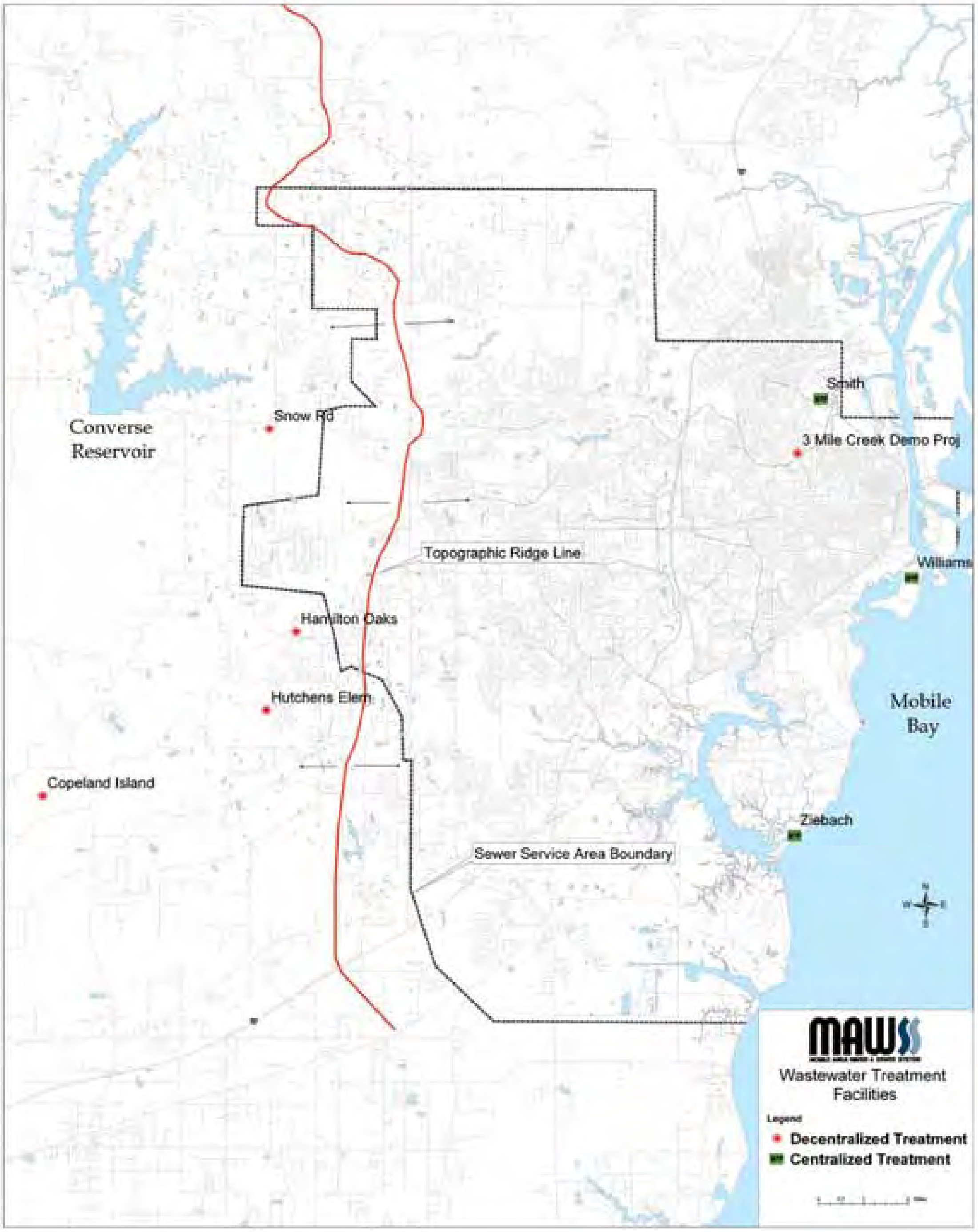
*Current permitted capacity. Solids removal and biological treatment systems were expanded in the late 1990s, in anticipation of pursuing a higher permitted capacity in the future.

Source: MAWSS website, http://www.mawss.com/waste.htm

As in many older American cities, Mobile's wastewater system includes miles of aging sewer lines that suffer from infiltration and inflow (I/I) during wet weather. I/I, grease blockages, and other problems have historically resulted in several hundred sanitary sewer overflows (SSOs) per year. In 1999 an environmental group, Mobile Baywatch, filed a suit against MAWSS for violations of the Clean Water Act. The United States Environmental Protection Agency (US EPA) and the Alabama Department of Environmental Management also filed separate suits. Negotiations between the parties led to a January 2002 consent decree agreement between the plaintiffs and MAWSS in which MAWSS agreed to spend $60 million over five years for repairs and other actions to address the SSO problem.

In addition to dealing with increased scrutiny of its existing sewer system, in recent years MAWSS has had to make decisions regarding expansion of its service area to accommodate suburban growth in greater Mobile. The western edge of the MAWSS service area roughly follows a topographic ridgeline (see Figure 6-2). MAWSS has made limited extensions of sewer service into areas beyond the western ridgeline over the last 15 years. Land west of the divide drains away from Mobile Bay and to the Escatawba River, which flows into the state of Mississippi. Pump stations and force mains are necessary to move wastewater back over the divide to the Mobile Bay watershed, and from there gravity sewers and interceptors take it to MAWSS plants along Mobile Bay.

Much of the recent growth in greater Mobile is occurring west of the city limits, beyond the divide and beyond the current boundaries of the MAWSS sewer service area. Growth beyond the service area has historically utilized conventional septic systems regulated by the Onsite Division of the Mobile County Environmental Health Services Department. In roughly the last decade, suburban-style subdivisions have begun to appear in this area. Demand for denser development and urban amenities are growing, and some developers have approached MAWSS for sewer service. MAWSS has had to answer and address whether and how to provide wastewater services to this growing area.



Courtesy of the Mobile Area Water & Sewer System

Figure 6-2: Map of the Greater Mobile Area Showing the MAWSS Sewer Service Area

Historical Overview

MAWSS has developed and planned decentralized wastewater projects both in the suburbs beyond its sewer service area and within the service area, in the urban core of Mobile. These projects and their histories are described separately and briefly in the following sections. The analysis section delves into the rationales for the projects in greater detail.

Development of Decentralized Projects in Suburban Areas

MAWSS first began considering remote wastewater treatment in 1994. The utility, Mobile County, and the South Alabama Regional Planning Commission had meetings to discuss needs outside the sewer service area and how wastewater services might be provided. MAWSS board members are active in the American Water Works Association and the Water Environment Federation, and some of them had learned about decentralized wastewater systems at conferences. In the fall of 1996, MAWSS met with the Mobile County Housing Authority to review alternatives and concept-level costs for onsite wastewater treatment for a proposed housing project in northern Mobile County.

None of these discussions proceeded beyond the concept stage. However, MAWSS decided the idea of providing remote wastewater services merited further consideration and in July 1997 MAWSS's board authorized $25,000 for a study of potential treatment and effluent disposal options, costs, and management requirements. The study was prepared by Harold Baker of BCM (now with Volkert & Associates), with assistance from Kevin White, a civil engineering professor from the University of South Alabama. White was very familiar with decentralized wastewater technologies, including projects and policy developments in other regions. The study was completed in October 1997.

By the summer of 1998, a developer, Steve Brewer, had approached MAWSS regarding wastewater services for a proposed subdivision outside the MAWSS sewer service area. Brewer had seen alternative decentralized wastewater systems in other parts of the country where conventional septic tank/soil absorption systems were not adequate. In response, MAWSS staff, Baker, and White briefed the MAWSS board on the 1997 study results and other developments in the decentralized wastewater field. The board agreed that providing remote wastewater service could be worthwhile for MAWSS, and it instructed staff to discuss the matter further with the developer and establish some estimates. Meetings took place later that summer and fall, and a project began to take shape.

Meanwhile, MAWSS and the Mobile County School Board began to discuss provision of wastewater services by MAWSS to a new school being planned outside the sewer service area. The MAWSS board authorized the school project in early 1999. Phase I of the Nora Mae Hutchens Elementary School Wastewater Treatment and Disposal Facility consisted of two 15,000 septic tanks and an Infiltrator® chamber drain field, engineered and installed quickly to meet the school's Fall 1999 opening.

Phase II of the Hutchens project provided advanced treatment using a recirculating sand filter (RSF). Anticipating that residential development would occur around the new school, MAWSS and its engineering consultant, Volkert & Associates, designed Phase II to accommodate the school and up to 214 homes. In addition, the engineers determined that the treatment facility site provided to MAWSS by the school board was large enough to accommodate additional RSF modules that could be installed as growth occurred, up to a build-out capacity serving the school and 1,072 homes. Homes would be connected to the treatment facility with a Septic Tank Effluent Pump (STEP) collection system. RSF effluent would be dispersed in the Infiltrator® drain field initially; eventually it would be used for spray irrigation of an adjacent sod farm owned by the school district. The Phase II treatment facility was completed in December 2000, and the first homes were connected in early 2001.

December 2000 also saw completion of a decentralized treatment facility—Copeland Island—for the subdivision developer who had approached MAWSS in the summer of 1998. This facility also uses a STEP collection system and RSF treatment. Effluent dispersal occurs in a vegetated gravel bed. A subsurface drip irrigation system for a baseball field was also designed.

The Hutchens and Copeland Island projects established the basic model used by MAWSS for all decentralized wastewater systems it has built. The key physical elements of this model are:

- Primary treatment onsite, at the individual lot, in a septic tank. The tank includes an outlet screen and in most cases an effluent pump.
- Collection using small-diameter pressurized lines from the septic tank effluent pump. Gravity collection is used in some cases where topography is favorable.
- Advanced secondary treatment off-site, at a treatment facility of one or more modules, each featuring an influent/recirculation tank and an advanced treatment unit such as a RSF.
- Effluent dispersal as appropriate and cost-effective for each location. Systems used include subsurface dispersal trenches, vegetated gravel beds, spray irrigation, and subsurface drip irrigation.

Key institutional elements of the model are:

- A developer donates land for the treatment facility and effluent dispersal zone to MAWSS. The land area must be sufficient to accommodate future expansion.
- MAWSS builds, owns, and operates the advanced treatment facility and dispersal zone. In some cases equipment for additional effluent dispersal and reuse zones (for instance, the sod farm at the Hutchens site) are operated but not owned by MAWSS.
- The developer pays a lump sum and the developer, builder, or homeowner pays various per lot and per connection fees to offset part of MAWSS's capital costs for the advanced treatment facility and dispersal system.
- The development company, at its own cost, constructs and installs all onsite tanks, filters, and pumps and the collection system, all to MAWSS specifications. The developer or homeowner owns these parts of the system.

- MAWSS operates and maintains the collection system and all onsite septic tanks, effluent screens and pumps, and electrical equipment. MAWSS periodically pumps the septic tanks.
- Homeowners sign a MAWSS agreement regarding operation of the system and pay a monthly sewer fee to MAWSS.

MAWSS now has four decentralized wastewater systems in operation west of its traditional sewer service area. Another system is being planned. The currently operating systems are described in Figure 6-2.

Table 6-2 includes the capital costs for the initial phase of advanced secondary treatment and effluent dispersal. Based on costs to date and estimates of costs for additional modules of capacity, MAWSS estimates that at build-out the advanced treatment and effluent dispersal costs will be $2,500 to $2,800 per home served. This does not include engineering and legal costs, nor the value of land donated to MAWSS for treatment and dispersal sites. Experience to date shows onsite costs for tanks, pumps, filters, electrical equipment and other appurtenances also run $2,500 to $2,800 per home. Collection lines are an additional expense and depend on the layout of each subdivision. MAWSS does not track collection line costs.

Development of a Decentralized Project in the Urban Core

In 1999, as MAWSS undertook design and construction of its first decentralized wastewater treatment systems in western Mobile County, MAWSS staff learned of a new federal program, the National Community Decentralized Wastewater Demonstration Project. This program provided federal grants, through the US EPA, for substantial projects that demonstrate innovative decentralized wastewater concepts suitable for adoption by other communities.

MAWSS believed decentralized systems might also be useful within its existing service area. It proposed a project that would withdraw wastewater effluent from a major sewer interceptor with a history of SSOs in Mobile's urban core, treat the wastewater with various low operation and maintenance (O&M) decentralized technologies, and use the treated effluent to irrigate a newly developed city park. In the Fiscal Year 2000 Appropriations Bill, Congress appropriated $1.2 million for this project. Preliminary design and formal application procedures took considerable time, and in 2002 the US EPA finally approved the project. Further design work took place in 2002 and 2003. Installation of monitoring wells and pre-project sampling of ground and surface waters began in 2003. In August 2003 Volkert & Associates completed a required environmental assessment for MAWSS (Volkert & Associates 2003). The assessment has been approved, and bids on the project were solicited in January 2004.

Table 6-2: Decentralized Wastewater Systems Currently Operated by MAWSS

	Hutchens	Copeland Island	Snow Road	Hamilton Oaks	Totals
Serves	School, subdivisions	Subdivisions	School, subdivisions	Subdivisions	
Operation began	12/00	12/00	10/01	10/01	
Initial capacity	60,000 GPD (School + 214 homes)	20,000 GPD (80 homes)	20,000 GPD	20,000 GPD	
Advanced treatment module size	30,000 GPD	20,000 GPD	20,000 GPD	20,000 GPD	
Build-out capacity	240,000 GPD (School + 1,072 homes)	170,000 GPD (790 homes)	200,000 GPD	20,000 GPD (no expansion planned)	
Connections 2000	0	17	Not built	Not built	17
Connections 2001	37	50	2	8	97
Connections 2002	83	101	2	25	211
Total connections as of Summer 2003	124	136	2	42	304
Total connections expected by end of 2004	200	240	2	80	522
Sewer type	Gravity from school; STEP from homes	STEP	STEP	STEP	
Advanced treatment	Recirculating sand filter	Recirculating sand filter	Recirculating textile filter	Recirculating textile filter	
Effluent dispersal	Infiltrator chamber beds; spray irrigation of sod farm	Vegetated gravel beds	Vegetated gravel beds	Vegetated gravel beds	

Table 6-2: Decentralized Wastewater Systems Currently Operated by MAWSS (Cont.)

	Hutchens	Copeland Island	Snow Road	Hamilton Oaks	Totals
Advanced treatment and dispersal system cost (initial phase)	$732,841	$307,450	$422,077	$278,604	
Notable features	Includes effluent storage ponds for detention in wet weather. Spray irrigation requires disinfection (UV and supplemental calcium hypochlorite)	Effluent may eventually irrigate baseball field (subsurface drip). Project is into Phase 2 (first expansion)			

GPD: Gallons per day. STEP: Septic Tank Effluent Pump.
Sources: Paper and presentation by Dr. Kevin White (White 2002a and 2002b). Construction cost data and route (connections) data provided by MAWSS

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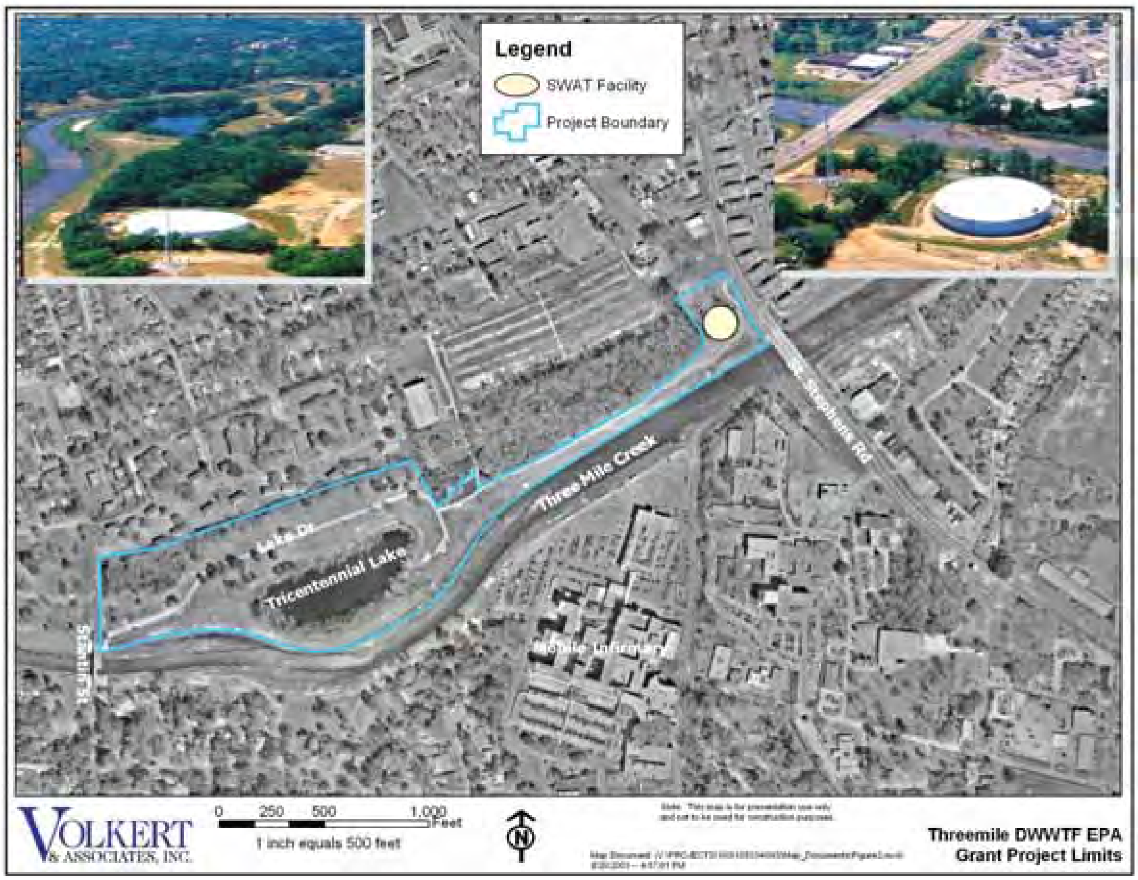
Figure 6-3 shows the project location. The system will withdraw 55,000 gallons of sewage per day from MAWSS's 42-inch Three Mile Creek Interceptor Sewer. Solids will be removed with separators and filters and returned to the interceptor. After water quality sampling, influent will be diverted into four different treatment units to evaluate their treatment effectiveness and O&M requirements. Effluent from each unit will be sampled prior to co-mingling in an irrigation water supply tank. Subsurface drip irrigation systems will disperse the effluent in open areas in the park, across a total area of 192,000 square feet.

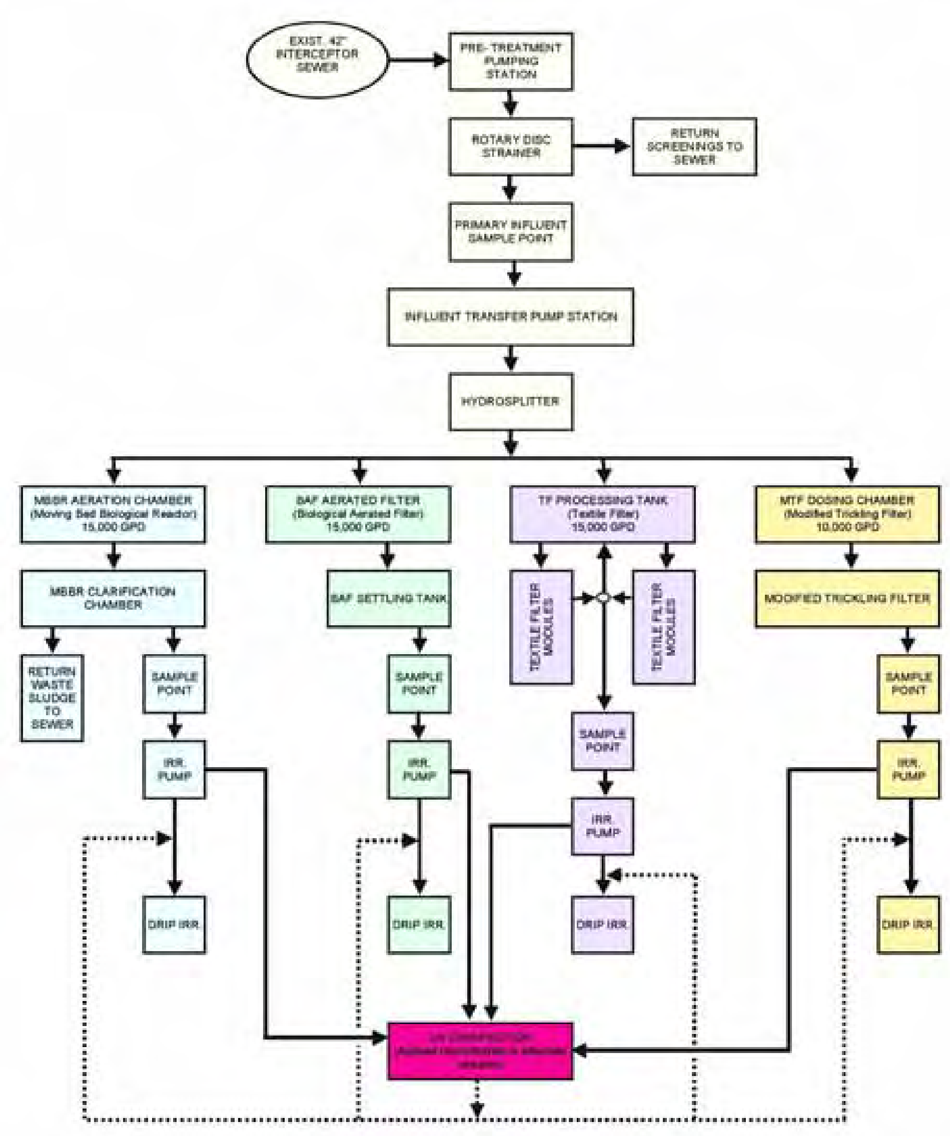
The treatment units will be located near the existing Severe Weather Attenuation Tank (SWAT) facility. Treated effluent will be dispersed via a subsurface drip irrigation system along the path between the SWAT facility and Tricentennial Lake, and around Tricentennial Lake and Lake Drive.



Courtesy of Volkert & Associates, Mobile, AL

Figure 6-3: Views of the Site for the Three Mile Creek Watershed National Decentralized Wastewater Demonstration Project

Figure 6-4 is a flow diagram of the planned system. Groundwater in the park and surface water in Three Mile Creek will be tested throughout the two years of system operation. Intermittently during wet weather, operators will withdraw twice as much sewage from the interceptor, to both test the effectiveness of the treatment units with dilute sewage and to evaluate the ability of the drip irrigation system and receiving soils to handle an increased hydraulic load.



Courtesy of the Mobile Area Water & Sewer System.

Figure 6-4: Flow Diagram for the Three Mile Creek Watershed National Decentralized Wastewater Demonstration Project

The objectives of the project are as follows (MAWSS Undated):

1. Demonstrate a concept of integrating decentralized wastewater elements into a centralized wastewater system that may offer advantages to large, urban utilities. Decentralized treatment systems to be implemented are characterized by minimal collection and solids handling, low O&M technologies, and employing reuse—thus are relatively cost efficient to build and operate when compared to conventional treatment systems. Operational effects on the existing centralized treatment facility should be minimal; however, reuse benefits, capacity enhancement benefits, and some watershed load reductions should be recognized. Costs and performance information will be determined. Decentralized treatment systems (typically low O&M) will be evaluated in terms of cost, performance, capacity, and flexibility under conditions of:
    - Diurnal flow variation
    - Dry weather flows
    - Wet weather flows
2. Demonstrate to (and educate) the local environmental regulatory agency (ADEM) and other water/wastewater utilities that urban wastewater reuse is viable in Alabama and has many applications that offer benefits to drinking water source conservation and watershed management.
3. Demonstrate that decentralized wastewater concepts can minimize stream loadings in an innovative and cost-effective way. By documenting the proposed decentralized treatment system performance, cost, and reuse, comparisons can be made to more traditional centralized treatment upgrade costs and performance to achieve the same results. While only minimal flow reductions (and pollutant discharge load reductions) will be achieved in this demonstration, it is hoped that the data gathered will show that a comprehensive integration of decentralized concepts throughout a watershed may have a significant impact.
4. Demonstrate how the utility managed decentralized (or satellite) wastewater treatment concepts can be part of an overall strategy to address wastewater infrastructure planning, including capacity issues.

The US EPA grant for this project is $1,140,000. MAWSS is providing a $400,000 cash match and $235,000 worth of in-kind services.

Analysis

MAWSS is one of a very small but growing number of urban water utilities that have seriously considered decentralized, cluster-scale wastewater systems. Actually owning and managing such systems is almost unique among such utilities. This case study focuses on how MAWSS made the decision to pursue decentralized wastewater management, why, and the results.

Value of Decentralized Systems to Large Utilities

This section addresses the following:

- ***How was system architecture relevant to this issue?*** MAWSS had to choose between providing centralized service, decentralized service, or no service to growing exurban areas of the county. This decision had substantial economic, political, and other implications for the utility.
- ***How was the issue addressed?*** MAWSS learned about decentralized options and then made a strategic decision to develop decentralized wastewater services. MAWSS's director championed the idea of the utility building and managing decentralized wastewater facilities. The utility tried several technologies to gain experience. It developed design, management, service, and revenue strategies to reduce its costs and risks.
- ***Did the issue resonate with the community?*** Developers have been very responsive to cluster systems, finding they offer reduced liability and increased marketability compared to individual septic systems. Homeowners are happy to have a utility managing their wastewater system.
- ***Results/Status:*** MAWSS plans to build no more interceptors beyond the watershed divide and to use decentralized systems instead. Other utilities have adopted the concept and are competing with MAWSS for customers.

How Was System Architecture Relevant to This Issue?

MAWSS faced essentially four choices regarding service beyond its existing sewer service area:

- Build a new centralized system in the watershed beyond the ridgeline, including sewers and a new treatment plant
- Extend force mains and build other sewer lines and lift stations as necessary to bring sewage back to the Mobile Bay watershed
- Build cluster systems to provide utility-managed decentralized wastewater services
- Provide no services, and let this growth be served by individual septic systems or decentralized wastewater facilities built and operated by developers or other entities

The question for MAWSS was, which approach best served the utility and customers? This was a question with economic, environmental, political, and other implications. MAWSS decided to embark on a path of building, owning, operating, and managing decentralized wastewater systems in exurban areas. Soon after, the utility found itself exploring an additional question: could decentralized wastewater facilities be useful within its existing, urban sewershed?

How Was the Issue Addressed?

MAWSS addressed the issue in multiple ways:

- Learning about decentralized system options, requirements, and general status
- Making a strategic decision
- Identifying additional benefits
- Trying different technologies
- Developing a legal agreement with system users
- Working with developers
- Developing strategies to minimize financial risk

MAWSS Learned About Decentralized System Options, Requirements, and General Status

The consultant's report commissioned in 1997 by MAWSS covered a range of decentralized treatment options, effluent disposal options, and residuals management (Baker 1997). For each option, the report provided applications, a process description, O&M requirements, technology limitations, and key design criteria. It gave concept-level costs for each option, including costs at different cluster sizes for technologies that presented economies of scale. It briefly described the STEP system approach. The report also outlined utility management activities and responsibilities for decentralized systems.

The report's author, Harold Baker, and Professor Kevin White discussed the technologies presented in the report at a July 1998 MAWSS board meeting. They emphasized that certain decentralized options, particularly treatment wetlands and sand filters, have low O&M requirements. Dr. White described developments nationally in the decentralized wastewater field, including a 1997 US EPA report to Congress that recognized the cost-effectiveness of decentralized systems. He mentioned that a reason decentralized wastewater treatment had not proliferated is the lack of management expertise and authority; homeowners' associations are typically left with management responsibility and fare poorly. Thus there is increasing interest in management of decentralized wastewater systems from utilities, including electric utilities. As an example, he noted a demonstration project in northern Alabama that was being funded by the Tennessee Valley Authority and the Electric Power Research Institute. The MAWSS commissioners discussed the report and presentation, asked questions of Baker, White, and MAWSS staff, and noted that the decentralized approach seemed promising. One commissioner opined that it seemed prudent to investigate the opportunities further, because if MAWSS did not do so, "somehow down the road we may just be uninvolved." (Board of Water and Sewer Commissioners 1998) The board instructed staff to continue discussions with developers.

MAWSS Made a Strategic Decision

MAWSS did not undertake a master planning process or comparative engineering studies of decentralized options, sewer extensions, or a new treatment plant in western Mobile County. The director of MAWSS, Malcolm Steeves, championed the idea of MAWSS involvement in decentralized wastewater systems because he felt it made sense on a number of grounds. Essentially, the MAWSS board concurred and made a strategic decision to pursue this approach. This decision was never set out in a formal decree or plan. Rather, it became the board's unstated philosophy, expressed at strategic planning meetings regarding MAWSS's role in the development of areas outside the current sewer service area.

The reasons that motivated MAWSS to invest in decentralized systems were many:

- ***Decentralized systems could be cost effective:*** MAWSS was keenly interested in keeping O&M costs low as it moved into exurban Mobile County. A centralized treatment facility in a new watershed would have substantial O&M costs. Likewise, operating new lift stations and force mains across a large region would be costly. Decentralized collection and treatment systems could be operated and maintained relatively cheaply. Further, solids handling would be reduced through anaerobic primary treatment in onsite septic tanks.
- ***A centralized approach would require large upfront capital expenditures:*** A new centralized WWTP and collection system, or an expanded network of force mains, would require many millions of dollars in near-term capital expenditures. The rate and dispersed nature of growth in western Mobile County meant that centralized collection systems, and any new treatment plant, would not be fully utilized for decades. MAWSS did not want to commit large amounts of capital to such projects. Capital expenditures to rehabilitate the existing collection and treatment system in the Mobile Bay watershed were already substantial. And large investments in West Mobile County would be risky—continued growth there seemed likely, but might not continue indefinitely. Further, though this issue did not receive much discussion, there was a question of intergenerational equity. With a capital-intensive centralized approach, current ratepayers would end up subsidizing infrastructure that would mostly be used by future generations. With modular decentralized systems, each generation would pay for its own capacity.
- ***Obtaining approval for a new surface water discharge would be difficult:*** A large centralized plant in western Mobile County would likely discharge to a stream. MAWSS was not eager to take on the work necessary to obtain NPDES and state permits for such a facility. Also, public resistance might arise if environmental problems relating to a stream discharge in a relatively undeveloped watershed occurred. People in the watershed, including those in Mississippi, might resist receiving waste from growth generated by Mobile. This latter concern may have had its genesis in the legacy of an earlier wastewater facility siting process for the Theodore area in southern Mobile County. In the late 1970s the county and MAWSS developed a wastewater plan for the Theodore area that called for two 20 MGD treatment plants. Residents near the proposed plants resisted, stating they did not want to be a receiving zone for wastewater. An environmental group sued to stop the project, and a protracted legal battle followed. Eventually MAWSS and the county gave up. MAWSS ended up building lift stations and force mains to bring wastewater from the area back to one

of its existing treatment plants, and the county's purchase of 2,000 acres for an extensive wetlands treatment system turned out to be unnecessary.

- ***Returning sewage to the Mobile Bay watershed would exacerbate capacity issues:*** When treatment plants, outfall lines, trunk sewers, and interceptor sewers for Mobile were designed 40 or more years ago, they were sized to handle development within the Mobile Bay watershed only; a reasonable and financially prudent decision at the time. The watershed is not yet built-out, but I/I problems have created capacity issues, particularly in the collection system. MAWSS has built an eight-million-gallon side-stream storage facility to relieve the Three Mile Creek Interceptor Sewer in wet weather. Under the consent decree addressing SSOs, MAWSS is obligated to reduce I/I for each new hookup to the system. Introducing significant new amounts of sewage into the existing system by substantially expanding the force main system west of the watershed divide would aggravate capacity issues, and in certain cases require expansion of trunk or interceptor sewers on the Mobile side, and possibly WWTP expansion as well. Further, one of the force mains on the far side of the divide was itself limited in capacity.

- ***Decentralized systems would generate new customers and a positive image for MAWSS:*** One option for MAWSS would have been to refuse service to development outside the existing service area. Given the issues noted already, this position could have been justified; however, it would have served the utility poorly in many respects. MAWSS has long been interested in providing *water* service across a larger area. The utility has an ample supply, and its marginal cost for extending water mains is low. New water customers represent valuable new revenues for MAWSS. However, as one MAWSS commissioner noted in a July 28, 1997 meeting, the utility had a reputation of only being interested in serving the City of Mobile. He stated that MAWSS needed "to be in a position to reach out with water and wastewater service." (Board of Water and Sewer Commissioners 1997) In the July 6, 1998 discussion of the consultant's report and opportunities with a developer, another MAWSS commissioner saw decentralized systems as a way to provide service in the northern part of Mobile County. This was important because the county was receptive to a whole-county approach for MAWSS's water system. Also, one county commissioner, from the north, maintained that MAWSS only ever targeted the south part of the county. This would be one way to address his concerns. (Board of Water and Sewer Commissioners 1998)

"City Water and Sewer"

Billboard advertising a rural subdivision served by MAWSS.

- ***Decentralized systems would provide a valuable tool in ongoing competition with other utilities:*** Two other utilities provide water service, using groundwater wells, in the growing unincorporated area outside the Mobile Bay watershed. By providing utility-managed wastewater services, MAWSS would be more likely to get the water service business of new developments. Further, decentralized wastewater systems could be built quickly, meeting the needs of developers (Lowe 2001). Interestingly, one of MAWSS's water service competitors, South Alabama Utilities, has adopted the same strategy. This utility has completed one decentralized wastewater system and has several more in the planning stage.

The MAWSS Team Noted Additional Benefits as the Program Proceeded

The rationales discussed in the previous sections were the primary reasons MAWSS choose to get into the decentralized wastewater services business. Since construction of its first systems, additional benefits of decentralized systems have been noted by MAWSS staff and consultants, all of which could increase MAWSS's standing in the region:

- Local reuse or dispersal of treated wastewater fits with an environmental sustainability paradigm, as compared to point-source discharge at a distant WWTP. (See Mobile Area Water & Sewer System Undated p. 13.)
- Decentralized systems could help meet total maximum daily loads (TMDLs) by reducing surface water nutrient loads. (See Volkert & Associates 2003, p. 9 and Mobile Area Water & Sewer System Undated, pp. 2 and 12)
- Decentralized systems could contribute to land-use planning (White 2002a). One MAWSS commissioner noted in an August 6, 2001 meeting that if the county is to become more urban, it needed decentralized systems and had to get away from individual septic systems (Board of Water and Sewer Commissioners 2001). In Mobile County, septic systems require a one-half-acre lot at a minimum.
- Decentralized systems could provide sewer capacity relief. While the volume of wastewater that will be removed from the Three Mile Creek Interceptor Sewer for the demonstration project is small compared to peak flows (110,000 gallons per day (GPD) versus 10 million GPD or more in wet weather), MAWSS will learn how to "mine" sewers. This knowledge could be strategically applied to projects in smaller, up-slope sewer sheds where the marginal impact of decentralized systems might be higher and could represent important sewer relief.
- MAWSS's demonstration project will contribute to neighborhood improvement by irrigating a newly developed park. Further, a MAWSS commissioner in a September 10, 2001 meeting said the project was "good public relations" as it is in a neighborhood where MAWSS has had a lot of complaints concerning sewage getting into Three Mile Creek.

As for MAWSS's public spin on decentralized wastewater systems, the utility describes on its website the nature and objectives of its offerings as follows:

> **Remote (Off-Site) Alternative Treatment Systems**
> Until 1999 MAWSS relied on the traditional method of managing wastewater, depending on collection and interceptor sewers to bring wastewater from thousands of homes and businesses to a centralized facility for treatment, monitoring, and disposal. The process is typically safe, economical, and environmentally sound. However, treatment and disposal of large volumes of effluent into receiving bodies of water at point locations is increasingly drawing opposition from some customer and regulatory interests. At the same time wastewater service for dispersed population growth away from urban areas is becoming costly.
>
> Alternative treatment systems offer a solution to providing wastewater management to presently unsewered areas without extending interceptor sewers. To keep septic tank use in the County to a minimum, MAWSS has extended its wastewater management efforts outside of the drainage area of its centralized treatment facilities by planning and constructing alternative treatment systems. These systems use existing collection,

> treatment, and disposal technologies designed for small numbers of customers to produce treated wastewater that can be reused or otherwise disposed of in the ground at or near the generation location. The concept provides economical wastewater management solutions for population expansion in less densely populated areas of Mobile County consistent with a clean environment. The service is offered to groups of customers willing to share actual costs. Contact us for further information. (MAWSS website, http://www.mawss.com/ww-alt.htm)

MAWSS Has Been Trying Different Decentralized Treatment Technologies

In its first two systems, MAWSS employed recirculating sand filters, a well-proven technology. For its next two facilities, MAWSS chose recirculating textile filters, a newer but promising technology (see Figure 6-5, Figure 6-6, and Figure 6-7). The engineered textile filter media is consistent as delivered to every site. Sand filters rely on local gravel specified to a certain size. Such gravel can be difficult to locate, expensive, and variable in quality. The textile filter technology also takes one-half to one-third the area needed by a recirculating sand filter treatment system. The demonstration project will evaluate four technologies: a textile filter and three other technologies not yet used by MAWSS (biological aerated filter, modified trickling filter, and moving bed biological reactor). MAWSS is "learning by doing": learning the costs, treatment performance, and operational requirements of decentralized technologies. Once the demonstration project is completed, MAWSS will have operational experience with five different technologies. According to Director Malcolm Steeves, one objective of the demonstration project is to provide information that will allow the utility to standardize on two technologies for future systems. This will enable a consistent and competitive bidding process, as well as consistency and efficiencies in operation and maintenance.

Courtesy of the Mobile Area Water & Sewer System

Figure 6-5: Construction of the 20,000 GPD Decentralized Wastewater Treatment System at Snow Road, Showing Installation of Textile Filter Units

Courtesy of the Mobile Area Water & Sewer System

Figure 6-6: Close-Up View of the Filter Media and Effluent Distribution Systems

Courtesy of the Mobile Area Water & Sewer System

Figure 6-7: The Completed Treatment Facility with a Portion of the Vegetated Gravel Bed Effluent Dispersal Area in the Foreground

MAWSS Designed Cluster Systems to Minimize O&M

A major objective for MAWSS in pursuing decentralized wastewater management was to minimize O&M requirements. Besides cost issues, frequent maintenance or repair calls would be disruptive to staff, who were and are still located about a one-hour drive from the most remote decentralized system. To minimize O&M and ensure system reliability, MAWSS took the following steps regarding the design and construction of cluster systems:

- Septic tanks are sized to require pumping only every three to five years.
- The onsite system has sufficient capacity to operate normally for 48 hours if a pump fails, allowing ample time for MAWSS personnel to respond.

- Septic tank outlet screens are required. These screens reduce discharge of solids and grease, which could clog collection lines and components of the advanced treatment facility. Filtering effluent at each connection also allows advanced treatment units to be sized for and operated at a higher hydraulic loading rate (White 2002a).
- Developers must build collection lines and onsite components to MAWSS specifications.
- Each connection (septic tank and appurtenances) receives a final inspection by MAWSS personnel before start-up.
- The developer must provide a two-year warranty on the collection system.
- Each advanced treatment facility has backup power.
- MAWSS has installed Supervisory Control and Data Acquisition (SCADA) systems to allow remote monitoring of the systems.

MAWSS Developed a Legal Agreement Specifying Homeowner Responsibilities

To further reduce O&M, MAWSS took steps to ensure system users would not misuse their "sewer." The developer must have each homeowner sign a "Homeowner's Sewer Collection System Agreement" before a sewer connection is established. This agreement is binding on future owners and is recorded in the manner of a deed with the Probate Court of Mobile County. The original is forwarded to MAWSS. The terms of the agreement include:

- The homeowner understands that the subdivision is served "by a treatment and disposal facility located in that vicinity as well as septic tanks serving the subdivision's individual homes."
- The homeowner will allow MAWSS or its contractor "permission to come onto the subject property and to have free access to the collection system for operation and maintenance." The homeowner will not place or plant anything on or over the system that impedes MAWSS O&M efforts, and indemnifies and holds MAWSS harmless for removal or damage to any items that impede access.
- The homeowner will not install a garbage disposal, and "homeowner further agrees not to dispose of grease or other kitchen waste solids into the sewer or collection system."
- "Homeowner understands and agrees that damage to the collection system or excessive maintenance caused by homeowner . . . will be billed to homeowner."
- The homeowner will immediately notify MAWSS of any problems.

MAWSS Kept Its Costs Down by Working With Developers

MAWSS kept its costs down by working with developers in sharing system costs, which kept capital costs and financial risk down. Developers benefited by having a well-managed “sewer” system that could improve the marketability of homes. An important factor in this equation was the donation of land by the developer. If MAWSS had to purchase land for the treatment and effluent dispersal system, the utility’s costs would be considerably higher. This might require MAWSS to reduce land costs by choosing a more active treatment technology that would have a smaller footprint than relatively passive and land-intensive sand filters.

MAWSS Developed Service and Revenue Strategies to Minimize Financial Risk

MAWSS commissioners had some initial concerns about ensuring a “market” for decentralized wastewater services. Why would a developer donate land for a treatment facility? Or continue to hook houses up to the system? It was pointed out that a cluster treatment system would enable development at a greater density than septic systems would, providing a net increase in the number of units. The commissioners felt “the numbers” would be attractive to developers (Board of Water and Sewer Commissioners 1998). MAWSS also built three of its first four decentralized systems near schools, where development was likely. Even so, it was possible that developments using individual septic systems instead of cluster systems could proliferate around the schools. MAWSS staff held discussions with Health Department and County Planning Department staff, who were supportive of the idea of requiring connection to decentralized systems sewers where available, rather than allowing individual systems (Board of Water and Sewer Commissioners 2001). However, no such requirement has been formally adopted, and some subdivisions using individual septic systems have been built near MAWSS decentralized facilities.

MAWSS also developed conservative revenue structures to ensure its costs would be covered. As noted earlier, developers share the costs by donating land for a treatment/dispersal facility and building the collection system. Developers also share the costs of the treatment/dispersal facility. MAWSS estimates costs for each facility, and determines utility and developer contributions. Typically MAWSS funds 30–40 percent of the facility cost, and recovers the remainder from developers who connect to the system. MAWSS calculates fee levels such that it captures the developer’s portion of the facility cost within 10 years. The fees are also based on estimates of how many homes are likely to connect to the system within that time. The basic fee structure is shown in Table 6-3.

Table 6-3: Fee Structure for MAWSS Decentralized Cluster Systems

Fee	Amount
Lump sum fee (called an "acreage fee," and analogous to a frontage fee) paid by the developer up-front	Varies. $6,000 for several developments. The school board paid an up-front fee of $75,000 but no other connection fees for the Hutchens facility
Per-lot fee paid by the developer up-front	Varies according to the system and phase. The range to date is $935 to $1,800 per lot.
Capacity fee paid by the developer, builder, or homeowner at the time each home applies for sewer service	$720 per home
Connection fee (or "service line fee") paid by the developer, builder, or homeowner at the time each home applies for sewer service	$150 per home

Source: Contract letters between MAWSS and developers

Did the Issue Resonate With the Community?

Developers who have participated in MAWSS decentralized projects are reportedly pleased that MAWSS is offering this service. In some cases the systems have allowed greater housing density—up to 30 percent more homes on the developer's property than with septic systems. (See White 2002a, p. 15.)

> Participating in a MAWSS cluster system "costs more, but we buy insurance when we build the house. At least that's how we look at it."
>
> Jay Weber, developer/builder

One developer/builder contacted for this study said that the geometry of his property dictated the layout of lots, so he could not increase the number of lots. Connecting to the MAWSS system cost "a couple thousand dollars" more per home than if he had developed with individual septic tanks, but the marketability of the homes was greatly increased. In this developer's experience, individual septic systems "work great except for the one that doesn't." If there is a problem, it is the builder who gets the call, not the subcontractor who installed the system. Further, if the subdivision is in the active sales phase, the last thing the developer or builder wants is realtors and potential buyers hearing that someone in the development has a septic system problem. Participating in the MAWSS cluster system provides a comfort level to the builder, as there is no onsite drainage field to worry about.

This developer/builder reports that homeowners are very pleased to be on a MAWSS system. The system has to be explained to prospective buyers, but they like the fact they do not have a drainage field that could have problems or could restrict what they build or grow on a portion of the lot. They also like having a reputable utility operate and maintain the system. The homeowners do not mind the rule against garbage disposals and dumping of kitchen wastes.

They understand that they are far from sewer lines, and the alternative is an onsite septic system that would have the same restrictions.

No homeowners in his subdivision have complained about the sewer rate charged by MAWSS (140% of the rate within the conventional sewer service area), but he has heard that some homeowners in another subdivision have complained about the rate.

Developers consider it an advantage to be able to market their development as being served by a "sewer system." It is also considered an advantage to have MAWSS service rather than service from a competing utility. One can then advertise "city water and sewer."

> "Homeowners love it! They don't have to ever worry about septic systems. Most know somebody who's had a nightmare with septic."
>
> Steve Brewer, developer/builder

One developer says MAWSS is well-regarded in the developing rural portion of the county for offering service there. Another says that MAWSS has not realized the positive public relations it could have enjoyed through self-promotion regarding the decentralized wastewater projects. He says MAWSS gets a lot of bad press for sanitary sewer overflow (SSO) problems in the older areas of Mobile. In his view, MAWSS could have "played offense" to improve its image by drawing more attention to the innovative and environmentally sound wastewater services it is providing with its decentralized systems.

As for MAWSS's demonstration project in the urban core of Mobile, this does not seem to have attracted much attention yet. Construction has not yet begun, and public response to the results of the drip irrigation scheme will not be heard for some time yet. However, at least one citizen group, Keep Mobile Beautiful, is supportive of the project and has participated in planning meetings.

Results/Status

MAWSS has gained a great deal of experience with cluster-scale wastewater systems through its four existing projects, and it expects to gain valuable information from the demonstration project. The utility is convinced the concept is technically sound. The economics will not be entirely clear until growth around the decentralized facilities proves out or not. However, considerably less capital is at risk in these projects than would be the case if the utility had chosen a centralized alternative.

The four existing MAWSS systems are functioning well. Ammonia levels in effluent from the Hutchens systems were high for the first year, when only the school system was connected. This was likely due to cleaners used by the school's custodial staff, and it has since been resolved. Otherwise, the systems are performing at or beyond expectations.

Harold Baker credits MAWSS director Malcolm Steeves for much of the utility's success with decentralized systems. Steeves had the vision to promote MAWSS's entry into the cluster system field, and he has established an atmosphere at the utility that is conducive to integration of decentralized systems into an urban utility.

"The manager sets the scene for everyone. One of the things when it comes to operations and maintenance is that the effectiveness of these systems depends on the operating staff. Staff [members] like these systems. They have full permission from Malcolm [Steeves] to do what's needed."

Harold Baker, Senior Project Manager, Volkert & Associates

Connections to MAWSS's systems are increasing steadily. shows that MAWSS served roughly 300 customers as of 2003 and expects that number to grow to 500 or more in 2004. Operating costs appear to be manageable and in relation to revenues. shows O&M costs and revenues to date.

Table 6-4: Operating Expenses and Income for MAWSS Decentralized Cluster Systems

	2000	2001	2002	2003 (annualized actual)
Total O&M costs	$9,800	$62,200	$48,300	$75,700
Income from sewer rates	$2,900	$18,300	$34,800	$120,600

Source: MAWSS financial data

Revenues were less than expenses in early years, as would be expected. MAWSS will turn a net profit for the decentralized systems account in its fourth year.[7] Expenses are expected to increase in coming years as septic tank pumping begins, but revenues should increase with additional connections.

MAWSS is still studying needs and accounting for long-term renewal and replacement of the decentralized systems. Because the textile filter systems consist of multiple small units or "pods," there is not a single large item representing a substantial part of the whole. It is likely MAWSS will expense these replacements on a schedule that would involve a small part in any year. Some of the other decentralized systems, however, have larger components that would not allow this approach.

[7] "Profits" help cover the 30–40 percent of a facility's capital cost that is paid by MAWSS.

Roughly five to 15 years ago, MAWSS extended force main interceptors into three areas beyond the Mobile Bay watershed divide. It now expects to utilize decentralized systems to serve any areas not in proximity to these force mains. The utility did recently decide to upsize one of these lines, the Semmes Interceptor, at the request of a Super-Wal-Mart planned for the Semmes service area. However, MAWSS expects to build no *new* interceptors beyond the divide.

Recently, at least one developer has begun to question the utility/developer financial equation. Steve Brewer says donating land and the collection system does not make good business sense for him. He gives away assets, and then the utility charges homeowners the same or higher fees as if they were on a centralized system.

He believes this is highly profitable for MAWSS, and says he would not do another decentralized wastewater system without being a part-owner of the system to share in the profits. Brewer would advise MAWSS to be more flexible in how it works with developers and in reducing the costs of its systems.

Other entities are now mimicking MAWSS, which is a sign of the viability of the cluster wastewater system concept. In fact, South Alabama Utilities (SAU), the competitor previously mentioned, appears to be highly successful with its decentralized wastewater service offerings. It has apparently secured deals with four developments and is reportedly negotiating with a school. Three of the developments are in areas to which MAWSS provides water service, and two are near MAWSS decentralized wastewater systems. This kind of block-by-block competition is possible because in Alabama, public service planning jurisdictions beyond the boundaries of incorporated municipalities are not decided at the local level. An act of the state legislature would be required to divide rural Mobile County into different service areas for different utilities, which is unlikely.

SAU is reportedly offering lower costs to the developers. This utility, owned by another Mobile County city, has a different cost structure than MAWSS, particularly in regards to pay and benefits scales. It may also be that SAU’s systems are somewhat less substantial than those built by MAWSS.

MAWSS is not entirely sure how to respond to this development. For the time being, Director Malcolm Steeves is just glad to see the concept catching on. He believes that advanced treatment cluster systems, not individual septic systems, are in the long-term interest of the growing rural areas of the county.

Perhaps more troubling is the fact that a private utility also beat out MAWSS for a decentralized wastewater system in the northern part of the county. This worries Steeves because many private utilities do not adequately depreciate assets and set aside funds for future maintenance and rehabilitation. MAWSS is helping initiate discussions in the state legislature aimed at improving financial regulation of private water and wastewater utilities. The proposal would require a private utility to put aside funds so that if it fails, there will be some assets available for the entity that takes over responsibility for the system.

Conclusions

Someday, as the exurban area around Mobile increases in density, MAWSS might connect-up its decentralized systems to create a more centralized system—or it might not. MAWSS will not have to face that decision for decades. It will be clear whether this makes sense when the time comes. Now, it is clear that decentralized systems are the best way for MAWSS to service this area.

MAWSS Director Malcolm Steeves believes decentralized wastewater management will make sense in the long term, too. He says:

> The idea of putting water into the ground close to where it was generated is sound. The infrastructure problems we are having in dealing with conventional gravity systems are huge. With decentralized systems, since most are pressurized, I think we're going to be able to sidestep those problems forever.

This comment reflects MAWSS's concern with I/I to gravity sewers. Pressurized sewers use smaller diameter pipes with many fewer joints, making them far less susceptible to I/I.

The approach MAWSS took to entering the decentralized field and building its capabilities to manage small, "alternative" systems is instructive. Other utilities considering decentralized wastewater systems would do well to follow MAWSS's lead:

- Learn the options. In the last 10 years there has been much activity in the decentralized wastewater management field. There are technologies and management models available for just about any situation.
- Consider what value decentralized systems can provide, based on the particular situation. Cost-effective service? Rapid response to a service problem or opportunity? Reduced financial risk? Reduced exposure to criticism on environmental, equity, or other grounds? Avoidance or reduction of capacity issues in an existing centralized system? A tool to gain new customers and compete with other utilities?
- Find a "champion." This case study points out the substantial impact a few well-placed individuals with vision can have on wastewater planning. The technical expertise of Professor Kevin White and the leadership of MAWSS's top manager, Malcolm Steeves, greatly facilitated the development and implementation of an alternative wastewater architecture for growing areas around Mobile. It is especially important that one or more senior managers in a utility support an alternative concept.
- Try it. Decentralized wastewater management does not require a large investment—to an urban or suburban utility—to get into. The decision need not be difficult. MAWSS did not need to intensively study its situation to know it made sense to try a decentralized approach. Formal master planning is appropriate and useful in many situations, but it is not necessary in order to justify trying the concept.
- Experiment with different technologies. Learn by doing, which is the surest way to find out what works best in a specific area and with particular management capabilities and constraints. After trying different technologies, standardize on one or two that meet the community's requirements most closely.

- Carefully consider cost structure when choosing technology. In MAWSS's case, given the remoteness of some of the developments it served, the utility felt it was best to pick low O&M technologies, and to design components of the system in ways that reduced O&M. Plenty of models for low O&M or low capital cost systems are available from around the country.
- Be clear with partners (developers) and users (homeowners) regarding what are the responsibilities of each.
- Develop a service strategy and revenue structures that minimize risks.
- Be open-minded and be ready for new ideas.

Malcolm Steeves said one of the greatest outcomes of his utility's foray into decentralized wastewater management is that the experience has opened up his staff and board's thinking in a general way that is helpful in many aspects of MAWSS's business.

Sources

Sources for this case study include:

Phone Interviews

All interviewees are located in Mobile, AL and include:

- Harold Baker, Senior Project Manager, Volkert & Associates
- Steve Brewer, President, Brewer Homes
- H. E. "Hap" Myers, former consultant on the Mobile County Master Plan; now Vice President, Malcolm Pirnie
- Malcolm Steeves, Director, Mobile Area Water & Sewer System
- Jay Weber, President, JBL Properties, Ltd.
- Kevin White, Professor, University of South Alabama Department of Civil Engineering

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August 29, 2003.

White, K. D. 2002a. *Use of Decentralized Wastewater Cluster Systems by a Large Urban Utility in Mobile, Alabama.* Water Environment Federation Technical and Educational Conference, September 28 to October 2, 2002, Chicago, IL.

White, K. D. 2002b. *Decentralized Wastewater Management by a Large Urban Utility: Mobile's Experience to Date.* Water Environment Federation Technical and Educational Conference, September 28 to October 2, 2002, Chicago, IL.

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7 PARADISE, CALIFORNIA

This case study addresses the topics:

- Incremental capacity provision
- Growth, development, and autonomy
- Performance and reliability
- Fairness and equity
- Stakeholder relationships and trust

The Community

Paradise is a community of roughly 27,000 people located in the northern California foothills of the Sierra Nevada mountains. It lies on the east side of the Sacramento River valley, 90 miles north of Sacramento and 15 miles southeast of Chico. The incorporated town covers 18 square miles of southward sloping terrace topography bounded on the east and west by rugged canyons. For this reason, the local residents refer to Paradise as “the Ridge.” Population is dispersed, industry is negligible, and commercial development is fairly limited, all of which contribute to a rural atmosphere cherished by many residents.

In 1950, federal highway funds were used to extend the “Skyway” road to Chico, and Paradise became a desirable bedroom community for those working in Chico and other valley cities. During the 1970s, publicity campaigns brought thousands of retirees to Paradise in search of a small, rural, foothills community lifestyle. Population growth in the 1980s was led by younger families leaving the large urban areas of California. This population growth was accompanied by growth in the service and medical sectors, and to a lesser extent, the retail sector. Table 7-1 shows population growth in Paradise in recent years.

Table 7-1: Town of Paradise Population by Decade

Year	Population
1960	9,750
1970	14,539
1980	22,571
1990	25,150
2000	26,408

Source: US Census 2000

Paradise incorporated in 1979 as the Town of Paradise to gain control over growth and provide services. It is a relatively new town and has experienced substantial political struggles over its future.

Figure 7-1: The Location of the Town of Paradise in the State of California

Wastewater Issues

Most of Paradise lies on soils that are suitable for wastewater soil absorption systems. The northern end of town lies at roughly 2,700 feet and receives more than 100 inches of rain per year. The north and central areas are characterized by ponderosa pine forests on deep, well-drained clay loam soils. Some areas have shallow, rocky, or poorly drained soils. The southern edge of town lies at 1,000 feet and receives about 30 inches of rain per year. This area is more sparsely populated; it has relatively shallow soils, rock outcrops, and volcanic debris as a result of ancient eruptions of nearby Mount Lassen.

Development through the 1970s was easily accommodated by conventional septic systems for both residential and commercial needs. But problems with relying on septic systems became apparent during this period as well. Many system failures were noted, and water sampling conducted in the late 1970s through 1982 found high bacteria levels in surface waters and some private drinking wells around the commercial district. The commercial district lies along two major road corridors in the central part of town. The high bacteria levels were thought to indicate septic system problems in this area.

The 1980s were a time of significant commercial growth for the nearby cities of Chico and Oroville, which experienced growth in sales tax revenues per capita of 37 percent and 45 percent, respectively. Paradise, meanwhile, saw only an 8 percent increase in sales tax revenues per capita (see Town of Paradise 1992, Table II). The construction of shopping centers in Chico at the foot of the Ridge forced many small businesses in Paradise to close, resulting in a severe loss of tax revenue and services. The Paradise business community perceived itself to be at a competitive disadvantage to Chico due to the lack of a wastewater collection and treatment system, despite other advantages in land and housing costs, labor, and lifestyle. Small lot sizes and a strained soil capacity in the Paradise business district often precluded commercial development and building renovations that would increase wastewater generation.

Photograph by Richard Pinkham

Figure 7-2: Many Homes in Paradise Are Nestled in a Forest of Ponderosa Pine Trees

Historical Overview

Four “eras” have occurred in the evolution of thinking regarding wastewater management in Paradise:

- Early developments, mainly onsite regulation and scoping of issues
- Study and rejection of sewers

- Development and evolution of a town-wide Onsite Wastewater Management Zone
- Movement toward use of cluster systems in selected locations

Early Developments

Discussion of wastewater system needs in Paradise began in the early 1970s. A citizen effort in 1970 to have the Paradise Irrigation District (the town's water supplier) provide sewer service in the commercial areas of town was voted down 61 percent to 39 percent. An attempt by the Paradise Chamber of Commerce to form a county service area for sewers also failed in 1972. However, in anticipation of future construction of a central sewer treatment facility, Butte County in 1974 laid approximately 1,000 feet of sewer line along the Skyway during a road-widening project.

In 1979, the Central California Regional Water Quality Control Board adopted a Water Quality Control Plan (a Clean Water Act Section 208 report), which included a recommendation for a centralized plant south of the business district to serve 500 lots along the Skyway. The board also suggested that new development might need a no discharge mandate until collection system and treatment plants were built and operational. The board also indicated that additional water quality data were needed to assess the suitability of septic systems in Paradise.

The 1983 *Town of Paradise Wastewater Management Study Phase I Report* (James M. Montgomery Consulting Engineers 1983) found surface water quality samples exceeded fecal coliform limits at a number of locations. The most affected basins were those in the commercial district, where septic effluent application rates in some locations exceeded 1,000 gallons per day (GPD) per acre. Springs and groundwater generally had low fecal coliform counts. While the study found elevated nitrate levels in only one sample, a water-nitrogen balance analysis suggested that perched groundwater might be approaching or exceeding the allowable nitrogen limit in several basins. The study recommended the development of a groundwater monitoring program and consideration of a centralized wastewater treatment facility for basins of the commercial district.

In response to these findings, the town council in 1983 enacted Ordinance 103 to establish its own wastewater regulations for septic systems. Up to this point, Paradise was subject to the Butte County Department of Environmental Health septic regulations. The county's authority remained in place after 1983, but now it enforced the city's stronger rules within Paradise. Town officials felt more stringent requirements might help alleviate the need for sewers and also help control growth. Among its many provisions, the ordinance established permit fees, dual-compartment septic tank construction specifications, and defined the usable area necessary for leach fields as a function of slope, depth to groundwater, and percolation. The regulations required that each soil absorption system greater than 400 gallons-per-day (GPD) capacity have a 100 percent reserve leach field located upon the subject property, and established a maximum wastewater loading rate of 900 GPD per acre. This requirement was placed upon new construction and existing development. This effectively acted as a growth control measure, since many small lots in the town did not have the ability to subdivide and still meet loading requirements and accommodate a reserve leach field.

Meanwhile, the Regional Water Quality Control Board found that the bacteriological data presented in the Phase I report were "insufficient to justify the need for centralized wastewater facilities." (See Tchobanoglous 1984, p. 2) The town commissioned a supplemental study in 1984 by wastewater expert George Tchobanoglous. Based on additional bacteriological tests, Tchobanoglous concluded that a serious pollution problem did not exist at that time, and that rigorous implementation of the 900 GPD per acre maximum loading rate would help minimize the impact of residential development on water quality. To accomplish this, he recommended formation of an onsite wastewater management district and development of a public education campaign. For the commercial district, he noted that wastewater volumes would, with continued development, exceed hydrogeologic capacity in various locations, resulting in the surfacing of partially treated effluent. He recommended installation of water conservation fixtures to forestall such problems, and the study of small community facilities for selected locations along the Skyway.

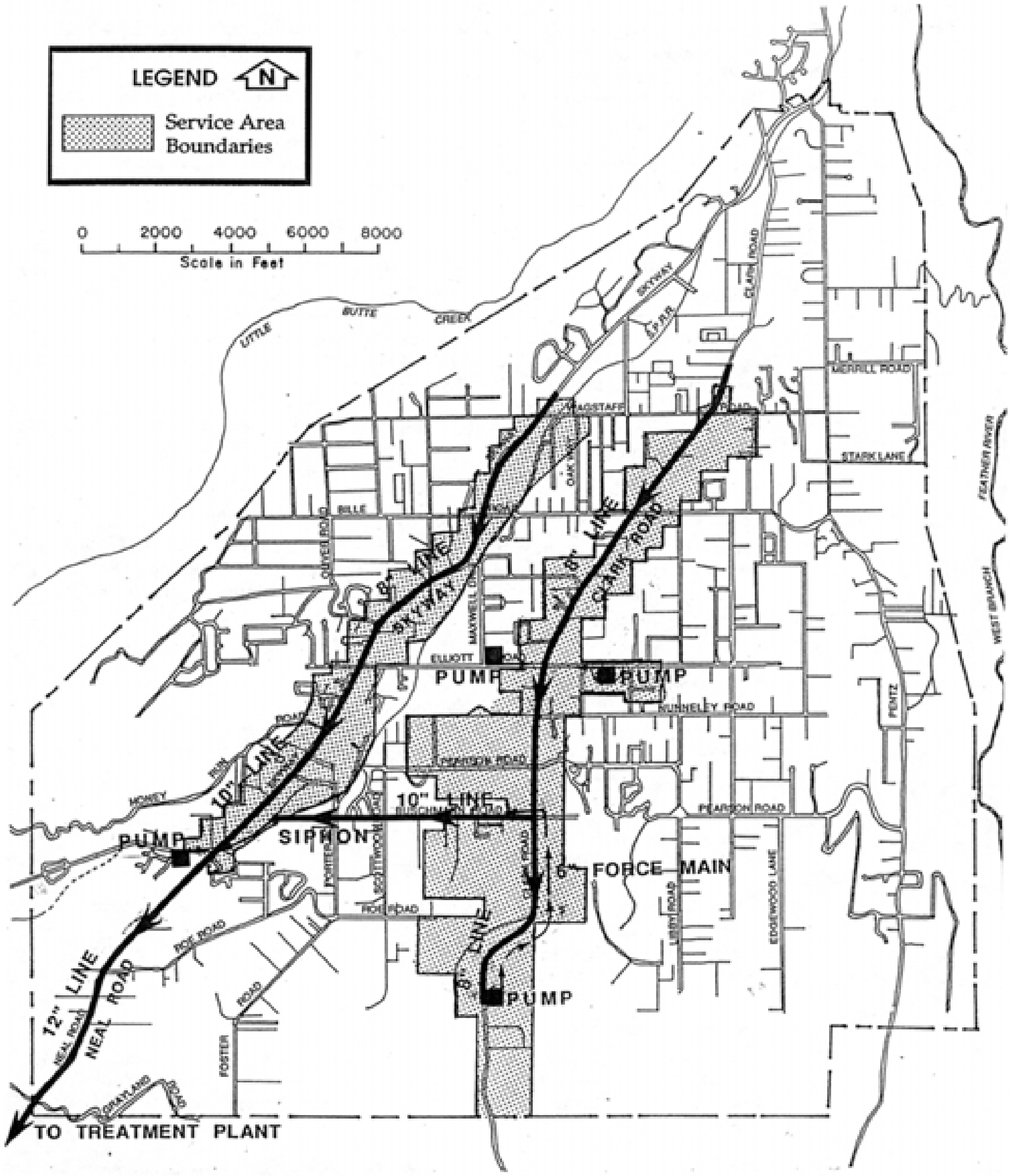
In 1985, R. A. Ryder & Associates completed a Phase II planning study (R. A. Ryder & Associates 1985). The consultant determined that with the exception of the commercial district, the majority of Paradise was suitable for onsite systems. The report recommended conventional gravity sewers across a 1,351-acre commercial service area and construction of a treatment facility for the collected wastewater plus septage from onsite systems. It also recommended expanded water quality monitoring and formation of an onsite management district.

Study and Rejection of Sewers

Paradise retained Kennedy/Jenks/Chilton Consulting Engineers (K/J/C) in April 1988 to perform analyses supporting the design and construction of sewers and centralized treatment for the commercial areas of town. Figure 7-3 shows the proposed service area. The map in Figure 7-3 also shows trunk lines for a gravity sewer option. Note also Little Butte Creek and the West Branch of the Feather River. These waterways lie in deep canyons. Paradise occupies the high terrain in between.

The resulting March 1989 feasibility study (Kennedy/Jenks/Chilton Consulting Engineers 1989) estimated capital costs at $14.5 million for a collection system to serve the area at full build-out and treatment capacity adequate for existing users plus 10 to 15 years of growth. The study recommended setting connection fees for initial users at $3,500 per equivalent dwelling unit (EDU), financed by an assessment bond and recouped by property tax assessments over a 20-year term at a rate equivalent to $30.50 per month per EDU. Operating costs would be supported by a monthly rate of $13.50 per EDU initially.

Business owners opposed the proposed costs. They maintained costs should be spread across the community. A community group formed named Citizens Looking for Affordable Sewer Systems (CLASS) to explore funding and other cost reduction measures. This effort led to the town council establishing a Wastewater Steering Committee, composed of several staff and a number of citizens, in May 1990.



Courtesy of the Town of Paradise
Source: QUAD Consultants 1989

Figure 7-3: The Service Area Recommended by Kennedy/Jenks/Chilton Consulting Engineers in 1989

The council commissioned K/J/C to prepare the Engineer's Report necessary under state law to establish an assessment district (Kennedy/Jenks/Chilton Consulting Engineers 1990). This report outlined necessary tasks for design of a wastewater collection system and treatment plant for the commercial area and development of an Onsite Wastewater Management Zone for those areas with adequate soil capacity. Both projects were to be funded by a town-wide Wastewater Design Assessment District (WDAD). The WDAD would utilize authorities provided under California's Municipal Improvement Act of 1913 and Improvement Bond Act of 1915 to levy an assessment on every property in the town and issue bonds. This assessment was to be for design activities only, not construction.

The estimated cost of studies and design activities of the WDAD was $4,015,000. Properties were assigned one or more “assessment units” based on an allocation of EDUs according to property size (up to 10 units for properties 20 acres or larger), with each assessment unit assessed $323.82 if paid over 15 years. Property owners wishing to avoid finance charges could make a one-time cash payment of $273 per unit. In late November 1990, after conducting a required protest hearing and receiving fewer written protests than needed to preclude the assessment (protests from property owners representing over one-half the land area to be assessed are required), the town council voted unanimously to create the WDAD. The WDAD hired a staff project engineer and retained Nolte and Associates to conduct and coordinate design work and a number of other studies.

Many residents were upset when the council proceeded with the WDAD. Reasons included feelings that the assessment scheme was inequitable, concerns over potential implications of sewers for growth and change in the character of the town, doubts that sewers could be affordable to residents, and an overall perception that the council was not really listening to citizens. After first attempting and then dropping a poorly designed lawsuit, a group of citizens launched a successful recall petition and campaign based on opposition to the council’s sewer actions and an anti-smoking ordinance council had also recently passed. In March 1992 voters recalled four out of five town council members. In July 1992, Paradise held a replacement election and elected an anti-sewer majority.

Also in July 1992, Nolte presented its designs and cost estimates for a centralized system for the commercial district (Nolte and Associates 1992a, 1992b, and 1992c). The engineers reviewed three alternatives for a centralized collection system and 11 alternatives for centralized treatment and disposal. The service area recommended by Nolte and Associates differed somewhat from the Kennedy/Jenks/Chilton Consulting Engineers recommended service area (Figure 7-3), but not in essence.

Nolte’s report recommended a combination of conventional gravity, septic tank effluent pump (STEP), and septic tank effluent gravity (STEG) sewers. A centralized treatment plant would be built several miles downslope of the service area, using an aeration pond (primary treatment), overland flow (secondary treatment), and traveling bridge filter system (advanced filtration), plus an ultraviolet disinfection system. Discharge would be to a canyon. The discharge would create a perennial stream, with some water used to create a 20-acre wildlife habitat wetland. The Nolte study put capital costs at $20.7 million, as shown in Table 7-2. Operating costs were estimated at $364,000 per year.

Table 7-2: Capital Costs for Recommended Wastewater System, July 1992

System Component	Capital Cost (1992$)
Collection system	$14,450,000
Treatment and disposal	$6,251,000
Total	$20,701,000

Source: Nolte and Associates 1992b, Table III-1

When the new council members from the July replacement election were seated, one of their first actions was to place an advisory measure on the November 1992 election ballot. The question put to the voters was, “Shall the Town of Paradise design and construct a formal sewer system in those areas determined by the town council to be in need of sewerage?” The vote was 7,406 no and 5,797 yes. Ironically, the November election also returned a three to two pro-sewer majority to the council. However, according to Town Clerk Frankie Rutledge, this new council decided not to contradict the advisory vote of the people, and in March 1993, effectively ended the sewer proposal by passing two resolutions to retire early some of the WDAD bonds and to refund about two million dollars in unspent WDAD funds to property owners.

Development and Evolution of the Onsite Wastewater Management Zone

An Onsite Wastewater Management Zone is a legal entity authorized under the California Water Code, Sections 31145–31149. It allows a community to implement its own management and enforcement program, thus assuming responsibility and accountability for the effective operation and maintenance of onsite systems within its jurisdiction. As of 1991, when the Nolte team began advising Paradise on formation of a zone, four other California communities—Stinson Beach, Georgetown Divide, Sea Ranch, and San Lorenzo—had established zones.

The town council established the zone in May 1992, and in July approved Ordinance 219 establishing new onsite system regulations. Notably, the new regulations eased some density constraints created by the 103 regulations; they no longer required 100 percent of the reserve leach field to be on the property served, thus opening the door for communal leach fields and cluster systems. Through the zone, Paradise established a program for initial and periodic operational evaluation of all onsite systems by private evaluators. The town required operating permits for all new and existing systems; adopted design criteria, including special regulations for large systems and innovative systems; set up variance and enforcement procedures; and established a monitoring program.

After the sewer proposal was abandoned, the already established zone became the means for Paradise to manage wastewater town-wide. The regional board, which had previously approved the zone for areas outside the sewer district, accepted this change. Since inception, Paradise has occasionally revised the policies and operation of the zone. Most notably, the town:

- Developed a certification and training programs for evaluators
- Revised regulations for large systems, placing some discretion in the hands of the onsite sanitary official
- Revised maximum hydraulic loading rates and established maximum nitrogen loading rates, thereby allowing greater use of pretreatment systems for area-limited lots
- Formed and disbanded a Wastewater Management Zone Commission
- Formed and let lapse a variance committee
- Replaced town zone staff with a private contractor, 7-H Technical Services
- Commissioned an outside review, by Questa Engineering Corporation, of zone programs and operations
- Established an annual operating permit fee of $14.40 per residential customer (more for commercial customers), maintained since formation of the zone. Over time the town revised the fee structure for other permits and activities so that the zone budget went from being subsidized by the town to being self-supporting. Additional fees range from $15.40 for a minor building clearance to $970.00 for an onsite rule variance application. In the 2002 fiscal year (ending June 30, 2002), zone expenses totaled $284,968. Revenues, derived from $199,880 in annual permit fees and $164,472 in other permit fees, totaled $364,352

At present, the zone has three full-time and one part-time staff members. All are 7-H employees, but operate out of the town hall and represent themselves as town staff. In addition, the president of 7-H, Lloyd Hedenland, serves as the Paradise Onsite Sanitary Official, operating out of town hall one day per week. 7-H is responsible for essentially all functions related to managing the zone. Its services include:

- Review, prepare, and implement procedures for numerous types of permits, reviews, notices
- Evaluate and approve or disapprove applications for wastewater systems
- Perform inspections of onsite systems as required to enforce town and state sanitation laws
- Perform annual inspections of certain advanced systems
- Represent the town in meetings with applicants and the general public
- Respond to and answer complaints from the public regarding onsite systems
- Perform sampling and analysis of ground and surface water stations twice a year
- Review and assess quarterly and semi-annual monitoring reports required of certain systems
- Operate and maintain any town-owned wastewater systems constructed during the five-year contract term
- Confer with the Regional Water Quality Control Board and other professionals regarding wastewater systems and ground and surface water related matters within the town
- Prepare monthly activity reports that are then submitted to town management and annual reports that are then submitted to the Regional Water Quality Control Board

- Respond to emergency calls from the town public works director

The 2002 fiscal year expenses for the zone totaled $284,968, of which $228,776 was for the 7-H contract. The difference represents allocated salaries and benefits for town staff (management, finance, and code enforcement), furniture and equipment purchases, debt service, depreciation, lab and permit fees, and miscellaneous office and operating expenses. The full budget amounts to just over $25 per onsite system per year. In addition, property owners pay about $65 to a private evaluator for a conventional system evaluation once every two to twelve years, with the frequency depending on site conditions, occupancy (owner or renter), and previous evaluation results.[8]

Paradise had 11,324 onsite wastewater treatment systems as of November 2002, making the zone one of the largest onsite system management programs in the country.

Movement Toward Use of Cluster Systems

Realizing that the use of onsite systems continues to constrain commercial development and that the reserve fields of many existing commercial onsite systems are already in use and some are failing (requiring extremely frequent septic pumping), Paradise has begun planning cluster systems to treat effluent in the commercial district.

In 1998 the Onsite Sanitary Official proposed a demonstration cluster system for 15 commercial properties on the Skyway (Figure 7-4), with subsurface drip irrigation dispersal on a town-owned vacant lot. The plan was not implemented at that time, perhaps due to lack of support from affected businesses. The town later incorporated the project into a downtown revitalization plan. This plan includes improved streetscapes and parkland, which could be irrigated with treated effluent from cluster systems.

Voters in November 2002 supported creation of a redevelopment agency to fund the proposed improvements. Wastewater master planning for the redevelopment area is now underway. Preliminary plans call for the first of three phases to utilize a cluster system with a capacity of 30,000–40,000 GPD with subsurface drip irrigation for effluent dispersal.

[8] The evaluation includes probing the septic tank to check for structural integrity and corrosion, measuring sludge and scum accumulation, performing a hydraulic load test, and conducting a surface inspection of the drain field. Inspection and monitoring requirements for non-standard and advanced onsite systems are considerably greater and more costly, and are discussed in the Performance and Reliability section.

Photograph by Richard Pinkham

Figure 7-4: A Portion of the "Skyway" Commercial District in Paradise

Another cluster system outside the redevelopment area will come on-line sooner. The council in 2002 authorized the town manager and the onsite zone to establish a cluster system for the Paradise Kmart Plaza. This shopping center has a history of failed leach fields. The tenants have agreed to pay for construction, operation, and maintenance of a cluster system that the town would own and oversee. Some initial issues in financing have been resolved and the system is now under design. The town expects to have this system operating by September 2004. The system will use a secondary treatment activated-sludge package plant with advanced filtration, ozone disinfection, and subsurface irrigation dispersal. The town will use this system to evaluate the cluster concept and its operation and maintenance requirements.

Analysis

The history of wastewater decision making in Paradise reveals a difficult long-term struggle over appropriate wastewater system architecture. Early on, the community rejected a centralization proposal. It then implemented and revised a management scheme for onsite systems. Later it recognized that some parts of town need offsite, semi-centralized treatment. A mixed architecture of onsite and cluster systems is likely to develop in coming years.

The main decision point analyzed in this section is the process up to and including the rejection of a centralized sewer system. Some aspects of the ongoing evolution of the Onsite Wastewater Management Zone and the movement toward cluster systems are included to round out the discussion.

Incremental Capacity Provision

This section addresses the following:

- ***How was system architecture relevant to this issue?*** A phased, decentralized approach could have avoided the extreme negative reaction to the high cost of a sewer system.
- ***How was the issue addressed?*** Phased development of decentralized systems was proposed early on. Based on limited analysis, other early studies dismissed this approach as insufficient for the town's needs. The town did not ask later consultants to re-evaluate a decentralized approach.
- ***Did the issue resonate with the community?*** There is no evidence that the public was especially interested in decentralized options, but substantial portions of the population were clearly not comfortable with the cost of a centralized approach.
- ***Results/Status:*** The town now sees phasing-in of cluster systems as advantageous for financial and equity reasons.

How Was System Architecture Relevant to This Issue?

Since the no-sewer decision, pretreatment systems have allowed some commercial expansion and helped address water quality concerns. The now-historical employment of such systems and the fact that commercial growth in Paradise has slowed indicate that some type of commercial district system architecture between total reliance on individual onsite systems and a complete sewering scheme could have been possible. While it is unclear what the costs of such an approach would have been—it is quite possible the total costs over time might have been higher than all-at-once development of a central system—the cost of initial capacity improvement or expansion would likely have been more acceptable to the public than the $21 million price tag for the single-system approach.

How Was the Issue Addressed?

Paradise addressed the issue in several ways:

- A decentralized architecture was considered and dismissed
- The reuse value of decentralized treatment was examined

A Decentralized Architecture Was Suggested, But Quickly Dismissed in Later Studies

For the commercial area, consultant George Tchobanoglous in his 1984 report (Tchobanoglous 1984, p. 39) concluded:

> It is anticipated that several smaller centralized wastewater management facilities will be needed as opposed to one single system. Initially, several commercial activities and residences might be combined and the wastewater pumped to a community septic tank

> and leachfield. As the town continues to grow, it may ultimately be appropriate to combine one or more of the smaller sewerage systems to provide treatment at a centralized facility.

However, other studies focused early on a single solution that would address build-out and paid little attention to phasing decentralized alternatives. The 1985 Ryder report devotes slightly more than a page (R. A. Ryder & Associates Consulting Engineers 1985, p. VI-2, 3) to analysis of community system options. It looked at no potential effluent dispersal sites smaller than five acres and dismissed the 78 acres of larger parcels found within the commercial area as insufficient to accept more than a small portion of the ultimate build-out wastewater load of the entire commercial area. Interestingly, for residential areas, the Ryder report did note that "Management of onsite systems would permit the orderly growth of the community to occur without creation of public debt for a sewerage system." (See R. A. Ryder & Associates Consulting Engineers 1985, p. V-1.) However, the report did not consider onsite system management for the commercial area, having already concluded that hydraulic loading rates would become excessive with continued growth.

In the next study, the town council charged K/J/C to re-evaluate the collection system option recommended by Ryder rather than reconsidering system architecture. Nolte and Associates also was not charged with evaluating decentralized alternatives to a single system for the commercial areas. However, Nolte's 1992 preliminary design report noted that community systems would face regulatory uncertainties and likely be cost-prohibitive based on the land requirements of the existing 900 GPD per acre hydraulic loading limitation (Nolte and Associates 1992c, p. VI-8).

After the Tchobanoglous recommendations, no studies assessed the potential to serve needs in the commercial district through targeted small cluster systems, such as the 3,000–40,000 GPD systems now being considered. Perhaps a more rigorous analysis of needs and opportunities by specific geographies within the commercial district could have identified interim and permanent decentralized solutions. Ron Crites, project manager for the Nolte team at the time and now a prominent national authority on decentralized wastewater systems, agrees that a little more foresight might have helped show the validity of a more decentralized approach. Documents show the team was aware of the cluster system option: a study was undertaken to compare cluster systems to sewer connection for several high-density areas more than one-quarter mile from the sewer service area that were determined to be at risk for eventual onsite system failure. It appears this study occurred very late in the process and was not finished before sewer planning was halted (Northstar Engineering 1992). Factors that made it difficult to conceive of a cluster system approach for the commercial district included a push by town officials and development interests to remove growth constraints, and the fact that fewer onsite pretreatment technologies for nitrogen removal were available a decade ago. Plus, the capabilities of those pretreatment technologies were less understood at the time than today.

Studies Did Examine the Reuse Value of Decentralized Treatment

The Nolte study evaluated options for “scalping” wastewater from the proposed collection system to provide irrigation water at several large landscapes in town. It concluded that such schemes were cost-ineffective compared to the costs of developing the PID substantial water rights. Now, Paradise officials are considering the local reuse potential of cluster wastewater systems. They hope to use sub-surface irrigation with treated effluent from cluster systems to water street landscaping and parks contemplated for the downtown redevelopment area. This would reduce demand on the limited supplies of the PID. Water development contemplated in the Nolte study has not occurred. Also, due to earthquake risks, PID had to substantially reduce storage in one of its two reservoirs some years ago, and it has yet to make up the difference with other sources.

Did the Issue Resonate With the Community?

There is little evidence that the public in the 1980s and early 1990s was interested in the alternative architecture concept suggested by Tchobanoglous. Sewer opponents did promote alternative concepts; for instance, by distributing information from the National Small Flows Clearinghouse. The negative reaction to the high cost of the single solution proposed in 1992 was a substantial factor in the rejection of the sewer proposal. Apparently no effort was ever made to determine what number of residents or businesses would be willing to pay for sewer service in the commercial district. While a key objective of town officials and commercial interests was to remove development constraints, and a decentralized, cluster system approach would probably not have done so to the same extent as a centralized system, it probably would have gained public support.

Results/Status

A decentralized approach would have faced a number of conceptual and real obstacles, including physical difficulties in grouping facilities and locating dispersal fields for each cluster. Institutional and cultural issues, such as regulatory approval and acceptance by business interests, would also have been difficult. Nonetheless, the outcome of the centralized approach is clear: due to high cost and perceived problems with growth inducement, equity, and other issues discussed later, the community rejected the proposal.

The Town Now Sees Advantages in Phased Implementation of Cluster Systems

In the aftermath of the divisive sewer debate, development of a central sewer system in Paradise is no longer considered an option, so a master plan financial comparison of centralized versus decentralized treatment is moot. However, it is clear that town officials now see decentralized systems as advantageous for several reasons. One is that the apportioning of costs is simply easier to accept. Second, the costs can be financed without going to the voters, as is required for a large sewer bond. Third, financing mechanisms can put costs squarely on the shoulders of those who need or benefit most from a new system. Two financial mechanisms have been proposed: a municipal lease concept and tax increment financing by a redevelopment agency.

Municipal Lease Concept

A municipal lease arrangement allows a town and eligible private parties to mutually benefit from the tax-exempt borrowing power of a municipality. In the same manner as most municipalities buy fire trucks and other small capital items, the town of Paradise will borrow funds through a lending institution at a low interest rate specially set up for government institutions. Technically, the lender purchases the system, and the town obtains a lease-to-purchase from the lender. Effectively, the transaction is a loan. The debt service is then passed on to the users of the system, along with costs for operation and maintenance. Once the loan is paid off, the town, not the users, owns the system. But the loan will have been paid by the users, not general taxpayers. To use this mechanism, a public good must be served. In this instance, the public benefit is the long-term viability of the commercial district. If the town loses businesses because of inadequate wastewater systems, it loses a portion of its tax base, and town residents suffer from higher taxes or lost services. This approach will be used for the Kmart Plaza cluster system.

Tax Increment Financing

Another funding option is tax increment financing set up through establishment of a redevelopment agency (RDA). This mechanism is available to areas where state criteria for physical and economic blight are met. An RDA sets a base assessment at the time of its establishment and takes 75 percent of subsequent increases in property tax revenues to finance projects in the redevelopment area. The RDA can issue bonds that are repaid through the increased tax revenues. Paradise has recently set up an RDA for a large portion of the commercial district. Officials expect this RDA will raise $64 million over its 45-year life. Proposed projects include cluster wastewater systems that will provide badly needed treatment capacity. After the town council established the RDA, several citizens initiated a ballot measure to give citizens an opportunity to vote on it. The initiative sought to repeal in its entirety the chapter of the Paradise Municipal Code related to the need for and governance of the RDA. On November 5, 2002, 67 percent of voters voted against the initiative. The RDA is now proceeding.

Growth, Development, and Autonomy

This section addresses the following:

- ***How was system architecture relevant to this issue?*** Historically, Paradise took control of onsite systems to establish community autonomy and control growth. The centralized system proposal was promoted and feared as removing constraints on development.
- ***How was the issue addressed?*** An Environmental Impact Report evaluated growth and community character impacts of the 1989 sewer proposal, but did so in a cursory manner. Paradise undertook general planning about the same time the sewer study took place, but the general plan results were not ready in time to inform the wastewater planning process.
- ***Did the issue resonate with the community?*** Sewer opponents were concerned that sewers would enable too much growth. The community experienced a clash of values over development.
- ***Results/Status:*** No consensus on growth emerged, but those wary of growth impacts gained the upper hand. Since defeat of the sewer proposal, development approval and density have remained key issues regarding citizen perception of the Onsite Wastewater Management Zone.

How Was System Architecture Relevant to This Issue?

System architecture was relevant because

- Decentralized systems were used to control growth
- Centralized systems could lift development constraints

Paradise Used Regulation of Decentralized Systems To Control Growth and Establish Community Autonomy

After Paradise incorporated in 1979, it gained additional autonomy by passing Ordinance 103 to take over regulation of onsite systems from Butte County. With the passage of the 103 regulations in 1983, the assimilative capacity of soils became the limiting factor that held back high-density development. Former Paradise Community Development Director Jon Lander recalls that town council members said they were trying to avoid a sewer system as part of the regulations. Lander then asked, “Why not do that with zoning rather than wastewater?”—a question the council did not answer until the 1990s with adoption of a new general plan. Lander recalls problems with implementing the ordinance. For instance, new setback distances created lots on which the buildable area was too small for the development desired. But by that time pretreatment systems—which made the lots developable—were available. This, in turn, helped create the need for a management zone. When sewers were defeated, the zone became an essential structure to maintain and increase town control in the face of county and Regional Water Quality Control Board concerns about the efficacy of onsite systems.

Centralization Was Seen As a Way To Lift Development Constraints

Economic development was, and still is, a key factor in general and wastewater planning in Paradise. Town officials have always seen an increase in commercial activity as a way to increase the tax base and provide services. The town approached the Economic Development Administration for assistance in funding the proposed sewer for the commercial district; supporting documents (Town of Paradise 1992b, pp. 18-21) described 10 commercial projects that were proposed but not allowed because of the town's restrictive onsite regulation, Ordinance 103. An application to the California Department of Housing and Community Development for assistance on the sewer project contains many references to achieving "full economic potential" in the commercial district (Town of Paradise 1992a). While town officials, commercial property owners, and developers pushed for a sewer to help achieve the economic potential, many residents became concerned that sewers would lead to uncontrolled growth.

How Was the Issue Addressed?

Environmental evaluation was cursory. Growth impacts of the sewer proposal were addressed in an Environmental Impact Report (EIR) prepared under the California Environmental Quality Act for the Town of Paradise by QUAD Consultants in 1989 (QUAD Consultants 1989). This report did not evaluate any alternative system architectures, but simply compared the centralized project recommended by K/J/C with a "no project alternative" of continued use of individual onsite septic systems. QUAD Consultants found that the impact on land use would be minimal, essentially because the absorption rates of new development, even under a worst-case scenario in which all the Town's development was assumed to occur in the sewer project area, would not substantially outstrip recent growth rates. Further, the consultants found that traffic increases were within capacity of the existing roads, and that impacts on municipal services such as utilities and schools were "less than significant" because the service needs were consistent with the Town's general plan. Also, many impacts, such as project impacts on viewsheds and noise, light, and glare, were only evaluated for the treatment plant site and not the community as a whole.

General Planning and Wastewater Planning Were out of Synch

In 1990, Paradise embarked upon its first self-generated general plan. The town had been operating from a 1982 general plan, produced soon after the town incorporated, that reflected previous county goals more than town goals. The new plan was intended to better reflect the town's evolving character. This new general plan and the WDAD project were started at approximately the same time.

This timing proved unfortunate for the wastewater planning process. Growth concerns with the sewer might have been addressed by the general plan if the plan had been done prior to or in coordination with wastewater planning. For instance, if general plan limitations on the rezoning of properties for commercial or high-density residential units had been in place, then growth concerns of sewer opponents might have been assuaged. Instead, the defeat of sewers had significant effects on the general planning process. The town was forced to fire some general plan consultants because they were suspect "outsiders." Between the shift in planned infrastructure (no sewers) and the loss of contractors, the plan took much longer to prepare.

Did the Issue Resonate With the Community?

The issue resonated with the community in several ways:

- Paradise experienced a clash of values regarding growth
- The WDAD assessment seemed pro-growth

Paradise Experienced a Clash of Values Regarding Growth

During the 1980s and early 1990s, Paradise was still a fairly new town. Different segments of the population had different visions of the town's future. Much of the retirement-aged population moved to Paradise to escape the sprawl and other problems of urban areas and desired slow or no growth. More recent, younger residents sought a bedroom community for valley jobs and wanted goods and services to be more accessible. Developers were ready to serve those needs. The stage was set for a clash of values.

The WDAD Assessment Seemed Pro-Growth

Allocating assessment units on the basis of parcel size troubled many property owners who had no development plans. This bolstered suspicions that the sewer plan was strongly pro-development. According to several people interviewed, increased multi-family housing development was a special concern because of the potential boost in population and resulting changes to traffic and the community's character. Even the EIR mentioned rezoning of commercial land to multi-family if the sewer project progressed.

> "Both the fear of those who opposed it and the hope of those who supported the sewer was that this was really going to allow a lot more apartments."
>
> Lise Young, former mayor

Results/Status

The results/status included:

- Revised approaches could have helped
- Density is still a contentious issue

Revised Approaches Could Have Helped

Planning Director Al McGreehan believes a more rigorous assessment mechanism would have better addressed the intertwined fairness and growth issues. Downward adjustments to assessment allocations based on development constraints of particular parcels would have reduced some complaints.

For remaining parcels, a more detailed mechanism would have allowed the town to argue that the growth potential was real, regardless of landowners' intentions, and therefore the community needed to assess properties for the proposed system based on that long-term potential.

McGreehan believes other approaches could also have helped address growth issues. For instance, he suggests that a poll—one aimed at objectively understanding what the public anticipated and desired for Paradise—probably would have found that some growth was okay. Such information would have been useful in addressing some of the anti-growth sentiments of vocal sewer opponents.

Density Is Still a Contentious Issue

After defeat of the sewer proposal, the role of onsite regulations in relation to growth became less clear than in the era of Ordinance 103. Since inception of the onsite zone, the town council has eased restrictions on the size of the area required for effluent discharge. Inclusion of rights of way in calculating usable area for soil absorption fields, relaxation of the application of net lot area requirements to existing lots, allowing leach field areas to be located outside the subject property, variance procedures, and other changes have allowed development to occur where it was previously restricted. Some citizens have been critical of these changes and tell of projects that were once denied but then allowed after changes in zone policies. One critic, Stan Zemansky, set out his general concerns over density and critiqued management of the zone in a lengthy, documented report to town leaders and citizens in 1997 (Zemansky 1997). Zemansky wrote, "Every attempt apparently is being made to maximize use of available soil rather than be concerned with control of density."

Since 1997, a new zone manager is in place, and some of Zemansky's complaints have been addressed. However, in 2000, maximum hydraulic loading rates were increased for pretreated effluent from 900 GPD per acre to 2,000 GPD per acre. Pretreatment systems enable properties that previously could not support conventional systems to be developed. While pretreatment addresses bacterial and nutrient loading, this change fueled criticism that the zone has become a pro-development tool.

Town officials emphatically deny this and maintain that planning and zoning are now the real growth-control tools in Paradise. They point to a six-year legal defense against a developer who requested and was denied a higher subdivision density than allowed by the town's general plan. Seventy-five other California cities joined an amicus (friend of the court) brief supporting Paradise in the litigation, believing it key to protecting the efficacy of municipal general plans. An appeals court recently upheld the town's right to refuse the higher density request.

Performance and Reliability

This section addresses the following:

- ***How was system architecture relevant to this issue?*** Perceived environmental and public health risks from onsite systems were a key justification for the sewering proposal.
- ***How was the issue addressed?*** Numerous water quality studies and reviews of onsite system failures were inconclusive about the risk posed by onsite systems, but nonetheless they were largely used to support sewering. Application of a hydraulic loading regulation to the wastewater needs analysis was conceptually flawed. The potential benefits of water conservation and improved onsite management to reduce failures in the commercial district were not evaluated. The town did carefully consider how to structure the onsite zone.
- ***Did the issue resonate with the community?*** Sewer proponents publicized environmental and public health concerns with septic systems. The public response at the time is not clear.
- ***Results/Status:*** Concerns over other issues such as costs, growth, and equity were apparently more important than any concerns about onsite system performance and reliability when the sewer proposal was defeated. Now, the zone provides the regulatory means to address performance and reliability. Zone critics believe zone policies are more concerned with allowing growth than protecting public health.

How Was System Architecture Relevant to This Issue?

Concern that onsite systems posed substantial health and environmental risks was an important driver for the centralized sewer proposal. Failures of onsite systems were of special concern. Sewers were promoted by town officials and commercial interests as the way to remove pathogen and nutrient (primarily nitrogen) loading, from both functioning and malfunctioning systems from settled parts of town. Because sewers were clearly not economic for residential parts of town, onsite system management was promoted for areas outside the proposed sewer district.

How Was the Issue Addressed?

Performance and reliability issues were addressed through:

- Water quality studies
- Assessment of septic system failures
- Hydraulics
- Consideration of conservation
- Onsite zone study
- Consideration of rainfall

Numerous Water Quality Studies Indicating Bacteriological Problems Were Used To Argue for Sewering

As noted earlier, the results of several early studies indicated problems with septic tank effluent, but they were not conclusive. Additional sampling was commissioned through the WDAD to help delineate the area to be served by sewers. In this study, fecal coliform counts exceeded the state's Water Quality Basin Plan limits at 14 of 22 surface-water testing locations. However, the Nolte team noted that, "Due to the limited numbers of samples collected, there is no conclusive link between the fecal contamination and septic tank effluent."

This is a responsible statement: ascertaining a source of contamination was difficult at the time and is still not easy today. Additionally, little evidence of bacteriological contamination of groundwater was found. (Nolte and Associates 1992b, p. II-5, 6) However, fecal contamination findings were used by the state to promote sewering in Paradise. Also, with the exception of the Tchobanoglous study, all studies used the indicative results and projections of commercial area growth to argue for centralized collection and treatment for the commercial district and improved onsite system management for the remainder of Paradise.

Proponents of Sewering Used Septic System Failures As a Justification, Though the Relationship of Failures to Sewer Need Was not Clear

The physical facts regarding septic failures were summed up in the Nolte study, which found that about 37 percent of systems were more than 20 years old and that about 100 failures were occurring per year, a failure rate of roughly one percent per year. However, "the location of these failures was not readily correlated with physical factors such as soil type or depth to groundwater and could not be considered in delineating the sewer service area." (See Nolte and Associates 1992b, p. II-6.) This suggests that factors such as poor design, faulty installation, inadequate maintenance, and age may have been responsible for many failures. But it appears improved oversight and management of onsite systems for the commercial district was not seriously considered by any studies except the Tchobanoglous study.

Using Hydraulics As a Proxy for Performance Biased Needs Analyses Toward Greater Reliance on Sewering

Based on a water/nitrogen balance analysis, the 1983 Montgomery study suggested that application of septic tank effluent in excess of 900 GPD per acre risked raising nitrate levels in groundwater. Paradise in 1983 adopted this rate as a maximum hydraulic loading rate for onsite systems. No studies ever found nitrate contamination to be a significant problem in Paradise. Yet later studies took this number as fixed when delineating a sewer service area. In the absence of conclusive evidence of a health threat from onsite systems, it appears that application of this loading rate provided a key justification for sewering. Various non-residential land uses were calculated to produce greater loading rates—the Nolte study, for instance, used rates up to 2,000 GPD per acre for commercial and industrial parcels, based on metered water deliveries to existing facilities. Therefore, these studies concluded that onsite systems could not meet wastewater dispersal requirements for such uses.

However, 900 GPD per acre was not a real limitation based on hydraulics but a recommended nitrate-loading limit expressed as a hydraulic figure. Note that 2,000 GPD per acre is equivalent to less than one-tenth of an inch per day per unit area. Also, in the Paradise area rainfall often exceeds several inches per day, much of which is readily absorbed by local soils. Using hydraulics as a sewer area design criteria without accounting for the nitrogen-reducing potential of decentralized pretreatment technologies biased the needs analysis toward greater reliance on sewering, increasing the size of the area calculated to require sewers.

Former Nolte project manager Ron Crites agrees that basing sewer area delineation so strongly on hydraulic loading, and not directly on nitrogen loading, was probably a flawed approach. However, in fairness to the various engineering studies, nitrogen removal technologies for onsite systems were less developed then than they are now. Also, a key working assumption, according to Crites, was that pretreatment systems would not be affordable to many property owners.

Conservation Was Suggested As a Reliability Improvement Measure, But Was Partially Implemented and Not Seriously Studied

It appears that the idea of implementing water conservation to stave off failures or meet hydraulic-loading regulations received some attention in Paradise. A long drought in the 1970s and water supply problems of the PID contributed to awareness of the need for water conservation. PID hired a conservation coordinator. An education effort emphasized that water flow affected onsite systems. Apparently some commercial establishments used low-flow fixtures and appliances to help reduce wastewater flows and obtain onsite system permits. On the other hand, the Ryder study considered conservation a measure to eventually adopt town-wide. Should connection of residential areas ever become necessary, the study noted that conservation could create 20 to 40 percent additional capacity in a centralized wastewater system (R. A. Ryder & Associates Consulting Engineers 1985, p. II-4). This perspective was apparently not extended to analysis of the hydraulic loading issues of the commercial district, probably because so much growth was projected for that area. Nor was water conservation considered in the sizing of centralized collection and treatment systems, despite the potential for significant savings, according to an outsider reviewer (Gearheart 1992).

Paradise Studied How To Best Structure the Onsite Wastewater Management Zone

The Nolte team's work for the WDAD included a review of other, existing onsite zones in relation to staffing, office and equipment needs, budgets, fee structures, programs and policies, and relationships with Regional Water Quality Control Boards and county health departments. The consultants also worked with town management and the Wastewater Steering Committee to develop a draft *Manual for the Onsite Treatment of Wastewater*, which the town adopted as a regulatory document.

Rainfall Has Been Considered a Vulnerability Issue for Onsite Systems and a Design Issue for Centralized Systems

Annual rainfall can approach 100 inches in the highest elevations of Paradise, and 20 inches can fall in a week. The 1985 Ryder report noted that in places soils can be at or near saturation for three to four months a year. Thus, “the addition of septic tank leachate to a soil that periodically has little or no absorptive capacity can produce failures by inducing the surfacing of effluent.”

However, the report also noted that rainfall has the benefit of diluting the waste stream in the soil and any resulting waste seepage to local streams. Because lower elevations have much lower precipitation rates and higher evapotranspiration requirements, the Ryder report recommended that lower locations outside town would be best suited for central treatment facilities that relied on any type of land dispersal of treated wastewater (such as pasture irrigation) as the land requirements would be significantly less than at higher elevations (R. A. Ryder & Associates Consulting Engineers 1985, pp. III-13, 15).

Did the Issue Resonate With the Community?

It is not clear whether water quality and public health concerns related either to onsite failures or long-term area-wide loading rates caused concern among residents up to and during the sewer debate. What is clear is that septic system failure anecdotes were used by the town and others to promote a sewer. Pressure from state regulators heightened the push to point out potential health threats from septic systems. The failures were real. Improved management at the least was needed, and it was proposed for the residential parts of town. Whether management could have also solved most commercial area failures was not given serious consideration, probably because the development agenda favored sewers.

Results/Status

When the sewer proposal was defeated, community concerns about costs, growth, and equity clearly overwhelmed any concerns about the reliability of onsite systems. The onsite wastewater management zone was then expanded across the entire town as a way to address state regulatory concerns for public and environmental health. Since establishment of the zone, various critics have been quick to point out any egregious onsite system failures as evidence, they believe, of lax zone policies resulting from a pro-growth agenda.

Clearly, identifying and fixing failures is a key purpose of the zone, in addition to preventing failures through improved siting, design, and maintenance. Since 1999, the zone operations contractor has tracked major and minor failures. Failed absorption systems are classified as major failures, and averaged 108 per year from January 1999 through June 2003; a failure rate of about 1 percent per year for all of the 11,324 onsite systems in Paradise as of November 2002. An additional 87 minor failures/repairs (inlet/outlet tees, lids, and other minor items) have occurred per year.

Zone Regulations Address Reliability and Longevity of Onsite Systems

Zone regulations include inspection and septic tank pumping requirements. Regulations of the Regional Water Quality Control Board require a reserve leach field for all onsite systems. Paradise maintains this requirement for small systems and large systems with pretreatment, but requires two reserve fields for any conventional system greater than 1,000 GPD.

Table 7-3 shows pretreatment systems that were in place as of August 2002.

Table 7-3: Pretreatment Systems In Place as of August 2002

Type of System	Number	Size Range (GPD)
Bottomless sand filters	25	300-450
Intermittent sand filters	14	450-4,000
Recirculating gravel filters	17	450-4,000
Activated sludge package plants with N removal	8	3,000-20,000

Management of pretreatment systems receives special attention as follows:

- All newly installed pretreatment systems must not increase groundwater nitrate nitrogen concentrations above 7 mg/l, as calculated with the Hantzche-Finnemore equation. This equation calculates nitrogen concentrations in terms of the volume of wastewater averaged over gross developed area, total nitrogen strength of wastewater entering the soil, recharge of groundwater from rainfall, background nitrate concentration, and soil denitrification. Paradise allows no credit for soil denitrification, which is a conservative stance.
- The owners of all pretreatment systems with a capacity of over 2,000 GPD (except for owners of bottomless sand filters) must sign a maintenance contract with a zone-certified wastewater operator. Pumpers without certification cannot service these systems. Owners of these large systems, which are mainly package plants, pay $500 to $1,500 per month for operating fees with qualified contractors, depending on the system and contractor. These services include inspecting the premises and pump systems, backflushing filters as required, recording flow data, taking effluent and influent samples, maintaining absorption fields, and additional monitoring and sampling in the case of activated-sludge systems.
- Smaller pretreatment systems are subject to annual inspections by zone personnel. Fees for the inspection range from $62 for a bottomless sand filter to $300 for a recirculating gravel filter.

In addition, all systems with a capacity greater than 400 GPD require three monitoring wells, in accordance with Regional Water Quality Control Board requirements. One monitoring well is located upgradient of the discharge zone, and two are located downgradient. The rules require a system owner to have in place a contract for quarterly or semi-annual sampling of total nitrogen and BOD. These tests run $55 (if a well is dry) to $150 per well (if water is encountered) per test period. These requirements are very unpopular. For systems that are not much larger than the threshold size, installation of three wells can cost more than the rest of the wastewater system. The ongoing costs are onerous. Engineers try to design systems below the threshold capacity when possible, but they have little leeway due to wastewater design flows required by the zone. The zone is currently negotiating with the Regional Water Quality Control Board to raise the threshold for the monitoring well requirement to 2,000 GPD.

The Zone Monitors Ambient Conditions

Paradise has five groundwater monitoring wells that are sampled quarterly. Results are sent to the state Regional Water Quality Control Board. According to the sanitary official, there have been no observed increases in total nitrogen, and fecal coliform ranges "have not increased dramatically." Both the state and the Paradise sanitary official think Paradise needs more monitoring wells. Two were included in the fiscal year 2003 budget. For surface water monitoring, there are 31 stations that are sampled twice per year (wet season and dry season).

Fairness and Equity

This section addresses the following:

- ***How was system architecture relevant to this issue?*** Centralization, including the sewer study itself, was expensive and raised questions about how benefits and costs would be spread across a large and diverse service area. Costs of septage management for onsite systems also needed to be addressed.
- ***How was the issue addressed?*** The K/J/C study and the Wastewater Steering Committee reviewed options for the design assessment allocation. No studies rigorously addressed the equity implications of decentralized alternatives for the commercial area.
- ***Did the issue resonate with the community?*** Fairness in cost allocation, particularly for the design assessment district, was a topic of considerable community concern and uncertainty.
- ***Results/Status:*** The design assessment allocation was a key factor in defeat of the sewer proposal.

How Was System Architecture Relevant to This Issue?

System architecture was relevant in several ways:

- Benefit generation and cost spreading for centralization was controversial
- Sunk costs and fixed incomes raised equity issues

Benefit Generation and Cost Spreading for Centralization Was Controversial

Interests in the commercial district opposed the 1989 K/J/C proposal because both design and construction costs of a centralized system were to be borne exclusively by them. Some businesses felt the costs would make them less competitive with businesses in Chico. Businesses created much of the necessity for the central sewer, yet felt that the whole town should share the costs of the treatment system, as residents would benefit from the increased tax base afforded by improved commercial activity and from septage management at the proposed treatment plant.

For this and other reasons, the town council chose to assess all properties in Paradise for the sewer design work, along with development of the onsite zone. This irritated many people outside the commercial district. Current Public Works Director Dennis Schmidt, then in another position with the town, recalls that many local residents considered the plan, focused as it was on sewering the commercial district, a gift to developers. Sewering would benefit business owners. Many people did not see other benefits, both subtle and general: an increased tax base, more money in the general fund, improved water quality, and more shopping opportunities.

Sunk Costs and Fixed Incomes Raised Equity Issues

Some businesses that had already invested in pretreatment systems questioned why public funds should be spent on a collective system, instead of other businesses paying for their own systems too. Also, because a large number of Paradise residents are retired and living on fixed incomes, the additional costs of sewer design or sewer implementation raised concerns about affordability and fairness.

How Was the Issue Addressed?

The issue was addressed in several ways:

- No studies evaluated the fairness and equity implications of decentralized options
- Several approaches to the WDAD assessment allocation were considered

No Studies Evaluated the Fairness and Equity Implications of Decentralized Options

No comparison of decentralized with centralized systems on the basis of fairness and equity was made because a decentralized approach was dismissed early in the planning process. While a decentralized approach would have had its own problems—no doubt those who would have needed community systems would have protested the costs—it may have been more palatable to the body politic. It is interesting that the town now sees placing costs directly on failing systems or those with high capacity needs as one of the advantages of cluster systems.

Several Approaches to the WDAD Assessment Allocation Were Considered

The K/J/C 1989 study recommended that assessment units be based strictly on EDUs and only in the sewer district itself. K/J/C reasoned that this approach would be more equitable than a formula combining parcel size, front footage, and EDUs (based on zoning) that generated relatively large assessments for larger and vacant parcels. The consultants felt that might increase development pressure on large parcels whose owners would have to pay the assessment.

When the town decided to include all of Paradise in the WDAD, the Wastewater Steering Committee and the Director of Public Works advised the council on the assessment. Each EDU in town was to be assessed the same amount, regardless of its location in the onsite zone or the sewer area. The reasoning was that each would benefit from:

- The abatement of documented septic system failures and surface water quality problems
- The establishment of a town-wide wastewater management program
- Economic development opportunities offered by the removal of onsite disposal area-related constraints

Also, the local septage-receiving landfill was to close in 1992, necessitating the construction of a sewage treatment facility to receive septage from the onsite zone. However, the Wastewater Steering Committee also determined that the benefit derived would be greater for larger parcels. Thus the final assessment allocation distributed the total number of EDUs to individual properties according to property size only, with no consideration of zoning and other factors. Larger properties were assessed multiple EDU assessment units based on a sliding scale of up to 10 units for parcels of 20 acres or more. The Committee rejected a simple per-parcel alternative that seemed inequitable because it treated a small residential property owner the same as the owner of a large parcel along a commercial thoroughfare.

Regarding the assessment allocation, in hindsight Planning Director Al McGreehan thinks the planning department should have been more involved, to address constraints that offset development potentialities. Perhaps a greater concern for fairness and equity would have also addressed whether properties were in areas to be sewered or not, commercial versus residential properties, high water users, or other considerations.

Did the Issue Resonate With the Community?

The issue resonated with the community in an important way:

- The allocation of assessment units was problematic, and the assessment authority too open-ended

The Allocation of Assessment Units Was Problematic, and the Assessment Authority Too Open-Ended

Basing the assessment amount for the town-wide Wastewater Design Assessment District on parcel size caused an uproar. Not all large property owners had either plans or the ability to develop their land. Many larger properties had characteristics—topography, road access, traffic circulation patterns, or other characteristics—such that the increased assessment units assigned them were not realistic reflections of development potential.

Although the initial assessment was the same for equal-sized properties in both the area to be sewered and the onsite zone, properties in the onsite zone would have ultimately paid considerably less for wastewater services than sewer-area properties. Sewer construction and financing costs were to be borne mainly by the properties receiving sewer; in-town and out-of-town users of septage facilities would contribute as well. The Nolte team identified seven elements for the proposed system's capital costs.

Based on distribution of costs and benefits across those seven elements, they recommended a financing plan of grant funding, cash contributions (for example, from Butte County for septage management), revenue funding (loans to be paid off through rates and fees), and assessment funding within the sewer service area. Nolte estimated that $6 million in grants might be available, and that the balance of capital costs could be paid mainly through revenue. However, the town-wide assessment district liens legally enabled the town to levy supplemental assessments. Sources for this case study were uncertain on this point, but it appears that residents may have feared they would end up paying further assessments for sewer services they would not themselves receive.

Results/Status

Paradise failed to reach consensus on fairness and equity in the distribution of design and construction costs for a centralized system. Perceived inequities in the WDAD assessment allocation, in particular, were a key factor in the defeat of the sewer proposal.

Stakeholder Relationships and Trust

This section addresses the following:

- ***How was system architecture relevant to this issue?*** Lack of clarity on the need for replacing septics with a centralized system created confusion and mistrust.
- ***How was the issue addressed?*** Inadequate attention to trust-building appears to have occurred throughout the facility planning process.
- ***Did the issue resonate with the community?*** Clearly, yes. The community became polarized over how the sewer proposal was developed and promoted. Public process missteps exacerbated the tension.
- ***Results/Status:*** Information became politicized. Mistrust of public officials lingers to this day, including mistrust over management of the onsite zone.

How Was System Architecture Relevant to This Issue?

Mixed signals on the need for replacing septics with a centralized system created complications.

Mixed Signals From Higher Regulators Complicated the Planning Process

Several sources for this study noted that the regional board’s position on sewering was unhelpfully vague. Many in local government felt the board issued a mandate to sewer or face prohibitions on new septic systems. To other people, it seemed sewer proponents conveniently interpreted the board’s position as a mandate and used this as a cudgel. Sewer opponents who approached board staff were told the board had not ordered sewering. Ron Dykstra of the regional board explains that the board supported sewering in Paradise because of evidence of water quality degradation, but the board lacked the “substantial evidence” legally required to issue a septic prohibition. Indeed, as discussed in the reliability section, the impact of septic systems on groundwater was never demonstrated, and studies regarding the impact on surface waters were never conclusive.

How Was the Issue Addressed?

The issue was addressed in several ways:

- The public perceived town officials as “on a track” and unwilling to listen
- Studies inadequately incorporated public input and non-economic factors
- Problems arose because the town’s project lead was charged with both technical engineering and consensus building

The Public Perceived Town Officials as “On a Track” and Unwilling to Listen

Former Community Development Director Jon Lander thought the outreach performed by the town during the initial stages of the sewer project was good. He believes the town made reasonable efforts to listen to community members and incorporate their ideas into the project in the period before the WDAD was formed.

However, it appears that the public involvement process broke down as the WDAD was formed and further sewer planning proceeded. According to Stan Zemansky, a perception that the public was consulted merely as a formality was an important impetus for the petition to recall the town council. Key citizens and the general public both came to have additional reasons to believe town officials were not interested in getting input.

> “It was, ‘OK, here’s our plan, and you guys need to buy into it.’ It didn’t come the other way, it was from the top down. You either signed on or you signed off, and people, as soon as they saw there was a cost associated with it, signed off. They didn’t want it. So, I think the key there is to not just make the appearance of public participation, but to have real public participation so people have some important input from the get-go, rather than just assuming the conclusion and saying ‘This is what we’ve decided; now, is it OK?’”
>
> Lise Young, former mayor

For instance, the Wastewater Steering Committee included 11 volunteer residents, as well as the town manager and the WDAD project engineer. When she joined the committee, local citizen Vicki Kunst anticipated that it would dissect Paradise’s wastewater problems and look at many possible solutions. She says, however, that because more than a year was spent planning a commercial district sewer before it got to the steering committee, there was already considerable investment in that solution. She thought the town manager pushed the committee in particular directions.

Ron Crites, Nolte’s project manager, believes that the WDAD project engineer (a town staff member) decided what the project should be very early in the facility planning process, and he steered the process accordingly. Former mayor Lise Young contrasts what she saw as a top-down approach on the sewer project with initial development of the general plan. There a consultant helped establish broad public representation through four citizen committees, each of which presented its vision for Paradise to the town council.

After the recall, according to Young, pro-sewer members of the council remaining in office tried desperately to push the project forward before the seating of a new, anti-sewer council. Their aggressive approach helped undo the project because of the loss of public accountability.

Studies Inadequately Incorporated Public Input And Non-Economic Factors

An outside expert asked to review the 1992 draft preliminary design report largely approved of its technical content, but he criticized the facility planning process for incompletely addressing community issues and failing to articulate clear and broad criteria for the evaluation of alternatives. Robert Gearheart, an alternative wastewater systems expert from Humboldt State University, wrote:

> Because of the manner in which treatment alternatives were evaluated it is difficult to determine how the consultants came up with the system of choice.…
>
> The steering committee, city staff, city contractor, and consultants should have developed a weighted criteria list to compare alternatives. This weighted criteria list would force the city to articulate its priorities and values. Without any criteria to evaluate alternatives it is left to economic factors and constraints of the site to determine the alternatives of choice. A list of possible criteria are listed below:
>
> - Conjunctive use/water reclamation
> - Reliability
> - Effectiveness
> - Expandability
> - Ecological value
> - Ease of operation
> - Capital cost
> - O&M cost
> - Aesthetics
> - Land requirements
> - Phasing of implementation
> - Etc. …
>
> The document represents a thorough analysis of collection, treatment, and reclamation alternatives. It does not reflect community values and inputs. Except for a brief mention in the acknowledgments the role and function of the Steering Committee is not discussed. I feel that Nolte and the subcontractors have done an exceptional job in meeting the intent of the facility process within severe time constraints. What is missing is the public process. That is not Nolte's problem but the city's problem. (Gearheart 1992)

Gearheart's criticisms were largely directed toward selection of a treatment and disposal system. In hindsight, it is probably fair to say that greater consideration of public input and better definition of evaluation criteria might have led Paradise to a fuller examination of decentralized options.

Problems Arose Because the Town's Project Lead Was Charged With Both Technical Engineering and Consensus Building

Jon Lander remembers the criticism the town's WDAD project engineer faced when proceeding with the wastewater planning effort after the recall, but explains that at that time, there was a serious lack of political leadership. The project engineer tried to push the project through, as required by previous council actions and bond commitments, despite other town staffers arguing for a slower approach. One key lesson that Lander took away from his experience at Paradise is the importance of separating the technical and consensus-building roles in community infrastructure projects. The project engineer had to be a project proponent, but in this case he also was charged with building community consensus. Those are somewhat contradictory roles. In good public project work Lander sees currently, there is a neutral facilitator who does not hold a particular technical point of view. That person helps the community reach consensus on the parameters of a desirable system design prior to the design work occurring. In Paradise, the project engineer attempted to move a design forward and obtain community support for it at the same time; community buy-in had not been obtained first.

> "It's about how you approach people. And unfortunately, the first time around, they approached people by hitting them in the pocketbook and then said come on over to our side and jump on our program."
>
> Dennis Schmidt, current director of public works

Did the Issue Resonate With the Community?

The issues of stakeholder relationships and trust clearly resonated within the community. The community became polarized over how the sewer proposal was developed and promoted due to several factors:

- The method of adopting the assessment district created ill-will, and liens exacerbated public displeasure
- Changes in the sewer project boundary complicated public perception of the project
- Combining the sewer decision and other hot political issues was too much at once

The Method of Adopting the Assessment District Created Ill-Will, and Liens Exacerbated Public Displeasure

Use of the Municipal Improvement Act of 1913 to establish the WDAD generated public distrust of town officials. This act allows municipalities to establish a district, levy an assessment, and lien properties without going to the electorate for a vote. Despite drawing an estimated 600 people to the required protest hearing, most of whom had reservations about the assessment, the town council approved the assessment district at the end of the hearing.

After defeat of the sewer plan, the city retired late years of the WDAD bond issue early, but liens remained on properties until the remaining bonds were completely paid off and the district dissolved in 2002. The ten-year presence of the liens complicated home sales for some individuals and created the impression of an open door for future assessments that homeowners would have no control over.

Changes in the Sewer Project Boundary Complicated Public Perception of the Project

During the planning process, several large water users—a high-density residential complex, a convalescence home, a mobile home park, and others—petitioned to have sewer extended to their property. The service area expanded from 1,207 acres in the 1989 K/J/C study to 1,665 acres in the 1992 Nolte study. Some of the additional users were well outside the initial sewer boundary, and their inclusion drew in other property owners who were not interested in sewer service. Worse, this exposed the town council to charges of favoritism.

Combining the Sewer Decision and Other Hot Political Issues Was Too Much At Once

Jon Lander believes that the recall was not primarily about sewers. There was a minority group that really opposed the sewer project, but when the council passed a no-smoking ordinance, it created another minority of dissatisfied voters. He thinks the council underestimated the effects of "adding one minority and another minority and getting a big dissatisfaction." Unhappy voters became a majority.

Results/Status

The results of issues in stakeholder relationships and trust in Paradise include:

- Information became politicized
- Town/public relationships remained problematic
- Conflicts of interest developed
- Operation of the zone was outsourced

Information Became Politicized

Interviewees for this study related strong opinions that information was withheld or distorted during the sewer debate. Town officials maintain that anti-sewer forces twisted information to the point of being abusive, lying, and using scare tactics to push their views. Other individuals pointed fingers at the staff and politicians who promoted the sewer plan. One complaint is that the town withheld outside expert Robert Gearheart's critique of the facility planning process; another, that funding for a septic maintenance manual was diverted into newsletters that amounted to pro-sewer propaganda. In response, an alternative newspaper, the *Ridge Riposte*, was spawned to counter perceived false information from town government. Town officials characterize that paper as "not long on facts." Judging the accuracy of the various claims is well beyond the scope of this study. But widespread accusations about information management indicate that politicizing information became a problem. All sources agreed that during and for some years after the sewer debacle, the politics of information in Paradise became extremely manipulative. Such manipulation is symptomatic of deeper problems of trust and failed public process.

Town/Public Relationships Remained Problematic as the Onsite Zone Evolved

Public distrust of local government created during the sewer debates has no doubt contributed to doubts about the policies, direction, and efficacy of the onsite wastewater management zone. Besides the continuing concern over loading rates and density mentioned earlier, zone critics point to citizen oversight of the zone. In 1994, two years after formation of the zone, the town council unanimously created and appointed a permanent, five-member Onsite Wastewater Management Zone Commission. Only five months later, however, the same council members abolished the commission by a three-to-two vote, stating only "it was in the best interests of the town." Shortly thereafter, the council appointed a five-member Onsite Wastewater Management Zone Variance Committee. The committee met for several years, approving and denying variance applications. Current town and zone management, while not involved prior to the variance committee, believe that citizens involved in zone functions largely pursued an anti-growth agenda. Since enactment of the 2,000 GPD per acre loading rate for pretreatment systems, variance applications have ceased to be needed and the committee has not met.

The Zone Has Had to Address Conflicts of Interest in the Onsite Inspection Program

Since its inception, the zone has utilized private sector onsite system evaluators. Most are septic tank pumpers. The 1985 Ryder study (R. A. Ryder & Associates Consulting Engineers 1985, p. II-6) noted evaluations by private companies might cost half as much as evaluations by a public agency, but warned this would provide reduced levels of service and be subject to responsibility and liability problems. However, the private evaluator approach was adopted, apparently because town officials were pro privatization at the time. The result has been that the vested interest by evaluators to mandate pumping or repair work, which could in turn be performed by their companies, has created a conflict of interest, and many citizens have perceived that ordered work was unnecessary.

Current town officials say if they could start again, they would have an in-house department or a contractor without a vested interest do the evaluations. However, the current system is a historical legacy that would be difficult to change, so the town is creating checks and balances. The sanitary official and town council established the certified evaluator program. This program created a *Paradise Onsite Management Zone Evaluators Handbook* and mandates that evaluators attend training organized by the sanitary official. The sanitary official does spot checks of evaluators to verify findings and reporting. Evaluators found guilty of pumping indiscriminately or otherwise defrauding a resident can lose their certification. There have been accusations of deceptive reports and fraud. To date, the town has not revoked the certification of any operator.

The Town Commissioned an Outside Review of the Zone to Assist Reform, and Out-Sourced Operation of the Zone

Recognizing that a number of problems existed with the zone, the town council in 1998 commissioned Questa Engineering, a firm with substantial onsite wastewater expertise, to evaluate and assess zone programs and operations. Questa issued its final report in March 1999 (Questa Engineering Corporation 1999). The report identified more than 20 problems and made recommendations regarding each.

Just prior to retaining Questa, Paradise hired 7-H Technical Services to staff all zone positions, and appointed 7-H President Lloyd Hedenland as the town's Onsite Sanitary Official. Hedenland and his firm brought increased technical competence compared to previous town staffing of the zone. Since coming on board, Hedenland has implemented a number of policy and operational changes and he has addressed some of the Questa recommendations. Town officials report that public concern over the zone has decreased in recent years. However, several prominent citizens remain critical of zone policies. They believe that the activities of 7-H have “gone far beyond real needs” and that the zone has not provided transparent public accounting of its actions and results.

Conclusions

While the inherent virtues of the early 1990s sewer proposal may have been good or bad—that determination is beyond the scope of this analysis—it is clear Paradise made a number of mistakes in the analytical effort leading to the sewering proposal, and in the related public process. While considerable effort and technical acumen was directed at developing a centralized system for the commercial area, too little attention was paid to decentralized options.

The Paradise experience reveals the following lessons for other communities embarking on a wastewater facility planning process:

- Beware of the momentum of historical proposals. The centralization idea for Paradise was set in motion in the late 1970s by a state-generated water quality management plan. Various studies kept the idea simmering for years. Well over a decade after the initial suggestion, the town could have taken a fresh, comprehensive look at its options before sinking millions of dollars into a design process.
- Incomplete analysis of options leads to project rejection. This can lead to substantial delay in dealing with problems. Paradise is only now addressing wastewater capacity constraints in the commercial district.
- A “single solution” may be no solution. Be willing to accept that incremental improvement is better than proposing a system that is too big to be accepted by the public. Here, Paradise could have designed onsite and cluster solutions to address some capacity constraints in the commercial district, even if not all constraints could be lifted this way.
- In a time of change and flux, consider a more finely phased solution. In the case of Paradise, a bit more foresight might have anticipated useful improvements in onsite technologies and the town’s need for water reuse.
- Realize that the relationship of system architecture to growth is clearly an issue for citizens, especially in a town where people want very different things. Beware of undertaking wastewater planning without a defensible, widely supported vision and general plan for the community’s future. Otherwise, the facility planning effort may be wasted.
- Be sure that the needs analysis is sound. Poor concepts bias results, especially when the concepts support a direction that has official backing. In the Paradise studies, the hydraulic loading rate approach to service area delineation was flawed.
- Consider onsite management carefully before rushing to a centralized solution. In Paradise this was not done for the commercial area. Because of the momentum toward a centralized sewer, the town overlooked what now seems an obvious step: detailed consideration of whether onsite system failures were unavoidable or simply a result of poor oversight and maintenance.

- Consider carefully whether existing onsite systems are really to blame for water quality problems and whether the problems are serious enough to warrant big new expenditures. Basing a multi-million dollar investment on inconclusive studies is risky at best. At the same time, this recommendation must be tempered by a realization that conclusive linkage of water quality findings to suspected sources is difficult. A “weight of evidence” approach may be required, but it must be carefully and fairly explained.
- Remember both the benefit and the liability that big systems create by distributing costs. Big systems are often promoted as achieving economies of scale. But they also often raise equity issues in how benefits and costs are spread.
- Equity issues may come up not just in support of construction costs, but also in support of the large costs necessary to design large systems, as shown by the furor over the WDAD assessment allocation.
- Work for clarity with regulators regarding their powers and intentions. Constructive engagement in both directions is necessary to avoid costly confusion. Arbitrary or unclear positions are typically mitigated in face-to-face settings.
- Include substantial, genuine public participation. Professional facilitation by individuals not connected to the technical outcome may be necessary.
- Avoid management structures, like the private onsite system evaluator approach Paradise adopted, that create conflicts of interest.

Perhaps the final lesson is to be aware of the cost of getting it wrong. In Paradise, incomplete option analysis, poor public process, inadequate attention to equity issues and trust-building, competing visions of the town’s future, and other factors impeded facility planning efforts. These problems fed on each other to a point of turmoil. This had long-term impacts on local governance, including management of the onsite zone. Town Manager Chuck Rough describes the result:

> There was a lot of tumultuous politics in this town for many years as a legacy of the sewer battles. It created factions in the town that hated each other with a passion. And it became the worse kind of politics—personality-based politics. And as a result you had a lot of political instability, and you had a city government where the staff was afraid to go one direction or the other direction, because of the changing complexion, politically, at the top. And so a lot of things that needed to get done in this town didn’t get done.

Paradise is still healing from the trauma.

Sources

Sources for this case study include:

Personal Interviews

Ron Dykstra, staff member, Central California Regional Water Quality Control Board, Redding, CA

Greg Haling, former member (subcontractor) of Nolte and Associates preliminary design study team; now with Greg Haling Engineers, Chico, CA

Lloyd Hedenland, Onsite Sanitary Official, Paradise Onsite Wastewater Management Zone

Michael Huerta, staff member, Butte County Public Health Office, Chico, CA

Vicki Kunst, citizen, former Wastewater Steering Committee member

Wilson Locke, former citizen and Onsite Zone Certified Evaluator; now living in Middleton, CA

Al McGreehan, Director of Community Development

Charles Rough Jr., Town Manager

Frankie Rutledge, Town Clerk

Dennis Schmidt, Director of Public Works

Lise A. Young, former Mayor and town council member

Stan Zemansky, citizen, former member of various onsite zone committees, former onsite zone Certified Evaluator

Phone Interviews

Ron Crites, former Project Manager of Nolte and Associates preliminary design study team; now with Brown and Caldwell, Davis, CA

Norm Hantzsche, staff member, Questa Engineering, Port Richmond, CA

Jon Lander, former Paradise Community Development Director, Public Works Director, and Town Engineer; now with the Napa County Flood Control & Water Conservation District, Napa, CA

Karen McBride, staff member, Rural Community Assistance Program, West Sacramento, CA

Documents

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Town of Paradise. 1992a. *Community Development Block Grant Program, Public Facilities Application.* Paradise, CA. March 1992.

Town of Paradise. 1992b. *Economic Development Administration Pre-Application for Public Works Grant Infrastructure Program, Exhibit IV-A-2.* Paradise, CA. June 1992.

Zemansky, S. 1997. *Paradise Public Health and Safety at Risk.* Paradise, CA. June 1997.

Additional documents reviewed for this case study included zone manuals, handbooks, administrative documents, operational data; Paradise town council resolutions, agendas, and meeting summaries; Paradise ordinances; WDAD official documents and public newsletters; Regional Water Quality Control Board letters to Town of Paradise and other documents; and miscellaneous other documents.

8 CHARLOTTE COUNTY, FLORIDA

This case study addresses the topics:

- Performance and reliability
- Incremental capacity provision
- Fairness and equity
- Growth, development, and autonomy
- Stakeholder relationships and trust

The Community

Charlotte County is located on the gulf coast of Florida, south of Sarasota and north of Fort Myers (Figure 8-1). The county encompasses 832 square miles, of which 129 square miles are inland surface waters of Charlotte Harbor. The harbor receives the Peace and Myakka Rivers and is the second largest estuarine bay in Florida. It was designated an “estuary of national significance” by the US EPA in 1995.

Figure 8-1: The Location of Charlotte County in the State of Florida

Since the 1960s, Charlotte County has experienced a substantial influx of new residents. In the 1960s and 1970s, a development company subdivided some 68 square miles of the county into one-quarter-acre lots. Roads were built to all lots by the 1970s (Vincent 2003). The wide availability of cheap land (roughly 200,000 lots were still vacant as of the mid-1990s) (Charlotte Assembly 1996) made Charlotte County an affordable choice for tens of thousands of northern retirees. Developers also built over 300 miles of navigable boat canals and drainage canals, resulting in nearly 30,000 waterfront lots (Vincent 2003) that increased the drawing power of Charlotte County.[9]

Population growth boomed in the 1970s and 1980s. It slowed somewhat in the 1990s (Table 8-1) but growth remains a key fuel for the county's economy. Commercial development to service the county's expanding population is considerable. Industrial development is limited. As of the mid-1990s, 84 percent of the county's jobs were in retail trade, services, or construction (Charlotte Assembly 1996, p. 6).

The population of Charlotte County is strongly skewed toward older, retired persons, many of whom are on fixed incomes. As of 1999, one-third of the year-round residents were over 65, and the population's median age of 58 was one of the highest in the nation. In addition to the permanent residents reported in, Table 8-1 some 60,000 people, mostly retired, occupy Charlotte County homes for four to six months in the winter (Vincent 2003).

Table 8-1: Charlotte County Population Growth

Year	Year-Round Population	Percent Increase Over the Preceding Decade
1960	23,355	--
1970	27,559	18
1980	58,460	112
1990	110,975	90
2000	139,964	26
2002	148,521	--

Source: Charlotte County Utilities 2002 Annual Report (Dufresne – Henry, Inc. 2003, Table 1-1).

Charlotte County has only one incorporated city, Punta Gorda, which had a population of 14,344 people according to the 2000 census. Thus, the county government is responsible for planning and other services for most of the county's land area and population.

[9] According to one county official, "The swamp-land-in-Florida joke originated here." This illustrates something of the nature of the development boom in Charlotte County.

In 1990, the company that had platted most of the lots in the county, General Development Corporation (GDC), filed for bankruptcy. Charlotte County decided to acquire GDC's water and wastewater utility subsidiary, General Development Utilities, and did so through condemnation in 1991. The county reconstituted the formerly private utility as a new public utility, Charlotte County Utilities (CCU).

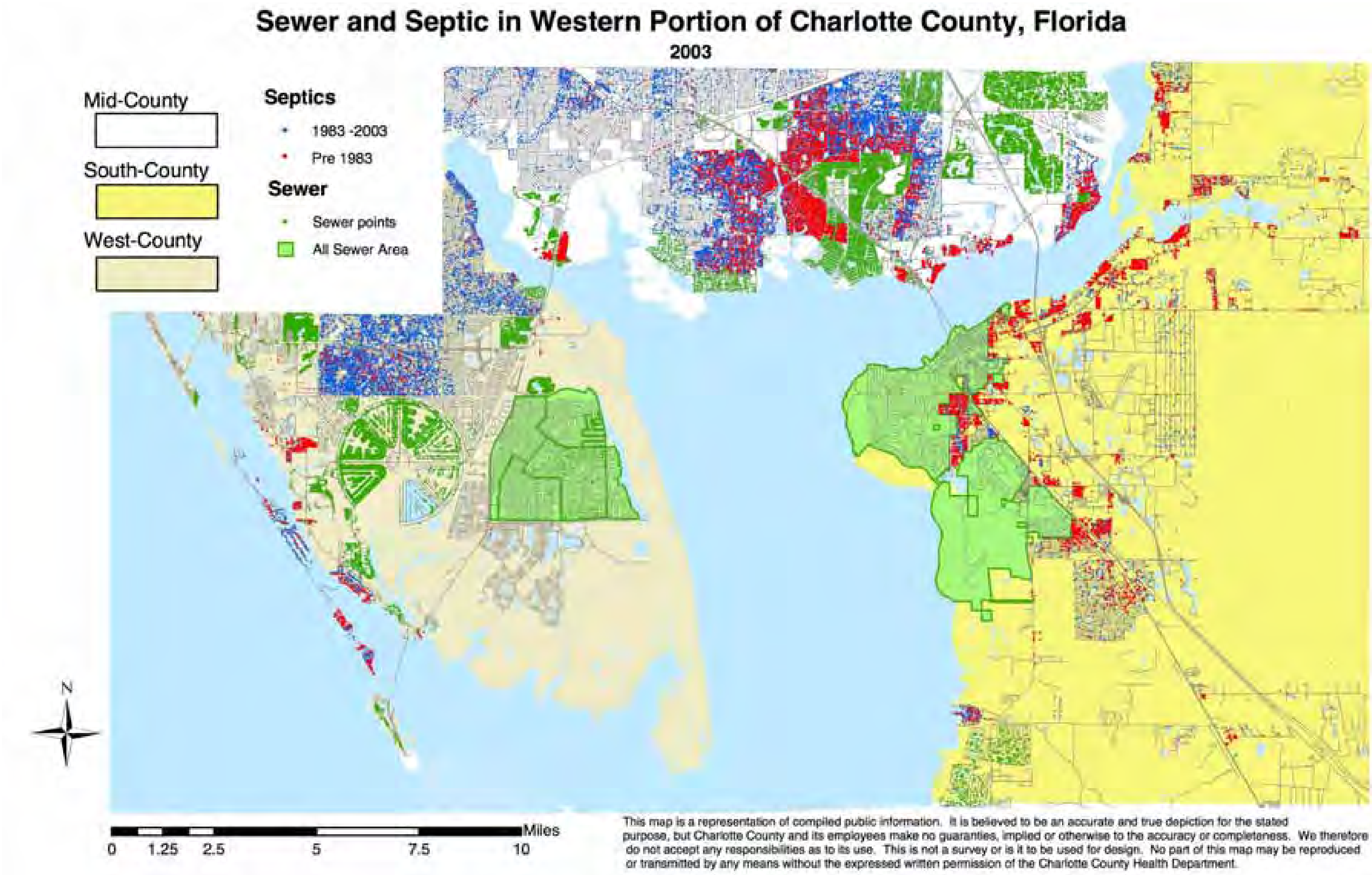
While the City of Punta Gorda and several certificated private utilities provide water and wastewater service in portions of the county, CCU is by far the county's largest utility. As of mid-2003 it provided water to 52,000 units and wastewater service to 30,000 units (both figures represent individual households and businesses; this includes units behind master meters). (See Charlotte County Utilities 2003.) CCU obtains roughly 95 percent of its water from the Peace River through the Peace River/Manasota Regional Water Supply Authority. The utility currently operates three wastewater treatment plants.

Wastewater Issues

Roughly half of the platted lots in Charlotte County have access to water distribution lines. However, the original developers provided sewer service to a much more limited area. The county had to decide whether and where to expand sewer service once it acquired General Development Utilities in 1991.

Charlotte County's maximum elevation is 25 feet. Most lots lie only a few feet above sea level, and during several wet months each year, the water table rises to within one foot of the ground level. Less than one percent of the county's land area has soils that are *not* considered "severely limited" for conventional septic systems and drain fields, according to the U.S. Soil Conservation Service. Since 1983 the state has required a 24-inch separation between the bottom of a drain field and the wet season water table. As a result, over 90 percent of onsite wastewater systems installed in Charlotte County since 1983 were built with mounded drain fields.[10] However, of the county's estimated 37,000 onsite systems, 22,000 were built before 1983. Figure 8-2 shows the distribution of sewer systems and pre- and post-1983 septic systems as of 2003. This figure includes sewering completed during mini-expansions of the sewer system (see Figure 8-3). Note the extensive street pattern through areas with few sewer or septic dots (not including "all sewer areas"); these areas have tens of thousands of platted lots that have not yet been built on.

[10] Florida's definition of a mound system differs from other states. In Florida, a mound system is one where the bottom of the drain field is located above the natural surface prior to building. In most cases the whole yard and house are elevated from the original grade to accommodate flood zone requirements as well as septic system gravity flow. In Charlotte County, few lots have a distinct "mound" sticking up that is fed by a pump.



Courtesy of the Charlotte County Health Department

Figure 8-2: Distribution of Sewers and Pre- and Post-1983 Septic Systems in Charlotte County

From 1977 through 1990, the Charlotte County Health Department (CCHD), a division of the Florida Department of Health (FDOH), issued more than 1,000 septic system permits per year. In 10 of those years, permits exceeded 1,500 per year (Charlotte County 1997). During this period, concerns arose that widespread use of septic systems, even with mounded drain fields, would exceed the assimilative capacity of the environment. Officials felt the four-lots-per-acre density of most platted land in the county was too crowded for septic systems. In addition, it was clear that many systems were poorly operated and maintained. Bacteria and viruses became a concern of local officials. The potential exposure paths included drinking water wells in areas not served by the central water system, contact with water in the canals that lace many areas served by septic systems (tidal pumping contributes to communication between groundwater and canal water), and surfacing of effluent at drain fields due to poorly maintained or inadequate systems. Pathogens could easily spread through the many grass-lined drainage swales of local subdivisions. Most drain fields are located in front yards, with little setback from street-side drainage swales. The front-yard drain field location is a result of small lot sizes. Also, because septic systems were long considered temporary, directing house plumbing to the front was considered a step toward eventual connection to a sewer system.

County officials were also concerned about the adequacy, operation, and maintenance of small package wastewater plants that proliferated during the boom of the 1980s. By 1989, when the county issued a request for proposal (RFP) for a water and sewer master plan, the county had 106 wastewater systems permitted by the Florida Department of Environmental Regulation (FDER). FDER, now the Florida Department of Environmental Protection (FDEP), regulates all systems over 10,000 gallons per day, while FDOH regulates smaller, onsite systems. FDOH delegates authority to FDEP for most mechanical systems over 5,000 GPD and some systems over 2,000 GPD.

Historical Overview

In 1988, Charlotte County and the City of Punta Gorda jointly submitted a comprehensive plan to the Florida Department of Community Affairs (FDCA), as required by state law. FDCA found the plan noncompliant in a number of areas, including its infrastructure element. FDCA and Charlotte County negotiated an agreement in 1989 (finalized in early 1990) in which the county committed to prepare a water and sewer study and use the results to establish zones for infrastructure expansion within the county's "Urban Service Area." (See Charlotte County, *et al.* 1995, p.12-63.)

Study and Rejection of Widespread Sewer Construction

To satisfy this agreement, the county in 1989 issued an RFP for a 25-year water and sewer master plan. The contract was awarded to Giffels-Webster Engineers, in association with James M. Montgomery Consulting Engineers. The consultants started a two-phase, two and one-half year study at a total cost of $837,000. (See Charlotte County *et al*. 1995, p. 12-61).

At about the time the contract was awarded, Charlotte County initiated its condemnation and acquisition of General Development Utilities.

After the acquisition, the master plan study focused on the service area of the new public utility, CCU. The objective of the plan was to provide water and sewer service to all lots within CCU's service area in an orderly and cost-efficient manner.

The final plan, released in June 1993, provided phasing recommendations for water and sewer projects through 2000 and every five years thereafter to 2015. Estimated costs over the entire period totaled $461.6 million (1992 dollars) for wastewater service for CCU, $148.0 million for water service for CCU, and $68.3 million for water and sewer service by private utilities. The total cost projection came to $677.8 million. $216.8 million would be required through 2000 for CCU to expand and upgrade wastewater treatment facilities and construct nearly 22 square miles of wastewater collection systems. The cost per single-family residential unit for wastewater service was estimated at $4,000–$4,500, not including house to street connections and financing (Giffels-Webster Engineers, Inc. and James M. Montgomery Consulting Engineers, Inc. 1993, Table SC-1 and pp. 27, 31). The county modified the 1988 comprehensive plan to incorporate the master plan into the capital improvements element.

In 1993, the county hired Camp Dresser & McKee (CDM) to lead implementation of the master plan. CDM undertook design engineering for sewers and facilities included in the initial project phases covering 20,000 to 30,000 lots. These studies put costs at $6,312 to $7,119 per Equivalent Residential Connection (ERC) for lots with existing structures, and $4,333 to $5,140 per ERC for vacant properties (Charlotte County et al. 1995, pp. 12-88–12-89). Several people interviewed for this case study reported that the figure that circulated publicly was $8,700 per lot for 22,000 lots.

Public reaction to the proposed sewer plan was overwhelmingly negative. Reasons included the high per-unit cost relative to the low, fixed incomes of many residents; the fact that many residents had already paid for a septic system and would be paying again for sewer service; and a belief that the environmental and public health risks posed by septic systems had not been substantiated. Sewer opponents organized and packed public meetings regarding the sewer proposal. In November 1994, two candidates who favored scaling back the sewer plan were elected to the five-member Board of County Commissioners (BCC).

Other commissioners began to have second thoughts on the plan as well. In April 1995, the BCC authorized a somewhat reduced sewer expansion plan (See Charlotte County et al. 1995, p. 12-79). Public and private debate continued.

Meanwhile, county and Punta Gorda staff in 1993 began work on an Evaluation and Appraisal Report (EAR); a state-mandated five-year review of the 1988 comprehensive plan. This effort offered a way for the county to back away from its earlier commitment to FDCA to undertake a major sewer expansion. The county claimed that earlier planning efforts were faulty. The final county- and state-adopted EAR, published in November 1995, included a 17-point critique of the

1988 comprehensive plan's infrastructure element and a critique of the water and sewer master plan. It also suggested new directions for water and sewer policy. (The county was so interested in taking a new approach that some of the EAR's critiques may have been somewhat disingenuous. The analysis section that follows points out some such points.)

By May 1995, Charlotte County had spent approximately $15 million on engineering for sewer expansion (Charlotte County *et al.* 1995, p. 12-91). Despite this investment, and because of continuing public pressure and increasing concerns about the financial viability of a major sewer project, the BCC voted to stop the sewer expansion altogether in early 1996. As if to underline their views on the subject, voters in November 1996 elected a leader of the vehement anti-sewer movement to the BCC.

Development and Implementation of an Alternative Approach

In Florida, comprehensive plans must be updated every 10 years. The 1995 EAR was Charlotte County's first step in developing its next comprehensive plan. It recommended policy changes and programmatic initiatives in every area covered by the plan.

Charlotte County leaders ensured substantial public input into the new plan. From mid-1995 through early 1997, the BCC, planning commission, and other county bodies held at least 78 meetings to which the public was invited (Forgey 1997). One important public participation initiative was the Charlotte Assembly; a three-day workshop of more than 100 local leaders and citizens held in mid-1996. The assembly developed a statement that set out participants' visions and goals for Charlotte County, as well as suggested policy directions (Charlotte Assembly 1996). Subsequently, in the Fall of 1996, some assembly participants divided into five sub-groups and held a series of workshops (four to nine, depending on a group's focus; the land use and infrastructure group met nine times). The groups reviewed draft sections of the comprehensive plan and provided suggestions to county staff. A new comprehensive plan was transmitted to FDCA in March 1997. FDCA requested certain content be clarified. The final comprehensive plan was adopted in November 1997.

The overall thrust of the 1997 plan was to diversify the county's economy, protect its environment, manage growth, and deal with problems created by the excess of platted lots. The large number of platted lots made it difficult to efficiently provide infrastructure. The plan aimed to steer growth by improving infrastructure in certain places, and to discourage growth in other places by employing a variety of policies and programs. With regard to wastewater, the plan set out the following initiatives:

- The county would limit extension of water lines without concurrent provision of sewer service. Providing water without sewers would result in construction of more septic systems. Additionally, the county would only encourage or allow centralized water and sewer service to designated "Infill Areas" within an "Urban Service Area" delineated in the plan's future land-use element.

- Charlotte County Utilities would develop mini-expansions of sewer service in portions of its service area during 1998 to 2002. Some additional expansions would occur in the following five-year period.
- The county would develop a new ordinance to require the installation of advanced onsite wastewater treatment systems, instead of septic systems, when small lots and lots near surface water are developed.
- The county would develop a septic system management program.
- The county would develop a water-quality monitoring program to determine the impacts of pollution from wastewater systems.

The comprehensive plan itself established most of the policies referred to in the first item listed. These policies are discussed in the Analysis, Growth, Development, and Autonomy section. The septic system management program and the water-quality monitoring program have seen only partial development; they are discussed in the Performance and Reliability section. The CCU sewer expansions and the onsite wastewater system ordinance have proceeded largely as outlined in the plan. The following sections describe the history of these two initiatives.

Mini-Expansions of the CCU Sewer System

By the mid 1990s, CCU was saddled with a huge debt. Borrowing had been necessary to acquire General Development Utilities, to pay engineering and other costs for the proposed sewer expansion, and to expand and upgrade the main wastewater treatment plant. Debt service became the single largest budget item for the utility, and huge rate increases—24 percent in one year alone—were necessary from 1991 through 1996. By 1996, CCU's rates were among the highest in Florida, with an average residential customer paying $39.66 per month for water and $40.75 per month for sewer.[11] The public was outraged by the rates, and in 1996 the BCC formed an ad hoc citizen's committee to examine the feasibility of privatizing CCU.

Utility staff mobilized to fight privatization. They identified technological and organizational efficiencies to cut costs and developed a plan to expand the customer base of the utility. In mid-1996, CCU submitted to the BCC a management plan that outlined the employees' proposal and included four years of rate reductions from 1998 through 2001. The BCC accepted the plan and rejected the privatization option (Charlotte County Utilities 2003, pp. 4–5).

Expansion of its customer base was a cornerstone of CCU's management plan. This would increase revenues available to pay off high fixed costs. Expansion would be accomplished in three ways:

[11] The combined water and sewer bill for a residential user with an average usage of 5,000 gallons per month increased from $50.48 on 11/1/93 to $80.41 on 8/1/96. Rates at the latter date were composed of a $3.06 customer charge, base charges of $16.00 water and $24.00 sewer, a water usage charge of $4.12 per 1,000 gallons, and a sewer usage charge of $3.35 per 1,000 gallons (based on water use).

- Providing water and sewer service to a rapidly growing *new* development called South Gulf Cove
- Moving to acquire privately held utilities in the county when financially feasible
- Strategically extending the sewer network into portions of the area previously targeted for the massive sewer expansion

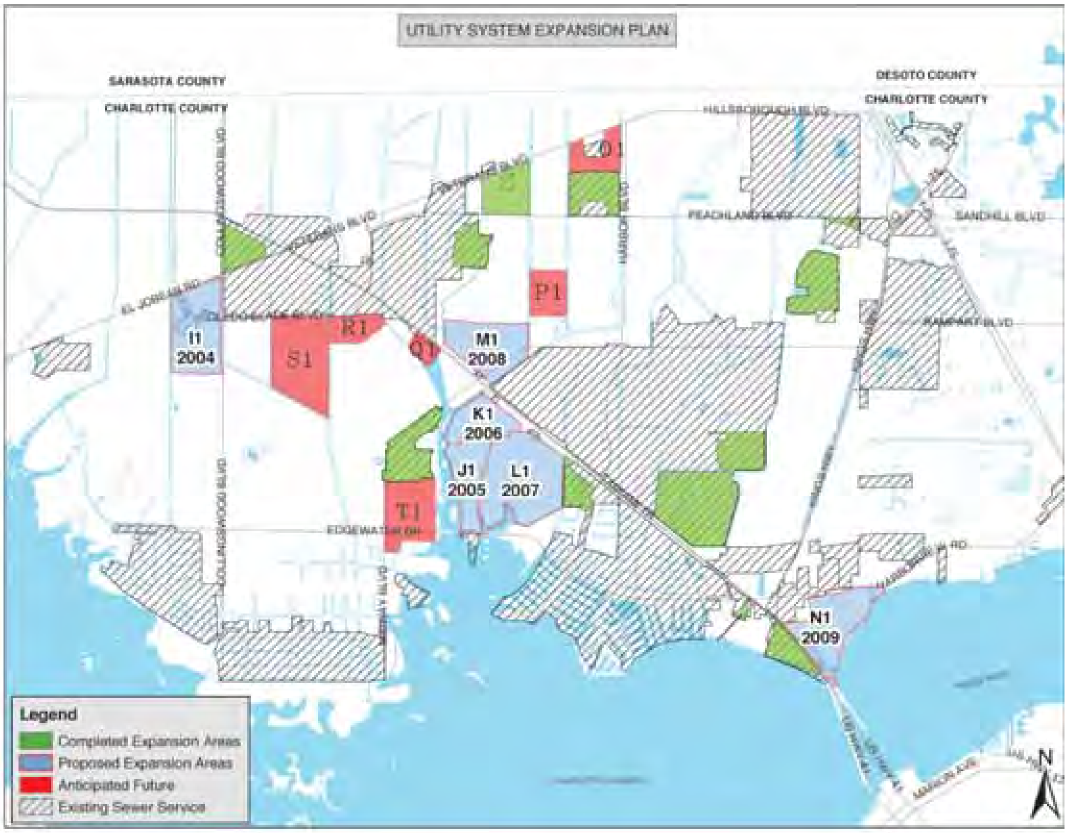
The latter program became known as the mini-expansion program, to differentiate it from the earlier sewer plan. CCU identified 12 areas for sewering. These areas encompassed 3,680 properties, of which 2,275 were already developed. They were selected based on:

- Available capacity in existing lift stations and force mains
- Low sewering cost
- High proportion of developed lots
- High proportion of homes using pre-1983 septic systems (the state improved its onsite wastewater system standards in 1983)
- Proximity to waterways

CCU scheduled construction for the 12 areas to take place over a five-year period. Figure 8-3 shows the locations of these areas, and areas proposed (but not yet approved by the Charlotte County BBC) for future sewer expansions. To pay for the program, CCU staff proposed the establishment of a revolving fund with seed money from the Operation and Maintenance Fund. The BCC agreed that this use of savings derived from operational efficiencies in 1995 and 1996 offered a higher long-term return, by garnering new ratepayers, than paying down the debt or giving a one-time credit on customer's bills. Thus, a portion of the connection fee paid by homeowners in the mini-expansion areas is returned to the revolving fund and used for the next round of construction.

In most cases, low-pressure sewers are used for the mini-expansion projects. Trenchless directional boring is often utilized to minimize disturbance to streets, driveways, and landscaping. Roughly 80 percent of the time, the existing septic tank is retained and fitted with an effluent pump. CCU takes over ownership and maintenance of onsite components of the system.

Homeowners are charged a connection fee of $3,982. This includes plant, transmission, and collection components of $2,762, and onsite conversion costs of $1,220. The only additional cost for the homeowner is $150 to $300 for an electrician to mount and connect a control panel that CCU provides.



Courtesy of Charlotte County Utilities

Figure 8-3: Locations of Completed and Proposed Sewer Mini-Expansion Areas

This program, along with the other expansions of the customer base, plus operational and organizational efficiencies, enabled CCU to keep its promise to reduce rates every year from 1998 through 2001. The utility also reduced rates in 2002. Over the five-year period, CCU reduced water rates by 15 percent, and sewer rates by 14 percent. In dollar terms, charges per month for the average residential customer decreased to $34.08 per month for water and $35.33 per month for sewer. CCU achieved these rate reductions while simultaneously absorbing cost increases from the regional authority that supplies treated water to CCU. CCU's success is in part due to the high rate structure resulting from previous rate increases and to the available sewer transmission and treatment capacity CCU had already paid for. These factors make targeted expansion of the customer base highly profitable. Regardless, for reasons described in the analysis section, the mini-expansion program has helped CCU and the BCC rebuild trust with citizens that they lost during the earlier utility acquisition and sewer expansion debacles.

Onsite Wastewater System Ordinance

The 1988 comprehensive plan recommended a general phasing out of septic tanks in the county. This recommendation was based on a discussion of general problems associated with septic tanks, rather than any particular evidence of failures in the county (Charlotte County *et al.* 1995, pp. 12-28 and 12-45). The 1995 EAR recommended that the county discourage septic systems because of the county's poor soils. It recommended steering growth to areas with sewer service, instituting a septic system management program, and developing stricter standards for construction and maintenance. The level of control of such standards would be based on the length of time septic systems would be in operation before sewer service reaches a property (Charlotte County *et al.* 1995, pp. 12-12 and 12-54).

The 1997 comprehensive plan put less emphasis on eventual replacement of septic systems with sewers. In addition to proposing a management program, it addressed the location and density of septic systems. It included a policy that by July 1, 1998, the county would require the installation of an advanced onsite treatment system in new development where the setback between a drain field and surface water is less than 150 feet. This would include many canal-side lots. The standard lot size in Charlotte County is 80 by 125 feet. By the same date, the county would also require advanced systems in new development on lots less than or equal to 10,000 square feet that are not scheduled to receive sewer service within five years. Thus, owners of standard, 10,000-square-foot lots would be required to either install an advanced system or to purchase another, contiguous lot and vacate the building rights for that lot. The goal of these standards was "to reduce development densities and the concentration of effluent when standard septic systems are used." The requirements would have the effect of reducing the density of construction using standard septic systems to two lots per acre, the same density applied in state law to new subdivisions using well water. The plan defined advanced onsite treatment systems as aerobic treatment units (ATUs) and nutrient reduction systems (Charlotte County 1997, pp. 4-141–4-142).

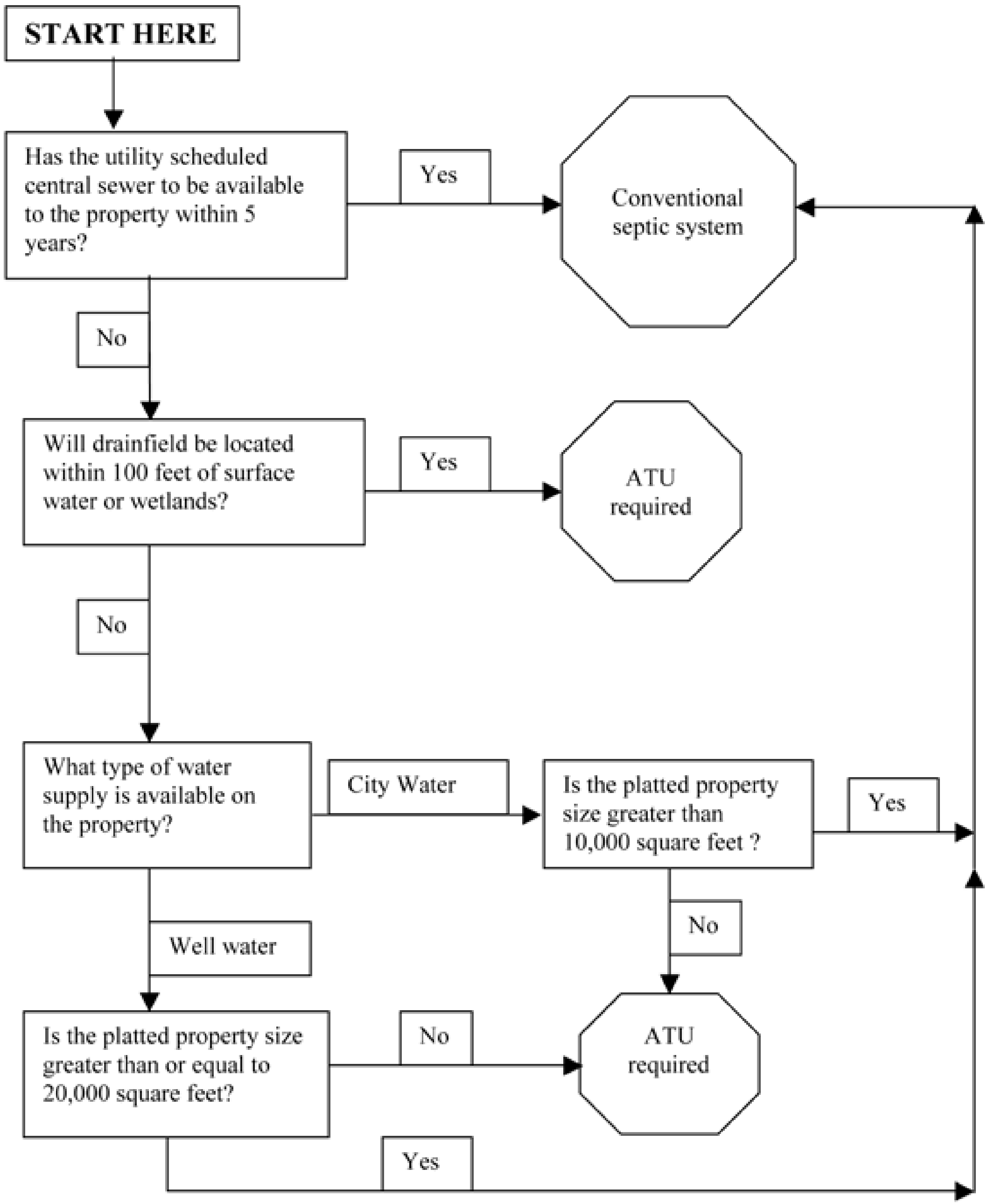
Development of these policies began with discussions between county staff and staff of the Charlotte County Health Department (CCHD) during drafting of the new comprehensive plan. By January 1997, county and CCHD staff had put together a rough set of policies for onsite wastewater. The BCC discussed the policy directions and requested further development (see BCC Meeting Minutes for January 28, 1997). In April 1997, CCHD presented the BCC with a matrix of recommended policies, including a comparison to state regulations and ordinances of other Florida counties. The matrix addressed setbacks of drain fields from surface waters; minimum lot sizes for conventional septic systems, ATUs, and nutrient reduction systems; separation distances to groundwater; and other onsite system standards that would exceed state onsite system regulations. The BCC agreed with the directions established in the matrix, requested staff to prepare specific policies, and instructed staff to obtain input from citizens, notably builders and realtors (see BCC Meeting Minutes for April 8, 1997). The BCC reviewed draft policies in June and in July approved a set of clarified policies to be developed into an ordinance (see BCC Meeting Minutes for July 29, 1997). Key elements of the policies were incorporated into the final comprehensive plan.

The assistant county administrator and CCHD formed a citizen work group to review drafts of the ordinance and implementation plan. The group included builders, realtors, engineers, developers, onsite system contractors, and interested citizens. The review process resulted in some changes. Nutrient reduction systems were dropped from the ordinance; based on information from a demonstration project in the Florida Keys such systems were expensive. Further, in Charlotte County nutrients were considered much less of a concern than pathogens (some people disagree with that assessment). ATUs were deemed adequate for pathogen removal. The surface water setback distance was also reduced during the review process to 100 feet. The BCC approved a final ordinance on October 6, 1998 with an effective date of March 1, 1999.

The ordinance established sections 3-8-250 through 3-8-263 of the Charlotte County Code. The lot size and setback requirements for new construction are as follows:

- For any lot where a utility has scheduled central sewer service to be available within five years, a conventional septic system may be used.
- Where surface water or delineated wetlands are within 100 feet of the system’s drain field, an ATU is required.
- If there is no surface water within 100 feet and the lot has central water service, construction on a lot of 10,000 square feet (for example, standard 80-feet % 125-feet lots) or smaller requires the use of an ATU.
- If there is no surface water within 100 feet and the lot has well water, construction on a lot of less than 20,000 square feet requires an ATU. These requirements are clarified in Figure 8-4.

Given these requirements, most owners of standard 10,000-square-foot lots have two choices: pay for installation of an ATU or purchase a second, contiguous lot and vacate building rights on that property. The legal instrument for this is a utility easement filed with the clerk of the Charlotte County Court. This easement runs with the property and functions like a deed restriction. If and when an owner connects to central sewer service, the restriction is terminated. The county waives the usual $902 fee for a plat vacation. The choice of ATU or extra lot is roughly the same economically. A standard septic/drain field system in Charlotte County costs $3,000 to $5,000. An ATU/drain field system costs $2,000 to $3,000 more. Operating costs (mainly electricity for the ATU blower), the $50 cost of an annual permit, and roughly $150 per year for semi-annual maintenance by a licensed entity as required by the ordinance must be added to the cost. In comparison, non-waterfront lots in Charlotte County cost $1,500 to $4,000 without central water service, and $5,000 to $8,500 with central water. Lots with water and sewer service run $15,000 to $25,000, depending on the area.



Courtesy of the Charlotte County Health Department

Figure 8-4: A Flow Chart Showing the Conditions Under Which an ATU Is Required for Development of a Single Lot

The ordinance also established certain requirements above and beyond the requirements of state regulations for:

- Groundwater separation distances for replacement drain fields
- Content of sand used where digout and backfill of soil below the drain field is required by state regulations
- Licensing of maintenance entities
- Content of the maintenance contracts required for ATUs
- Testing and laboratory standards
- Septic tank pumpout practices and reporting (but not pumpout schedules)
- Septage treatment and land spreading

It also established procedures for variances, designated the BCC to set fees, allocated collected revenues to the onsite wastewater program, established compliance and enforcement powers, and established the right of representatives of the CCHD, FDOH, and BCC to enter private property for monitoring and inspection of onsite systems.

During the five months between passage and implementation of the ordinance, CCHD worked to educate builders, realtors, and the general public on the new requirements. In the month before implementation, CCHD received three times the usual monthly applications for standard septic system permits. Following implementation, CCHD received a number of applications that attempted to use partial lots to fulfill the minimum area requirement. This would have pushed standard septic system density above two systems per acre. The county attorney clarified that the ordinance does require joining of whole, originally platted lots for use of standard septic systems. CCHD developed literature explaining this and showing the various possible lot combinations: side to side, back to back, corner to corner, directly across a street or canal, and corner to corner across a street or canal.

Since the mid-1990s, CCHD has permitted roughly 400 onsite systems per year. It was expected that under the new ordinance roughly half of the applications would be for ATUs. This has not been the case. From the March 1, 1999 effective date of the ordinance through the end of 2003 (nearly five years) 466 ATU permits were issued—a little less than 100 per year—and 320 were installed and approved. Most applications instead utilize the lot combination provision.

This has been fortunate for CCHD because the anticipated 200 ATU applications per year would have required an additional staff member for system inspections, and the $50 annual permit fee is not sufficient to support the position (the fee was originally $150 but was lowered statewide by the Florida legislature).

Figure 8-5 shows an ATU installation at a new Charlotte County home in October 2002.

Photograph by Richard Pinkham

Figure 8-5: Installation of an ATU at a New Charlotte County Home

Analysis

This section provides information regarding analysis of:

- Performance and reliability
- Incremental capacity provision
- Fairness and equity
- Growth, development, and autonomy
- Stakeholder relationships and trust

Performance and Reliability

This section address the following topics:

- ***How was system architecture relevant to this issue?*** The county's philosophy regarding onsite wastewater systems has changed; it has gone from viewing them as temporary to considering them permanent in many areas. This required improved performance and reliability. Sewer opponents questioned sewer reliability.
- ***How was the issue addressed?*** The county proposed then studied a septic system management program. The county proposed but did not fund a water-quality monitoring program to identify areas where wastewater systems are inadequate. CCHD conducted a surface water sampling program to document contamination. The county developed an ordinance that reduced the density of new septic systems. Vulnerability to hurricanes was considered but was not regarded as an important decision factor. CCU targeted older septic systems for sewer service.
- ***Did the issue resonate with the community?*** Many residents questioned why sewers were needed when their septic systems seemed to work fine. Some believed leaking sewers were as serious or a more serious problem. Yet the master plan did not address sewer maintenance. Later, some parties also questioned the county's push for increased performance of onsite systems and doubted the reliability of ATUs. Elected officials made trade-offs between performance and reliability concerns when they directed how staff should develop the onsite systems ordinance.
- ***Results/Status:*** ATU reliability remains a concern, with less than adequate support from ATU manufacturers. CCU has developed a sewer-lining program. The county expects to develop a septic system management ordinance and a water-quality monitoring program in the near future.

How Was System Architecture Relevant to This Issue?

The 1988 comprehensive plan, the 1993 water and sewer master plan, and to some extent the 1995 EAR considered onsite wastewater systems as temporary systems until sewer service was provided. Yet, as of the 1997 comprehensive plan, septic systems and package plants provided approximately half of the county's wastewater treatment capacity. The 1997 plan indicated the county's policy would be to decrease reliance on these technologies while recognizing that onsite systems would be permanent in many areas. The county recognized that certain situations required higher performance onsite systems, and that ensuring their reliability required improved management and maintenance. As for sewers, concerns about their condition and reliability were raised by some participants in the sewer debates of the mid-1990s and in the development of onsite wastewater programs.

How Was the Issue Addressed?

During the early 1990s, the sewer planning team attempted to show that septic systems posed health risks in the county. A study prepared for CDM showed that fecal coliform levels increased downstream, along canals in urban areas, and it concluded this indicated contamination from septic systems. Another study tested groundwater around septic systems. It reportedly showed elevated nitrogen levels in leachate plumes in the groundwater around canal-front lots with septic tanks. The inference was that onsite systems contributed to nutrient enrichment and eutrophication in Charlotte Harbor. However, according to CCHD, the study was poorly designed, and its results were not conclusive.

Later, CCHD tested standing water in roadside swales for fecal coliforms. County code required only a 15-foot setback between a drain field and the centerline of a swale. The tests were designed to compare swales in septic-served and sewer-served areas. However, not enough samples were collected in the sewer-served areas to statistically validate the observed higher fecal counts in septic-served areas.

While health risks from septic systems were not proven by these studies, one thing was clear: since the county was backing away from the massive sewer expansion it previously promised, FDCA expected the new comprehensive plan to address the likely risks posed by the number, density, and age of septic systems in Charlotte County. Thus the county developed the initiatives described in the following sections, including:

- Septic system management program
- Water quality monitoring program
- Surface water sampling program
- Ordinance to reduce the density of new septic systems
- Wastewater systems vulnerability
- Older septic systems targeted for sewer service

The County Proposed and Worked Toward a Septic System Management Program

At the time of the 1997 comprehensive plan, CCHD estimated the county had 40,000 septic systems. An estimated 24,000 were installed prior to 1983 when the state improved its onsite system standards. Between 1991 and 1994, 401 septic systems failed, 70 percent of which were pre-1983 systems (Charlotte County 1997, pp. 4-140 and 4-161). In more recent years, CCHD has investigated 200 to 300 complaints per year and documented roughly 150 failures per year.

The 1997 comprehensive plan made clear the county's intent to develop a septic system management program requiring mandatory inspections and pumpouts of installed systems. The program would be based on the results of a pilot septic system management program. The health department had just received funding for this program—really a research study, as it did not test any specific, proposed regulations—through the federal Clean Water Act 319c program.

Implementation would begin by October 1, 2000. (See Charlotte County 1997, pp. 4-158 and 4-196.)

The county has not yet developed the management program due to delays in the research project. Results of the study were forwarded to FDEP in August 2003, and the final report was released that October (Charlotte County Health Department 2003).

This project comprised several elements. Locations of all septic systems in the county were entered into a GIS system. Based on a stratified random sample of different soil types, system ages, system sizes, proximity to surface water, and other factors, septic systems owners were asked to participate in the study. Two-hundred-thirty system owners were surveyed for household characteristics and practices affecting wastewater volume, flow rate, and composition. The residents were then educated about proper use of their systems. The researchers installed observation ports on participants' septic tanks and drain fields. All septic tanks were pumped. Necessary repairs were performed, such as repair or replacement of faulty outlet tees.

The researchers carried out a follow-up evaluation of household practices within 6 to 12 months to see if household practices had changed as a result of the education effort. They also returned at 6 and 12 months to check accumulation of septic tank solids and scum, and drain field ponding levels. A key objective of the research was to develop a quantitative model of septic system performance under different household practice scenarios (such as water use, use of a garbage disposal, management of fatty kitchen waste, and other practices) that would allow prediction of necessary pumping frequencies. The results of the education efforts and the model would be used to develop a county-wide education program and schedules of mandatory pumping frequencies. However, sludge and scum accumulation measurements over one year proved too random to be useful in developing a predictive model.

On the other hand, correlations were found between scum accumulation at 12 months and certain household practices. Use of large to extra-large washing machines, regular garbage disposal use, and not scraping food from plates before washing contributed to excessive scum accumulation. A correlation was also shown between lack of excessive scum accumulation and use of low-flow showerheads (Charlotte County Health Department 2003). These findings, together with data on the age and condition of septic tanks and drain fields, will be used by CCHD to recommend amendments to the chapter of the county code that regulates onsite wastewater systems. The recommendations will be prepared in early 2004 and will likely include an education program and a requirement for periodic system inspections.

The County Proposed a Water Quality Monitoring Program

The 1997 comprehensive plan proposed a long-term ambient water quality monitoring program to "identify areas where the installation of a central sewer is needed because of soil, groundwater, or surface water pollution resulting from septic system discharge." (Charlotte County 1997, p. 139) While the text of the comprehensive plan focused on problems derived from onsite systems, its specific objectives and policies encompassed sewer systems as well, which many people in the county suspected were leaking:

> Objective 11.2: By December 31, 2000, Charlotte County will develop and begin implementation of an ambient water quality monitoring to determine the impacts of pollution resulting from the use of sanitary wastewater treatment systems (septic systems, package treatment plants, and central sewer systems). …
>
> Policy 11.2.3: When analysis indicates that a sanitary wastewater treatment system is adversely impacting the environment according to state water quality standards … and that public health standards are endangered, wastewater treatment systems causing the situation will be repaired or replaced. (Charlotte County 1997, p. 4-197)

CCHD provided cost estimates to the BCC and county staff for purchase of a boat and other equipment, and monthly sampling. The comprehensive plan indicated costs would be $110,000 per year for both groundwater and surface water monitoring and noted possible funding sources. Since inception of the plan, the county has hoped to obtain outside funding and has not appropriated its own funds for a monitoring program, despite its commitment to implement a program by the end of 2000. The EPA's Gulf of Mexico Program will provide funding for some monitoring beginning in late 2003.

CCHD Conducted a Surface Water Sampling Program to Document Contamination

While the long-term monitoring program did not materialize, CCHD did obtain funds from the Southwest Florida Water Management District for a short-term sampling program. From March 1997 through February 1998 a team of scientists took water quality samples at 15 locations in upper Charlotte Harbor, including both canals and open waters. This was an advanced study that used some state-of-the-art techniques. Samples were analyzed for bacterial indicators (fecal coliforms, Enterococci, *Clostridium perfringens*, and Coliphage) and for enteric pathogens, including enteroviruses (polio, coxsackie, echo) and protozoan parasites (*Cryptosporidium*, *Giardia*). (Lipp *et al.* 2001 and CCHD summary memorandums)

Levels of indicator organisms and enteroviruses were highest during the heavy rains of December 1997 to February 1998. High stream flows induced rapid transport and prolonged the survival of organisms, making pathogens and indicator organisms present in the inland and harbor water column. Human enteroviruses were found, but this did not point out the source of pathogens.

Another part of the study, however, indicated a likelihood that septic systems were introducing contaminants to surface waters. Hourly samples obtained over a 24-hour period were taken at the surface and bottom of the Frizell Canal in the "El Jobean" area of Charlotte Harbor. The entire community around this canal uses septic systems, most more than 20 years old and with less than six inches of unsaturated zone below drain fields. Levels of Enterococci, Coliphage, and fecal coliforms all showed statistically significant correlations with tidal levels— the highest levels were at low tide. While boat privy discharges and other sources could contribute to these high levels, the scientists believed the likely cause was the flow of septic-contaminated groundwater into the canal at low tide, when the water table slopes toward the canal. At high tide, water flows in the opposite direction, from the canal into the groundwater. (This surface/ground water communication pattern is known as "tidal pumping.")

CCHD used the results of this study, which came out during the period when the ordinance work group was meeting, to convince the group and the BCC of the need for improved onsite system standards. While the source of contamination was not proven, CCHD believes this study, and media coverage that followed, contributed to an important change in perceptions about wastewater problems. Other sampling data showing fecal indicators at beaches and in canals also contributed to local awareness.

A follow-up survey of some sites, conducted in June and July 1999, used ribotyping of *E. coli* fecal bacteria to identify human and non-human bacteria. This study and the 1997–98 study's enterovirus findings together documented human-source pathogens or *E. coli* at five sites. The investigators believed the sources were probably septic systems or boat discharges at three sites, septic systems at one site, and boat discharges or leaking sewers at one site.

The County Developed an Ordinance That Reduced the Density of New Septic Systems

The ordinance described in the historical overview is the most substantial policy initiative addressing onsite systems adopted since the 1997 comprehensive plan was finalized. This ordinance addresses performance and reliability of onsite systems. It implies and codifies a conclusion that, given local soil and groundwater conditions, septic systems do not provide an adequate level of treatment (performance) for safe long-term use at the four-lot-per-acre density of most platted lands in Charlotte County. Development at this density requires the higher performance provided by ATUs. The ordinance also addresses reliability by requiring operating permits and maintenance contracts for ATUs. A contract must include twice yearly inspections by a licensed maintenance entity. Also, to help CCHD begin to get a handle on septic system maintenance, the ordinance requires septage pumpers to report on a monthly basis the date, location, volume, and other parameters for each system they service.

Vulnerability of Wastewater Systems Was Considered But Not Regarded as a Decisive Issue

Charlotte County can be hit by hurricanes. Issues of flooding and power outages as a result of hurricanes were brought up during consideration of wastewater system choices and development of the ordinance. Officials reportedly decided that if flooding were bad enough to inundate onsite systems, it would affect sewers too. No special materials or construction techniques for either onsite or centralized systems have been mandated. As for ATUs and power outages, officials say that ATUs can go for a week without power before waste-eating microbes die off, and they do not expect outages of that duration.

CCU Targeted Older Septic Systems for Sewer Service

While available system capacity and sewering costs were the primary considerations in identifying areas for the mini-expansions of the sewer system, CCU also used septic system age as a selection criterion. Once areas meeting capacity and cost criteria were identified, areas with a high proportion of pre-1983 septic systems were given priority.

Did the Issue Resonate With the Community?

The performance and reliability issue resonated with the community in several ways during:

- The sewer debate
- Development of the onsite system ordinance
- Elected officials' compromises between performance and reliability considerations

Issues of Performance and Reliability Resonated Strongly With the Public During the Sewer Debate

The 1995 Evaluation and Appraisal Report specifically referred to citizen concerns regarding the need for sewers:

> The main question that a current landowner asks is: Why is the county requiring me to fund another sewage system, especially when my septic system appears to be working properly? …
>
> The lack of data in Charlotte County is one of the reasons that public resistance has been so great to the sewer expansion project. It has not yet been proven to the public that the environment is being polluted by the use of septic tanks in Charlotte County[12]. (Charlotte County 1997, p. 12-81)

Relative contributions of septic systems and other sources of pollutants also received attention, as did relative spending on possible sources. According to a local engineer, members of the public said they were being asked to spend thousands of dollars to replace septic systems with sewers, but local cattle ranches, another known source of bacteria and nutrients, were not required to do anything. Another resident remembers that many people believed sewer systems had been poorly maintained by the private utility predecessor to CCU, and likely contributed pollutants to the environment. Water levels in some sewers near the harbor were known to rise and fall with the tide. Sewer overflows in wet weather were another known problem. Yet the water and sewer master plan focused entirely on expanding sewer service to accommodate growth and replace septic systems and did not address the need for or costs of maintenance and repair of existing sewers. Such a review of existing conditions and operational practices was apparently deemed outside the scope of the master plan when it was initiated because General Development Utilities was a private company.

[12] This may be an example of the possibly disingenuous tone of the 1995 EAR referred to earlier. The question had an obvious answer that the staff knew well: your system may work hydraulically—you don't have plumbing backups or effluent surfacing from your drain field—but its environmental performance, its contributions of pathogens and nutrients to ground and surface waters, is unseen. On the other hand, septic-derived pathogen and nutrient problems had not been clearly proven and were a matter of some debate.

These Issues Continued To Be Contentious During Development of the Onsite System Ordinance

Many members of the local construction and real estate community opposed the ordinance on the grounds that it was unnecessary. They felt (some still do) that the insufficiency of baseline septic systems had not been proven. One participant in the ordinance work group interviewed for this report pointed out that the 1997–98 canal study used to justify the ordinance did not compare failing and properly operating septic systems. He suggested that sampling of water quality directly below drain fields and below the underlying soil treatment zone should have been done to determine whether baseline septic systems provided enough treatment.

According to the health department, the sufficiency of existing septic systems was not the entire point. Regardless of whether current systems were contaminating local waters, it was clear to the department that at some point, with more than 100,000 lots available for onsite wastewater systems, septic systems would impact water quality. The department told this to the public repeatedly.

Several interviewees also maintained that ATUs are unreliable. They note that the mechanical systems can fail, and they claim residents often turn off power to the units. Indeed, in addition to inspecting ATU installations, CCHD now makes an extra inspection after a certificate of occupancy is issued. It once found that power to two ATUs had never been turned on. Further, some people claim that ATUs are inappropriate given local demographics: much of the population is retired, residents are often absent during summer months and away on long trips at other times. In such cases, the microbes necessary for ATU function die off for lack of food. Opponents of the ordinance believe that it was really designed for growth control, and that it was disingenuously promoted as an environmental and public health need. (Local officials maintain they were clear it was both. This argument is addressed further in the analysis of growth issues.)

Elected Officials Compromised Between Performance and Reliability Considerations

During development of the comprehensive plan and the onsite system ordinance, county and CCHD staff presented the BCC with options for improved regulation of onsite systems. According to one participant, the health department favored development of an onsite system management ordinance over an ordinance specifying development density and system performance requirements. The department considered improved reliability of the 40,000 existing systems—achieved through programs and rules for inspection, repair, and maintenance—a higher priority than regulation of new system performance. Reportedly the BCC opted for regulation of new systems because it was politically easier to address systems that would mostly belong to future voters than to regulate existing systems owned by existing voters. The BCC could also justify this approach because the septic system management research study had been funded; therefore, development of a management ordinance could await the study results.

Regarding regulation of new systems, the BCC was given a choice between mandating ATUs or mandating that houses be constructed on raised ground to allow for gravity flow to drain fields with an increased (three-foot) separation distance to groundwater. The former option seemed less onerous to the BCC and therefore was chosen. The health department would have preferred a passive system approach.

Results/Status

Charlotte County's ordinance is the strictest set of onsite standards voluntarily adopted by a Florida community. The standards in Monroe County (the Florida Keys) are tighter, but were mandated by the state government. No studies of the efficacy of the new requirements have been conducted.

ATU reliability remains a concern. The state legislature, when it recently reduced the ATU permit fee from $150 to $50 per year, also reduced ongoing FDOH (CCHD) inspections, from two to one per year, and removed the requirement for annual sampling and analysis of ATU effluent.

Six brands of ATUs were originally licensed for use in Charlotte County. Some manufacturers have reportedly not been supportive of their local distributors, in some cases refusing to provide warranty services or repairs. The distributor/maintenance contractor for one company recently quit, and CCHD had to take legal action against the manufacturer to get a new maintenance contractor in place.

Utility management of ATUs is discussed from time to time. CCU staff members report that they could provide this service, including inspection, testing, maintenance, and billing, but the utility is concerned about financial and regulatory liability.

As for sewer systems, CCU now has a pipe-lining program. The utility spends as much as $1 million per year to identify and line failing sewers. It has lined roughly 17 miles of pipe in the last seven years. (CCU's sewers include approximately 248 miles of gravity sewers, 213 miles of low-pressure lines, and 132 miles of force mains (Dufresne-Henry, Inc. 2003, p. 8-2). As one county official put it, "We have more pipe in the ground than Boston, but without the tax base."

Recently the Charlotte Harbor Environmental Center, with funding from the Charlotte Harbor National Estuary Program and a local philanthropist, completed a study of septic system pollutant loadings for the entire watershed of the Peace and Myakka Rivers, which extends well beyond Charlotte County. The study used census data to plot septic system densities throughout the watershed and the Method for Assessment, Nutrient-loading, and Geographic Evaluation (MANAGE) model to estimate pollutant loadings. Results of this study will be used to promote water quality monitoring and to guide monitoring efforts at identified "hot spots." As noted previously, Charlotte County expects to commence a water-quality monitoring program soon and to develop a septic system management ordinance in the near future.

It is important to note the overall change in direction of Charlotte County's wastewater programs since the sewer controversy. Essentially, the idea of sewering thousands of existing canal-side lots with septic tanks (and thousands of other lots as well) was gradually supplanted with the politically less difficult goal of requiring higher standards for new development, regardless of location. The extent of pollution—including pathogens and nutrients that might contribute to eutrophication in Charlotte Harbor—from existing septic systems was unclear. But authorities were convinced that continued development of tens of thousands of lots with conventional septic systems would produce substantial problems. Also, previous promises to state regulators required the county to take action. It was politically easier to focus on new development and to address all lots, even those that do not readily contribute to coastal pollution. According to one technically and politically knowledgeable interviewee, the county essentially overlooked the issue of pollution from existing canal-side onsite systems. The soon-to-be-developed management program will begin to address this issue. It will help ensure that septic systems perform as intended. But it will not address whether septic systems provide a sufficient level of treatment.

Incremental Capacity Provision

This section addresses the following:

- ***How was system architecture relevant to this issue?*** While its implementation was phased, the water and sewer master plan called for high upfront expenditures. Also, it did not examine whether onsite or cluster systems could provide permanent wastewater solutions for portions of the service area.
- ***How was the issue addressed?*** The master plan used questionable methods for projecting growth and flows, resulting in an expansion plan later deemed "too much, too soon." The plan largely ignored alternative sewers and onsite and cluster treatment systems. Later, CCU used existing capacity and engineering resources to develop a smaller, affordable sewer expansion plan.
- ***Did the issue resonate with the community?*** The community revolted against the costs of the first sewer expansion plan. A leery public greeted the CCU mini-expansion plan with skepticism, but eventually most residents in targeted areas realized the program was a "good deal."
- ***Results/Status:*** The mini-expansion program helped CCU maintain its promise to reduce rates. Future expansions, however, will be more costly. CCU is considering cluster systems to serve development in remote parts of the county.

How Was System Architecture Relevant to This Issue?

The sewer and water master plan proposed a massive sewering effort using conventional gravity sewer technology. The plan proposed phasing construction over a 25-year period, but it stayed entirely within the centralized system paradigm. Engineers who prepared the study apparently gave no attention to the possibility that onsite and cluster systems could be permanent solutions for portions of the service area. Nor did they evaluate alternative sewers that might be less expensive and built in smaller increments. These decisions were based on the sewering promises made to FDCA and the preferences of utility staff for low-maintenance gravity sewers.

How Was the Issue Addressed?

The issue was addressed in multiple ways:

- The water and sewer master plan used questionable methods for projecting growth and flows
- Alternative sewer and treatment technologies were largely ignored
- CCU incrementally increased service at low cost

The Water and Sewer Master Plan Used Questionable Methods for Projecting Growth and Flows

The first requirement of any wastewater infrastructure planning process is an accurate estimate of future needs. The 1988 comprehensive plan provided no estimates of demand—it only inventoried existing facilities—and yet it called for widespread sewering. The plan did include population projections. These were based, as required by Florida law, on medium-range projections developed by the University of Florida's Bureau of Economic and Business Research (BEBR).

A few years later, the water and sewer master plan specified its own set of projections. According to the authors of the 1995 EAR, these projections were based on a questionable methodology.

The master plan study was divided into "expansion zones" that each represented the smallest area for which an increment of sewer service could be economically constructed. Using aerial photos, the master planners determined the number of houses built between 1979 and 1989 for representative subdivision plats. These counts were then used to project population growth for expansion zones throughout the service area. According to the EAR (Charlotte County *et al.* 1995, pp. 12-63–12-78), this methodology was flawed in the following ways:

- The areas analyzed with aerial photographs were all served by both water and sewer lines. These were not representative of areas served by water alone or areas without either water or sewer service. This resulted in population estimates that local planners considered suspect.
- The master plan's small-area population projections were not adjusted to reflect large area projections available from BEBR. As a result, the total population projected for the service area and county was substantially higher than BEBR's projections—20 to 23 percent higher, or up to 50,000 persons higher in 2015. (Summation of small-area projections without adjustment to larger-area trends often suffers from the "fallacy of composition," resulting in projections that are too high overall.)
- A more common approach to small-area population projection is to start with large-area projections based on demographic models and parse those populations to smaller areas based on local building trends, zoning, and socioeconomic conditions. The Charlotte County and Punta Gorda planning staffs, together with a private planning consultant, used this socioeconomic data approach to prepare projections for the Florida Department of Transportation in the spring of 1993. This approach yielded substantially different small-area

> projections than those developed in the master plan. Most importantly, for the mid-county area where the first sewer expansions were planned (Port Charlotte), the master plan projected a 2015 population of 184,514, while the socioeconomic data forecasts projected a much smaller population of 115,434, a difference of 69,080 or 60 percent.

The authors of the EAR believed that because of these problems with population projections, the infrastructure needs put forward in the master plan were flawed: "The massive infrastructure expansion required by the Master Plan is too much too soon. The population will not be large enough to support or justify the expansion on such a large scale over the next 20 years." (Charlotte County *et al*. 1995, p. 12-82) As an example, the authors pointed out that the 2015 socioeconomic data forecast for the mid-county population was only 33 percent of the assumed eventual build-out population of the area based on platted lots. Even using projections in the master plan, the 2015 population would amount to only 44 percent of build-out. These levels of development would not justify sewering the entire area, which is essentially what the master plan recommended (Charlotte County *et al.* 1995, p. 12-76). The EAR commented that a lengthy period of underutilization of infrastructure increases the financial carrying costs of a capital project and could also lead to gravity sewer maintenance problems such as increased infiltration and accumulation of sediment (Charlotte County *et al.* 1995, p. 12-78).

These arguments in the EAR were to some extent distractions. By the time the EAR was published in 1995, the public was against all sewering, regardless of phasing. So the details of the master plan no longer much mattered in Charlotte County. Also, CDM reportedly did not follow the master plan once better information become available through the company's own studies. Nonetheless, the county had to build an analytical basis to back away from the sewering promises it had made previously to FDCA. Staff developed every argument they could against the master plan. Also, strongly attacking the master plan probably provided some cover for the county's movement away from the previous objective of reducing pollution from pre-1983 septic tanks, especially those along canals. These areas were targeted first in the sewer plan because they were a likely pollution problem and a ready customer base. But the voters who lived in these areas did not want to pay for sewers. The county moved instead toward the politically easier objective of regulating new onsite systems, regardless of location.

It also appears that the master plan engineers failed to account for actual development patterns in the county—such as the common practice of building a home on multiple lots due to the small size of single platted lots—or for actual use patterns such as seasonal occupancy. This could affect both the per-household cost of the plan and the functionality of the proposed gravity sewers. An alternatives analysis prepared by Ayres Associates in 1994 (Ayers Associates 1994) explains these issues well:

> Cost estimates for installing centralized sewer service for Charlotte County are currently reported to be assessed based on installation of collection lines and services for the platted lots in these developments, rather than the number of actual developable lots within the study area. The CHWA certificated area [a portion of the Mid-County area studied by Ayres Associates] consists largely of retirement communities. Residential housing units within these communities are frequently constructed on multiple small platted lots. The future buildout of these developments may result in building improvements to only a portion of the remaining platted lots.

> Wastewater flows from these communities may also be lower than those predicted for other more conventional residential areas, and they are seasonal in nature. Because of the method of sewer assessment proposed for this project, the cost of service to each homeowner may also be significantly affected by the actual number of residences within these communities. The methods of assessing costs may actually result in a much higher per resident cost of service.
>
> The function of conventional gravity sewers is based on the movement of wastewater and solids by hydraulic force. In areas where wastewater flows may be sporadic, or intermittent over time, solids may be trapped, or they may accumulate within pipelines. Much of the CHWA certificated area consists of communities where dead end streets, seasonal occupancies, numerous vacant lots, and multiple platted lot development may not provide adequate levels of wastewater flows to function as designed. This situation can potentially create blockages or odor problems within the upper portions of a gravity collection system.

The Master Plan Largely Ignored Alternative Sewer and Treatment Technologies

The Ayres study cited previously was commissioned by a Charlotte County philanthropist who was concerned about the projected cost of the master sewer plan. He asked Ayres Associates to evaluate the applicability and cost of alternative sewer systems. According to the Ayres report, the 1994 draft collection system study prepared by CDM included a "brief consideration" of alternative sewers, but no detailed evaluation or comparison. A subsequent value engineering effort recommended further evaluation of small diameter gravity sewers.

The Ayres report summarized advantages and disadvantages of the following sewer technologies:

- Conventional gravity
- Simplified gravity
- Small-diameter gravity
- Low-pressure septic tank effluent pumping (STEP)
- Low-pressure grinder pump
- Vacuum

It presented lifecycle cost estimates for each type of sewer for a representative neighborhood of 75 lots, with 45 homes at the time and an expected build-out of 50 homes. This neighborhood, like many canal-side neighborhoods in Charlotte County, was situated on a relatively short dead-end street. The study found that conventional gravity sewers were the most expensive option. It estimated that STEP or grinder pump low-pressure sewers would cost 10 to 13 percent less, respectively. Vacuum sewers would cost 22 percent less, and small-diameter gravity sewers would cost 24 percent less.

CCU had extensive experience with low-pressure sewers—Charlotte County had the first installation of low-pressure sewers in the country in the 1970s. According to an interviewee familiar with the master planning effort, CCU staff disliked the continuing maintenance cost of low-pressure sewers. Most of these staff members had been with GDU before the takeover and were very familiar with the low-pressure systems.

Staff members were adamantly opposed to high maintenance sewer alternatives, so the master plan, as a matter of client choice, did not consider further use of low-pressure sewers or other alternatives. Thus, the master plan executive summary (Giffels-Webster Engineers, Inc. and James M. Montgomery Consulting Engineers, Inc. 1993, p. 39) simply asserts:

> The low-pressure system installed in Charlotte County has proven to be quite expensive to install, operate, and maintain. The fact that this system relies on on-site septic is a hindrance to proper wastewater plant operations.
>
> Recommendations: The installation of the low-pressure systems into new areas should not be considered.

CCU staffers have clearly changed their minds regarding low-pressure sewers. Most of the sewer mini-expansions in recent years use low-pressure sewers. One reason is that these sewers can often be installed with less disruption to developed properties and neighborhoods.

The master plan also did not consider continued use of onsite systems as a viable option for certain areas. Widespread sewering seems to have been considered a given. This was probably due to the 1988 comprehensive plan's policy that septic systems should be phased out. The master plan's executive summary refers to reports from the county health department indicating "many areas of Charlotte County have a history of poor soil compatibility with the use of on-site septic systems." Relying on a blanket characterization of soil suitability was a disservice to the county. The primary soil limitation for septic systems in Charlotte County is a high wet-season water table. Also, as noted earlier, a high proportion of septic system failures in the county are attributable to pre-1983 systems built to inadequate standards. It appears the master plan gave no consideration to the suitability of modern mound systems or advanced pretreatment systems for the onsite management of wastewater. Cluster systems are not mentioned in the master plan executive summary at all; however, it recommends taking package plants out of service by extending sewers, based on the contemporary view that such plants are usually poorly maintained.

Both alternative sewers and appropriate use of onsite, cluster, and small wastewater systems would likely have allowed a finer phasing of wastewater capacity. This is in fact what occurred after the public rejected the massive and rapid proposed expansion of sewer service.

CCU "Used What It Had" to Incrementally Increase Service at Low Cost

CCU took a much different approach to sewer service. The utility developed the sewer mini-expansion program by taking advantage of assets already in place. The main treatment plant had already been expanded as part of the earlier, ill-fated sewer expansion plan. A value engineering study showed the utility had excess capacity in a number of force mains, and many lift stations were underused—some were at only 10 percent of capacity. CCU identified neighborhoods for small expansions based on locations of available capacity in the sewage transmission system. While water quality (replacement of pre-1983 septic systems) was a consideration, sewering decisions were based primarily on business criteria—available capacity and low sewering cost-in part because the utility was under threat of privatization and needed to stabilize and reduce rates. One well-placed interviewee also noted that CCU picked areas where a lack of sewer was precluding further growth and redevelopment, thus depressing property values. In such areas, opposition to sewers would be minimal.

The utility also had available survey work and other engineering from CDM's design work for the abandoned sewer project. These resources enabled CCU to re-engineer small area, low-pressure sewer designs in-house, helping keep project costs down.

Did the Issue Resonate With the Community?

Clearly the huge upfront costs of the master plan sewer program angered the public. As for the subsequent mini-expansions, there was some public resistance at first. The sewer debate resulted in general suspicion about anything to do with sewers, and many people did not trust the BCC or CCU. In time, most people came to accept the smaller sewer projects. This change occurred due to CCU's strong community relations effort (described later) and because people realized the sewer projects were "a good deal." The homeowner's total cost of just over $4,000 easily beat the predicted cost of the earlier expansion plan, and it was also far less than sewer retrofit connection fees of $8,000 to $12,000 charged by some utilities in the region.

Results/Status

The sewer mini-expansion program has been a key part of CCU's successful drive to lower rates. The utility is now entering a second phase of sewer expansions, as promised in the 1997 master plan. CCU has nearly run out of areas where marginal expansion costs are low because increases in transmission capacity are not required. Future expansions in the mid-county area will require higher connection fees. Public hearings will also be required for the second phase of the plan.

CCU staff mentioned that the possibility of building and operating cluster systems is under consideration. Systems serving neighborhoods of roughly 100 homes may prove economical in western portions of the county.

Fairness and Equity

This section addresses the following:

- ***How was system architecture relevant to this issue?*** When the county took over General Development Utilities, it may have taken on an obligation to provide central sewer service throughout GDU's service area. The county developed a plan to do essentially that. But the plan's cost shifted the primary fairness issue. Residents were now concerned about paying twice: once for septic, and again for sewer at a high price. Later, some people complained that the ATU or lot combination ordinance imposed unfair extra costs.
- ***How was the issue addressed?*** The county developed and then abandoned a sewer plan due to public reaction to its costs. In the later sewer mini-expansions, the county developed several financial mechanisms to lower the cost of the connection fee. It also waived the ATU/lot combination requirement in areas slated to receive sewers within five years.
- ***Did the issue resonate with the community?*** Charlotte County's demographics heightened affordability and fairness issues. Retirees felt their fixed incomes could not support the cost of sewers, and many feared that appreciation of their low-priced homes would not recover the high cost of a sewer connection in a timely fashion.
- ***Results/Status:*** Future sewer expansions will be more expensive than the 12 recent "mini-expansions." Higher connection fees may raise equity issues for later sewer recipients. The onsite standards have raised costs for many owners of un-sewered properties, but they have also created a market for vacant lots.

How Was System Architecture Relevant to This Issue?

Many property owners in Charlotte County bought lots with the expectation that they would be provided sewer service. When Charlotte County acquired General Development Utilities, it may have acquired an obligation to provide sewer service to all lots platted by General Development Corporation. However, the per-lot costs for the proposed major sewer expansion probably reduced desire for sewers among would-be residents. For those property owners who had already built homes and septic systems, an equity issue of paying twice for wastewater service arose. This issue arose again when the county placed a mandatory connection policy in the 1997 comprehensive plan and developed the sewer mini-expansions. Some people also complained, during and after development of the onsite standards ordinance, that mandating advanced onsite systems (ATUs) or lot combinations imposed unfair extra costs on lot owners.

How Was the Issue Addressed?

The water and sewer master plan did not really address the service obligation issue because the scope of the sewering plan was so broad. Once an area reached 50 percent of build-out, it would be sewered. As the county backed away from this plan, the service obligation issue arose. The

1995 EAR noted that a "moral obligation" is created by public takeover of private systems (Charlotte County *et al.* 1995, p. 12-12):

> Lot owners purchased their land in good faith, relying upon the developer to provide water, sewer, and other utilities in the long run. Upon the departure of the original developer, local governments inherit the moral responsibilities from that original developer. Is development an absolute right? Charlotte County, and indeed the State of Florida, lack the resources to make all platted lots developable in the short run. Nevertheless, it is important to recognize the moral obligation to the original purchasers.

The EAR did not provide a solution to the obligation problem, other than to suggest that landowners who install septic tanks in certain areas could be informed that the county regards such systems as temporary and the owner will eventually have to pay to connect to a central sewer when it becomes available. It appears not to have occurred to the EAR authors, at least not in this section, that non-centralized systems, *with proper management,* could be promoted as permanent solutions.

At any rate, the issue became largely theoretical when the cost of the proposed sewer system became known. Most lot owners did not want sewers because of the cost.

Residents who had already built had a different problem: why should they have to pay for a sewer when they already had a wastewater system—a septic system—that, most believed, worked just fine? Many believed septic system pollution had not been satisfactorily documented. Perhaps this question would not have been posed with so much emotional force and resistance behind it if the cost of the proposed sewer system had been lower. But affordability and fairness (paying twice) issues together were too much for the proposal to sustain.

In the 1997 comprehensive plan, the county developed a variety of policies and programs designed to encourage growth in some areas and discourage it in others. Providing sewer service to some areas was a key component. To ensure financial viability of any sewering, and to be consistent with state law, the county adopted a policy mandating that homes connect within 365 days of a sewer becoming available. Some county residents protested this policy vigorously. A legal challenge to the policy was filed on the grounds that mandatory connection was unconstitutional. The challenge failed.

To soften the affordability and fairness issue during the mini-expansion program, the county (CCU) developed several programs. Residents could receive a 10 percent discount on the connection fee by fully paying the fee up-front, or they could pay the full fee over seven years at eight percent interest. Residents meeting certain low-income requirements could receive financial assistance from state funds administered by the county housing authority.

The county also recognized it would be unfair to require ATUs or lot combinations in areas slated to receive sewer service in the near future. The onsite system standards ordinance allows a baseline septic system to be used for lots where utility sewer service is scheduled to become available within five years.

Did the Issue Resonate With the Community?

The previous discussion revealed some of the public's thoughts on affordability and fairness concerns. There were a number of additional dimensions to these issues:

- Equity issues did not include concerns about different treatment of different social groups. There are no racial divisions by geography in Charlotte County (its population is overwhelmingly white) and few economic distinctions. While there are both rich and poor residents, economic disparities across neighborhoods and sub-areas of the county are not pronounced.
- The main concerns were affordability for retirees and the perceived unfairness of requiring payment for a second wastewater system. These issues were all the more acute because of the low value of most houses in Charlotte County. Residents believed that a $50,000 to $60,000 house would take many years to appreciate enough to pay off an investment in sewer service that approached $10,000. In fact, house prices in the county fell in the mid-1990s. Thus the idea of absorbing the cost with a second mortgage had little appeal for many residents, especially older ones.
- The BCC did recognize that some residents would have difficulty affording an assessment for sewer connection. Thus it built some slack into the rate structure so that the bond repayment schedule could be met even if some properties defaulted and the assessment not recovered until a property in default was sold by the owners or their heirs. No one was going to be evicted for not paying their connection assessment or utility bill; however, for many residents the affordability concerns remained strong.
- Residents' ages made the CCU rate increases of the mid-1990s particularly difficult. A substantial portion of the population was made up of retirees on fixed incomes. Many reportedly feared that costs would continue to escalate because of the liabilities and obligations the county took on when it acquired General Development Utilities. Perhaps this fear, together with the perceived unfairness of paying twice, explains some of the later resistance to the mandatory connection policy. Without this policy, no doubt many residents would have opted out of connection to CCU's mini-expansions of the sewer network.

Results/Status

The CCU mini-expansion program has built sewers where they are most economical at a price that seems fair to most residents, especially in comparison to the previous sewer proposal. Time will tell how citizens feel about increased costs for the next phase of sewer expansions, and if an "inter-phase" equity issue will arise. That is, if residents targeted in the second phase will question why their connection fees are higher than those paid by friends in a different neighborhood a few years earlier.

As for the ATU/lot combination ordinance, some in the county maintain it imposes an unnecessary and unfair cost on property owners who now wish to build. On the other hand, one could argue that by creating a substantial market for vacant lots, the ordinance helps compensate individuals who bought Charlotte County property with the expectation of higher levels of utility service and who, without that service, no longer wish to develop their lots.

Growth, Development, and Autonomy

This section addresses the following:

- ***How was system architecture relevant to this issue?*** A plan for widespread sewering provided little growth management value to the county. When the plan failed, the county saw an opportunity to revise infrastructure policy—for both sewers and onsite wastewater systems—and direct growth to certain areas.
- ***How was the issue addressed?*** The county delineated areas in which it would encourage growth by providing centralized infrastructure. It acquired private utilities to gain control over sewer extensions, and it developed onsite system regulations that decreased density in non-urban areas. These policies were parts of a comprehensive suite of growth-management tools adopted by the county.
- ***Did the issue resonate with the community?*** In the early- and mid-1990s, many citizens feared that growth would undermine the quality of life. They supported county efforts to better manage growth. Some resented the onsite wastewater ordinance, calling it growth control masquerading as environmental policy. County officials firmly responded that the ordinance was both.
- ***Results/Status:*** The county's policies are directing growth to sewered areas and decreasing density in other areas, as intended. They are helping to reduce both sprawl and ultimate build-out. Charlotte County was lauded by a statewide advocacy group for improvements made in its 1997 comprehensive plan. The policies probably do not affect the rate of growth.

How Was System Architecture Relevant to This Issue?

The county's first approach to wastewater infrastructure—widespread sewering—did not help direct and manage growth. When the plan failed, the county had an opportunity to revise and link growth and infrastructure policies. It found it could use provision of sewer service to focus high-density growth in certain areas, and it used onsite system standards to reduce density in others.

How Was the Issue Addressed?

According to the 1995 EAR, the 1988 comprehensive plan did not regard control of water and sewer lines as a legitimate growth-management strategy. A contrary perspective, however, is that the county had little leverage to proactively direct sewering. With more than 200,000 platted lots on paved streets in the county, many with water service, the county government was somewhat at the mercy of General Development Utilities and other private utilities to provide sewers as they promised. The 1988 plan simply required that sewers be provided by the time an area reached 50 percent of build-out. This was an entirely reactive policy. The result was "undisciplined line extensions" that created "pockets, fingers, and enclaves of land served by utilities." The resulting sprawl was expensive to taxpayers and ratepayers, according to the EAR (Charlotte County *et al.* 1995, p. 12-2).

The water and sewer master plan was later inserted into this policy vacuum, becoming "the defining growth management strategy" (Charlotte County *et al.* 1995, p. 12-62). But because the master plan recommended sewering on such a large scale, it too provided little direction. The EAR recommended that Charlotte County "use infrastructure expansion, particularly potable water and sewer service, to influence the development patterns in the county." (Charlotte County *et al.* 1995, p. 12-2) This would require developing "a growth-management strategy that directs growth into certain areas where services can be provided in the most efficient manner." (Charlotte County *et al.* 1995, p. 12-82) Also, acquiring GDU and other private utilities provided the county with important means toward directing growth by controlling water and sewer service.

The growth, development, and autonomy issue was addressed through:

- Delineation of areas for growth
- Acquisition of private utilities to gain control of infrastructure provision
- Development of onsite wastewater standards to decrease density and direct growth
- Establishment of other policies addressing density

The County Delineated Areas to Which It Would Direct Growth

In the 1997 comprehensive plan, the county adopted an "Urban Service Area" (USA) concept as the cornerstone of its growth-management policies (Charlotte County 1997, pp. 1-135–1-141). The concept was also incorporated in the 1988 plan; however, the 1988 USA incorporated all of Charlotte County's platted lands, an area of 215 square miles. The 1997 USA was reduced to 187 square miles, but more importantly, it was split into infill and suburban areas. Infill areas were already at least 30 percent built-out. They were designated as zones where the county would pursue the highest level of infrastructure and services. The total infill area was 97 square miles, including 13 square miles within the city of Punta Gorda. The county's goal was to direct 90 percent of new urbanized development to infill areas.

Suburban areas encompassed platted lands and parcels that were mostly undeveloped. All lands outside the USA were designated as Rural Service Area(s). For both suburban and rural areas, the county would not actively pursue infrastructure improvements within the planning period (through 2010). Previously certificated private utilities, however, might provide such services, but without financial support from the county.

The County Acquired Private Utilities to Gain Control of Infrastructure Provision

Increasing the county's ability to control growth and steer development was one of the stated reasons for acquisition of General Development Utilities in 1991. This has also been one of the rationales for acquisition of private utilities in the county (Charlotte County Utilities 2003, pp. 4–5).

At the time of the 1997 comprehensive plan, two public utilities (CCU and Punta Gorda) and 12 private utilities provided central water service in Charlotte County. Central sewer service was provided by the two public utilities and by seven private utilities (many utilities provided both services). Many of the private utilities had large certificated service areas that the county had previously granted. The state Public Service Commission (PSC) took over regulation of these private utilities in 1994. The county cannot legally prohibit private utilities from expanding within their certificated areas, including within suburban and rural areas, or from enlarging their certificated areas by petitioning the PSC.

Thus, to provide the county with increased control over infrastructure provision and to gain new ratepayers to help cover fixed costs (discussed further in the Stakeholder Relationships and Trust section), CCU has since 1998 acquired three private utilities with 5,900 water customers and 4,800 sewer customers, and in the summer of 2003 was preparing to acquire a fourth. In effect, these acquisitions increase the county's autonomy relative to the PSC and to other major players in the growth arena—private utilities.

The County Developed Onsite Wastewater Standards in Part to Decrease Density and Direct Growth

The county is using the USA strategy, utility policies, and other tools to direct growth to the 30,000 vacant lots already served by sewer and to limited areas of new sewer development through 2010. However, as a former county planning official said, sewers encourage growth in certain areas but do not discourage it in others. To achieve its overall growth management objectives, the county developed policies that would discourage growth in unsewered areas. These included USA-related policies that discourage such growth by not providing other infrastructure. The onsite wastewater system standards are another such policy.

The county addressed multiple objectives through the onsite code's requirement for a minimum lot size of 20,000 square feet for development on a septic system (in areas that will not be sewered within five years). According to the 1997 comprehensive plan, "The program's intended results are that build-out density will be reduced, new development will be induced to locate to areas served by the county's existing inventory of central sanitary sewer served lots, protection of ground and surface water bodies, and installation of better performing onsite treatment and disposal systems which treat effluent to higher levels than standard septic systems." (Charlotte County 1997, p. 4-142)

Reducing build-out density is an important objective for Charlotte County. If all 226,000 lots in the previous plan's USA were built on and occupied by 2.23 persons per household (the county average), the county would have a total population of well over 500,000, spread out over 215 square miles. The strain and costs imposed on transportation infrastructure and other services would be enormous. However, the county could not exclusively mandate lot combinations when onsite systems are used, as this might constitute taking of private property. Thus the ATU provision of the code allows for development of a single standard lot while ensuring improved wastewater treatment for such development, which represents an effective density of four homes per acre.

The policy of reducing density is not universally applauded in Charlotte County. Some question why the county has policies to encourage infill, yet also has adopted the onsite wastewater standards that in many instances result in lots being undeveloped. This precludes waste collection options, such as gravity sewers, that require density in order to be cost effective. This also spreads out the population, increasing the adverse fiscal effects of sprawl.

For instance, spreading the population reduces the number of taxpayers per mile of road. Proponents of the policy would probably respond that gravity sewers have already been shown to be prohibitively expensive, and that *total* population is a critical determinant of future infrastructure costs such as the number and size of schools.

The County Established Other Policies Addressing Density

To address the build-out issue—dubbed "the platted lands challenge" in the 1997 comprehensive plan—the county has developed additional policies and programs. One sets up a Transfer of Development Rights (TDR) system. This requires developers to purchase and retire development rights on a number of lots or a land area proportionate to their proposed density increases elsewhere in the county. The objective is zero net increase in build-out. Others include an environmental lands acquisition program that has removed 12,000 lots from development and a land-swap program that trades county-owned lots (for instance, lots acquired through tax delinquencies) near sewer for those distant from sewer.

Did the Issue Resonate With the Community?

It is clear that growth was one of the key issues during the sewer debate and the planning efforts of the mid-1990s. For instance, the policy statement of the 1996 Charlotte Assembly (Charlotte Assembly 1996) in multiple passages addressed local sentiments on growth:

> Residents are concerned that population growth may undermine the quality of life, that taxes may rise beyond some homeowners' ability to pay, that the local economy will not provide adequate wages or jobs, and that in other ways the community may deteriorate. … (p. 1)
>
> In a sense, the county is at the edge of a precipice. Growth and development have not gone so far that they cannot still be channeled and shaped, but this may not be true much longer. Decisions today, or failure to make decisions, will affect the character of Charlotte County forever. … (p. 2)

> Existing platted lands. … Many Assembly participants, but not all, feel that if these subdivisions are build out [sic] as they are currently designed, there will be a major—indeed, perhaps catastrophic—drain on the financial resources of overlying local governments, because they will generate relatively little in taxes compared to what they are likely to require in services, road maintenance, and off-site facilities. (p. 4–5; underlining as in the original)

It appears that many citizens recognized the connections between wastewater infrastructure and growth. They feared that creation of sewer infrastructure enabling high-density development throughout much of the county would result in substantial, unaffordable burdens on other infrastructure and services.[13]

Some people object to the growth-management aspects of the onsite wastewater standards. Interviews for this study revealed that some in the development and construction communities believe the county was dishonest in developing the onsite standards ordinance. They maintain the ordinance is growth control in the guise of water quality protection. They believe that their industries have been hurt by the ordinance. Also, they believe that the threat posed by septic systems (at least by those that are properly built and maintained) was never proven, so the ordinance it prompted was unnecessary.

Interestingly, proponents of the ordinance do not disagree that it was a growth-control device. For instance, County Commissioner Adam Cummings is explicit that the measure was intended to manage growth *in addition to* managing wastewater and protecting water quality. He concedes that the latter goal does not stand alone because there are probably more cost-effective ways to reduce water pollution in the county.

Cummings characterizes the ordinance as one part of a carefully crafted set of policies that together support the county's need and goal to direct growth to certain areas and reduce growth in others. Developing the ordinance was a stated policy of the comprehensive plan, and growth management is the primary purpose of comprehensive plans in the state of Florida.

> "I feel like we stepped beyond just that narrow scope, and we really took a holistic approach, and looked at the whole—the growth management, the finances, the environment—and brought a host of tools together to deal with it that will not only affect wastewater, but will provide more green spaces for the community as we get closer to buildout. And I think that it will really help us preserve our quality of life."
>
> Adam Cummings, County Commissioner

Results/Status

The mini-sewer expansions have attracted development to areas where sewers were installed. As for the onsite systems ordinance, building rates reportedly declined for a period after implementation of the onsite systems ordinance, but have since rebounded. As noted earlier,

[13] It should be noted that many people in Charlotte County prefer to live in sewered neighborhoods. Most building permits are issued for areas served by sewer, and property values are higher in these areas.

most homeowners opt to combine lots rather than install ATUs, so the policy is reducing density in unsewered areas.

Charlotte County has developed a suite of growth-management policies and programs that represent a notable departure from the passive, informal approach of the previous comprehensive plan and the water and sewer master plan. For these efforts, the county received the 1998 Florida Successful Community Award from the 1000 Friends of Florida, a non-profit group that advocates responsible planning. The group lauded the county:

> … for the significant strides county leadership has made to improve and strengthen its comprehensive planning process. … In its revised 1997 plan, Charlotte County employed a number of techniques to curtail urban sprawl and reduce septic tank pollution, taking incremental but positive steps to reverse decades of poor planning. In large part due to the active participation of the citizens and the resolve of its commissioners, Charlotte County is using its comprehensive planning process to deal with, in a forthright and admirable manner, decades of planning mistakes.
> www.1000friendsofflorida.org/Awards/Past_Award_Winners.asp

Though Charlotte County's efforts likely reduce sprawl and build-out, the third important aspect of community growth–its growth rate–is probably little affected. Because Charlotte County contains such a vast supply of subdivided lots, their prices are quite low. Therefore, government measures to date, including the lot combination requirement, are unlikely to significantly influence the rate of growth.

Growth-rate management is crucial in the short term because of its profound effect on a government's ability to supply public services besides wastewater treatment; for example, schools, water, and police and fire protection. Charlotte County's current growth rate is much more manageable than it was during the boom of the 1980s that was fostered by large development companies. However, changing economic conditions could speed up growth once again.

Growth-rate management is strategically critical in the long-term as well; when a county's economy is based on a certain rate of growth, it is unlikely that those who depend on that rate will accept regulatory and infrastructure constraints when build-out is reached. Unless gradually slowed, the momentum of growth will brush aside political barriers. Therefore, the community's apparent unwillingness to control the rate of growth may mean that its build-out numbers are little more than wishful thinking. However, build-out in Charlotte County is many decades away.

Stakeholder Relationships and Trust

This section addresses the following:

- ***How was system architecture relevant to this issue?*** Acquiring a centralized water and wastewater utility cost a lot. Expansion of the system required additional investments. These costs and the way officials handled these efforts hurt citizens' trust in local government. Some groups also grew cynical about development of an onsite wastewater ordinance that became necessary when the county turned away from widespread sewering.
- ***How was the issue addressed?*** The county failed to adequately engage the public when planning a massive sewer system expansion. Its consultants appeared arrogant to citizens, and when they announced the per-household cost the public was shocked and outraged. The BCC received bad advice regarding the utility acquisition, the costs of which turned out to be far greater than expected. The public became upset about the resulting high rates.
- ***Did the issue resonate with the community?*** By 1994, the BCC had lost the trust of most citizens. Public hearings became shouting matches. Voters replaced several county commissioners. Regaining trust took a long time. The public eventually responded to firm BCC leadership, much stronger public involvement in development of the 1997 comprehensive plan, provision of good information, sincere efforts by utility officials to address citizen concerns regarding the mini-expansions of sewer, and CCU's delivery of five years' rate reductions. Some cynicism and distrust remains in the development community over how the county promulgated the onsite wastewater systems ordinance.
- ***Results/Status:*** The mini-sewer expansion program has dramatically improved public perception of sewers. However, future sewer expansion will be more expensive. Public reaction to increased costs is not yet known. Also unknown is how the public and various interest groups will respond to increased regulation of existing onsite systems when an onsite wastewater systems management ordinance is developed in the near future.

How Was System Architecture Relevant to This Issue?

Acquiring a large private utility generated a huge debt for the county. In part to gain customers to pay off that debt, the county proceeded with a large-scale sewer expansion plan. This plan itself had costs that exceeded the tolerance of citizens. The BCC lost the public's trust. Turning away from widespread sewering required the county to tighten regulation of septic systems. Some groups objected to these regulations.

How Was the Issue Addressed?

Stakeholder relationships and trust were impacted by:

- Poor sewer planning
- Utility acquisition problems

- Sewer plan abandonment
- Rate-reduction plan development

A Poor Concept and Poor Execution Regarding Sewer Planning Generated Trouble

The master plan was developed from 1991 to 1993, and CDM undertook project design in 1993 and 1994. The county undertook this effort in large part because it had promised the state a substantial sewer program when the county settled the state's concerns over the 1988 comprehensive plan.

The reported price of $8,700 per lot was a shock to citizens. A variety of other factors and missteps contributed to a meltdown in public support and trust:

- As discussed earlier, many homeowners were outraged that they had paid for a septic system and now were asked to pay for another wastewater system.
- The recession of the early 1990s and the disappearance of the county's largest developer led to a downturn in the housing market and the county's economy. Anxiety mounted over personal and county finances, and many people feared substantial tax increases would also occur.
- Public participation in development of the sewer plan had been minimal. What participation did occur largely involved realtors, developers, and other proponents of growth. There was no organized or solicited counterpoint to land-development interests.
- The master plan team, and subsequently CDM, failed to prepare a thorough review of alternatives.
- The county put its design engineer, CDM, in a difficult position. The county hired an outside attorney to write the contract. The contract included a provision that CDM would guarantee the cost estimates or absorb any overrun. As a result, according to several observers, CDM had an incentive to develop high cost estimates. Later, as public opposition to the project mounted, CDM apparently reduced the cost estimates. This had the effect of undermining the credibility of the consultant and the estimates. Many people reportedly began to feel that the county was being "gouged."
- The county let its engineering and public relations consultants take the lead in public hearings. The public perceived the consultants as arrogant outsiders in "white shirts and ties."
- Another indication of the county's loss of control of the sewer planning process was that the engineers first presented the sewer cost estimate in a public hearing. The BCC was not briefed beforehand.

The Utility Acquisition Mechanism Got the County Into Further Trouble

It is important to understand how the county got itself in a financial bind. To acquire General Development Utilities from the bankrupt GDC, the county used an eminent domain action known as a "quick take." In acquiring the utility in this way, the county committed to paying a price to be determined later by a court. People from disparate points of view agree that the county commissioners, in effect, rolled the dice and lost.

According to a former county commissioner, when GDC went bankrupt in 1990, the BCC was financially unsophisticated. The board was urged by its financial consultant to move quickly to acquire the utility, otherwise GDC would bleed the value out of the utility during the bankruptcy proceedings. Indeed, the regional water authority and another county were moving to acquire portions of GDU. The consultant told the board the value of the utility would be no more than $65 million. The county raised this amount through a bond issue in 1993.

In 1994 a court set the final price at $110 million. The county was then forced to sell more bonds to pay the difference (Charlotte County *et al.* 1995, p. 12-4). (The county later sued its financial consultant. The parties settled for the consultant's insurance coverage.) The BCC chose to raise rates by about 22 percent and pay for the balance of the bonds by expanding the customer base through the planned sewer program. This substantial rate hike fed public discontent with the BCC. Also, the fact that the utility cost a lot more than the BCC was first told, and had in turn told the public, became a significant issue in the 1994 election.

Abandoning the Sewer Plan Resulted in Further Rate Increases

Later, when the BCC abandoned the sewer plan due to public fervor, it was forced to raise rates again by about 24 percent. This was to make up the lost revenues that expansion of the customer base would have generated.

In effect, the BCC placed the full fiscal burden of the GDU condemnation on the existing rate base, even though parts of the wastewater system had capacity to accept more customers as a result of improvements made in the early stages of the expansion plan. The rate increases, however, further irritated the public, and contributed to calls for privatization of CCU.

CCU Developed a Rate-Reduction Plan

In response to the privatization initiative, CCU staff developed a plan to reduce rates. Technical and organizational efficiencies were one component. Another was a different approach to expansion of the customer base. In a perhaps ironic way, the rate increases positioned the utility to generate rate reductions. In lieu of large, politically controversial sewer expansions in septic-served areas, the utility proposed to expand the customer base in three ways. One was to provide sewers to a large *new* development, South Golf Cove, poised for rapid growth if sewer were provided. Property values there were depressed because restrictions in the original development permits made it difficult to develop with septic tanks. Thus sewering this area was not opposed by property owners. Another way was to acquire private utilities within the county. CCU's higher rate structure, once applied to the new customers after a short grace period, made these acquisitions highly profitable. Finally, CCU developed the sewer mini-expansion program, targeted at areas within the previous sewer expansion plan where other, existing ratepayers had already paid for the necessary sewer transmission capacity.

Did the Issue Resonate With the Community?

Evidence of how the stakeholder relationships and trust issue resonated in the community is seen in the following:

- Government by screaming
- Communication and public involvement helped rebuild trust
- Some distrust lingers regarding the onsite systems ordinance

"Government By Screaming"

One result of the utility acquisition bond issues and the sewer plan announcement was widespread citizen opposition, much of it voiced at highly charged public hearings. The 1996 Charlotte Assembly characterized what ensued as "government by screaming." Interviewees recalled that many hearings were "raucous" and participants "rude." The assembly's statement explains this somewhat diplomatically (Charlotte Assembly 1996, pp. 5–6):

> A handful of citizens with negative attitudes sometimes exercise an inordinate and destructive influence over the county government. These individuals and others like them came to Charlotte County expecting a paradise, but many feel that they were exploited by big developers, and now they fear that rising taxes coupled with declining income may make it impossible for them to survive. The anxieties of individuals in these circumstances are understandable and deserve both sympathy and accommodation, but unfortunately they are being expressed in a manner that that undermines the political process. This group sometimes addresses the Commission emotionally and without proper respect for either the Commissioners or for those in the community with differing opinions. This attracts media attention, which further distorts the political atmosphere of the county.

A second result was the effect on BCC elections. In the 1994 election, one commissioner who supported the sewer plan chose not to run. Another was ousted. Both of their replacements favored scaling back the sewer plan. Debate continued over the next two years, and in 1996 voters elected a firmly anti-sewer candidate who had led the sewer plan opposition.

Earlier in 1996 the BCC gave up on the sewer plan altogether. The commission did so despite the fact that a low-interest State Revolving Fund (SRF) loan had already been obtained for the first sewer project, and despite the fact that scrapping the plan risked state sanctions. The state could have withheld funding for other programs because the county broke its comprehensive plan settlement promise to build sewers. A former commissioner believes that it would have made sense to do the first project to gain more customers for the rate base. He says the BCC gave in to public pressure.

Once the BCC stopped the sewer plan, something of a backlash from sewer supporters occurred. This group was upset that the BCC discarded an investment of more than $15 million in engineering and right-of-way acquisition. However, as noted earlier, CCU has been able to put some of the products of the sewer planning effort to use.

Communication and Public Involvement Helped Rebuild Trust

County officials understood that, regardless of the personnel change on the BCC and the scrapping of the sewer plan, the public did not trust the county. Therefore, they began a concerted program to rebuild public trust.

Public involvement was a first step. As the 1995 EAR noted while the sewer debate raged, "A meaningful lesson that has been learned by citizens and government is that citizen participation is important at the beginning of projects. Citizens must be involved in every step of the process from origination to implementation." (Charlotte County *et al.* 1995, p. 12-97) Thus the county arranged for more than 78 public meetings and workshops during development of the comprehensive plan, including the highly participatory Charlotte Assembly and its follow-on work groups.

Control of public hearings was another factor. According to former County Commissioner Don Ross, BCC Chairman Matt DeBoer deserves a lot of credit for establishing civility and order at meetings.

Media relations were also important. The CCHD cultivated its relationship with the media through rapid, honest, health-oriented information whenever possible, especially when new information or a disease outbreak occurred (for example, drowning prevention, safe food preparation, hurricane preparedness, West Nile virus, rabid raccoons, boil-water notices, and other topics). As a result, in 1998, when CCHD's water quality research revealed water-borne human viruses and pathogenic bacteria in waterways, a more sophisticated and open-minded local media understood the implications of these findings and reported them fairly. Some local officials report that public opinion began to shift toward recognition of legitimate health risks from septic systems. This made it easier for the BCC to support and eventually approve the new onsite systems standards. While the public was leery of the proposed ATU regulations because of ATU costs, most saw the new requirements as cheaper and better than the previous sewer plan.

A potentially controversial effort was implementation of the sewer mini-expansion program. The 12 targeted areas had previously been included in the proposed 22,000-lot expansion, so many residents were suspicious of any kind of sewer program. CCU staff handled this difficult situation adroitly. CCU's Mike Saunders explains the approach as follows:

- For each mini-expansion, CCU would first invite neighborhood residents to a meeting at a county facility. Officials gave a presentation, explained the program and described how construction would take place. Residents who voiced vigorous objections were answered courteously, and staff approached these individuals after the meeting for further dialogue.
- In each neighborhood, a second purposefully informal meeting was held, often outside, and with staff in informal attire. Officials met with known sewer opponents for one-on-one conversations before the meeting got underway.
- At this meeting, officials frankly detailed disruptions that would take place in the neighborhood due to construction. They identified staff and contractor vehicles, and

introduced every member of the job crew. They showed every piece of equipment that would be used or installed in the project, and answered all questions.

- During the meeting CCU also told residents what to do if construction problems arose. Residents were encouraged to find the CCU inspector (who had been introduced), who would immediately work with the contractor to address the problem. This invitation successfully kept problem-solving in the field; the main office heard very few complaints, and residents did not bring problems to elected officials.

This effort was more than public relations. As noted earlier, the county carefully chose neighborhoods where sewering would be most cost effective. This reduced the connection fee for a changeover to sewer to just under $4,000, and officials compared that amount to nearby counties' fees of $8,000 to $12,000. CCU structured construction contracts to reward quick restoration of disrupted properties. To avoid tearing up nice yards and driveways when installing sewer lines, contractors often chose directional boring.

As part of their effort to be frank and straightforward, county officials admitted that the purpose of the sewer projects was not only to avoid water pollution, but also to reduce rates by spreading the utility's massive debt. They indicated that rates could be reduced three percent for every 1,000 new customers. Reducing rates for five straight years went a long way toward restoring trust in the utility and the BCC.

Some Distrust Lingers Regarding the Onsite Systems Ordinance

Some people in Charlotte County, largely in the construction industry, remain somewhat cynical about the county's approach to development of the onsite wastewater systems ordinance. They feel the ordinance was "a done deal" before it reached the citizen work group. They believe their critiques and suggestions were largely ignored. The former CCHD environmental administrator admits the work group meetings were "not friendly," but were negotiations and some compromises were made.

He states that the remaining ordinance opponents are few in number and are individuals who wanted no ordinance at all. He also maintains that ordinance was necessary from a public and environmental health viewpoint, and because the county was under pressure from FDCA to address the proliferation of septic tanks.

One workgroup participant, a skeptic of the need for the ordinance, says it was a success from the county government's point-of-view because it:

- Satisfied FDCA
- Increased the cost of un-sewered development, moving some home-building to sewered areas, which benefits CCU's rates
- Looked good environmentally, though he believes it probably does not have much of a real impact

- Was easy politically, because it put costs on new residents rather than current voters

County officials say the real estate and construction communities eventually acquiesced to the ordinance because they saw that things could get worse. During debate over the ordinance, it was mentioned that if Charlotte County did not itself address septic systems, the state could step in and declare the county an “Area of Critical State Concern,” as the state had done in Monroe County (the Florida Keys) some years earlier. This would result in much stronger regulations. Ordinance opponents say this was an over-exaggerated threat.

Results/Status

CCU officials suggest that because of the success of the sewer mini-expansions, the public now associates expansion of sewer with rate reductions. However, the least expensive areas have now been sewered. Future expansions will have a higher marginal cost. Connection fees will probably have to increase. It remains to be seen how the public will react as sewering of existing neighborhoods becomes more expensive.

As for the onsite ordinance, some confusion arose early in its implementation regarding the lot size requirement. The issue was clarified with a legal interpretation by the county attorney and with new literature. County officials were loathe to re-open and change the ordinance itself because of the controversy that had surrounded its development. However, the ordinance will be modified in the near future, as the county develops an onsite system management program. Time will tell how the public and various interest groups react to any proposed new requirements.

Conclusions

Charlotte County recovered from a disastrous, too-large sewer proposal by defining its desired future and by using improved onsite system regulation and manageably sized sewer expansions to steer local development. The original sewer proposal, along with other factors such as a costly utility acquisition, destroyed citizens’ trust in their leaders and government institutions. Regaining that trust took considerable effort on diverse fronts.

Other communities can avoid a similar fate by heeding the following lessons:

- Study all of the options. Be sure all feasible types of sewers and treatment systems across a wide spectrum of infrastructure scale are considered. According to one local official, a major theme in the public opposition to the sewer plan was, “You have not looked at alternatives.”
- Make sure a wastewater master plan encompasses the lifecycles of both existing and proposed infrastructure. The 1993 plan pointed to septic system failures, but it did not look seriously at sewer failures. The costs of rehabilitating existing sewers should have been included. Capital for system maintenance and new construction is limited; do not plan the latter without considering the former.
- Check consultants’ plans with outside authorities and peers. Here an institutional disconnection becomes apparent. In many states, regulators of wastewater systems (in this

case the Florida Department of Environmental Protection) evaluate only the environmental and public health adequacy of wastewater plans; they do not evaluate project economics. In many places sponsors of wastewater plans and projects will have to turn to other organizations for benchmarks on costs. For instance, one interviewee suggested that local government associations at the state and national level may provide expertise or networks that local officials can use to help determine whether the type and cost of projects proposed by their consultants are reasonable—that is, not out of line with projects proposed or completed in other communities.

- Work with consultants to critically evaluate assumptions. In the Charlotte County Water and Sewer Master Plan, consultants made two mistakes regarding growth. First, they took full build-out of all platted lots in the county as a given. This was not the direction the community needed to go—full build-out at platted densities would have generated unsupportable demands on other infrastructure and services. A good consultant will help a community ask the right questions. For example, is there a widely supported community vision? If not, are the implications of implicit growth assumptions understood?
- Get the growth projections right. The second major growth-related mistake of the master plan consultants was to base their small-area population projections on a faulty methodology. Extrapolation of change over a recent high-growth period was not sound. Summation of optimistic small-area forecasts across a large area yielded large-area figures that were much too high according to other available population projections. Beware of these exceptionally common mistakes.
- Focus infrastructure investments. Widespread sewering was indefensible without very optimistic population projections, and it was not always defensible on that basis—build-out percentages were too low within the planning period to justify sewering. The sewer plan proposed too much infrastructure, too soon. The resulting high costs created substantial citizen outrage and distrust. Focusing smaller investments based on a proactive growth management policy would have made more sense and is essentially what eventually happened with the sewer mini-expansion program.
- Recognize that engineering is an inherently conservative profession. Engineers can lose their licenses if a system fails. In Charlotte County's case, the contract with the design engineers exacerbated the bias by holding them liable for any cost overruns. Thus, Charlotte County got a preeminent sewer plan and a high cost estimate.
- Recognize that conventional engineering often emphasizes that recommended infrastructure capacity must never be insufficient. While the cost of carrying underutilized capacity is recognized, and typically dealt with by a phasing plan, an engineer's goal is often—though not stated—to avoid the risk of building too little capacity, resulting in expensive capacity increases at a later date. If sewers are to be installed, it is prudent to design them for full build-out because the life of pipe in the ground is very long and the added cost of increasing their capacity is small compared to increasing that capacity later. But build-out may be a half-century or more in the future. Thus constructing for build-out can lead to long periods of over-capacity in certain portions of the infrastructure. If too much over-capacity is planned, project expense mounts and citizen revolts may occur, as Charlotte County's experience shows. What is needed in many communities is an approach to infrastructure that allows a

more incremental approach to capacity. Decentralized systems offer "just-in-time" capacity, whereas the capacity of a sewer line cannot be phased, once a decision to install it has been made. So decisions must be made as to a) where sewers are appropriate in the long-term, which is a community character issue, and b) in sewer-appropriate areas, the timing of replacement of onsite and cluster systems by a sewer, which is a cost optimization issue. Both require close coordination between engineers, planners, developers, and elected officials, to appropriately select the type of service and to stage growth across sub-areas of the service area.

- Involve the public. The differences in public involvement in the 1993 master plan and the 1997 comprehensive plan were substantial, as were the results—outrage in the former case, acceptance in the latter. Remember that the best involvement is *participation.* As Charlotte County Commissioner Adam Cummings said, this requires vesting participatory bodies with some power and trusting their reasonableness. The county did this with the Charlotte Assembly, which set a tone for public discussion and established important directions for policy makers.
- Take care to avoid making participatory bodies into "rubber stamp" groups. Some participants in the onsite systems work group felt the policy was already firmly established, as it mostly was. Perception of a "done deal" breeds cynicism. On the other hand, before they go to the public for input, elected leaders must understand what is required of certain policies given regulatory and other concerns. The trick is to avoid pre-determining results, and to know how much control to give the public in particular circumstances.
- Communicate public policies and the intent of leadership honestly and clearly. Some interest groups saw a hidden agenda—growth control—in the drafting of the onsite systems ordinance. Local politicians say that was, in fact, their intent (they prefer the less charged term *growth management*), along with protection of environmental and public health. Somehow this dual intent was not effectively communicated to the interest groups that felt most affected by the growth-management component.
- Note that good communication is essential not just in planning and policy-making, but also in implementation. Exemplary communication in the CCU mini-expansions helped rebuild trust broken by poor handling of the previous sewer expansion proposal.
- Never let consultants get ahead of or replace community leadership in the public's eye. Involving consultants in public participation is often very helpful, even necessary, but government or utility officials must maintain control of the process.
- Remember that context always affects planning and policy making. History is one important dimension. The 1995 EAR report (Charlotte County *et al.* 1995, p. 12-88) noted that the seriousness of the county's difficulties with the sewer master plan resulted from past practices and events: the over-platting of residential subdivisions, the lack of proactive growth management, the haphazard extension of water lines that encouraged widely dispersed development, and the high cost of the quick take of General Development Utilities. Demographics and economics are other key dimensions of context. The sewer plan's cost might have been less of an issue in an area with a younger population, higher incomes, and higher property values.

- Note that paying twice for wastewater systems can be a big issue. Decentralized systems avoid this, but often require better management. It will be interesting to see the public reaction to costs imposed by the onsite system management ordinance Charlotte County will soon promulgate. Had this ordinance been developed on the heels of the sewer debacle, management costs may have been tolerated by the public because such costs could be clearly seen as an alternative to paying capital costs twice. However, county leaders probably saw such a move as politically risky given the heightened sensitivity of the public to wastewater policies.
- Take care to prove the case for new infrastructure or increased regulation and management by developing the best supporting information affordable. If a wastewater solution costs a lot, it is a safe bet someone will say the need for it has not been proven. What constitutes proof is always a complex issue, especially when the costs of conclusive studies can be so high.

  As a general rule, it is necessary to satisfactorily answer three questions:

  1. Are the contaminants of concern clearly of human origin? (Just finding fecal coliforms is not conclusive.)
  2. Is the human source clearly what it has been purported to be? (Ribotyping to show human origin does not *alone* reveal whether the source is septic systems or leaky sewers.)
  3. What is the relative importance and cost-effectiveness of addressing the pollution source that has been proposed to be addressed versus other sources? (The public generally wants to know that a program generates substantial results for the cost.) Remember that in many cases, what testing is for may be less important than the design of the study—where and when testing is done.
- Beware of the avoidance value of studies. In Charlotte County politicians avoided making onsite system management policies because a multi-year research study was underway. Often study is needed before policy is made. In this case, arguably enough was already known (and available in the national wastewater literature) about septic tank solids accumulations and other aspects of onsite system management that an ordinance could have been developed without the results of the study. However, local wastewater regulators emphasize that the public in Charlotte County really needed local data since many were convinced *their* systems were not polluting and did not need maintenance or replacement.
- Use infrastructure policy carefully as a growth-management tool. “Zoning by septic” alone, as is done by many communities unwilling to directly face growth issues, should be avoided because it is a blunt and often ineffective instrument.

But using onsite wastewater policy in the context of a comprehensive approach to growth may be very appropriate. Charlotte County's policy to reduce the density of septic systems or require advanced systems makes some sense given the small size of platted lots in the county, and because this policy works in tandem with other policies designed to attract higher density development to areas served by sewer. Interestingly, the frequently heard canard of opponents of advanced onsite systems—that they "are bad because they enable growth anywhere"—was irrelevant in Charlotte County because existing septic policies and historic land development practices already allowed high-density residential growth most anywhere.

Sources

Sources for this case study include:

Personal Interviews

All of the Charlotte County government officials below are located in Port Charlotte, FL:

Marty Burton, County Attorney, Charlotte County

Adam Cummings, Commissioner, Charlotte County BCC

Maury Denneler, President, ABS & Associates, Port Charlotte, FL; former member of the onsite systems ordinance work group

Rick Howell, former Director, Charlotte County Utilities; now with Sarasota County

Alan LeBeau, President, LeBeau Construction, Murdock, FL

Don McCandless, President, McCandless Homes, Port Charlotte, FL; former member of the onsite systems ordinance work group

Don Ross, former County Commissioner; now President, EarthBalance, North Port, FL

Mike Saunders, Utility Engineer, Charlotte County Utilities

David Smith, former Comprehensive Planning Supervisor, Charlotte County; now with the City of Sarasota, FL

Bob Vincent, former Environmental Administrator, Charlotte County Health Department; now with the Bureau of Water Programs, FDOH, Tallahassee, FL

Phone Interviews

Damann Anderson, former engineer with Ayres Associates; now Vice President, Hazen and Sawyer, Tampa, FL

Catherine Corbett, Senior Scientist, Charlotte Harbor National Estuary Program, North Fort Myers, FL

Jack Fawsett, former President, Northwest Port Charlotte Community League; former member of the onsite systems ordinance work group

Elliot Kampert, staff member, Charlotte County Planning Department

Betty Staugler, Environmental Scientist, Charlotte Harbor Environmental Center, Punta Gorda, FL

Bud Wimer, staff member, Charlotte County Health Department

Documents

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9 JOHNSON COUNTY, KANSAS

This case study addresses the following topics:

- Growth, development, and autonomy
- Performance and reliability

The Community

Johnson County includes the southwestern sector of the Kansas City, Missouri metropolitan area. The county is in Kansas, and Missouri borders its eastern edge. The county seat, Olathe, is about 20 miles from downtown Kansas City. Other cities include Prairie Village, Merriam, Lenexa, Overland Park, and Shawnee. About half the county is in unincorporated townships outside of any city boundary.

Figure 9-1: The Location of Johnson County in the State of Kansas

The majority of Johnson County consists of rolling to flat terrain, with some steep slopes and bluffs that define river and creek valleys. The incorporated areas support industrial, commercial, and residential development, while agricultural activity interspersed with residential development characterizes the unincorporated areas. Residents enjoy excellent access to interstate freeways I-35 and I-435 in the county, I-70 just to the north, plus major US and state highways.

Johnson County's population and economic growth from 1990 to 2000 placed it in the top two percent of the fastest growing counties in the US. Over the past 20 years the county has sustained an average net population growth of approximately 10,000 new residents per year (Johnson County 2003a, p. VII-5). Growth in Johnson County accounted for more than 91 percent of the state's estimated net population growth in 2002 (Johnson County 2003b). Table 9-1 shows that Johnson County's population is expected to increase 43 percent from 451,086 in 2000 to 644,559 in 2020.

Table 9-1: Johnson County Rural and Urbanized Area Population Forecast

	2000	2010	2020
Rural	29,539	44,571	75,040
Urbanized Area	421,547	506,333	569,519
Total	451,086	550,904	644,559

Source: Mid American Regional Council, as reported in Johnson County 2003a

Urbanization has expanded in a continuous fashion south and west from Kansas City. The vast majority of county residents live in incorporated urban areas with densities of three to four dwelling units per acre. Lower densities are experienced in urban fringe areas. Further annexation and urbanization of unincorporated areas is expected.

Water District No. 1 and five cities provide potable water for most of the county's residents. Sources include surface water from the Kansas and Missouri Rivers and a nearby reservoir, and groundwater from wells along the Kansas River. Several rural water districts supply potable water in the unincorporated area. They obtain water from multiple sources (Johnson County 2003a, p. VIII-19).

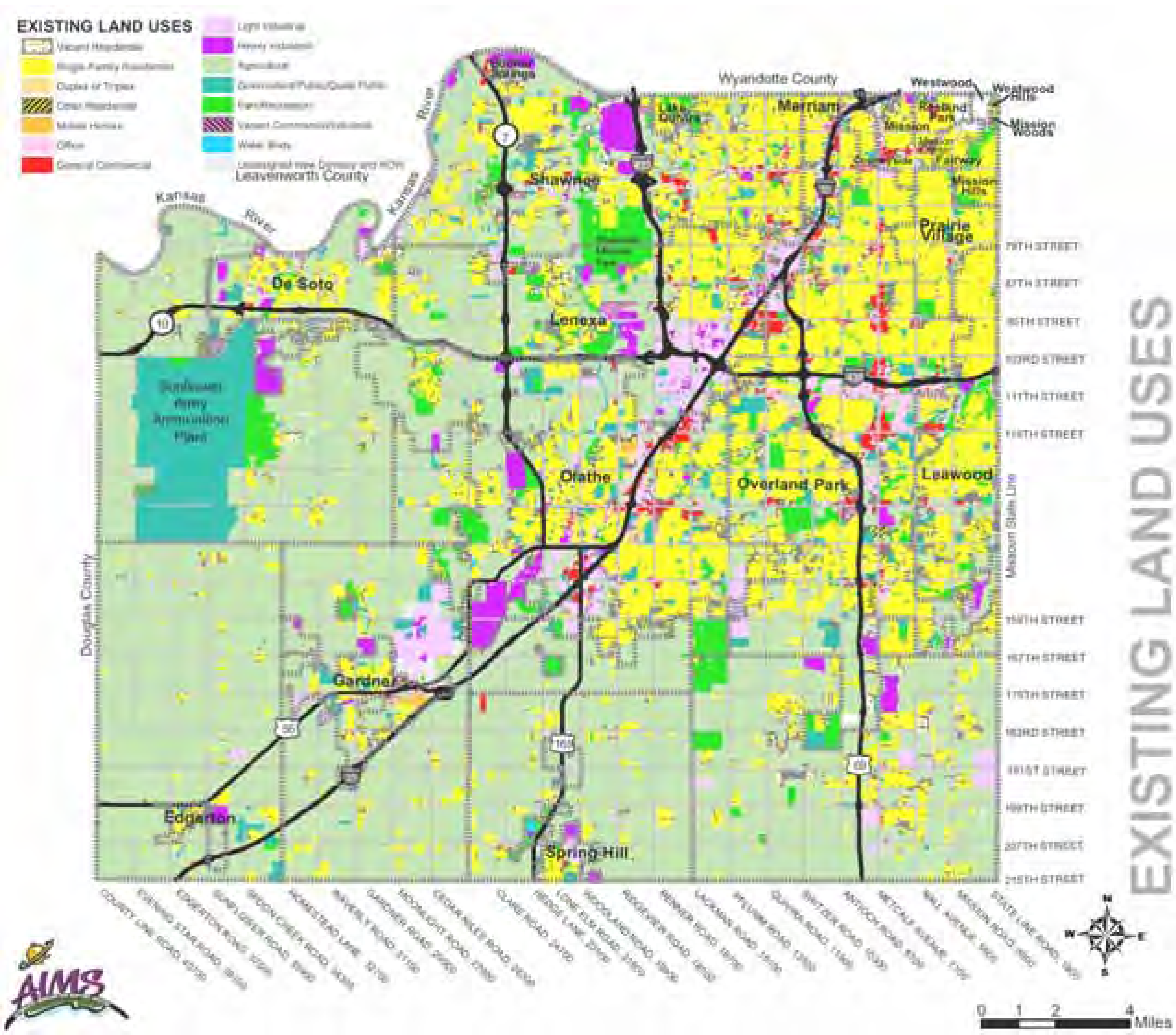
Wastewater Issues

The Johnson County Unified Wastewater District (JCW) provides wastewater collection and treatment services for much of Johnson County's population, which is concentrated in the northeast quadrant of the county. It operates nine treatment plants located throughout its service area. These plants have a total design capacity of 43.6 million gallons per day (MGD). JCW also conveys some sewage to Kansas City, Missouri wastewater treatment plants that have excess capacity. In 2002, JCW sent 17.3 MGD to Kansas City plants. Five cities in Johnson County operate their own wastewater treatment facilities and service their own residents. Otherwise, JCW services the rest of the developed areas of the county, as well as a few locations within the unincorporated areas (Johnson County 2003a, p. VIII-20).

Residents in unincorporated areas predominately use onsite wastewater treatment systems. The Johnson County Environmental Department (JCED) regulates onsite systems according to the county sanitary code. There are about 9,000 residential properties in Johnson County that utilize onsite systems. Of these, only about 50 percent employ conventional septic tank and soil absorption systems. More advanced onsite treatment systems, including elevated sand mounds, shallow in-ground, low-pressure pipe and aerobic treatment systems, intermittent sand filters and drip irrigation dispersal fields are required for the remaining properties. JCED estimates that at least 24 percent of onsite systems (about 2,000, mostly built before 1990 when regulations were strengthened) are either actively leaking untreated sewage or need repairs to prevent leaks (Johnson County 2003b).

Soils with limiting conditions mean that a large number of properties require advanced treatment systems. According to the US Soil Conservation Service, Polo (Pc) soils are the only kind commonly found in the county that offer only minor limitations for conventional septic tank use. All other soil types present moderate to severe limitations. Much of the county is constrained by high water tables, seasonal water tables, shallow soil depths, and soils with heavy clay content and poor percolation. The high "shrink-swell" characteristics of some soils also pose limitations for excavation and construction. (See Johnson County 2003a, pp. VIII-2–VIII-3)

Figure 9-2 shows existing land uses in Johnson County. Note how land use intensifies to the northeast toward Kansas City.



Courtesy of the Johnson County Automated Information and Mapping System (AIMS)

Figure 9-2: Existing Land Uses in Johnson County

Sewer lines in many parts of Johnson County are subject to infiltration and inflow (I/I) rates of 30–40 percent of average annual total flows. Peak I/I rates can exceed 80 percent of flows. Sewer service has been extended in roughly concentric bands as urbanization spreads south and west from Kansas City. Sewers are rapidly extended into growing exurban areas, primarily by JCW, but also by Olathe and Gardner in their service areas. The area in the county served by sewers increases by about four to five square miles per year, and generally moves outward to the south and west at a rate of about one mile every four or five years. JCW staff members believe there is a high likelihood the entire county will be sewered within 60 to 70 years. Of the 10 major watersheds in the county, five are now fully sewered, three have regional treatment plants and are having extensive sewer extensions built in them, and two have relatively few sewers and treatment capacity. The Johnson County Planning Department is less sure urbanization will continue at the current pace. But for now, rapid urbanization is the fundamental context for infrastructure planning in Johnson County.

Lower residential densities made possible by the use of onsite systems have accompanied movement away from the northeast portion of the county as well, creating obstacles for provision of cost-effective sewer service. Recently, development has become more scattered throughout rural, unincorporated areas.

To ease transitions from onsite systems to sewer service, the county has begun requiring dry sewers to be installed in some urban fringe developments. The county has also considered clustering development on smaller, urban-density lots, utilizing part of the conserved land for a community wastewater treatment system and the remainder of the conserved area for open space. The community treatment system would provide JCW with one connection point once regional sewer service was extended to the area. The dry sewer policy and community septic system proposal are described in the following sections.

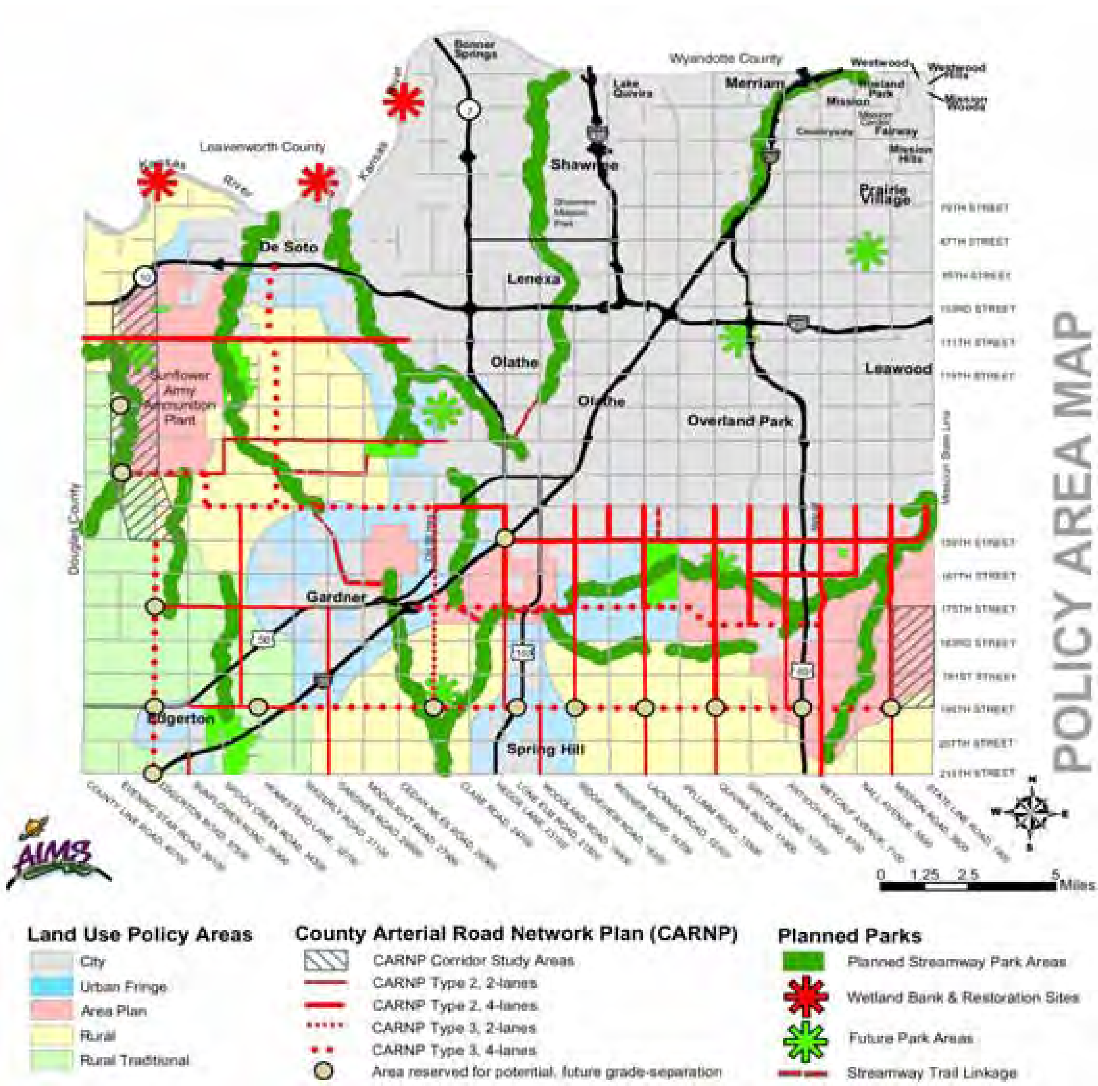
Historical Overview

Johnson County's first and only Rural Comprehensive Plan was adopted in 1986, and it continues to serve as the guiding document for the county. The plan supports a range of lot sizes, from less than one acre to 10 acres in the areas adjacent to cities; there is a 10-acre minimum lot size elsewhere. Incorporated areas establish their own planning and zoning criteria. Otherwise, there are three general land-use policy areas for the unincorporated areas. They are:

- ***The Rural Policy Area:*** The majority of unincorporated Johnson County is designated as rural policy area. This area consists primarily of large agricultural tracts interspersed with limited, very low-density residential development. The policies for this area recognize that the area is not exclusively agricultural and that existing development patterns may generate demands for minor expansion of non-agricultural uses.
- ***The Growth Policy Area:*** Areas where a clear pattern of suburban development has occurred even though a substantial portion of the area may remain un-platted, agricultural land are designated as growth policy areas. The policy for these areas recognizes that some land will eventually be annexed by neighboring cities.

- ***The Urban Fringe Policy Area:*** This policy area encompasses an area approximately one mile wide outside the boundary of each city. Emerging urban development in this area includes higher-density residential uses and limited concentrations of nonresidential uses. Planning for this area is closely coordinated between adjacent cities and the county.

Figure 9-3 shows the Johnson County policy area map. This planning map shows the Urban Fringe Policy Area where the community septic system policy would have applied. This map depicts the policy zones proposed in a draft update to the county's comprehensive plan. The new plan would keep the Urban Fringe Policy Area designation, drop the Growth Policy Area designation, and divide the Rural Policy Area into Rural and Traditional Rural designations.



Courtesy of the Johnson County Automated Information and Mapping System (AIMS)

Figure 9-3: Johnson County Policy Area Map

In 1994, the county updated its zoning regulations to require that a development have adequate infrastructure available. In particular, development must be near roads of adequate width, profile, and construction, and must have access to water lines providing the flow rate necessary to meet fire code. Proximity to schools and certain other services is also recommended by the regulations.

The county also revised the sanitary code in 1994. The code mandates a two-acre minimum lot size for structures using onsite wastewater systems, including aerobic treatment units, mound systems, and holding tanks, unless a waiver is granted (Johnson County 1994, Chapter 2). All commercial and industrial facilities that are not connected to a sewage collection and treatment system must have and utilize holding tanks. Existing facilities were grandfathered in under the rule as long as a permit was obtained and annual inspections showed the systems are operating successfully (Johnson County 1994, pp. 2-6, 2-7, and 2-15). Existing residential onsite systems may be inspected upon request during property transactions. Recent proposed amendments to the sanitary code would mandate county inspections upon property transactions.

JWC constructed its first treatment plant in 1945. The utility has grown rapidly to serve new residents. The trend for JCW infrastructure has been toward a more regionalized collection and treatment architecture. In 1995, JCW abandoned seven small-scale treatment plants that had outgrown their treatment capacity in favor of a regional collection and treatment system. This regional treatment plant, the Mill Creek Regional Plant, serves the fast-growing cities of Shawnee, Lenexa, and Olathe. JCW now serves more than 110,000 properties in approximately 1,027 sewer districts. JCW has issued an average of 3,200 sewer permits a year over the past five years and has added an average of 30 districts per year over the past five years.

Until 1992, all capital costs were funded by residents through a benefit district financing system, in which property owners of 51 percent of any given land area had to petition to form a sewer district, and all property owners were subject to a property tax assessment to pay for the collection and treatment system costs. In 1992, the Johnson County Board of County Commissioners (BOCC) revised the funding method for sewer projects, including sewer extensions to newly developing areas. Property owners in developing areas must still request sewer extensions through the petition process, which remained in place as a way to inform JCW when and where the private sector is generating demand for sewers. But JCW now recovers costs for such extensions through connection fees and an annual system-wide capital charge. Essentially all the benefit districts have been combined into one district, the Consolidated Main Sewer District (CMSD).

As before, the new process requires that the BOCC approve each proposed sub-district. After approval, JCW funds the extension of a sewer interceptor to within one-quarter mile of the top of a watershed, giving equal access to all properties in the watershed. Developers can then run sewers down to the interceptor, which roughly follows a natural drainage. The developer is responsible for connection to the interceptor, and construction of sewer mains and laterals to serve the subdivision. To cover JCW’s capital costs, all properties are assigned a certain number of Equivalent Dwelling Units (EDUs), with a single-family home classified as one EDU; other types of property are assigned multiple EDUs based on the size and use of the structure. Vacant ground is assigned three EDUs per acre. Each single-family home connecting to the sewer system pays a one-time connection fee of about $3,000, with higher fees for structures assigned a higher number of EDUs. An additional per-EDU capital charge of $81 is added annually to the real estate tax bill. JCW’s operation and maintenance costs are funded through a water-use-based sewer bill that is sent directly to customers on a bi-monthly basis for residential customers, and monthly for non-residential customers. This sewer charge averages $133 annually.

Sewer extensions to areas served by onsite systems and without dry sewers are still funded by a benefit district assessment. These benefit districts are based on the same criteria as the new sewer sub-districts—owners of 51 percent of the land area in the benefit district must sign the petition for the district. According to JCW, these retrofits typically cost property owners $15,000 to $20,000, through a property tax assessment. Usually low-pressure sewers (LPS) are used. When a retrofit is done, the septic tank is decommissioned and backfilled, a grinder pump is installed, and LPS lines are installed. About two-thirds of retrofit project costs are due to septic tank decommissioning and grinder pump installation.

Study of Dry Sewers and Community Septic Systems

In the late 1990s, the BOCC directed a task force composed of representatives from the wastewater, environmental, planning, and legal departments to explore policies requiring property developers to install dry sewers in new septic system developments in the urban fringe area. A dry sewer policy had already been informally practiced for a few years. After nearly four years of extensive study, the BOCC approved a Dry Sewers Policy on February 7, 2002. (See Metzler *et al.* 2003.)

The policy applies to any subdivision or re-subdivision that contains lots smaller than seven acres and is located within the Urban Fringe Policy Area, and any area considered “likely or reasonable to expect that sanitary sewer service would be available” within a 15-year period. The minimum lot size available to these developments is two acres, in order to comply with the sanitary code.

Where applicable, the property developer is required to provide:

- Sanitary sewers if the subdivision is upstream of and 1,320 feet or less from a sanitary sewer district sewer line capable of being extended and serving additional capacity
- Dry LPS mains (or rarely, dry gravity sewer mains) if the subdivision is not in proximity to existing sewers

Where dry LPS or gravity sewers are installed, an onsite treatment system must also be built for each lot to provide wastewater treatment until regional sewer service is extended. When JCW sewers arrive and a dry sewer main is made “wet,” JCW notifies residents of the availability of sewer service. Connection is voluntary. To connect, homeowners hire a contractor to decommission and backfill the septic tank, install a grinder pump, and run a lateral sewer line to the main that was previously installed. Costs per home for this retrofit typically run about $6,000 to $7,000 for the grinder pump and lateral, $2,000 for the septic tank decommissioning, and $3,000 for the JCW connection fee. Most residents are eligible for a five-year, interest-free loan on the connection fee.

The BOCC charged the same task force with exploring a policy whereby property developers would cluster development into smaller lots and construct a community wastewater treatment system to serve the development until regional sewer service arrived. Citing various cost concerns and budget limitations arising from preliminary cost estimates, as well as growth and performance concerns discussed as follows, the task force ultimately recommended against the community treatment system policy. According to the task force's final memo to the BOCC, the proposed Community Septic System Program would have included the following elements (Metzler *et al.* 2003):

1. At the developer's option, the developer would have petitioned for an enlargement of the Consolidated Main Sewer District (CSMD) for an area to be served by a community septic system, if the proposed development was within the Urban Fringe Policy Area where an adopted area plan also supports the greater densities.
2. The developer, at the developer's cost, would have installed gravity sanitary sewers, connecting to a central aerated septic tank and subsurface absorption system.
3. After treatment through the aerated septic tank, effluent would have been pumped to a subsurface drip irrigation system, usually adjacent to the community septic tank. The land area for the drip irrigation system would have been covered by an easement for wastewater disposal as long as it was used for a community septic system.
4. The subdivisions served by the community septic system would have become part of the CSMD and would have paid the ordinary capital and operations and maintenance (O&M) charges of the CSMD.
5. Johnson County Wastewater would have been responsible for operation and maintenance of the systems and the community septic system, but JCW would arrange for the Environmental Department to operate the community septic tank and subsurface disposal system.
6. Sometime over the next 15 to 20 years after each community septic system was installed, JCW would have extended traditional sewers to the subdivision, decommission the community septic tank, and connect the subdivision to traditional sanitary sewers.
7. The community septic system would have been an option only for residential uses; not for commercial or industrial uses.

The task force forwarded its recommendation to the BOCC on April 29, 2003. The BOCC has not yet acted formally on the recommendation. However, the recommendation was structured so that if the BOCC disagreed with the recommendation, it could schedule a work session to further discuss the matter. The BOCC has not requested such a work session. County staff considers the matter closed at this time.

A pilot community septic system project is under consideration in one of the incorporated cities in Johnson County. The county expects to work with the municipality to help design the project and to evaluate its results.

Analysis

Areas for analysis in this case study include:

- Growth, development, and autonomy
- Performance and reliability

Growth, Development, and Autonomy

This section addresses the following:

- ***How was system architecture relevant to this issue?*** Johnson County was looking to accommodate higher density growth in urban fringe areas than allowed by onsite septic systems. Cluster development served by gravity sewers and a community septic system, which would later be connected to the regional sewer network, was proposed.
- ***How was the issue addressed?*** A policy on community septic systems was discussed extensively over a four-year period by the wastewater, environmental, planning, and legal departments in the county. Advantages and disadvantages were considered. Concerns arose that the policy would create an incentive for large-scale, suburban-density growth in unincorporated areas.
- ***Did the issue resonate with the community?*** The county decided it wanted to avoid suburban style growth in unincorporated areas. The county wants to avoid the cost of providing services to higher density developments.
- ***Results/Status:*** The task force advised against a community septic system policy.

How Was System Architecture Relevant to This Issue?

At present, subdivisions served by onsite systems are primarily built where sewers have not yet been extended at the request of petitioners. Development using onsite systems establishes two-acre lot densities that are inefficient for sewers in the long run. The proposed wastewater system architecture of cluster developments served by community septic systems had many advantages for development in the urban fringe area. These included:

- Developers would be offered an alternative to installing onsite systems and dry sewers.
- Lot sizes smaller than the two-acre minimum required for onsite systems would be more compatible with future urban residential land use and achieve better economies of scale for sewer service.
- Gravity sewers would already be installed. Once regional sewer service is extended to the area, a community septic system would offer one connection point to service the development. Like dry sewers, this approach would avoid a costly retrofit to sewers in a development that was initially served by septic tanks.
- Once the regional sewer is extended, the open space devoted to the community treatment system could be redeveloped with additional residential units, providing further economies of scale in wastewater and public services, and more efficient land use.

While a cluster development policy with a community septic system would ease the transition to urban densities and regional sewer service, concerns arose that the policy would provide an incentive to develop land outside of incorporated areas, something the county was trying to avoid for the various reasons noted in the following sections.

How Was the Issue Addressed?

A task force from the wastewater, environmental, planning, and legal departments studied the community septic system idea for four years. A number of issues surfaced during development of the proposal, both favorable and unfavorable to the community septic system concept, including:

- An easier transition to sewer service
- A potential reduction in political difficulties
- Concern over increased development in unincorporated areas

Community Septic System Developments Would Ease the Transition to Sewer Service

As noted earlier, it is likely that most, if not all, of Johnson County eventually will be served by sewers. Community septic systems developments would make the transition to sewers easier than if individual onsite systems were used.

One of the difficulties the county encounters with current policies is that retrofitting areas served by onsite systems requires formation of a benefit district through the petition process. Often residents do not wish to form a benefit district because of the costs of retrofits, often $15,000 to $20,000 per home. If the district petition is successful (signed by owners representing 51 percent of the land area of the proposed districts) residents who did not sign the petition are not required to connect unless they have a failing system and are within 200 feet of a sewer line. However, all residents must pay an assessment for the LPS main (typically about $5,000 per home), and pay JCW's $81 per year capital charge. Those who connect also pay an assessment (for the balance of the total cost) for decommissioning the onsite system and installing a grinder pump, sewer lateral, and any other equipment, and pay bi-monthly JCW sewer bills. In short, forming and funding a district and installing sewers is a cumbersome and inefficient process, and it is often fraught with political difficulties.

The dry sewer policy circumvents the sewer benefit district petition process. It requires the developer to commit the subdivision land area to support any future sewer district petition. It also requires the developer to install dry sewers in addition to onsite wastewater systems when subdividing the property. Once regional sewer service is extended to the area, residents can elect to connect to the system individually; a community petition is not required. The property owner simply needs to construct a service line to connect to the sewer main for dry gravity sewers and to install a grinder pump for dry LPS. The county sanitary code still requires two-acre lots for the onsite systems, however, which is not in accordance with the three to four dwelling units per acre typical of urban densities.

> "The long-term vision for the future is additional suburban-density development after annexation by area cities. The CS concept was to be a tool in transitioning from exurban development to suburban-density development."
>
> David Peel, Principal Planner, Johnson County

As with dry sewers, connecting a subdivision with a community septic (CS) system to the regional sewer system would avoid the costly and politically difficult process of retrofitting sewer mains in a subdivision originally served by onsite systems. But community septic systems would also support subdividing the land into urban density parcels. Further, all residential units would already be members of a sewer district, so when regional trunk sewers are extended, there would be one connection point for JCW, and residents would automatically become regional sewer service members. A petition would not be required.

Residents on a community system would receive comparable wastewater service to those connected to a regional sewer system. The county would be responsible for operation and maintenance, and residents on community systems would pay the same rates as other sewer customers. With the community septic system policy, the transition to regional sewer service with urban densities is easy, and difficult and costly sewer benefit district projects to install sewers become unnecessary.

Community Septic System Developments Might Reduce Political Difficulties Associated With Sewer Extensions

Certain portions of the county's rural area had developed at low suburban densities prior to adoption of the Rural Comprehensive Plan in 1986. Many residents of these areas, as well as relatively newer areas along the urban fringe that have been developed in two-acre lots, wish to maintain a rural atmosphere. As urbanization and incorporation expands, rural residents who do not want to live within sewered and/or incorporated areas have protested.

Disagreements usually arise during sewer service extensions. Like the sewer conversion process described above, sewer extensions require approval of owners representing 51 percent of the land area. However, while districts formed for sewer retrofits are small, typically encompassing a few to perhaps 60 houses, districts formed to extend sewer interceptors often cover several square miles. Current residents of these proposed districts may represent a small proportion of the total land area, so a few owners of large tracts of vacant land can establish a district over their neighbors' objections. These residents often see formation of a sewer extension district as the first step in the deterioration of their area's rural character. In the words of one local official, the petition/extension process sometimes causes county staff and the BOCC considerable "heartache." County officials fear that an increasing number of subdivisions with two-acre lots and onsite septic systems in the urban fringe area may exacerbate the issue. To the extent the community septic system policy would result in developers creating urban-style cluster subdivisions instead of subdivisions consisting of two-acre rural lots, the policy could reduce some of these tensions.

The County Became Concerned Over Increased Development Pressure in Unincorporated Areas

County officials became concerned that allowing community septic systems might promote development outside of city limits. Typically, sewer service is only provided within cities. The increased development density allowed by sewers is an incentive for developers to build their projects within city limits. But the proposed policy—increased density, gravity sewers, and a treatment system that is operated and maintained by the county—would "equalize" many aspects of development in incorporated and unincorporated areas.

Tax structures could then cause some developers to choose unincorporated areas. Cities in Johnson County impose an excise tax for new development to finance roads and other infrastructure. Excise taxes range from $0.06 to $0.19 per square foot of platted land, thus adding anywhere between $104,500 and $331,100 to development costs for a typical 40-acre subdivision. There is no excise tax for subdividing county lands in unincorporated areas.

Local cities are particularly concerned about development in unincorporated areas because such projects may not adhere to city building standards and may not match a city's development plans. Once these areas are annexed, they may require costly public improvements or higher-than-normal maintenance expenses.

Did the Issue Resonate With the Community?

County staff developed the community septic system proposal as a policy for internal county consideration. There was no public involvement process. However, county staff were well aware of broad community concerns such as those mentioned previously—public resistance to growth in rural areas, and cities' desires to maintain control along their peripheries. Some additional issues are discussed in this section.

Some Feel the Market-Based Mechanism for Sewer Extension Locations Makes Planning Difficult

Developers and property owners must petition the BOCC for new sewer extensions. The commissioners must approve the extensions; thus the BOCC largely determines the timing and location of new sewer development. There is a mechanism whereby developers can set up a "contract district" and then purchase the extension for 10 percent of sewer interceptor extension costs (the county ordinarily fronts 100 percent of interceptor costs). This mechanism is used when petitioners cannot achieve the petition requirement of 51 percent of the land area of the proposed district. Such extensions must still be approved by the BOCC. These extension policies mean that individual sewer extensions are usually made independently of actions in other sewer service districts, and independently of county or municipal agencies charged with providing support services (Johnson County 2003a, p. VII-7–VII-8).

According to John Metzler, chief engineer for Johnson County Wastewater, JCW has already established facilities plans for each developing watershed that identify where sewers will eventually reach and where treatment plants will be located to service future development. The market-based extension policy simply leaves it up to property developers to determine when the anticipated extensions will happen. He feels the market-based policy is advantageous for the county because, under it, interceptors are not built until development demand is demonstrated. This system has also had no trouble keeping up with the rapid pace of growth, which has averaged over 10,000 new residents per year since 1992.

The planning department, however, describes the resulting patterns of development as potential "chaos" for agencies having to provide transportation, fire protection, safety, and schools for new residents. Under the previous benefit district approach to funding of sewer extensions, property owners paid the full costs of extensions through tax assessments. This tended to retard "leapfrog development" (scattered development that leaves large areas of land undeveloped) because the costs of long sewer extensions were prohibitive. Now, the county's sewer extension costs are recovered through a relatively small ($3,000 per home) connection fee and capital charges of $81 per EDU per year, collected from *all* sewer users. The new system spreads the costs of sewer extensions, and thus does not restrain developers from considering subdivisions distant from existing sewers. The problem, from the planning department's point of view, is compounded by the county's tendency to grant variances from its own minimum infrastructure standards for distances to arterial roads, schools, and so on. While leapfrog development proposals have actually been rare, the potential for a disorderly pattern of development remains a concern of the planning department and service agencies.

The County Believed a Community Septic System Policy Would Interfere With the Annexation Process and Increase Service Burdens on County Government

According to David Peel, principal planner for Johnson County, there is a dawning realization that because 90 percent of the county's unincorporated land lies within three miles of a city boundary, the county should serve as a "steward" of rural land until annexation—either leaving land undeveloped, or facilitating development that lends itself to future urbanization. Once annexed by a city, zoning could be set for urban densities, and city officials could require developers to extend sewers as a condition of subdividing land.

Community septic subdivisions were envisioned as "city-like" in their lot sizes and layouts. According to Peel, who consulted with local cities on the proposal, city staff expected fewer problems from community septic than from conventional septic developments. Peel believed the community septic proposal to be "annexation neutral."

County officials were concerned, however, that cities might avoid the current practice of early annexation of land. Cities now use early annexations to prevent developers from constructing low-density projects just outside city boundaries. The CS policy might slow early annexations, since sewer and density issues would be resolved.

Urban-density development in the unincorporated areas was also something that county officials preferred to avoid on fiscal grounds. Historically, the county only had the capabilities, equipment, and expertise to provide services (fire, police, and other services) to residents of rural areas. County officials became increasingly concerned about their fiscal ability to provide equivalent services to residents on higher density community septic systems. Further, increased development in the urban fringe might raise concerns that city residents are paying for services and facilities used but not paid for by rural residents.

Officials particularly wanted to avoid the creation of numerous large urban-density developments scattered throughout the unincorporated area. During the community septic system task force effort, the county invited several consulting engineers working with developers in the unincorporated area to provide input. One of those consultants then used the CS concept as a basis for a proposal to develop 160 acres in the unincorporated area. The development was to have more than 250 homes, or about 750 people. Officials feared that adoption of the CS policy would result in the approval of a series of similarly sized developments.

The impetus for the proposed policy was to provide a means to allow small, urban-density cluster developments in rural areas that could transition easily to sewers as urbanization arrived. Instead, it appeared the proposal would encourage large developments, and the cost per unit of the proposed wastewater system (detailed in the following section) would be prohibitive for small developments. Further, planners were concerned that owners of property close to existing sewers might prefer to wait for sewer extensions; conventional sewers would enable more subdivision design options than community septic systems, which require allocation of land to a subsurface drip irrigation system. Thus, not only might CS development proposals be large, they might tend to be located far from advancing urbanization, exacerbating problems with other services. The county's tendency to waive other infrastructure standards heightened this concern that CS proposals would result in increased leapfrog development.

Results/Status

For the following reasons related to county growth and development, the task force recommended against community septic system developments as follows (Metzler *et al.* 2003):

1. Staff is opposed to this concept and believes it is more prudent to try to preserve the Urban Fringe Policy Area for ordinary suburban development on traditional gravity sewers, rather than developing it prematurely on unconventional sewer systems in the unincorporated area. This is the area most likely to be annexed by cities and provided with conventional sewer service within the next 15 to 20 years.

2. Because of the relatively high per unit cost of community septic systems, it is likely these systems will only be cost effective for large parcels, 40 acres or larger. As a result, allowing these systems may have had the unintended consequence of facilitating large-scale urban density development in the unincorporated parts of the county. This will result in further demands on county resources for roads, public safety, code enforcement, etc., at a time when budget resources are declining. The absence of an excise tax on development in the unincorporated parts of the county would probably increase the likelihood of large parcels opting to use community septic systems.

According to the planning department, there are ongoing discussions about amending the Rural Comprehensive Plan to establish excise taxes for development in the unincorporated areas and to establish a policy prohibiting sewer extensions outside city limits.

Performance and Reliability

This section addresses the following:

- ***How was system architecture relevant to this issue?*** Performance and reliability were key criteria in the evaluation of wastewater collection and treatment technologies for community septic developments.
- ***How was the issue addressed?*** The BOCC had shown reluctance to use low-pressure sewers (LPS). The task force selected gravity sewer systems for community septic developments early in the decision process. Several different treatment technologies were explored along with their compatibility with gravity sewers. High rates of infiltration and inflow (I/I) in gravity sewers became a critical design factor.
- ***Did the issue resonate with the community?*** LPS had recently been "stigmatized" as unreliable by some parties opposed to sewer retrofits in developments with septic systems. Some officials were wary of LPS in new developments.
- ***Results/Status:*** Concerns over the ability of community treatment systems to withstand high rates of I/I resulted in system designs with excess capacity and additional I/I reduction measures. This raised system costs somewhat. More importantly, because of the unpredictability of I/I, conservative design could not eliminate the potential for failures from system overload. For this reason and the planning concerns discussed earlier, county staff recommended against the proposed policy. However, the county will participate in an anticipated community septic system project in a municipality. This will allow the county to further analyze the potential use of such systems.

How Was System Architecture Relevant to This Issue?

County staff's technology selection process for community septic systems was guided by the following constraints:

- Facilities should not discharge to area streams. Only subsurface discharge would be allowed.
- The BOCC's previous reluctance to use LPS for new development would most likely apply to community septic developments. Therefore, gravity sewers would be required.

Under these conditions, the multi-department task force examined the performance and reliability of various treatment configurations for community septic system developments.

How Was the Issue Addressed?

In order to address the issue of performance and reliability, the staff reviewed multiple treatment options.

Staff Reviewed Multiple Treatment System Options

A number of treatment configurations were considered, including:

- Aerobic treatment units (ATUs) for each lot
- Septic tank effluent pressure systems (STEP), with individual septic tanks and effluent pumps on each lot connected by LPS to a central treatment system
- Holding tanks on each lot, with waste trucked to a receiving station or treatment plant
- Central aerated lagoon treatment systems
- Central aerated septic tanks with drip irrigation effluent dispersal

Sewer options included gravity sewers or LPS powered either by grinder pumps or by STEP system effluent pumps. Vacuum sewers had been briefly considered during discussions over the dry sewer policy. They were rejected because of a lack of local experience with the technology—the task force was not aware of a single installation in the Kansas City metropolitan area.

Evaluation of the options included comparison of their costs to the cost of pumping wastewater to the closest regional sewage interceptor. In addition, task force members visited installations of a number of different treatment technologies, including aerated lagoon systems in the Chicago area. They also hired a prominent decentralized wastewater systems consultant, Dick Otis of Ayres Associates, to help them explore options and provide relevant examples and references.

The task force ultimately decided against the use of ATUs because of maintenance and access issues with onsite pumps. A community treatment system located within the subdivision, with drip irrigation for effluent disposal was considered the most desirable system. The Johnson County Environmental Department’s familiarity with the technology of aerated septic tanks boosted their adoption as the preferred community system treatment technology.

Staff and the BOCC Preferred Gravity Sewers

In 1996, the BOCC began allowing Johnson County Wastewater to use grinder pumps and LPS to retrofit subdivisions originally developed with septic tanks. LPS can be installed with less disruption to developed land than gravity sewers. JCW currently operates LPS systems for about 250 homes. There are a small number of homes, probably less than 50, on LPS systems operated by other entities in the county. Across the entire greater Kansas City metropolitan area, between 3,000 and 4,000 homes currently utilize LPS.

According the JCW, LPS collection systems have been reliable. However, the agency says there are several disadvantages of LPS relative to gravity sewers:

- One disadvantage of LPS arises during the frequent summer power outages caused by the county’s fierce thunderstorms. Sometimes power is down for several days. Winter ice storms, though less common, can also cause lengthy power outages. Many people have been concerned about the possibility of sewer backups when LPS grinder pumps lack power. However, during the longest and most widespread power outage in recent history (beginning January 31, 2002), none of the county-operated units had sewer backups. In fact, no sewer backups resulting from a power outage have ever occurred on properties served by JCW LPS systems. Water use drops considerably when homes do not have power. Also, in response to citizen concerns, JCW has required recent LPS installations to have “quick-connect” capability for power generator trucks. Further, JCW contracts with private companies for LPS maintenance. These contracts require a maintenance company to ensure that when a lengthy power outage occurs, a generator truck will provide LPS systems with power for the pumps.

- Another reported disadvantage is the need for easements to ensure maintenance access to grinder pumps on each property.
- While JCW considers LPS a reliable technology, it considers gravity sewers more reliable because there are no electrical or mechanical parts to fail, with the exception of pump stations.
- Operating costs for gravity systems are lower.

Upon approval of the LPS retrofit policy, the BOCC recommended that LPS only be used to retrofit existing development, and not to serve new development. However, the BOCC allowed dry LPS to be used for new homes built under the dry sewer policy because in the future, LPS would be used to retrofit the systems anyway. The high costs of installing dry gravity sewers also favored dry LPS. Costs for dry gravity sewers are about $7,500 per lot; dry LPS costs roughly $1,000 per lot (not counting laterals, pumps, and other items installed later).

Given the BOCC’s past decisions, the task force believed the BOCC would only allow new community septic system developments to use gravity sewers. Thus, the task force proceeded to examine system configurations that included the use of gravity sewers connected to a community septic system. When it explored community septic system configurations elsewhere in the country, the task force quickly realized that community systems are routinely served by LPS. However, JCW favored gravity sewers for the reasons noted previously, and the task force did not wish to challenge the BOCC’s preference for gravity sewers.

The Proposed Use of Gravity Sewers Raised Concerns About Vulnerability to Infiltration and Inflow

Gravity sewers in the county experience substantial rates of I/I—in some places I/I represents 80 percent of total flows during big storms. According to JCW, even new gravity sewers have I/I, due in part to the compact clay soils of the area. Trenching and backfill creates a path of least resistance for groundwater movement along buried sewer mains—resulting in infiltration into the sewers at any pipe or joint imperfections.

Increased flows from I/I during wet weather became a primary concern of the task force. To ensure the reliability of community septic systems in accommodating increased flows, extra capacity for central septic tanks and soil absorption fields was included in the proposed system. This raised costs somewhat. Table 9-2 shows a cost breakdown for several variations on the design. For comparison, conventional septic systems in Johnson County typically cost $6,000 to $6,500 per home, and mound systems cost $14,000 to $16,000 (all onsite systems, however, require two-acre lots).

Table 9-2: Community Septic System Collection and Treatment System Cost Estimate—Itemized Installation Costs for a 40-Home Subdivision

	Unit Price	Units	Best Case[1]	Average Case[2]	Worst Case[3]
Developer's Expense					
Shallow Gravity Sanitary Sewer	$4,000	40	$160,000	$160,000	$160,000
Treatment and Disposal					
Best Case Scenario[1]	$202,000	1	$202,000	--	--
Average Case Scenario[2]	$213,040	1	--	$213,040	--
Worst Case Scenario[3]	$351,400	1	--	--	$351,400
Subtotal			*$362,000*	*$373,040*	*$511,400*
Developer's Average Cost per Lot			**$9,050**	**$9,326**	**$12,785**
Homebuilder's Expense					
Service Lines	$500	40	$20,000	$20,000	$20,000
Connection and Permit Fees	$2,783	40	$111,320	$111,320	$111,320
Lift Pump and Pit[4]	$1,000	40	$40,000	$40,000	$40,000
Soil profile and onsite permit	$455	1	$455	$455	$455
Homebuilder's Average Cost per House			**$4,295**	**$4,295**	**$4,295**
Total Average Cost per House			**$13,345**	**$13,621**	**$17,080**

[1] Best Case – Aerated community septic tank treatment system. Dosing pumps and pressurized soil absorption pipe (10,000 lineal feet). Fencing. Telemetry. JCED construction permit. Design and construction management fees. Waterline with meter. 2.5 acres of land.

[2] Average Case – Aerated community septic tank treatment system with subsurface drip irrigation system (~27,000 lineal feet) with pumping chambers. Pumps. Installation. Fencing. Telemetry. JCED construction permit. Design and construction management fees. 2.5 acres of land.

[3] Worst case – Aerated community septic tank treatment system with mound system (~27,000 square feet basal area). Pumping chambers. Pumps. Installation. Fencing. Telemetry. JCED construction permit. Design and construction management fees. 4 acres of land.

[4] Lift pump and Pit are required for finished basements only.

Source: Metzler et al. 2003. These cost estimates were preliminary and may not reflect actual costs.

Additional Measures to Reduce Vulnerability and Increase Reliability Were Included in the Design

Vulnerability and reliability concerns became critical to overall system design. These concerns led to a number of additional design measures. For instance, it was decided that soil absorption fields would have to be fenced to keep vehicles and people off. This would avoid compaction of the absorption field area and would also reduce liability in case a problem with the system caused septic tank effluent to surface.

The task force proposed shallow trench excavation for gravity sewers to avoid the need for a pump station to deliver sewage to the community septic system. The primary concern with a pump station, like LPS, was the need for a standby power generator. The design called for locating sewer laterals approximately halfway up basement foundation walls. Houses with plumbing fixtures or appliances in basements would require a lift pump to deliver wastewater to the sewer lateral. In the event of power outages, homeowners would be instructed to not use basement fixtures.[14]

The task force also proposed that newly installed gravity sewer mains and lateral tie-ins be subjected to rigorous inspection prior to backfilling. This measure would help reduce I/I.

These measures added some cost to the proposed design. According to county officials, the cost increases were minor, and installation cost was not a major concern in the task force's recommendation. (CS system capital costs would be paid by the developer and homebuyers, not the county.) However, as noted earlier, the final cost did concern the planning department because it meant that the CS approach would probably not be adopted for small and near-city developments; rather, it would likely be popular for large projects far from the urban edge.

The added measures could not guarantee I/I overload and system failure (surface discharge from the soil absorption system) would not occur. JCW staff members note that it is impossible to accurately predict the patterns of I/I—where it will occur, how much flow, and for how long. Ultimately, concern over possible system failures was a substantial factor in the task force's recommendation against the CS policy.

Did the Issue Resonate With the Community?

The use of LPS could have avoided the I/I issue. However, a key reason the task force did not consider LPS was community politics. In several recent sewer retrofits at septic-supported developments, LPS was labeled unreliable and dangerous by parties who, for various reasons, sought to squelch support for sewer extensions. According to JCW, this "stigmatized" LPS, and since then decision makers have been reluctant to support this type of sewer. Also, staff had originally recommended (for the reasons noted previously) and the BOCC had approved LPS with the intent that the systems would be used primarily for retrofitting neighborhoods with onsite systems.

[14] Such issues and policies were not considered in detail because the shallow sewer concept was only developed as far as rough cost estimates before the entire community septic system policy was rejected.

The task force decided that the systems would have to be operated by the county as a special district within the Consolidated Main Sewer District. JCW would be ultimately responsible for system operation and maintenance. It would contract with JCED to operate the community septic system and dispersal fields. JCED, in turn, might contract out the O&M work while providing oversight. JCW would maintain the sewers. JCW was not entirely comfortable with being responsible for these systems, which represented a somewhat uncommon pairing of gravity sewers and community-scale treatment systems.

> "I think the secret to going forward with this concept is to be willing to go with LPS…and avoid the I/I issue. It does make the system more maintenance-intensive—having to maintain the LPS grinder pump units as well as the community septic system. But it would be reliable if you ensured proper O&M."
>
> John Metzler, Chief Engineer, Johnson County Wastewater Department

During the policy development process, the task force decided that community septic systems would only be allowed in the Urban Fringe Policy Area. In addition to concerns about growth discussed earlier, this decision was made because these are areas where sanitary sewers are expected to be extended within the next 15 to 20 years. Thus, while concerns about I/I would persist during the short period a community septic system would operate, the county would have less concern about I/I increasing, and possibly overloading community treatment and dispersal systems, over the longer run.

Results/Status

To ensure community septic system performance and reliability, the proposed design included extra capacity for septic tanks and soil absorption fields, and other measures. But lingering concerns about system reliability contributed to the task force recommendation against the community septic policy in its report to the BOCC. Reasons stated that related to performance and reliability included (Metzler *et al.* 2003):

1. The operating costs of these systems are high on a per-home basis. Based on our estimates, JCW would subsidize the operating costs of these systems at a rate of almost $300 per house per year. While subsidies already exist within the JCW system (i.e., some treatment plants are more expensive to operate on a per home basis than others), this $300 cost is likely greater than for any JCW facility.

2. In view of current and projected budget limitations, [the] staff believes it is not prudent to embark on a complex and manpower intensive program such as the community septic program. While operation of these systems could have been largely privatized, the administrative, technical, and legal oversight of reviews, approvals and operations of these facilities would be extensive. It is estimated that an additional 4 FTE [full time equivalent employees] would be needed to run this program. …

3. Using gravity sewers with community septic tanks may increase the chances that these systems may fail.

A developer in the Johnson County city of Spring Hill has recently proposed a cluster development away from sewer lines that is being considered for a pilot community septic system project. The city will make the decision on this project. If the project proceeds, the county anticipates working with Spring Hill to help design and later evaluate the project. According to parties interviewed, it will likely take five years to appropriately evaluate any pilot project.

Conclusions

This case study reveals the sometimes-complicated interplay between wastewater system choices and growth-related policies in a rapidly urbanizing area. It also reveals the interplay that can occur between technical and political considerations in technology choices. Other communities interested in growth and system reliability issues should consider the following lessons from Johnson County:

- Thoroughly review wastewater system options. Johnson County investigated a number of technologies for treatment of wastewater at a subdivision scale. Some would question the decision to go with gravity rather than LPS sewers for community septic systems. Gravity sewers meant that the design would have to address vulnerability to I/I; however, additional measures to mitigate I/I problems could not ensure that system failures would not occur. Still, Johnson County chose to go with gravity sewers for a number of technical reasons. Other communities might chose differently for their own reasons.
- Be prepared to correct misinformation about technical matters. The characterization of LPS as unreliable by parties with various agendas could have been counteracted with accurate information. Citizens' concerns about certain implications of wastewater technologies—in this case, perhaps the costs and growth implications of LPS retrofits—may be valid issues for debate, but factual inaccuracies about technical matters such as LPS reliability should not be allowed to circulate. Education of decision makers is particularly important. Recently, JCW's design requirements and contracts for backup power to LPS systems helped correct this perception problem.
- Realize that decentralized wastewater systems, properly designed and managed, are potentially permanent systems, even on the urban fringe. In Johnson County's case, growth is so fast and widespread that JCW anticipates sewering most, if not all, of the county. Given these conditions, Johnson County does not see decentralized systems as permanent systems, but instead is planning for transitions to sewers. Communities with different conditions might take a different approach. With different technical choices, community-scale collection and treatment systems can be built without the burden of expected system failure within 15 to 20 years due to sewer I/I.
- Thoroughly investigate options to surmount cultural and institutional barriers. Ensuring maintenance access to onsite tanks and pumps is not considered a major problem in many communities (including Mobile, Alabama, which is described in a case study in Chapter 6 of this report), especially for new development, where maintenance access is a condition of purchase of a new home.

- Be aware that the feasibility and advisability of wastewater infrastructure proposals may be strongly affected by other non-wastewater policies. For example, the presence of an excise tax in Johnson County cities and the lack of this tax in the unincorporated county meant that developers would probably move some projects to the county to avoid the tax. Also, consider the effect on the community septic system policy of the market-driven basis for sewer extensions. The county was interested in increasing the density of development on the geographic urban fringe in order to ensure more efficient provision of public services. The question was how best to support higher density: by allowing community-scale treatment systems, or by “early annexation” by cities? The latter approach has worked well for Johnson County, though there have been some concerns about and instances of leapfrog development. Staff anticipated that the CS policy might actually encourage more leapfrog development than occurs under the current situation. This was a key reason for the recommendation against the CS policy.
- Carefully consider the equity implications of proposed wastewater policies. Johnson County staff members were concerned that CS developments would prompt sentiments that city residents subsidize schools, roads, and other services and facilities for rural residents. In addition, the O&M costs for the proposed CS systems were higher than the rates paid to JCW by all residents, raising another subsidy issue.

It is important to keep in mind additional aspects of the context of Johnson County’s policies. As a large, rapidly growing, and comparatively wealthy county, both the county and many of its residents have greater resources than would be found in many other places. Dry sewers add substantially to the cost of a home. Such costs have not been supportable by developers, homeowners, and government officials in many other places; but they are, apparently, tolerated in Johnson County. The affluence of the county may be one reason. Another may be Johnson County’s choice of LPS as the dry sewer technology, at a cost of $1,000 to $1,500 per lot, rather than dry gravity sewers, at a cost of $7,000 or more per lot. JCW believes this may be the only instance of dry LPS in the country, while dry gravity sewers have been installed in a number of other communities. Further, Johnson County developers benefit from the county’s market-driven approach to sewer extensions. In many places, especially those with fewer resources, developers have less control over the timing of sewer extensions because the non-sewer public services costs of sewer infrastructure have motivated development of centrally directed sewer extension plans.

Johnson County may yet adopt a community septic system policy. The project with the City of Spring Hill could help the county decide if community-scale systems are appropriate for local physical and policy conditions. Thus, this case study brings up the role and importance of pilot projects. Communities should be prepared to pursue pilot projects if a potentially promising policy or program is not feasible at the current time. However, Johnson County officials caution that pilot projects are not always easy or practical. They saw significant legal concerns with the county allowing only one developer to implement a community septic system in the unincorporated area. Further, they say that a pilot project might take five years from approval to build-out, and then up to five years to study system effectiveness. As well, in Johnson County a single pilot project would not help determine if one of the main concerns with the proposed policy would occur: proliferation of large-scale, community-septic-supported developments in unincorporated areas. Communities considering pilot projects should determine if the projects will answer key questions, and then carefully design the experiment to yield sufficient results in a reasonable time.

Sources

Sources for this case study include:

Phone Interviews

Jack Maybee, Director, Sanitation Division, Johnson County Environmental Department, Lenexa, KS

John Metzler, Chief Engineer, Johnson County Wastewater Department, Overland Park, KS

David Peel, Principle Planner, Johnson County Planning Department, Olathe, KS

David Peterson, Planning and Development Coordinator, City of Spring Hill, KS

Documents

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Metzler, J., E. Lynn, J. Maybee, D. Peel, and R. Lind. 2003. *Community Septic Systems for New Subdivisions in the Urban Fringe Policy Areas.* Memorandum from the Johnson County Wastewater Offices to the Board of County Commissioners. April 29, 2003.

10 METROPOLITAN BOSTON, MASSACHUSETTS

This case study addresses the topic:

- Hydrologic Impacts

The Community

The greater Boston metropolitan area is home to more than three million people. It is characterized by intense urban development in and around the city of Boston, tapering to suburban and semi-rural development on the fringe. The metropolitan area has many rivers flowing through its communities and into Boston Harbor, offering numerous opportunities for industry and recreation. These rivers include the Charles, Neponset, Mystic, Weymouth Fore, and Weir. The Concord, Ipswich, and Shawsheen rivers also drain portions of the metro area but discharge to the ocean at locations outside Boston Harbor.

The Massachusetts Water Resources Authority (MWRA) provides sewage collection and treatment service to 43 communities in the greater Boston metropolitan area, serving approximately two million people and making it one of the largest wastewater utilities in the country. It treats all sewage at one regional plant, the recently reconstructed Deer Island Treatment Plant (DITP), which has a peak capacity of 1.3 billion gallons per day (GPD), a 9.5-mile ocean outfall, and a sludge-to-fertilizer processing facility. The MWRA sewer collection system encompasses about 240 miles of MWRA-owned interceptors, 5,400 miles of publicly owned community sewers, and more than 5,000 miles of private sewer service connections. MWRA also supplies potable water to 48 communities from reservoirs in the western part of the state.

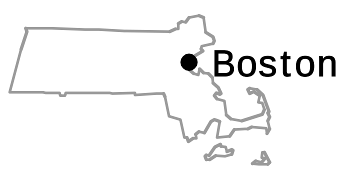


Figure 10-1: The Location of the Boston Metropolitan Area in the State of Massachusetts

Wastewater Issues

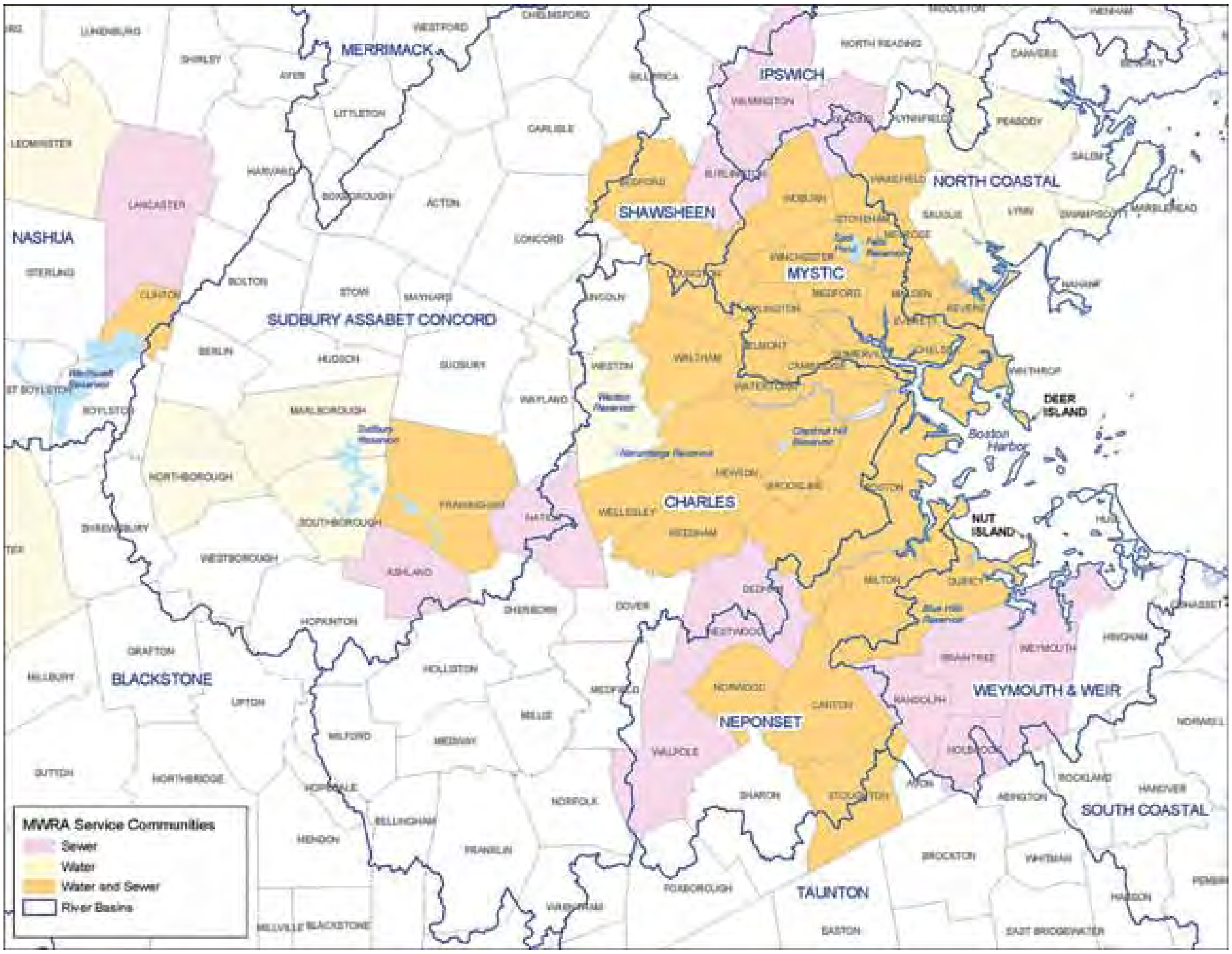
There are many issues for a region this large. This case study focuses on hydrologic issues associated with the MWRA regional sewage collection and treatment system. The configuration of sewer and water systems results in substantial transfers of water within and between the various basins of the region. The mechanisms of these transfers include:

- ***Drinking Water Imports:*** On average, MWRA imports roughly 250 million gallons per day (MGD) of drinking water from western Massachusetts reservoirs and delivers it to 48 communities. Thirty of those communities utilize MWRA sewer services, passing through most of this imported water to the DITP. In the remaining communities, the imported water is added to local watershed water budgets through onsite, community, or sub-regional wastewater systems.
- ***Groundwater Withdrawal to Regional Sewers:*** Thirteen MWRA sewer communities utilize their own local groundwater supplies for potable water. This configuration results in locally withdrawn water being sent out of local watersheds through regional sewerage.
- ***Infiltration/Inflow (I/I) to the Collection System:*** I/I to sewer lines removes water from local watersheds, accounting for up to 60 percent of total flows received at the DITP.

These mechanisms of interbasin water transfer impact three major watersheds in the region, those of the Charles and Neponset Rivers, and to a lesser extent, the Ipswich River.[15] All three watersheds experience low-flow periods that some attribute in part to groundwater exports via the regional sewer system. This study examines these and related hydrologic issues by reviewing the regional facility planning decision undertaken in the 1980s and examining the resulting and current status of watershed issues and efforts. In addition, it explores the increasing role of individual onsite and community soil-absorption systems in the metropolitan region in helping maintain hydrologic budgets.

Figure 10-2 shows the river basins and communities of the greater Boston region, and services provided to communities by MWRA.

[15] In contrast to the Charles and Neponset basins, the MWRA system covers a relatively small portion of the Ipswich basin. Other wastewater systems in the Ipswich basin contribute to low-flow conditions there through the mechanisms of local water supply withdrawals from groundwater and I/I to wastewater collection systems.



Courtesy of MWRA

Figure 10-2: River Basins and Communities of the Greater Boston Region

Historical Overview

Sewer construction in the greater Boston metropolitan area began in 1891 and proceeded along two primary collection routes, the "north system" and the "south system." It was estimated that by 1939 more than 250 million gallons of raw sewage were being discharged into Boston Harbor each day.

In response to the public health threat, primary treatment plants were constructed on Boston Harbor's Nut Island in 1952 and Deer Island in 1968 to serve south system and north system flows, respectively. As of 1977, 43 communities encompassing 500 square miles were connected to the regional sewer system, sending wastes to the primary treatment plants at Nut Island and Deer Island. Both plants discharged primary treated effluent into Boston Harbor. Anaerobically digested sewage sludge was also discharged into the harbor with the outgoing tide. Boston Harbor was considered one of the most polluted bodies of water in the country.

Passage of the federal Clean Water Act in 1972 required wastewater treatment plants to incorporate secondary treatment. In 1973, the Metropolitan District Commission (MDC), the sewage authority predecessor to MWRA, began the regional wastewater infrastructure planning process for the Boston Harbor and Eastern Massachusetts Metropolitan Area (EMMA). The study, often referred to as the EMMA Study, was intended to provide wastewater management guidance for the region over the next 80 years (Metcalf & Eddy, Inc. 1976).

A technical subcommittee composed of public agencies and private citizens reviewed five regional wastewater treatment alternatives representing various degrees of regionalization before agreeing upon a plan. The plan recommended the following (Metcalf & Eddy, Inc. 1976, Summary):

- ***Service Area:*** Allow eight additional towns (a total of 51 towns) to be connected to the regional sewage system.
- ***Boston Harbor:*** Upgrade the Boston Harbor treatment plants at Deer Island and Nut Island to provide secondary treatment of average flows of 400 MGD and 130 MGD, respectively, by the year 2000. Construct a sludge incinerator on Deer Island, and undertake combined sewer overflow regulation and treatment.
- ***Neponset River:*** Construct an advanced treatment facility with a 25 MGD capacity to serve five towns and discharge to the Neponset River, thus reducing flows to Nut Island and retaining reclaimed wastewater in the basin to improve river flows in dry summer months.
- ***Charles River:*** Construct a 31 MGD advanced treatment facility in the middle reach of the river to serve eight towns and discharge to the river, thus reducing flows to Nut Island and retaining reclaimed wastewater in the basin to improve river flows.

Construction costs to build the recommended facilities were estimated at $855 million in 1975 dollars (Metcalf & Eddy, Inc. 1976, Summary). In the fall of 1976, the U.S. EPA requested a formal environmental impact statement (EIS) be prepared before proceeding with facilities planning.

The two satellite treatment facilities on the Charles and Neponset were proposed to minimize any effects that further sewering would have on base flow conditions in the rivers. Results from river sampling and flow modeling performed during development of the EIS, however, showed that satellite treatment plant discharges would adversely impact water quality in both rivers and jeopardize public health in those communities drawing groundwater from wells downstream of the proposed facilities. Upon completion in 1978, the EIS recommended that all treatment facilities be consolidated on Deer Island, and that Nut Island be used as a headworks and pump station (US EPA 1978, p. 3-283). Supplemental environmental impact statements generally corroborated these findings.

Deer Island offered the availability of deep-ocean access for an outfall location, thus avoiding the assimilative capacity issues related to river discharge under the satellite configuration. This deep-water availability prompted the MDC to apply for a waiver of certain secondary treatment requirements that had become available to coastal areas meeting specific conditions under a 1977 amendment to the Clean Water Act (US EPA 1978, p. 3-330). Several years of deliberation about project funding, treatment level requirements, outfall locations, and capacity issues followed, stagnating the facility planning process.

In 1983, the Conservation Law Foundation initiated a lawsuit against MDC and state and federal regulators for failure to comply with the Clean Water Act. The Massachusetts legislature created the MWRA and transferred to it responsibility for MDC water and sewer systems soon thereafter. In 1986, a federal district judge ordered MWRA to undertake a 13-year schedule to construct a new Deer Island Treatment Plant with secondary treatment capabilities and related facilities. Since that time, a number of milestones have been reached, as shown in Table 10-1. MWRA also became actively involved in combined sewer overflow (CSO) and I/I remediation projects throughout the region as part of the court order.

Table 10-1: MWRA Facility Construction Timeline

Year	Project Milestone	Effects on Harbor
1988	Interim disinfection system installed	Sewage scum landfilled instead of discharged to harbor
1989–1998	Pumping capacity increased from 500 MGD to 700 MGD	
1991	Sludge-to-fertilizer pellet plant comes on line	Sludge discharges to harbor ended
1995	Improved primary treatment at Deer Island begins	
1997	Startup of Battery A secondary treatment at Deer Island	35 percent of wastewater receives secondary treatment
1998	Battery B comes on line. Inter-island tunnel completed. South system flows transferred from Nut Island to DITP.	85 percent of wastewater receives secondary treatment. Effluent discharges into harbor from Nut Island are ended.
2000	Start-up of 9.5 mile ocean-outfall diffuser	End of effluent discharges into Boston Harbor
2001	Battery C secondary treatment comes on line	100 percent of wastewater receives secondary treatment

Source: MWRA 2002a

Since the completion of secondary treatment facilities at Deer Island and the new outfall location in Massachusetts Bay, water and sediment quality in Boston Harbor have improved dramatically.

Sewage effluent, which formerly constituted 40 percent of the freshwater flow into the harbor, is gone, and nearly all harbor waters are within EPA guidelines for recreational use. Fish and shellfish populations are also increasing in abundance and diversity and show less toxicity.

In contrast with most of Boston Harbor, the tributary rivers frequently do not meet the Massachusetts water quality standard for average fecal coliform counts (less than 200 colonies per 100 ml), reflecting the impacts of CSOs and urban storm runoff. Closures of some CSO facilities and better treatment at others have reduced inputs of bacteria to the Neponset River, which has shown improvement, but stormwater continues to impact water quality. The Charles River, on the other hand, has shown dramatic improvements in water quality over the past 10 years as average bacteria levels have decreased 80 percent (MWRA 2002b). Much of this success has been attributed to the elimination of illegal sanitary sewer connections to separate storm sewer systems, and to greatly decreased discharges from Charles River CSOs as a result of improved pumping and hydraulic capacity at DITP. Also, communities along the Charles have been working to clean up discharges from separate storm sewer systems.

Both rivers continue to send millions of gallons of water out of their respective basins every day through the sewer system, and continue to experience extended periods of low flow. Whether the regional sewage treatment system is to blame for low flows has been a controversial question in the region. The issue is explored in detail in the next section.

Analysis

An analysis of hydrologic impacts is provided in this section.

Hydrologic Impacts

This section addresses the following:

- ***How was system architecture relevant to this issue?*** A satellite treatment configuration with inland river discharge was proposed to address hydrologic concerns. It offered opportunities to keep locally collected wastewater within the respective basins to augment river flows.
- ***How was the issue addressed?*** The costs and benefits of the satellite configuration were discussed, but concerns over river pollution suggested the need for a centralized plant with ocean outfall. Other flow-augmentation methods were found to be more cost-effective than satellite plants.
- ***Did the issue resonate with the community?*** Avoiding large interbasin transfers of wastewater was an important goal during the initial facility planning. Residents of inland watersheds expressed concerns over satellite facility discharges and plant siting.
- ***Results/Status:*** Watersheds are still experiencing water deficits. Concerns over flow issues have increased. A number of state, regional, and local efforts are underway to mitigate the problem. Decentralized wastewater systems are seen as an important part of the solution in some communities.

How Was System Architecture Relevant to This Issue?

A regional infrastructure configuration with inland satellite treatment plants was proposed in part to augment river flows. Low-flow conditions that occurred on each river during the summer months stressed waste assimilative capacity, restricted recreational use, and created potential water supply problems. Without satellite plants, wastewater would be sent to the harbor and "lost" to local watersheds, along with groundwater and rain water through I/I to the regionalized sewer system. Keeping those waters in-basin could potentially alleviate low-flow conditions. The proposed satellite plants would also keep waters in-basin that would otherwise leave due to increasing future groundwater withdrawals from municipal water supply wells and transfer to future sewer connections (US EPA 1978).

Additional advantages of a satellite treatment architecture included (US EPA 1978, p. 3-74):

- Reducing flows to the Nut Island and Deer Island harbor treatment plants, thus avoiding large expansions and increased effluent discharges to the harbor.
- Reducing the need for interceptor relief by reducing the demands placed on sewers downstream of the satellite facilities, thus a lesser amount would need to be spent on relief sewers and sewer rehabilitation projects.
- Increasing flexibility and options for future wastewater recycling, land application of effluent, and innovative small-scale sludge processing methods that were not available at the time. The facility plan did state that this option value, however, was a "potential benefit that may or may not be realized."

How Was the Issue Addressed?

The hydrologic impact issue was addressed by:

- Treatment plant configuration studies
- Watershed hydrology studies
- Satellite treatment plan evaluation
- Consolidated regional DITP plan evaluation
- Supplemental environmental impact statement

Treatment Plant Configurations Were Studied Extensively

During the initial master planning that took place under the EMMA study, 109 cities and towns were considered in determining the ultimate reach of the regional sewer service area. A technical subcommittee developed five broad-scale wastewater management concepts for evaluation. The concepts, listed as follows, were proposed as planning guidelines rather than actual proposals (US EPA 1984a, pp. B-6–B-7). They included:

1. Upgrading existing harbor facilities (at Nut Island and Deer Island). A minor expansion of the service area. No satellite plants

2. Limited decentralization—creating five regional satellite systems with river discharges and a total capacity of 123.5 MGD
3. Maximum expansion of the service area—with treatment of all flows at expanded harbor facilities with harbor discharge
4. Maximum decentralization—creating six regional satellite systems with river discharges and a total capacity of 177 MGD
5. Like alternative 4, creating six satellite treatment facilities, but with five facilities using land application for disposal and one with river discharge

An extensive rating system was developed. Concepts 3 and 5 were eliminated from consideration, but concepts 1, 2, and 4 were all ranked very closely (US EPA 1984a, p. B-5). The subcommittee concluded that a "moderately decentralized system would be the best overall solution considering river flows, increasing demand and decreasing opportunities for water-oriented activities, and the difficulties associated with extensive interceptor construction through urban areas and the filling of the harbor." (See EPA 1984a, p. B-5, which cites reference 1, p. 4-2.)

Watershed Hydrology Was Studied Extensively During the Environmental Impact Review

Ground and surface water modeling were conducted in both watersheds to assess flow impacts from treated wastewater discharges into the rivers under the satellite plan. Both rivers were found to have highly regulated flows: the Charles has significant water storage capacity behind many dams along its lower stretches, and the Neponset is actively regulated for industrial water supply. Regulation of flow in these rivers complicates the hydrologic picture. However, water budget analyses of both river systems were performed that revealed the following:

- I/I represents a significant loss to both the Charles and Neponset rivers where interceptors run through sand and gravel deposits adjacent to the rivers.
- Upon closer examination of the Charles River watershed, it was found that significant flows to a proposed satellite plant originated outside the watershed, from imported water supplies, and from imported I/I water. (I/I importation occurs because some sewers located in the Sudbury River watershed flow into sewers in the Charles River watershed.) Including all inputs—local and imported water supplies and local and imported I/I—less than 40 percent of flows diverted to a proposed Charles River plant would originate within the Charles watershed. After water budget analysis, the Charles watershed would realize a net benefit of 13 MGD by constructing the proposed satellite treatment plant (US EPA 1978, p. 3-241).
- Ninety-five percent of the flow diverted to a Neponset facility would originate within the watershed. The Neponset watershed would realize a net benefit of 24 MGD (US EPA 1978, p. 3-247).

Despite finding the net benefit smaller than originally perceived, a satellite plant architecture was found to have many advantages, including:

- Satellite plant discharges would significantly increase flow in both rivers and make up a significant portion (greater than 20 percent for the Neponset) of average flow conditions during the months from July to October.
- The additional export of 13 MGD and 24 MGD from the two rivers' systems (under an architecture that did not include satellite plants) had the potential for "long-term negative impacts" associated with decreased groundwater availability for water supply and reduction in river base flow (US EPA 1978, p. 3-247).

It was proposed that the satellite treatment facilities would augment river flows with treated wastewater of quality equal or greater than water quality parameters for the river at the time. The satellite plants proposed by the EMMA study would offer conventional secondary treatment facilities followed by biological nitrification designed to meet the monthly average effluent criteria as shown in Table 10-2.

Table 10-2: EMMA Study Satellite Treatment Plant Effluent Criteria

Effluent Parameter	Discharge limit
Biochemical Oxygen Demand (BOD_5)	5 mg/l
Suspended Solids	5 mg/l
Phosphorous	1 mg/l
Ammonia Nitrogen (NH_3-N)	1 mg/l

Source: US EPA 1978, p. 3-91

To assess water quality impacts, the hypothetical facilities on both river systems were modeled assuming effluent with the characteristics shown in Table 10-2. Also modeled was an advanced treatment process that included the addition of breakpoint chlorination for removal of ammonia nitrogen to bring treatment levels to 0 mg/l NH_3-N (US EPA 1978, pp. 3-86–3-88).

Sampling of the Neponset River indicated that the river's water quality had improved significantly (higher dissolved oxygen and lower BOD_5) between 1965 and 1973 due to the elimination of many industrial discharges. Given the finding of higher-than-expected water quality, it was determined that any wastewater discharge to the middle reaches of the Neponset would result in "significant detrimental impact on the river's dissolved oxygen resources and overall water quality." In addition, water supply wells were located downstream of proposed discharge points, creating public health concerns (US EPA 1978, p. 3-91). Discharge points below the wells would be too far down the river to provide significant flow augmentation benefits.

Water quality testing and effluent modeling on the Charles River also concluded that a satellite plant discharge would deteriorate water quality in that river, and effectively preclude the river from recovering from its stressed condition. As in the Neponset, hydrologically connected water supply wells were located downstream of appropriate Charles River discharge sites.

The Risks of Satellite Treatment Facilities Outweighed Any Benefits

The three major advantages of the satellite treatment architecture were evaluated for their relative costs and benefits and included:

- River flow augmentation
- Interceptor relief
- Harbor treatment plant expansions

River Flow Augmentation

Flow augmentation from satellite treatment plants was found to negatively impact river water quality and jeopardize major water supply wells downstream. These negative impacts were compared to any benefits from flow augmentation.

For the Charles River, hydrologic modeling indicated that future wastewater discharges above the service area could be expected to roughly balance wastewater exports under a no-satellite approach. The Neponset could not anticipate future upstream discharges, but like the Charles, could be managed more effectively to augment low-flow conditions.

Initial and supplemental environmental impact reviews concluded that negative water quality impacts outweighed any flow augmentation benefits from satellite treatment plants. The EIS stated explicitly that: “While recycling of water within a basin is a worthy objective, it should not be done at the expense of water quality.” (US EPA 1978, p. 3-257) Implementation of water conservation methods, I/I reduction, and more effective river water management were all found to have greater potential long-term benefits than flow augmentation with wastewater (US EPA 1978, p. 3-253–3-258).

Interceptor Relief

Construction of satellite treatment facilities would reduce flows in interceptors down-system of the facilities and potentially reduce costs of interceptor relief projects. Estimates under the satellite treatment proposal included a need for 36 miles of interceptor relief compared to 56 miles if the satellite facilities were not constructed (US EPA 1978, p. 3-74).

One disadvantage of the satellite proposal would be the requirement to construct new sewer lines under city streets to redirect sewage flows. The issue was not discussed in any depth, and no analyses were performed weighing the specific costs and benefits because specific locations for the satellite treatment plants were never finalized. Nonetheless, a wastewater solution using harbor treatment facilities where all sewer lines were already in-place avoided the issue.

A supplemental draft environmental impact statement (SDEIS) in 1984 concluded that satellite systems should not be implemented at that time because (US EPA 1984b, pp. 5-6–5-8):

- The high-level sewer delivering south system flows to Nut Island was sufficient in size to accommodate projected peak flows through 2010.

- Even if the satellite treatment facilities were constructed, major interceptor relief projects would still be required to alleviate overflows and other surcharging conditions created by constrictions, inadequate pump capacity, and other structural/hydraulic problems that were present in the system.

Harbor Treatment Plant Expansions

A significant benefit of the satellite treatment proposal was diversion of wastewater discharges to satellite plants up-system of the Nut Island plant, thus reducing the flow increases and expansion requirements at that facility. This was important because any flow increases would require expanding the physical island itself, by filling along its shorelines. Under the satellite plan, only 42 acres of additional land area on Nut Island would be required for additional wastewater treatment facilities, compared to several hundred acres if a larger facility was built (US EPA 1978, p. 3-283).

Neighboring municipalities and environmentally minded citizens concerned about additional pollution in the harbor objected to the filling, as did the shipping community because of concerns about impacts to a nearby shipping channel. In response, the Massachusetts legislature enacted legislation prohibiting the physical expansion of Nut Island (US EPA 1978, p. 3-73).

The legislature's decision created a conundrum for facility planners. Expansion of the Nut Island treatment plant was proposed to meet increased flows through 2000, albeit from a smaller service area under the satellite plan. Those flows now had to go somewhere else. Meanwhile, the environmental impact review had recommended against the proposed satellite plants, so expanding those proposed facilities to accommodate Nut Island flows was also not an option.

The Consolidation of All Treatment Facilities on Deer Island Offered Many Advantages

The consolidated regional DITP plan proposed the construction of expanded secondary treatment facilities on Deer Island to serve existing and future flows from the north and south collection systems. Flows from the south system going to Nut Island would be redirected to Deer Island through a new under-harbor crossing. The primary advantage to a consolidated DITP was access to deep-ocean outfall locations for wastewater discharge. Other advantages included lower operation and maintenance costs and lower energy costs.

The DITP required a major harbor crossing from Nut Island to Deer Island, which would involve trenching and its attendant environmental impacts. These construction effects were viewed as temporary, however, and preferable to redirecting wastewater flows with construction of new large sewers in city streets as would be required if a large plant (or plants) were sited elsewhere (US EPA 1978, pp. 3-229–3-330).

A comparison of the EMMA satellite plan and the DITP plan showed the following environmental impact tradeoffs (US EPA 1978, p. 3-283):

1. The violation of water quality standards in the Neponset River and a further deterioration of the Charles River under the EMMA plan.

2. The need for 42 acres of harbor fill at Nut Island under the EMMA plan.
3. The need for a major harbor crossing, additional interceptor relief, and drumlin removal under the DITP plan.

As for the hydrologic impacts of consolidation to the DITP, it was determined that 57.5 MGD of locally supplied water would be exported from inland watersheds, equal to about 10 percent of total projected flow to the plant. In addition, I/I was estimated at 180 MGD, or 31 percent of projected flow, representing another significant potential loss of local water. These flow impacts to watersheds were proposed to be mitigated through water conservation, I/I remediation, and limiting the size of the service area (US EPA 1978 p. 5-15).

A More Decentralized Architecture May Be Necessary In the Future

A supplemental draft environmental impact statement (SDEIS) (US EPA 1984b) commissioned to evaluate the risks and benefits of satellite plants versus a consolidated treatment plant concluded that advanced satellite facilities may be required sometime in the future if removal of I/I from the sewer system did not achieve necessary sewer flow reductions. The SDEIS went on to say: "following the completion of interceptor relief projects and new pump facilities for south system flows, satellite treatment facilities should be re-evaluated versus other flow reduction/management options (I/I removal) to determine a cost effectiveness and equitable solution to future system expansion needs and capacity problems" (US EPA 1984b, pp. 5-6–5-8).

The SDEIS included "Recommendations for Additional Siting and Evaluation Criteria for Future Satellite Treatment Facilities" in its final report. These recommendations are as follows (US EPA 1984b, pp. 5-11–5-13):

- ***Receiving water assimilative capacity:*** The sizing of facilities should be more closely related to the assimilative capacity of the receiving streams. "As the siting of facilities will also be related to the hydraulics of the sewer system, it may be necessary to evaluate a larger number of smaller facilities possibly located in several watershed areas or communities."
- ***Land/site selection:*** Assessment of potential water quality impacts to receiving waters should be expanded to consider mitigation measures to ensure attainment and maintenance of water quality standards. Such measures could include: in-stream aeration, multiple discharge locations, treatment/removal of in-place non-point sources, and effluent polishing by artificial wetlands.
- ***Public health protection:*** Rigorous risk assessments should be performed to ensure protection to water supplies.

Did the Issue Resonate With the Community?

This case study's researchers did not comb the historical record for the details of public concern over the wastewater system planning process, but it is fair to say that many issues resonated with state and federal agencies, politicians, watershed groups, and the public at large.

The idea of using wastewater to augment river flows was hotly debated during the facility planning process, as was the desirability of having wastewater as a major component of flow during times of recreational use. Residents attending public workshops generated concerns over viruses entering the river and water supplies being jeopardized by satellite facilities (US EPA 1978, p. 3-92). Citizens and politicians became committed to cleaning up the "eyesore" that Boston Harbor had become, but at the same time were reluctant to expand Nut Island to accommodate better wastewater treatment facilities.

Site selection committees assembled in both the Charles and Neponset river communities to evaluate potential satellite treatment plant locations became uncomfortable with the idea. The Middle Charles group concluded that none of the sites they evaluated met their criteria, and "expressed reluctance to endorse the use of a riverbank site for treatment plant use." The Upper Neponset Site Selection Committee went a little further in ranking their sites from "Least Acceptable" to "Least Objectionable." (US EPA 1978, p. 3-78)

> "The unintended result of the collection system associated with centralized wastewater treatment is massive depletion of groundwater aquifers, higher costs to unnecessarily treat potable water, and severe ecological harm to rivers."
>
> Robert Zimmerman, Executive Director, Charles River Watershed Association (Zimmerman 2002)

Martin Pillsbury, regional planning manager at the Metropolitan Area Planning Commission, a regional planning agency for greater Boston communities, remembers that the technology (or lack thereof) available for the satellite treatment facilities at the time made the concept infeasible. He also believes that the availability of sewer collection pipes already leading to Nut Island and Deer Island, the costs for rerouting large flows to satellite facilities, and the property costs for locating satellite plants within this urban/suburban area, comprised an obstacle to a satellite architecture that was too high to overcome.

Results/Status

This section of the analysis is organized into three parts. The first part examines the current status of hydrologic (water budget) issues on both the regional and watershed level. The second and third sections focus on regional and local actions underway to better manage water and wastewater in the region, including initiatives directly addressed at interbasin transfers.

Current Hydrologic Status

The United States Environmental Protection Agency (US EPA) regulates wastewater surface discharges under the National Pollution Discharge Elimination System (NPDES). During the NPDES permitting process in the late 1990s for the consolidated DITP, the US EPA was concerned enough about the effects of sewer-based interbasin transfers on inland watersheds that it attempted to include several related permit conditions in the wastewater discharge approval. These conditions included having MWRA enforce water conservation and I/I remediation requirements in member towns. The engineering community and MWRA itself objected, as the conditions would have changed the institutional relationship between MWRA and its retailer communities, from wholesaler to regulator. The conditions were not imposed.

As part of the NPDES permit, however, MWRA was required to update its I/I Reduction Plan based upon findings from a multidisciplinary task force. MWRA became the lead agency for I/I remediation within its service area. In the mid-1990s, MWRA imposed a limit on the overall size of the service area. The agency would accept no new communities or substantial portions of communities for a period of five years in order to evaluate, among other things, the hydrologic status of the system. This limit has since been lifted, but to date there have been no substantial expansions of the service area. MWRA also developed a grant/loan program, discussed later, to fund local I/I reduction projects. I/I continues to account for about 60 percent of water treated at Deer Island.

Since completion of the DITP, dry weather flows have been maintained well below the permit limit of 436 MGD (365-calendar-day running average dry day flow). For fiscal year 2002 (ending June 30, 2002), the 365-calendar-day running average dry day flow was 293.5 MGD (MWRA 2002c). Changes to the state plumbing code in 1989 (reductions in fixture flow rates) and an aggressive water conservation program by MWRA started in 1987 have helped reduce water demand and resulting dry-weather flows. These reductions helped MWRA to avoid building an additional secondary treatment battery at Deer Island. MWRA remains actively involved in demand-side management initiatives to keep flows within permit levels.

As part of a federal court order in 1986, MWRA also undertook a three-phase combined sewer overflow (CSO) remediation plan. To date, 21 CSO outlets have been closed, CSO volumes have been reduced by 70 percent, and much of the remaining flow is now partially treated prior to any release into water bodies.

Before discussing water transfers between the various watersheds in the region, certain elements of the issue need to be addressed. First, many river systems in the region are highly manipulated, so defining original river flows is difficult and not completely applicable to the discussion. There are caveats on the available data as well. Transfers have not yet been studied in great detail. Some overall numbers exist, but these numbers could be misleading.

When studying water transfers and river flows, timing is key. For instance, MWRA points out that I/I decreases significantly in periods of low flow, as the groundwater table drops below sewer lines. On the other hand, watershed associations ask how removal of groundwater through I/I early in the year directly contributes to those low groundwater levels and low flows experienced later. The issue has not been studied in depth, but enough concern exists that various government entities have taken steps to address water transfers and low-flow conditions (discussed later). The following discussions for three major basins present what is known to date. The Neponset River has the most documented information available.

Neponset River

The Neponset River watershed is home to roughly 300,000 people. About one-half get some portion of their water from sources in the watershed, mainly municipal groundwater wells. On the wastewater side, roughly two-thirds are served by the MWRA regional sewer system. The Neponset River Watershed Association has calculated that on average the balance between out-of-basin water supply inputs (increases), sanitary sewer flows of locally withdrawn water supplies (decreases), and I/I (decreases), leaves the basin with a conservatively estimated net loss of 25 MGD (Neponset River Watershed Association 1998, p. 44). This translates into a total annual loss of 9.1 billion gallons transferred out of the basin by the regional sewer system, which is approximately equivalent to 23 percent of the Neponset River's annual flow (Neponset River Watershed Association 1998, p. 44). The basin's hydrology is not well enough understood for a determination of how much of the transferred water would otherwise have reached the river, but 23 percent is significant.

MWRA took another approach to assessing the regional sewer system impact. It calculated that sewer system transfers of water out of the basin were equivalent to only 10 percent of the total annual rainfall in the basin. This seems a small figure, but when one considers that 40 to 50 percent of annual rainfall is transferred back to the atmosphere by evapotranspiration, and that groundwater recharge is also reduced because of impervious surfaces and storm drainage systems, the relative importance of the 10 percent figure increases.

Reductions in Neponset River flows cause rising water temperatures and reduced dissolved oxygen, weed growth on the river bottom, mobilization of nutrients as a result of increased sunlight penetration, and drying out of wetlands. Recreation has been constrained by low flows and high bacteria levels during summer months. Water temperatures of 91° F (32.8° C) forced one industrial user to convert to refrigeration after previously using river water for non-contact cooling (Neponset River Watershed Association 1998, p. 3). (Industrial discharges probably also contribute to elevated temperatures.)

Several mechanisms cause the interbasin transfer, according to the watershed association's study. Transfer of water to other watersheds through the local water withdrawal and distribution system is a small portion. So too are transfers of locally withdrawn water as sanitary sewage through the regional collection system. The bulk of the transfer is due to collection system I/I. The municipal systems feeding into the MWRA system are quite old and many are in poor condition. Five Neponset Basin communities rank in the MWRA "top ten" of communities with the highest rates of I/I measured as a percentage of total flow. On average, 52 percent of all wastewater flows from basin towns was infiltration, and 12 percent was inflow between 1995 and 1997 (Neponset River Watershed Association 1998, pp. 33 and 44).

Water quality monitoring data found "only very limited water quality impact from failed septic systems in the Neponset Basin," contrasting with "severe water quality impacts from failed and overloaded sewer systems," which widely replaced septic systems over the last several decades, according to the Neponset River Watershed Association (Neponset River Watershed Association 1998, p. 31). However, MWRA notes that many of the worst areas of septic system failures have been sewered, so the comparison is not entirely fair. As well, the agency points out that impacts from sewer systems are infrequent, typically occurring during very high flows, when stormwater would have degraded water quality anyway. Contamination from septic systems can occur year-round and, while not as dramatic as sewer failures, can be substantial.

Charles River

Flows in the Charles River are reduced, with negative impacts on water quality, although overall water quality improved dramatically in the 1990s in part due to the new Deer Island plant. The MWRA regional sewage collection system transports groundwater out of basin through I/I. In addition, sub-regional municipal wastewater collection and treatment systems, which discharge wastewater within the basin but bypass long reaches of the river, are believed to contribute to localized groundwater depletion and low-flow conditions. In the Charles River watershed, between 60 and 65 percent of instream flow comes from groundwater recharge (Zimmerman 2002). The Charles River Watershed Association and other organizations have given considerable attention to the disconnection between rainfall and groundwater recharge caused by impervious surfaces and by I/I to sewer collection systems in the watershed.

On the other hand, the Charles benefits from inputs of water to the watershed by the MWRA water supply system. In towns that receive drinking water from MWRA's western Massachusetts reservoirs, but do not utilize the MWRA regional sewer system, imported water is added to local watershed budgets through onsite, community, or sub-regional wastewater systems. This input may prevent the Charles from having low-flow problems as serious as those experienced by the Ipswich River.

Ipswich River

The Ipswich River basin is mostly outside the MWRA service area except for a few locations near the headwaters of the river in the town of Wilmington. In the Ipswich, local supply withdrawals coupled with centralized wastewater collection systems (including but not limited to MWRA) have actually resulted in the river drying up in some summers, producing significant fish kills (Armstrong *et al.* 2001). Yields of local groundwater wells may have been reduced as well.

Source: Armstrong *et al.* 2001, p. 8 and Figure 3

Figure 10-3: Fish Kills in 1995 in a Dried-Up Reach of the Ipswich River Downstream of the Reading, North Reading, and Wilmington Well Fields

State and Regional Actions

Population growth and increased density in the region are expected to further complicate decisions. Nonetheless, state, regional, and local officials have begun to address interbasin water transfers and river flows with the initiatives described in the following sections.

Massachusetts Interbasin Transfer Act

The Commonwealth of Massachusetts passed the Interbasin Transfer Act, effective March 8, 1984, in response to large-scale surface water supply developments proposed in the 1970s. The act covers any "transfer of surface or groundwaters, including wastewater, of the Commonwealth outside a river basin." Before a community can transfer water out of its basin, it must meet the following requirements—as applied to wastewater—to the satisfaction of the state Water Resources Commission (Garrigan 1987):

1. All reasonable efforts are made to identify and develop all viable methods of wastewater treatment within the basin in which the community is located
2. All practical measures to conserve water are performed and an active, approved I/I reduction program is in place
3. An environmental review is performed
4. Reasonable in-stream flow in the river from which water is diverted is maintained

5. Communities receiving sewer service are actively engaged in local water resources management planning
6. Cumulative impacts on the basin receiving diverted wastewaters are considered

All interbasin transfers in excess of 1 MGD qualify as significant and are subject to the act. Interbasin transfers less than 1 MGD may be deemed significant if they have the potential to impact the donor basin.

The MWRA collection system and most community interceptors were constructed prior to the effective date of the act, and are thus "grandfathered" and need not meet the regulations. Extensions of MWRA community collection systems are exempt from interbasin transfer review as long as the design capacity of the MWRA interceptor is not exceeded. Communities wishing to join the MWRA system or to increase interceptor capacity, however, must comply with the act.

The act requires the Commission to consider the cumulative impacts of all past and proposed transfers. However, the act does not address incremental effects of small changes within individual communities. For example, between 1989 and 1997, the percentage of the Neponset River basin population serviced by sewers increased by 14 percent. The incremental nature of the movement from septic to sewer, a loss equal to nearly 3.2 MGD (Neponset River Watershed Association 1998, p. 31), did not require an Interbasin Transfer Act approval because the existing sewer interceptor was grandfathered and the interceptor capacity was not being increased.

Comprehensive Water and Wastewater Planning

The Massachusetts Department of Environmental Protection in 1996 developed new guidelines for sewer facility planning in its Comprehensive Wastewater Management Plan (CWMP) process. The guidelines require communities to discuss the full range of alternative wastewater collection and treatment systems when examining solutions. In particular the process requires a detailed evaluation of decentralized systems in meeting long-term wastewater treatment and disposal needs. A diversified approach of using both centralized and decentralized systems is encouraged where appropriate conditions exist. A 1996 CWMP guidance document states (Massachusetts Department of Environmental Protection 1996, p. 25):

> Decentralized alternatives should be evaluated in meeting long-term wastewater treatment and disposal needs. Conventional Title 5 systems as well as recirculating sand filters, peat systems, attached-growth systems, and other innovative, alternative on-site systems have been shown to provide efficient wastewater treatment and disposal when installed in appropriate locations. The opportunities for utilizing package plants and cluster systems should also be evaluated. The site compatibility, pollutant removal efficiency, groundwater and surface water impacts, and operation and maintenance requirements of these systems should be evaluated along with the other alternatives.

The planning process now encompasses the full water cycle. It addresses water supply as well as wastewater, and the plans produced are known as Comprehensive Water Resources Management Plans (CWRMPs). Each CWRMP is also required to undergo an environmental impact review under the Massachusetts Environmental Policy Act (MEPA), where the full environmental impacts of wastewater collection, treatment, and disposal projects are considered, including impacts to water supplies and to stream base flows from water transfers. Adverse impacts are minimized and mitigated under the public review process.

Any community seeking low-interest loans from the State Clean Water Revolving Fund (SRF) must adopt a CWRMP. The Massachusetts DEP is trying to use the SRF to discourage transfers out of basins by favoring projects that support in-basin use of water resources.

Title 5 Septic Management Regulations

At about the same time that the DITP was coming on line, statewide attention to onsite wastewater systems was growing. The Massachusetts state onsite sewage system code, known as Title 5, had been last revised in 1978. But a new set of revisions took effect on March 31, 1995. The main purpose of the revisions was to further protect ground and surface waters from non-point source pollution and to protect drinking water supplies and coastal areas from excessive nitrogen loading. Another benefit of the improved regulations was an increase in the reliability of onsite systems, allowing them to take on a greater role in wastewater treatment around the region. In particular, onsite and cluster systems are increasingly being used to replenish local groundwaters.

The revised code requires mandatory inspections of existing systems upon the sale or expansion of use of a property. If the system is found to be failing, it is required to be upgraded within two years. There are exemptions from the requirement if a local inspection and maintenance program is in place. Alternative and shared systems must be inspected at least annually. New systems must have acreage available for alternate leaching fields, and setbacks were increased to protect drinking water. New systems handling more than 2,000 GPD require a recirculating sand filter (or equivalent advanced technology) if they are located in well-water recharge or nitrogen-sensitive areas.

One of the initial unintended consequences of the revision has been an increased demand for sewer service by citizens faced with large repair bills (Neponset River Watershed Association 1998, p. 26). Part of the strong resistance to the revisions came from the lack of financial assistance for properties requiring septic system upgrades or replacements. In response, the Commonwealth made $30 million available through the SRF to municipalities that utilize the money for low-interest loans to homeowners (Shephard 1996).

MWRA Has Developed a Wastewater Rate Methodology and I/I Remediation Plan Designed to Decrease Sewer Flows

In 1995, MWRA changed its wholesale sewer rate methodology to include wastewater flow data as a component. Previously, MWRA wholesale charges were based on sewered as well as total population, and not based on flows. Most MWRA communities are entirely or nearly built-out, so the difference between current total and current sewered population represents potential future capacity demands. To provide an incentive to control flow into the regional system, wastewater flow now accounts for about 50 percent of the wholesale sewer charge. Both average daily and peak month flows are part of the methodology (Infiltration/Inflow Task Force 2001, pp. 15–17). Those flows determined to be excessive and attributed to I/I are charged a premium. Still, 25 percent of sewer charges are based on system capacity, providing some incentive to maximum use of the sewer system. This affects only a few communities with a significant difference between total and sewered population.

MWRA has also undertaken an I/I Local Financial Assistance Program, which has earmarked more than $140 million in grants and interest-free loans for local I/I reduction projects. According to MWRA communities, the financial assistance program is funded directly by the municipalities by sewer charges. The money is then returned to the towns, but earmarked for I/I remediation on a non-competitive basis. This process essentially circumvents local elected bodies, many of which have been reluctant or unable to fund local collection repairs.

To put the regional I/I problem in perspective, some estimates indicate that a reduction in I/I from 60 percent of total flows to 40 percent of total flows would cost between $3 and $5 billion.

Water Management Alternatives and Increased Stormwater Recharge Are Under Extensive Study

The effects of water management alternatives on stream flow in the Charles and the Ipswich River watersheds have been studied by the United States Geological Service (USGS). Hydrologic modeling conducted in the Ipswich showed how reduced groundwater withdrawals during the summer, local wastewater recharge using septic systems, and large volumes of wastewater discharged inside the basin could alleviate low-flow conditions (Zarriello 2002). In the Charles, hypothetical scenarios modeling additional groundwater recharge equal to the transfer of water out of a typical sub-basin by sewers was found to increase base flows by about 12 percent. The addition of recharge equal to that available from artificial recharge of residential rooftops, and alternative water supply withdrawal techniques were also modeled (Desimone *et al.* 2002).

The Charles River Watershed Association is currently studying the concept of flow trading. The concept is centered on the importance of flow volume in determining nutrient concentrations in the river. The proposal suggests that facilities like power plants or wastewater treatment plants currently discharging (or looking to do so) may be able to invest in flow increases to offset their pollution rather than investing in monetarily infeasible treatment improvements. The association has also developed and is testing a proprietary stormwater recharge technology called *SmartStorm*, which is capable of storing 2.5 inches of rain at the household level, thus reducing impervious surface runoff that fails to recharge groundwater, and making the water available for later use and local recharge.

Local Actions

The following section represents actions undertaken by greater Boston area municipalities to manage water and wastewater within their borders. Some communities are outside the MWRA service area, but have been listed to show how certain state and regional initiatives (described in the previous sections) are being applied. The communities are listed alphabetically.

Bellingham

Bellingham is located in the upper Charles watershed, but it is not in the MWRA service area. The town is a member of the Charles River Pollution Control District, an in-basin wastewater district that sends wastewater about four river miles downstream to the town of Medway before discharging to the river. This intra-basin transfer from upstream to downstream has contributed to a localized dewatering of groundwater. A power plant located in Bellingham owned by American National Power was proposed for expansion, but the expansion would have required drawing additional groundwater—the town's main supply of drinking water. To supplement groundwater supplies, the company is investing in a pilot project of the *SmartStorm* decentralized stormwater technology. Approximately 20 household systems have been installed.

Canton

The town of Canton, located in the Neponset watershed and using the MWRA regional sewer system, proposed development of a municipal groundwater well that triggered the Interbasin Transfer Act. The approval required the town to limit groundwater pumping during periods of low river flow and to reduce I/I in the sewer system.

Holliston

Holliston is a growing community of about 15,000 people located in the upper reaches of the Charles River watershed, outside the MWRA service area. In 1997 the town proposed sewering several areas of town and sending 1.1 MGD to the Charles River Pollution Control District, where treated wastewater would re-enter the Charles several miles downstream in Medway.

A CWMP facility planning effort and MEPA process for the town identified maintenance of local stream flow as a consideration. Based on density, soil conditions, and other factors, a needs analysis determined the portions of the town that could be served by conventional septic systems, and identified needs areas where other wastewater treatment was indicated. Alternatives examined for needs areas included advanced onsite systems, communal systems, one or more new, local (in-town) wastewater treatment plants (WWTPs), and transmission of wastewater to the existing sub-regional Charles River Pollution Control District treatment plant. Cost, environmental, and other factors were considered in the alternatives analysis. The sub-regional treatment plant was not allowed any capacity increases, however, thus removing this option.

The CWMP instead recommended a more expensive option (by 9 percent or 14 percent, compared to the sub-regional plant discharge options) that would keep all wastewater in-town. Two WWTPs would be built with total capacity of 1.1 MGD, and disposal would occur at four subsurface effluent dispersal sites. According to an article written on the project, this alternative was preferable because it “would allow the town to control its own destiny with regard to wastewater disposal. It would be the town’s most environmentally sound option and would maintain stream flows in the Upper Charles River Basin and insure the sustainability of the Town’s water resources for centuries.” (See Bell *et al.* 2000.)

The town expected to proceed with the recommended plan, but a peer review conducted in 2000 concluded that the subsurface disposal locations were upgradient and posed a threat to the town’s most productive well. The town was forced to start again. In 2002, it retained another consultant who has since recommended that two cluster systems with a total of 415,000 GPD of capacity be constructed, with the remaining areas of town using onsite systems. To serve the town center, a 400,000 GPD cluster system with subsurface disposal is proposed. To serve residents around a lake in town, a 15,000 GPD system with subsurface disposal is proposed. Consultants for the revised project have emphasized the importance of basing wastewater needs upon a lot-by-lot analysis in order to keep as many onsite treatment options available as possible.

Walpole

Walpole is a community of 22,500 located in the upper Neponset watershed. It is the last (farthest upstream) community serviced by the MWRA system in the watershed. Sewers currently serve about 60 percent of the population, while the remaining population utilizes septic systems. The town supplies its own drinking water from 10 municipal groundwater wells.

The town is encouraging onsite and cluster systems for new development, and is currently seeking a state grant to fund an onsite management program for existing septic systems. The encouragement arises from a polarizing growth versus no-growth debate in town, as well as an effort to recharge groundwater supplies. Growth issues prompted the town to pass a zoning ordinance mandating a minimum lot size of two-acres for septic systems.

According to a local wastewater official, some residents want septic systems and the resultant lower-density development to serve future households, while others feel septic systems and household chemicals pose a long-term threat to drinking water. Meanwhile property developers are strongly supporting denser development afforded by sewers.

According to one local public works official, the MWRA wholesale sewer rate methodology, in which 25 percent of the charge is based on total system capacity, provides a financial disincentive to the town diversifying its treatment methods to keep water in-basin.[16] This official calculated that current sewer customers’ monthly bills would decrease for every new customer connected. Despite the financial disincentive, the town is proceeding along a path that includes decentralized wastewater technologies, though local officials fear incentives to sewer may thwart their efforts in the long run.

[16] This disincentive only affects a few communities with a significant unsewered population.

Weston

The town of Weston, a suburb of Boston, built an innovative greenhouse system treatment plant to service the town center. The rest of the town consists of large homes on lots large enough to support septic systems. The solution enables economic development where appropriate while avoiding a costly and unnecessary municipal system.

Wilmington

Most of Wilmington is located in the Ipswich River basin and in the MWRA service area. The town currently utilizes between 1.5 to 2.0 MGD of MWRA sewer capacity, but has a 10 MGD interceptor that is grandfathered from requirements under the Interbasin Transfer Act. It utilizes groundwater to meet all drinking water supplies. MWRA has estimated that about 60 percent of wastewater exports are I/I.

Wilmington has been looking to expand sewer service and has begun the required Comprehensive Wastewater Management Planning process. The town is currently conducting an environmental impact review under the CWRMP and MEPA processes.

Although the town has an MWRA interceptor in place and the legal ability under the Interbasin Transfer Act to sewer the whole town, early evidence indicates that further sewering would negatively impact flows in the watershed. Wilmington is located at the headwaters of the Ipswich River, and therefore wastewater or groundwater exports out-of-basin could have significant effects upon the local water table, which is directly linked to drinking water supplies and stream flow.

The town was nearing completion of a draft CWRMP as this case study research concluded, but agreed to share certain options they were considering. According to a local public works official, the town is seeking to utilize a combination of solutions for long-term water and wastewater management, including continued use of onsite treatment systems, expansion of the sewer system only where needed, and mitigation of any increased exports by recharging stormwater and importing drinking water from other basins.

The town is also considering local stormwater recharge requirements for new development. For instance, if a new development impacted 50 gallons per acre (GPA) of rain water recharge, then developers would need to construct 100 GPA of recharge capacity onsite or possibly elsewhere in the basin. There have been discussions involving the development community, residents, and watershed and environmental groups on the initiative.

One local public official remarked on Wilmington’s endeavor: “I think it is a way to get sewer where you need it for environment and economic development with a good mitigation strategy for any environmental effects.”

However, in a December 29, 2003 review of the draft CWRMP, the Massachusetts Department of Environmental Protection (DEP) found that the document did not adequately address water transfer issues. DEP found the town is proposing “a substantial expansion of the sewer system although it acknowledges that Wilmington does not have the widespread septic system failures and site constraints that have caused other communities such as Gloucester and Essex to extend the sewer system." DEP recommended that "the Final CWRMP/EIR should propose a wastewater management program that maximizes the use of on-site systems and near-site and subregional facilities in order to minimize the amount of water sent out of the basin." (Kunce and Giles 2003) The MEPA Office of the Massachusetts Executive Office of Environmental Affairs was due to make a decision regarding the draft CWRMP in January 2004.

Conclusions

MWRA inherited an aging and badly deteriorated regional sewer collection and treatment system. Efforts to address concerns over interbasin water transfers from inland watersheds to Boston Harbor included evaluating the construction of inland satellite treatment plants. Technology limitations and siting concerns made construction of the satellite plants infeasible, but many lessons were learned in the facility planning process. Local, regional, state, and federal entities recognize that water budgets in some basins have been detrimentally altered by development, and wastewater systems play a role in this problem. Many entities have developed or are developing policies and plans to address hydrologic imbalances. Based on all these experiences and initiatives, some recommendations to other communities, especially those considering regionalization of wastewater infrastructure, include:

- Study demand-side management and other flow reduction measures, including I/I remediation, before engaging in facility planning. Weigh the costs of increased treatment plant capacity versus flow reduction efforts.
- If considering a regional system architecture that transfers wastewater between basins, consider potential hydrologic issues, including dewatering of drinking water supplies and reduction of groundwater support for stream flows. Also consider the economic services that a river system provides, like fishing and recreation, flood control, industrial process cooling, and other services.
- Realize that surface water discharges of treated wastewater to maintain hydrologic regimes are problematic. Maintain soil discharge wherever possible and sound from environmental quality and public health viewpoints.
- Analyze the hydrologic benefits of onsite and cluster systems with soil-absorption discharge as part of the system architecture. A municipal onsite management program could be implemented to provide the same services to onsite residents that residents with sewer receive.
- Accurately account for interbasin transfers of water and wastewater when calculating water budgets (Horn 2000). Pay special attention to outdoor water use. Lawn watering usually represents a significant percentage of water use during summer months, but much of the water is lost to evaporation and evapotranspiration.
- Explore the long-term cost of collection system maintenance, including increased treatment costs due to I/I, when deciding system architecture and scale.

- Take advantage of a local watershed's ability to assimilate stormwater and recharge groundwater. This has the dual benefit of maintaining water within the basin while mitigating peak capacity requirements in combined sewer collection and treatment systems.
- Impervious surfaces increase runoff and contribute heavily to peak flows. Work with planning departments and building code enforcement officers to mitigate unnecessary runoff from development. Options include pervious paving materials, rainwater collection and storage systems, bioretention (for example, rain gardens), and improved detention and recharge.
- Beware of the difficulties in siting new treatment plants in suburban and urban areas. Fast growing metropolitan areas should set aside land for future treatment plants sooner rather than later.
- When implementing new onsite treatment requirements, ensure that low-interest financial assistance is available to homeowners as would be available if a sewer system was chosen. This could reduce any resistance to the new requirements.
- Take care that policies addressing one problem do not exacerbate other problems. Massachusetts's Title 5 legislation took on water quality degradation from failing and substandard onsite systems, but created localized pressures for sewer service that could contribute to undesirable water transfers.

Since the facility planning process for Boston Harbor, the State of Massachusetts and MWRA have initiated several programs to evaluate the impacts of interbasin water transfers on water supply and wastewater management decisions. As a result, an increasing number of communities in the Boston metropolitan area have incorporated a more diversified wastewater architecture to satisfy both local wastewater needs and local/regional hydrologic needs.

Twenty years ago, a supplemental DEIS on wastewater options for greater Boston stated that satellite treatment facilities might be needed in the future. Satellite plants are still a technically feasible, if politically difficult, option. Wastewater planning efforts in Holliston and Wilmington have pointed towards use of small, advanced treatment facilities with discharge to the ground rather than a river, along with keeping people on onsite systems where possible. Some suggest that this approach, strategically interwoven with the regional sewer system, provides a vision for restoring the water budget of some watersheds and for sustainable water management in the region, and that it should be actively considered.

What is perhaps most needed locally and across the country is a "paradigm shift" away from standard solutions and toward holistic water management. Bob Zimmerman of the Charles River Watershed Association maintains that the conventional engineering approach "that treats rain water as a liability, disconnects rain water from groundwater with impervious surfaces, and transports locally drawn potable water to distant locations for treatment and discharge" is a fundamental problem (Zimmerman 2002).

In the Boston region, the best option has been to move forward. Mark P. Smith, former Director of Water Policy at the Massachusetts Executive Office of Environmental Affairs, characterizes the process in the following way: "It's hard to go back and second-guess the Deer Island project.

It's more productive to discuss how we go forward from here and how we will address the issues of maintaining and restoring the water budgets within our watersheds." Boston appears to be headed in the right direction.

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11 LAKE ELMO, MINNESOTA

This case study addresses the following topics:

- Performance and Reliability
- Growth, Development, and Autonomy
- Fairness and Equity
- Stakeholder Relationships and Trust

The Community

Lake Elmo is an incorporated municipality encompassing 24 square miles in the Minneapolis–St. Paul "Twin Cities" metropolitan area. It is located in central Washington County, about nine miles east of downtown St. Paul, and eight miles west of the Wisconsin border. Topography within the city consists of rolling farmland, woodlands, twelve lakes, numerous wetlands, and a 2,200-acre regional park reserve. A declining number of farms remain in operation, and development throughout the city is sparse.

Figure 11-1: The Location of the City of Lake Elmo in the State of Minnesota

Lake Elmo was a leisure destination in the early 1900s, as families from the Twin Cities would take a local railway to visit for the day or weekend. This spawned the Village of Lake Elmo, a small downtown area in the center of the city otherwise known as the "Old Village." Those summer villas and cottages are now occupied year-round, and Lake Elmo now serves primarily as a bedroom community for those working in the Twin Cities.

Lake Elmo residents have easy access to major roadways that border and bisect the city. Interstate Highway 94 separates the town from its southern neighbor Woodbury, Interstate spur 694 is about one mile west of Lake Elmo's western border, State Highway 36 delineates the northern border, and State Highway 5 bisects the city through the Old Village. Outside Lake Elmo, this portion of the metro area includes a few manufacturing plants, the campuses of Fortune 500 businesses, shopping centers, and suburban residential neighborhoods. As shown in Table 11-1, Lake Elmo residents enjoy above average household income relative to other metro cities.

Table 11-1: Lake Elmo Median Household Income

City	Median Household Income 1999 ($)
Lake Elmo	$76, 876
Twin Cities Metro Area	$54, 304

Source: U.S. Census 2000.

Compared to other metro cities, development in Lake Elmo was slow through the mid- to late-1900s. Development pressure has picked up in recent years, but Lake Elmo has not grown as fast as neighboring communities such as Woodbury, immediately to its south (Table 11-2).

Table 11-2: Lake Elmo and Regional Historical and Projected Population

Population	1980	1990	2000	2020 (projected)
Lake Elmo	5,296	5,903	6,863	15,200
Woodbury (southern neighbor)	10,297	20,075	46,463	73,500
Twin Cities Metro Area	1,985,873	2,228,729	2,642,056	3,282,000

Source: U.S. Census 2000 and Metropolitan Council 2002a. 2020 Projections made by the Metropolitan Council.

In the Twin Cities, local planning takes place in the context of regional planning. In 1967, the Minnesota State Legislature created the Metropolitan Council, often referred to as the "Met Council," to coordinate orderly development and regional solutions to pollution and transit problems in the seven-county Twin Cities metropolitan area (Figure 11 2). Citing a need to coordinate the infrastructure plans of local governments, the Minnesota legislature adopted the Metropolitan Land Planning Act (MLPA) in 1976, requiring the Met Council to guide land use and capital improvements in the region. Under the act, the council periodically prepares a "comprehensive development guide" for the purpose of aligning infrastructure decisions and investments. This document sets out policies, goals, maps, standards, and programs coordinating plans. According to the MLPA statute: "the Council may require a local governmental unit to modify any comprehensive plan or part thereof which may have a substantial impact on or contain a substantial departure from the metropolitan system plans."

The Met Council also provides the following services:

- Operates the region's largest bus system
- Collects and treats wastewater from 103 cities and accepts septage from throughout the region
- Operates 550 miles of interceptor sewers and eight wastewater treatment plants
- Provides forecasts of the region's population and household growth
- Provides affordable housing opportunities for low- and moderate-income individuals and families
- Provides planning, acquisitions, and funding for a regional system of parks and trails

The 17 voting members of the Met Council are appointed directly by the governor and confirmed by the Minnesota Senate. The Council is funded through a property tax levy. It also charges user fees based on sewage flow to municipalities for conveying and treating sewage flows; and charges riders for transit services.

Wastewater Issues

Most of Lake Elmo lies at the end of a glacial moraine. The glacial deposits are complex and intermixed. Five major geomorphologic areas have been identified in the city, ranging from excessively drained to somewhat poorly drained, but most soils are glacial till that "pose no limit to development" per the draft Lake Elmo 2020 Comprehensive Plan (City of Lake Elmo 2002). However, certain sections of the city including the Old Village have experienced surface water drainage problems.

Lake Elmo officials have long steered the town in the opposite direction of neighboring Woodbury, which has experienced considerable suburban-style growth in the past decade. For many years, Lake Elmo relied on large lot zoning (2.5 acres or more per home) as its primary means to retain rural quality of life. Most houses built under such zoning were served by private drinking water wells and septic tank/leach field systems, or individual sewage treatment systems (ISTS) in Minnesota Pollution Control Agency (MPCA) parlance. Along with ISTS, residents were served by several communal (cluster) septic systems serving up to six buildings, a package plant serving a 505-unit mobile home park, and regional sewer service in the southwestern corner of the city. More recently, Lake Elmo has focused on cluster development and open space preservation. To accomplish this style of development, developers and the city have turned to cluster-scale wastewater collection and engineered wetland treatment systems (EWTS).

In the fall of 2002, after substantial review, the Met Council declared that Lake Elmo's draft 2000–2020 Comprehensive Plan did not conform with regional development and infrastructure goals. Among various issues, the Met Council found that Lake Elmo is not planning for plans. According to the MLPA statute: "the Council may require a local governmental unit to modify any comprehensive plan or part thereof which may have a substantial impact on or contain a substantial departure from the metropolitan system plans."

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In the fall of 2002, after substantial review, the Met Council declared that Lake Elmo's draft 2000–2020 Comprehensive Plan did not conform with regional development and infrastructure goals. Among various issues, the Met Council found that Lake Elmo is not planning for sufficient urban growth required by regional infrastructure investments, including a planned sewer interceptor extension to Lake Elmo. The council was also concerned that individual and communal wastewater systems relied on by Lake Elmo may ultimately fail, and that Lake Elmo might not be prepared to accept the environmental and financial implications of such failures.

Historical Overview

Key junctures in the development of wastewater systems in Lake Elmo, discussed below, include:

- Early developments regarding septic systems
- Provision of Regional Sewer Service
- Development and evolution of cluster wastewater systems
- Conflicts over plans for growth.

Early Developments

The Old Village area has a relatively high groundwater table and has experienced surface water drainage problems. In the late 1950s, groundwater in twelve locations around Lake Elmo was identified as having nitrate concentrations exceeding the drinking water standard of 10 milligrams per liter (mg/l). Potential nitrate sources included septic systems, industry, and agriculture (State of Minnesota Office of Administrative Hearings 2003). In response, a municipal water system was constructed for 250 connections in 1960. This resolved the drinking water health issue, but it did not address the problem of nitrate in groundwater.

In 1980, Lake Elmo applied for and received funding through the United States Environmental Protection Agency (US EPA) 201 program to identify and correct septic system failures throughout the city. The St. Paul engineering firm Toltz, King, Duvall, Anderson & Associates, Inc. (TKDA) was hired for the project. Approximately 200 systems, ranging in size from single residences to the local junior high school, were identified as not conforming to septic regulations (State of Minnesota Office of Administrative Hearings 2003, Exhibit C). The repair and replacement of failing systems with state-of-the-art designs began in 1985. According to Met Council records, 123 household systems were corrected at a cost of $1.9 million, or $15,400 per household (Metropolitan Council 2002c, Attachment 7, Table 1). Many systems were corrected onsite with conventional and mound systems. Thirty-one systems could not be corrected onsite due to small property sizes or inadequate soils and high water tables because of their proximity to lakes. For these properties, the city constructed eight communal septic/drain field systems, each now serving from one to six connections. The city operates and manages these systems and bills users regularly for these services.

Over the next several years, city officials passed a series of new requirements for all ISTS in Lake Elmo. City officials also funded development of a computer database to track and report ISTS maintenance and remind residents to pump.

Provision of Regional Sewer Service

In the early 1990s a small number of landowners in the southwest corner of the city petitioned city officials to construct sewers to their properties from the Met Council's existing WONE regional interceptor, which served Woodbury and Oakdale, communities immediately south and west of Lake Elmo. The city council demanded property owners submit firm development plans prior to constructing any sewers, to avoid placing a financial burden on other residents if development was long to occur. The city had legal and hydrologic concerns about natural wetlands located on these properties, as well as concerns about the overall ability of the landowners to accommodate the commercial development proposed for the land. The landowners of roughly 400 acres successfully petitioned the state Municipal Board to secede from Lake Elmo and annex their properties to Lake Elmo's western neighbor Oakdale, which was said to have a higher tax base and the ability to finance sewers at that time.

Soon after the annexation, a change in city council leadership spurred further exploration into development along the southern I-94 corridor. A joint powers arrangement was made with Oakdale for sewer service, whereby Lake Elmo would use some of Oakdale's sewer network to access the WONE interceptor. In 1992, Lake Elmo officials petitioned the Met Council for regional sewer service to serve 440 acres of commercial development along I-94, but they were denied service because of a lack of allocated sewer capacity for the city at the time. The Met Council granted sewer service for 120 acres of commercial office space in the same area in 1994 (Metropolitan Council 2002b, p. 15). This portion of Lake Elmo is located within the Metropolitan Council's "Municipal Urban Services Area," (MUSA), which delineates areas that receive regional sewer services.

Development and Evolution of Cluster Wastewater Systems

In 1995, Robert Engstrom, a nationally recognized property developer, submitted plans for a housing development in Lake Elmo, in which he proposed houses be clustered together on smaller lots, and remaining lands be left permanently undeveloped as open space for the community. The planning commission viewed the cluster concept, known as conservation development, favorably, but it immediately realized that the city had no rules governing this style of development.

After enacting a building moratorium and performing considerable study, an Open Space Preservation Ordinance (OP) was adopted by the Lake Elmo city council on August 13, 1996. The OP ordinance grants developers a conditional-use permit for construction in a manner that preserves 50 percent of the total area capable of accommodating buildings. A minimum of 40 acres of contiguous land is required for the permit, and housing density is maintained at 16 houses per 40 acres. The original ordinance allowed additional density through various development/preservation bonuses. Given the lack of sewer service, city officials crafted the OP ordinance so that communal soil absorption fields would be allowed within a development's open space.

During this time period, former Lake Elmo Mayor Wyn John attended a seminar in St. Paul where he saw a presentation by North American Wetland Engineering, Inc. (NAWE) about wetlands wastewater treatment systems. This prompted him to explore the wetlands concept for use in cluster developments. Subsequently, the planning commission, city council, development community, engineers, and citizens had lengthy discussions about the wetland systems. Concerns about performance and reliability of the units were resolved, and the community proceeded with the concept.

Developer Robert Engstrom worked closely with Curt Sparks of NAWE, who had previously worked for the MPCA, to get an experimental permit for an engineered wetland treatment system (EWTS) at one of Engstrom's developments. Minnesota's regulations for wastewater systems are located at chapter 7080 of the state code. Engstrom's system was the first residential wetland wastewater treatment system installed in the state. Later, in October 1999, the MPCA revised the 7080 rules to include standards for wetland wastewater treatment, removing the experimental status.

In January 1998, Lake Elmo adopted Ordinance 97-22 relating to "Alternative Disposal Systems Wetland Treatment Systems." The ordinance expanded upon previous amendments to the wastewater code and established treatment levels for wetland systems. Operation and maintenance of EWTS are the responsibility of individual homeowners' associations. Systems in excess of 1,500 gallons per day (GPD) require a city-approved plan for annual effluent quality monitoring. A state permit is required for any system with capacity equal to or greater than 10,000 GPD.

While other technologies could be used for cluster wastewater treatment systems, engineered wetlands have become the preferred treatment system for OP developments in Lake Elmo. Since 1998, eight OP developments have been constructed in the city, all of which utilize a NAWE wetland system. A variety of configurations serve the eight developments, but most designs consist of a gravity sewer collection system flowing to a communal septic tank to settle solids prior to wastewater entering the treatment wetland. Treated effluent is then released to the environment through a drain field or other soil absorption system, which provides additional treatment before effluent reaches groundwater, Table 11-3 provides details for each development's system. The city has indicated that operating results of the wetlands systems over five years are "satisfactory—well within the standards of treatment forecasted (City of Lake Elmo 2002, p. 81)."

Table 11-3: Engineered Wetland Treatment Systems (EWTS) in Lake Elmo, Minnesota

Development	Start-up	Connections	Design Flow (GPD)	Wetland Treatment System	Infiltration Method	Notes	State Permit
The Fields of St. Croix (Phase I)	1998	45 homes	11,000	SSF Horizontal	Rapid infiltration bed	The Fields I is connected to The Fields II redundancy / overflow treatment capability.	Y
Hamlet on Sunfish Lake	1998	41 homes	8,200	SSF Horizontal	Wetland		N
Tamarack Farm Estates	1998	20 homes	4,000	SSF Horizontal	Pressure Mounds	Septic tanks on individual lots. SDPS used on upper lots. Central STEP pump station used for lower lots.	N
Prairie Hamlet	1999	15 homes	3,000	SSF Horizontal with FBA	Sub-surface drip irrigation	Effluent used for landscape irrigation.	N
The Fields of St. Croix (Phase II, includes 20 homes at Tana Ridge)	2000	88 homes	33,000	Vertical Flow (recirculating gravel bed) with FBA	Infiltrator® trenches	Tana Ridge purchased capacity from The Fields Phase II system.	Y
Carriage Station	2001	109 homes; professional/ office space	44,875	Vertical Flow (recirculating gravel bed) with FBA	Infiltrator® trenches	Also serves 40,000 sq. ft. commercial office space	Y
Wildflower Shores	2001	25 homes	3,600	SSF Horizontal with FBA	Infiltrator® trenches		N
Whistling Valley I	2004	22 homes	11,000	Vertical Flow (recirculating gravel filter) with FBA	Pressure-dosed infiltration beds		Y

SSF = Sub-Surface Flow; FBA = Forced Bed Aeration; SDPS = Small Diameter Pressure Sewers; STEP = Septic Tank Effluent Pump

All developments utilize conventional gravity sewer collection systems except for Tamarack Farm Estates.

Sources: NAWE; City Correspondence; City of Lake Elmo 2002, p. 79

Figure 11-3 and Figure 11-4 show the west and east wetland cells of the EWTS at The Fields of St. Croix, Phase II. The west wetland cell is shown just after planting. The east wetland cell, which is immediately adjacent to the west cell, is shown one year after construction.

Courtesy of North American Wetland Engineering

Figure 11-3: The West Wetland Cell of the EWTS at The Fields of St. Croix, Phase II

Courtesy of North American Wetland Engineering

Figure 11-4: The East Wetland Cell of the EWTS at The Fields of St. Croix, Phase II

As for costs, according to NAWE the cost of treatment and effluent dispersal components—but not including collection lines—for The Fields of St. Croix Phase I came out to roughly $7,000 to $8,000 per home. Costs at Carriage Station, the least expensive system, were $4,500 per home, not including collection. The cost breakdown for The Fields of St. Croix Phase II, excluding collection, is shown in Table 11-4.

Table 11-4: The Fields of St. Croix Phase II* Capital Costs, Excluding Collection System

Item	Bid Price
Engineering	$31,000
Sewage lift station	$47,579
Septic tank (1 large tank at the treatment facility)	$85,857
Wetland treatment and effluent dispersal	$336,162
Total	$500,598
Total per home (88)	$5,689

*Phase II also includes Tana Ridge (20 units) and The Fields of St. Croix Phase II "Twin homes" (14 units). All 88 units use the same treatment system.

Source: NAWE compilations provided by Robert Engstrom

The collection system (service laterals, sewer lines, manholes, and other components) serving the 54 single-family homes at The Fields of St. Croix Phase II cost $158,621 (based on payment vouchers provided by Robert Engstrom), or $2,937 per home. Thus the total wastewater system cost for those 54 homes came to $8,626 ($5,689 plus $2,937) per home. The total cost for the 14 twin home units was reportedly somewhat less, as each duplex shared some of the service lateral costs. Collection system costs for the Tana Ridge units, The Fields I, and Carriage Station were not available.

Operating and maintenance costs are as follows for two of the cluster EWTS in Lake Elmo:

Table 11-5: Monthly O&M Costs per Home

Item	The Fields Phase I*	The Fields Phase II**
Sampling and reporting	$2.97	$2.97
Analytical monitoring	$1.94	$0.99
Other operating and maintenance costs (electrical, septic pumping, sewer maintenance fund, monitoring well permits)	$4.74	$6.20
Total monthly costs	*$9.65*	*$10.16*

*45 units

**88 units; includes The Fields of St. Croix Phase II (54 units), Tana Ridge (20 units), and Twin homes (14 units)

Source: NAWE compilations provided by Robert Engstrom

The O&M costs in Table 11-5 do not include capital replacement. Economic sustainability would require that fees charged to homeowners not only include routine maintenance, but also include revenues set aside to cover replacement of capital assets at the end of their service lives. In other recent projects, NAWE has included replacement costs as part of the operation, maintenance, and replacement (OM&R) cost calculated for clients. For instance, for another Minnesota project serving 100 homes, NAWE estimated that monthly costs per connection would be $24.05, of which 16 percent, or $3.88, represented capital replacement costs (North American Wetland Engineering 2002a, Table 6.2).

Conflict Over Plans for Growth

Since 2002, Lake Elmo and the Met Council have been in a dispute over Lake Elmo’s draft 2000 – 2020 comprehensive plan. The parties have fundamentally different views of the future of Lake Elmo, in particular, the degree to which Lake Elmo will urbanize. The crux of the dispute is development density. To understand this dispute it is necessary to understand both land-use planning and wastewater system planning efforts by the Met Council and Lake Elmo.

The Met Council’s 1996 regional blueprint anticipated substantial urbanization of Lake Elmo by 2040, based on regional projections of household and employment growth, the proximity of Lake Elmo to St. Paul and to major highways, the potential for providing cost-effective transit and wastewater services to the city, and the presence of a regional park in the city (State of Minnesota Office of Administrative Hearings 2003, finding 32).

The blueprint called for Lake Elmo to:

- Plan for expansion of its existing urban area through 2020 at a minimum density of three dwellings per acre
- Maintain approximately two-thirds of the remainder of the city in "urban reserve" at a density of one unit per 40 acres (The council uses this designation to set aside areas for urban growth beyond the 20-year planning horizon)
- Maintain the remainder of the city as "permanent rural" at a density of one unit per 10 acres (State of Minnesota Office of Administrative Hearings 2003, finding 39)

In 1997, the Met Council provided Lake Elmo with a "system statement" based on the blueprint and the wastewater system plan that advised the city to plan for 1,500 sewered households and 1,000 employees at sewered job locations by 2020, and to include in the city's comprehensive plan an urban reserve as called for in the regional blueprint (State of Minnesota Office of Administrative Hearings 2003, finding 66).

In 1996, the Met Council undertook a wastewater facility planning process aimed at providing regional interceptor service to growth areas in Washington County. A new wastewater treatment plant, the South Washington County Plant, with a projected capacity of 15 million gallons per day (MGD), was commissioned and is scheduled to be constructed in Cottage Grove, two towns to the south of Lake Elmo. Lake Elmo took part in public discussions for interceptor planning via the Community Advisory Committee in 1998. City officials maintain, however, that Lake Elmo never requested more than 320 acres of additional regional wastewater service (to bring its total to 440, as originally requested in 1992).

The *South Washington County Interceptor Facility Plan*, published in March 2000 by Metropolitan Council Environmental Services (Bonestroo Rosene Anderlik & Associates Inc. 2000), indicates that three sewer interceptor alignments serving Lake Elmo were discussed. These alignments involved sewers entering the city from the south, approximately midway between its west and east borders or further to the east. A fourth alignment termed the "Lake Elmo Metro Alignment" was conceived during the facility planning process (Bonestroo Rosene Anderlik & Associates Inc. 2000, p. IV-14).

The Lake Elmo Metro Alignment would allow sewers to be extended along route I-94 from west to east, the direction of urban expansion from St. Paul, rather than bisecting the southern border. The Met Council ultimately chose this option because it extended capacity life on the new plant, and diverted capacity to the existing underutilized Metro Plant via the construction of the new Lake Elmo Metro Interceptor (referred to in later documents as simply the Lake Elmo Interceptor). It also allowed planners to delay sewer extensions into Lake Elmo until 2006 to correspond with a scheduled I-94 road-widening project. Lake Elmo would continue to use the WONE interceptor until the Lake Elmo Interceptor is constructed.

Lake Elmo submitted its draft 2000–2020 Comprehensive Plan to the Met Council on August 24, 2001.[18] Lake Elmo's plan outlines a development strategy focused on rural agricultural density (RAD) zoning, using cluster subdivisions as appropriate, and communal and onsite soil-infiltration systems for wastewater treatment. The plan aims to maintain Lake Elmo's rural character. Lake Elmo did not plan for development along I-94 that would utilize the proposed Lake Elmo Interceptor. The plan states (City of Lake Elmo 2002, p. 80):

> Lake Elmo has made a firm commitment to accommodate its growth and development to saturation utilizing onsite or communal wastewater infiltration methods rather than regional wastewater treatment.

Lake Elmo contests the minimum development density (three dwelling units per acre) required by the Met Council to support regional wastewater service, stating that this would compromise its rural character (City of Lake Elmo 2002, p. 80). By accepting additional regional sewerage, Lake Elmo fears it would forfeit certain powers over local community development policy to the Met Council, such as housing density, type, and cost.

Lake Elmo aims to achieve build-out by 2020 with a *total* of 4,500 households (there were 2,347 households in 2000). Much of the community would be developed through cluster development at a net density of roughly one dwelling unit per 2.5 acres. In contrast, the Met Council's 1996 wastewater system plan called for 1,500 *new* households on the regional sewer system by 2020, and the proposed capacity allocation for Lake Elmo from the Lake Elmo Interceptor would allow *additional* development beyond 2020 equivalent to 7,850 households (State of Minnesota Office of Administrative Hearings 2003, findings 50 and 53).

Upon review, Met Council staff found Lake Elmo's comprehensive plan to be inconsistent with the wastewater system plan and the regional growth strategy developed in the 1996 regional blueprint (Metropolitan Council 2002c, p. 6):

> The City's Plan fails to consider virtually all aspects of the [Met] Council's Regional Growth Strategy and key Systems Plans as they apply to Lake Elmo. The City plans for no expansion of the existing urban area despite the existing and planned regional transportation, sewer and park infrastructure located within the City or in very close proximity to the City. The City plans for no protection of any lands in the City for future urbanization by 2040. It plans for rural residential development at substantially higher densities than recommended by the Council Urban Reserve and other policies. By permitting substantially higher densities in rural areas than are recommended by Council policies, it will be very difficult to achieve future urban-level density development in those rural areas to match regional infrastructure serving those portions of the City.

[18] In 1995, the Minnesota legislature required all metro area cities to review and update as necessary their comprehensive plans by December 31, 1998. Lake Elmo obtained an extension until December 31, 2000 for submitting its plan to the Met Council, but did not submit the plan until August 24, 2001. In February 2002, after receiving additional information from the city, the Met Council deemed the plan complete for review (State of Minnesota Office of Administrative Hearings 2003).

In an attempt to resolve their differences, the Met Council prepared three alternative planning scenarios for Lake Elmo to consider. Each alternative maintained the council's previous residential equivalent units requirement on an overall basis, but increased densities over a smaller footprint to enable the city's remaining land to remain rural. The city was not interested in any of the alternatives (State of Minnesota Office of Administrative Hearings 2003, finding 71). On September 11, 2002, after hearing from Lake Elmo and its own staff, the Met Council adopted a resolution finding Lake Elmo's comprehensive plan had a "substantial impact on and contained a substantial departure from metropolitan system plans" and, therefore, had to be modified (Metropolitan Council 2002d). The resolution set out nine required modifications. These included requirements that the city accommodate the number of sewered households and employees identified for 2020 in the 1996 wastewater system plan and set aside an Urban Reserve capable of accommodating 7,850 residential equivalent units of sewer capacity after 2020.

Lake Elmo requested a contested case hearing. An administrative law judge issued a finding in March 2003 that the Metropolitan Council was acting within its statutory authority to require modifications to Lake Elmo's comprehensive plan. Further, the judge recommended that the council require Lake Elmo to modify its plan (State of Minnesota Office Administrative Hearings 2003). On April 9, 2003, a new set of Met council members, appointed by a new Minnesota governor elected in November 2002, re-affirmed the previous council's decision.

Lake Elmo and the Met Council met to negotiate a resolution, without result. Lake Elmo appealed the decision to the Minnesota Court of Appeals. On December 16, 2003, the court affirmed the Met Council's decision. Lake Elmo has appealed the case to the state Supreme Court.

Analysis

This section includes analysis of

- Performance and reliability
- Growth, development, and autonomy
- Fairness and equity
- Stakeholder relationships and trust

Performance and Reliability

This section addresses the following:

- ***How was system architecture relevant to this issue?*** Cluster-scale EWTS were new for the city and the state. The city needed to address performance and reliability concerns before approving their use.
- ***How was the issue addressed?*** Lake Elmo officials addressed performance concerns and adopted O&M guidelines. Homeowners' associations were charged with O&M of their own EWTS. Contiguous open spaces offered added system resilience. The city has adopted more stringent ISTS requirements than required by state law.
- ***Did the issue resonate with the community?*** Some officials had concerns about the cluster treatment systems, and believed the city should operate and manage them. Residents of cluster developments are somewhat unaware of the systems; some believe more education is needed.
- ***Results/Status:*** Understanding and regulation of EWTS performance has evolved at both the local and state levels. There have been some lapses in management by homeowners' associations. The city has improved its oversight of homeowners' associations (HOAs). The Met Council has concerns about long-term reliability of and accountability for cluster and individual wastewater systems in Lake Elmo. The city may opt for municipal ownership and management of cluster wastewater systems in the future.

How Was System Architecture Relevant to This Issue?

Before employing the EWTS for the cluster subdivisions, city officials first needed to be educated about wetlands treatment and had to resolve several concerns that arose over system performance and reliability. By rejecting sewers for new growth through 2020 and relying on local groundwater to meet its drinking water needs, the city also needed to ensure ISTS and EWTS reliability to prevent groundwater contamination.

How Was the Issue Addressed?

The performance and reliability issue was addressed by:

- Ensuring technology acceptance
- Adopting operational, performance, and monitoring requirements
- Encouraging contiguous open spaces between developments
- Developing an excellent ISTS maintenance management program

City Officials Sought Information, Addressed Technology and Performance Concerns, and Charged HOAs With EWTS Operation and Maintenance

The technology acceptance process in Lake Elmo was crucial. Aside from former mayor Wyn John and city council member Steve DeLapp, no city officials at the time had any knowledge of the wetlands treatment concept, and no previous wetland systems had been installed to treat residential waste in the state. City officials sought information, addressed technology and performance concerns, and charged HOAs with EWTS operation and maintenance. NAWE held a number of community discussions about the wetlands. The community meetings were publicized as a discussion about using wetlands for wastewater treatment at future developments in Lake Elmo. They were each attended by approximately 30 people, the majority of whom were on the city council or the planning commission.

Although a number of treatment technologies besides wetlands could have been employed to service the cluster developments, no others were studied in great detail. It appears that the local design expertise and oversight offered by NAWE—their office is about 15 miles north of Lake Elmo—was instrumental in the selection of EWTS as the treatment system of choice. Many officials also noted the natural aesthetics of the treatment wetlands matched well with open space preservation and contributed to their overall appeal.

A key concern of city officials was whether the EWTS could treat wastewater in the cold Minnesota winters. NAWE addressed these concerns by describing the treatment process in detail, explaining how wetland plants' roots and microbes function through the winter in a relatively warm environment underneath an insulating soil layer. They also pointed to examples of other, successful cold-climate treatment systems using wetlands.

Another concern raised at the meetings was whether residents connected to an EWTS understood the risk of pouring hazardous substances down the drain that could damage a wetland system. City officials wanted to ensure that residents were charged with a collective responsibility to ensure long-term wetlands health. According to Wyn John, ensuring that responsibility was the primary reason why city officials decided to make HOAs responsible for O&M of their own systems.

The City Council Adopted Operational, Performance, and Monitoring Requirements

The design engineer for each wetland system is required to develop an O&M plan to meet city and state requirements. To date, all engineered wetland systems in Lake Elmo were designed by NAWE. The city also requires a monitoring plan and annual monitoring of systems with a design flow greater than 1,500 GPD. Each HOA is responsible for implementation of the various plans.

For effluent dispersal, the city ordinance (City of Lake Elmo 1998) requires a minimum of three feet between the bottom of a soil infiltration system and the groundwater table. The levels of pretreatment shown in Table 11-6 are required prior to discharge to an infiltration bed.

Table 11-6: City of Lake Elmo Pretreatment Effluent Standards

Constituent	Standard
5-Day Carbonaceous Biochemical Oxygen Demand ($CBOD_5$)	50 mg/l
Total Suspended Solids (TSS)	20 mg/l
Total Nitrogen (TN)	15 mg/l
Ammonia (NH_4)	10 mg/l
Total Phosphorous (TP)	5 mg/l
Fecal Coliform (FC)	200 cfu/100 ml

Source: City of Lake Elmo

Inspection and monitoring ports are required within the system for easy measurement of water levels, and so that a water sample can be easily taken from within each treatment cell (section of wetland), and from one-foot below the infiltration bed. The city ordinance requires that effluent be sampled annually as it leaves the wetlands treatment system and again after passage through soil. The city charges a fee to review the results. Lake Elmo proudly notes in its comprehensive plan that water quality at the outfall of the wetlands, prior to entering the infiltration bed, is required to be at a higher standard than that for the Met Council's Metro Wastewater Treatment Plant outfall to the Mississippi River (City of Lake Elmo 2002, p. 81).

Contiguous Open Spaces Between Developments Offer Added System Resilience

Lake Elmo's OP ordinance encourages open spaces from neighboring developments to be contiguous. While the main intent is to create larger open areas for recreational and aesthetic purposes, contiguous open spaces also provide a large buffer area around cluster-scale wastewater treatment systems. This increases the assimilative capacity of the environment and may reduce risks to residents in the case of system failure or large storms.

In some cases contiguous open spaces allow for additional design features such as system redundancy. For instance, at The Fields of St. Croix, a transfer station was constructed to pump treated effluent from Phase I to Phase II in the event excessive precipitation overwhelms Phase I's infiltration system (North American Wetland Engineering 2002b).

Lake Elmo Developed One of the Region's Best ISTS Operation and Maintenance Programs

To ensure continued safe operation of ISTS and communal soil absorption systems, Lake Elmo has instituted a number of safeguards, including:

- All systems must be sized to accommodate garbage disposals, regardless of whether the residence has one
- All systems must have a secondary "fail safe" infiltration location (reserve leach field)
- A mandatory two-year pumpout schedule (MPCA requirements currently require three-year service intervals)
- Homeowners must bring ISTS manhole covers to the surface to facilitate proper maintenance

The city has built a custom wastewater system database to ensure that each of 2,000 private and communal systems in the city meets maintenance requirements. The Met Council notes that this ISTS maintenance management program is the oldest in the region to their knowledge. Further, the council notes that effective implementation of this program and the city's regulations means "ISTS failures will probably be less apt to occur in Lake Elmo than in many other metro area cities." (Metropolitan Council 2002c, p. 12)

The town owns and manages the six communal septic tank/soil absorption systems constructed during the 201 grant program, and it bills residences for O&M. The city employs a public works superintendent who manages two employees, one of whom has a Minnesota Department of Health wastewater operator license.

Did the Issue Resonate With the Community?

Because the cluster treatment systems and wetlands technology were to be used at new housing developments, little concern was generated among existing residents. Whether to proceed with the concept rested squarely upon city officials.

One former city administrator was concerned about the lack of winter performance data on wetland functionality, and "would have preferred some other town try it first." She was also concerned that city staff would get blamed if there were failures, as it is ultimately the city's responsibility to provide for the health and safety of the community. She believes the city should control the systems and contract out the services, paid for by the respective HOAs. In her view, if an HOA's system fails, the city would have to pay "one way or another."

The ultimate decision to proceed with the cluster treatment concept, according to current Mayor Lee Hunt, was because it offered the ability to work with one system rather than "60 or 70 septic systems," and because it avoided problems associated with what one official described as the "dump truck geology" of variable glacial moraine deposits, which has led to a high rate of ISTS failures in the metropolitan area. The fact that cluster wetlands treatment systems could be reconstructed on the site if any problems were experienced proved an important point for decision makers as well. There was concern, however, that the cluster developments would lure former city dwellers who would expect services incompatible with a rural lifestyle, such as the "flush and forget" mentality associated with central sewer service.

> "I would say that with respect to other people in the neighborhood, it [the wetlands] really hasn't been a topic of much concern or much conversation at all. And I think that probably people don't think about it, and perhaps they should think about it more, at least in terms of what they're putting down their drains. My personal view is that we need to remind people to not take it for granted."
>
> Gary Van Cleve, former HOA President, The Fields of St. Croix

Some People Felt the City Should Be More Involved In Homeowner Education

When deciding upon purchase of his house at The Fields, the wetlands system was a "curiosity, but not a concern," to the former president of The Fields of St. Croix HOA, Gary Van Cleve. He had heard stories about failures of onsite systems and requested some information about the engineered wetlands from the developer. He was given a description produced by NAWE, as well as a reprint of an article written about a similar system operating in Iowa that had been successful. This information was made readily available to any prospective homeowner that inquired.

According to Van Cleve, the HOA board's main concerns have been the septic tank pumping schedule and the cost of frequent monitoring of the system in its early years (because the system was still considered experimental by state regulators). Otherwise, the board and residents have given little special attention to the system. He believes more education and information for homeowners is warranted, as many residents are former city-dwellers who are unfamiliar with small wastewater systems.

Results/Status

Results included:

- Understanding of system performance is evolving
- Lapses in EWTS operation and oversight
- Concerns over long-term reliability and accountability
- Consideration of municipal ownership and maintenance of communal systems

Understanding of System Performance Is Evolving

According to Curt Sparks of NAWE, understanding of wetland treatment system performance by designers, the city, and the state has increased in the years since the first system was installed at The Fields of St. Croix, and it is still evolving. This has resulted in changes in the application of local and state regulations.

For instance, the city's wetlands treatment code, the first such city code in the state, includes the standards shown in Table 11-7 for effluent one foot below the soil infiltration bed.

Table 11-7: City of Lake Elmo Standards for Effluent One Foot Below Cluster System Soil Infiltration Bed

Constituent	Standard
5-Day Carbonaceous Biochemical Oxygen Demand ($CBOD_5$)	0 mg/l
Total Suspended Solids (TSS)	0 mg/l
Total Nitrogen (TN)	5 mg/l
Ammonia (NH_4)	1 mg/l
Total Phosphorous (TP)	1 mg/l
Fecal Coliform (FC)	10 cfu/100 ml

Source: City of Lake Elmo code

These standards were taken from NAWE's estimates of likely water quality after wetlands and soil treatment for the first proposed system, based on literature and models in the wastewater treatment field. The city did not understand, however, that sampling water quality below an infiltration bed but above the groundwater table itself is notoriously difficult. While these standards remain in the city code, the city no longer requires that such sampling be attempted and only requires the monitoring of effluent prior to discharge to an infiltration bed.

As for state monitoring requirements for systems over 10,000 GPD, the MPCA initially required lysimeters on the first system (The Fields of St. Croix Phase I), but, according to NAWE, when it was demonstrated that the lysimeters could not reliably recover a sample for permit compliance purposes, the MPCA abandoned this approach and standardized a sampling program using monitoring wells (Figure 11-5). Generally, one upgradient and two downgradient monitoring wells are required. MPCA initially required monthly testing, but it has since changed that requirement to four tests per year. It often allows the winter quarter test to be skipped because of the difficulty of sampling in winter conditions. A certified operator is still required to check state permitted systems monthly, however.

Courtesy of North American Wetland Engineering

Figure 11-5: Water Quality Monitoring at a Wetland Treatment System in Lake Elmo

The city has indicated that the EWTSs are operating as expected (City of Lake Elmo 2002, p. 81). Elevated nitrate levels (above the drinking water limit of 10 mg/l) in groundwater have been observed, but have been attributed to background (probably agricultural) sources. For instance, at The Fields of St. Croix, nitrate levels were high in both upgradient and downgradient monitoring wells, and chlorides were low in all wells (North American Wetland Engineering 2002b). According to an MPCA official, this situation is consistent with high background levels of nitrate and is not consistent with wastewater contamination of the groundwater.

In the years since Lake Elmo approved its first EWTS, numerous wetland treatment systems have been installed throughout the state. There is a substantial debate in Minnesota, as there is in the wastewater field generally, about how to regulate performance—should standards be enforced for effluent leaving a wetland cell or other pretreatment system, or at some point after soil treatment? In Minnesota, many cluster treatment systems (utilizing a range of treatment technologies, but all discharging to soil) are being located in former farmlands that have elevated nitrate levels. Because the background nitrate level is above the state groundwater standard of 10 mg/l, MPCA today does not require wastewater systems to meet the standard, but instead typically requires that discharges not exceed background levels. In some instances (but not all), the MPCA seeks pre-construction hydrogeologic investigations to determine background levels. According to NAWE, this can raise monitoring well installation costs from about $5,000 to as high as $50,000. Although developers can build those costs into housing prices, NAWE indicates that the unpredictability of cluster system monitoring requirements has prompted many developers to consider individual onsite treatment systems in order to avoid monitoring burdens.

Some Lapses In Wetland System Operation and Oversight Have Occurred

Lake Elmo placed management responsibilities on HOAs with the idea that HOAs would have a vested interest in properly maintaining the systems. Some lapses in wetland system operation and oversight have occurred. While the city code required O&M plans for all systems, monitoring plans for those over 1,500 GPD, and submission of annual monitoring test results, it appears that the city did not closely oversee the implementation of O&M plans initially. O&M problems occurred at some systems.

In one instance, Wildflower Shores subdivision was sold by its developer to a builder. The builder failed to recognize and pay for the O&M requirements of the management plan that was previously submitted to the city. A NAWE engineer happened to drive by the development's system and noticed some water surfacing. He phoned the developer and negotiated a maintenance contract. According to NAWE the system has been operating within the regulations ever since. However, this event exemplifies a lapse of oversight by both the HOA and the city.

Like implementation of effluent standards, implementation of EWTS management practices and rules has evolved as the city and local wastewater professionals have gained experience. According to the city and NAWE, after the Wildflower Shores incident the city informed all HOAs that the city would henceforth require them to have in place a three-year contract with a qualified firm for O&M and monitoring. Today, all HOAs with wetland systems have a contract with either EcoCheck (a NAWE subsidiary) or AAA Pollution Control.

The contracts vary on a system-by-system basis. For instance, the state requires that all systems over 10,000 GPD have a contract with a certified operator, a higher level of qualification than some O&M companies provide. NAWE is the certified operator for all state-permitted systems in Lake Elmo. At The Fields of St. Croix, NAWE carries out monitoring requirements, while AAA Pollution Control provides the following O&M services, most on a monthly basis:

- Clean outlet screens
- Test and verify pumps (for example, take current and voltage readings)
- Verify other electrical systems
- Clean flow measurement devices
- Flush distribution lines
- Check pressure on air blowers
- Regulate (turn on/off) drain field zones and lines to ensure effective use of the field without over-saturation

The city has one employee whose time is mostly allocated to reviewing ISTS report cards from biennial pumping of septic tanks and reports submitted by wetlands system operators. The city receives the monthly reports submitted to the state for large systems, as well as annual reports the city requires for smaller systems. If this employee sees something inappropriate, she forwards the concern to the city engineer, who is empowered to take necessary action.

The city has the authority to call in a contractor to pump an ISTS sewage tank or fix an EWTS problem if the owner or HOA will not do so in a timely fashion and to charge the owner or HOA for the services.

The Met Council Is Concerned About Long-Term Reliability and Accountability

While it acknowledges Lake Elmo's progressive ISTS and EWTS policies, the Met Council in its review of the city's Comprehensive Plan expressed strong concerns over Lake Elmo's readiness and ability to address the financial and political implications of ISTS and EWTS failures should they occur (Metropolitan Council 2002c, pp. 12–13).

The council requested from Lake Elmo staff, but never received, a detailed analysis supporting the city's claim that it accepts "full responsibility for the environmental and financial risks" associated with the city's comprehensive plan's reliance on ISTS and EWTS"[19] (Metropolitan Council 2002c, p. 13). Marc Hugunin, former representative to the council for the area that includes Lake Elmo, believes that Lake Elmo has high enough housing density to cause "urban problems," but not enough density to support a tax base to deal with the problems should they arise—in this instance reconstructing small systems or building a more expensive connection to the regional sewer system at some point in the future. To support its concerns, the council pointed to 11 communities that submitted amendments to their comprehensive plans involving sewer extensions to correct failed ISTS systems. The council also cited Lake Elmo's involvement with the federally subsidized 201 program, in which 123 Lake Elmo household systems were corrected in the early 1980s at a cost of $1.9 million, as an example of ISTS failure.

The council also claims that a regional wastewater system is more "effective and reliable" because it is monitored 24 hours per day by a professional staff. It believes that ISTS and communal systems should be limited to "areas where sanitary sewer cannot be efficiently provided." (Metropolitan Council 2002c, p. 13)

The Met Council has indicated that better financial accountability assurances from the city would ease its concerns about ISTS and EWTS failures. The council would like assurances that the city will be ultimately responsible for ensuring that failures are corrected and that the costs of correction will be borne by the city and not by residents of other communities in the region. The council ultimately did not include these concerns in its list of required modifications to the Lake Elmo comprehensive plan. However, the council's requirement that Lake Elmo increase the number of sewered households and reduce the density of new development in much of the remainder of the city would reduce the number of new ISTS and EWTS systems compared to Lake Elmo's plan.

The City Is Contemplating Municipal Ownership and Maintenance of Communal Systems

City officials have various opinions on the subject, but they appear to be leaning towards municipal ownership, operation, and maintenance of communal wastewater systems in the future. This would give the city better control over systems and help ensure adequate performance and reliability.

[19] One interviewee for this case study, not with the city government, believes the requested analysis was an unfair burden on a small community.

Growth, Development, and Autonomy

This section addresses the following:

- ***How was system architecture relevant to this issue?*** Large-lot zoning served by ISTS did not achieve desired results. The town looked to cluster developments served by development-scale treatment systems to accommodate growth. Residents and city officials fear high-density development and loss of rural character would result from regional sewer service.
- ***How was the issue addressed?*** The city enacted a building moratorium to study the issue, engaged in a visioning process addressing its future, gained approval for using the then-experimental engineered wetlands to serve cluster developments, revised zoning to allow cluster-style development, and rejected regional sewer service extensions into town.
- ***Did the issue resonate with the community?*** Citizens participated enthusiastically in a visioning process. Property developers reacted favorably to the cluster development ordinance. Property owners along the interstate highway reacted negatively to the lack of regional sewer service.
- ***Results/Status:*** Cluster developments have been successful. The Met Council gave Lake Elmo an award for its OP ordinance, but objected to the city's rejection of regional sewer extensions. An administrative law judge and an appeals court have ruled that the Metropolitan Council acted within its authority in requiring Lake Elmo to modify its comprehensive plan. Lake Elmo has appealed the decision to the state Supreme Court.

How Was System Architecture Relevant to This Issue?

Considerations relevant to system architecture include:

- Large-lot zoning
- Community character compatibility
- Rural community preservation

Large-Lot Zoning Did Not Achieve the Desired Results

The city has been trying to maintain its rural character since its incorporation. Early zoning included 1.5-acre lots in many areas, but there were concerns among city officials that this zoning was too dense, and would allow too many new subdivisions to be created. Subsequently, the city rezoned many areas for minimum lot sizes of 2.5 acres and 10 acres. According to one city official, the result of this style of development was the creation of "prairie palaces"—large homes surrounded by huge bluegrass lawns that provided little sense of the prairie and agricultural past, and failed to create neighborhoods. This led the city to clustering as a way to preserve its rural character and create a sense of community.

Engineered Wetlands Technology Provided a Treatment Solution Compatible With the Desired Community Character

Because Lake Elmo's long-term wastewater treatment strategy for residential areas relies on soil infiltration (via ISTS and EWTS), the city must maintain adequate land area to assimilate that waste. Clustering satisfies this requirement by preserving open land. This provides infiltration sites and assimilative capacity. The space requirements of EWTS are easily accommodated within an OP development's open space areas. Other treatment systems could be utilized, but the low O&M costs and compatible aesthetics of wetland treatment systems have made EWTS the preferred technology in Lake Elmo. Figure 11-6 shows the EWTS at the Prairie Hamlet cluster development. Plants include Narrow-leaf Cattail (*Typha angustfolia*), Boneset (*Eupatorium perfoliatum*), New England Aster (*Aster novae-angliae*), and Stiff Goldenrod (*Solidago rigida*).

Courtesy of North American Wetland Engineering

Figure 11-6: A View Over the EWTS at the Prairie Hamlet Cluster Development

City Leaders Have Rejected Regional Sewer Service as Incompatible With Lake Elmo's Desire to Remain a Rural Community

Despite previous offers from the Metropolitan Council to extend regional sewers into Lake Elmo, city officials have historically resisted because they fear the loss of the community's rural character to high-density and strip mall-type development. The town of Woodbury to the south has had regional sewer service since the 1960s, and, although located just south across I-94, it looks quite different. Woodbury experienced the largest net gain in households (9,749) in the metro area between 1990 and 2000, a growth rate of 131 percent. Two other neighboring communities with regional sewer service, Oakdale and Cottage Grove, had growth rates of 45 percent and 33 percent, respectively. In contrast, Lake Elmo's population growth was about 16.3 percent over the same period, a result, its leaders say, of the city's zoning and planning policies.

The Met Council has determined that a minimum of three dwelling units per acre is needed to provide cost-effective regional sewer service (City of Lake Elmo 2002, Metropolitan Council 2002b and 2002c.). Lake Elmo meanwhile has zoned a majority of the city at one unit per 2.5 acres (City of Lake Elmo 2002). City officials indicate that autonomy over local land-use decisions is a driving force behind their decision to not request regional sewer service.

How Was the Issue Addressed?

The issues of growth, development, and autonomy were addressed as follows:

- Lake Elmo undertook a process to identify and promote its vision for the future
- Lake Elmo began developing plans for the Old Village

Lake Elmo Undertook a Process To Identify and Promote Its Vision for the Future

By the early 1990s, the country-wide movement towards cluster development was gaining momentum. Lake Elmo's then-mayor Wyn John happened upon the book *Rural by Design: Maintaining Small Town Character* by Randall Arendt. He felt that this style of development would help accomplish Lake Elmo's goals of maintaining a rural atmosphere while accommodating inevitable development. City council member Steve DeLapp was a founding member in 1991 of the Washington County Land Trust, which became the Minnesota Land Trust, an institution that facilitates the permanent preservation of open space in cluster developments. Lake Elmo city officials began laying the framework for subsequent land-use and wastewater decisions.

In the midst of a "flurry" of building proposals in the spring of 1995, the city placed a moratorium on new construction to review the idea of cluster development. According to a former city official, the moratorium was essential in giving the city time to explore its development options and engage the community.

> "Our feeling was that if we had cluster developments going in, there would be enough of a concentration of homes to support and create…a recognizable downtown. If you go to Woodbury, there is no discernable downtown in Woodbury. It has expanded so fast. And now they are looking to create a city center, and they're not quite sure how to start from scratch."
>
> Wyn John, former Lake Elmo Mayor and Councilman

City officials invited the Minnesota Design Team, an organization of volunteer land planners and architects from the University of Minnesota, to hold a community design *charrette* (an intensive workshop) to examine long-term planning in Lake Elmo. The team held a number of meetings and public discussions around the city to gauge the opinions of homeowners and business owners about future development. The major themes uncovered by the team included a desire by current residents to remain a rural community and for Lake Elmo to have a discernable "sense of place" and a "viable city center." (City of Lake Elmo 2002) One recommendation identified open space development (cluster development, conservation development) as a way to accomplish these goals.

In light of the design team recommendations, two citizen organizations were established, the I-94 Task Force and the Village Commission, to review and develop land-use planning and design guidelines for the respective areas. Lake Elmo officials studied the issue further, and sent several officials to visit a mixed-use cluster development in Overland Park, Kansas that had won acclaim. The city then formed a committee to amend its comprehensive plan to include cluster development zoning (OP zoning), which was adopted by the city in the spring of 1996, and submitted to the Metropolitan Council for its approval. The Met Council determined that the amendment would not impact regional systems, and approved the amendment in August 1996. The building moratorium was then lifted 18 months after its initiation.

During the mid-1990s the city also discovered EWTS as a way to provide wastewater treatment for cluster developments. While other treatment technologies might also have been be suitable, wetlands had an aesthetic appeal and a nearby engineering firm (NAWE) had the expertise to design these systems. The idea that the city could support its own development using its own soil capacity began to take root, and an experimental EWTS was built for a showcase development. The city revised its wastewater code to accommodate and regulate these systems.

Lake Elmo Began Developing Plans for the Old Village

The Old Village is about 2,500 acres in size, and consists of a mix of commercial development and urban-density residential parcels on ISTS, surrounded by open land that is ready for development. The Village Commission envisioned additional commercial construction in the center of the city, surrounded by additional urban-density housing to provide a proximate customer base. In 2000, the Met Council, as part of its Smart Growth initiative, contracted with Calthorpe, Inc. to work with Lake Elmo in creating the design plan: “Lake Elmo: Recreating Village Character for New Development.” (Calthorpe Associates 2000) This study recommended ways Lake Elmo could establish and develop a viable mixed-use city center. Ideas included the establishment of a concentric greenbelt around the Old Village. This area could be used to locate EWTS for treating wastewater from existing and future residential and commercial development. Lake Elmo now views EWTS as an integral tool for developing the village in a manner that creates the desired sense of community. In early 2004, NAWE completed a study of the potential use of decentralized wastewater systems to serve village development. The study found suitable soils and determined that three or four systems could cost-effectively treat the 400,000 GPD of effluent from some 1,300 homes and businesses.

Did the Issue Resonate With the Community?

The issue resonated in Lake Elmo with:

- City residents
- Developers
- Property owners

City Residents Supported the Minnesota Design Team Visit

According to a former city official, over the course of a weekend, about 300 people attended the community design charrette held by the Minnesota Design Team. Participants took part in a visioning process to determine their desires for the future of the city. There was also an open forum and then a community dinner at the local fairgrounds. One former local official recalled the event as “a potluck at the fairgrounds, how much more ‘grassroots’ can you get?”

Developers Viewed Cluster Systems Favorably

From a property developer’s prospective, a subdivision served by a cluster-scale wastewater system offers many advantages over a conventional rural subdivision served by individual septic tanks. Communal septic tanks, treatment systems, and soil absorption beds are located in the development’s open space, eliminating the need to locate individual systems on each property. This configuration allows developers to construct houses and driveways in the best layouts for neighborhood creation. According to one developer, “it gives you design freedom.” In addition, the lots are easier to sell to home builders than lots served by individual septic systems.

Cluster developments have a smaller overall constructed-area footprint than conventional subdivisions, and developers take advantage of the efficiencies in construction and infrastructure design afforded by this style of development. Because cluster development is not mandatory, the city has provided density bonuses to developers for constructing in this fashion, such as allowing developers to construct an additional dwelling unit in return for preserving a historic structure on the site. According to developer Robert Engstrom, these bonuses are essential to steer the development community towards cluster layouts.[20]

Some Property Owners Are Unhappy and Have Requested Sewers

A number of property owners along the I-94 corridor are unhappy about the city’s minimal use of regional sewer service. Some property owners had previously made their request for sewer and water publicly known to the city and to the city’s I-94 Task Force. In an April 7, 1998 petition to the mayor and city council (prior to adoption of the 2020 comprehensive plan), 18 property owners representing approximately 1,500 acres or 64 percent of land within the I-94 corridor study area signed a formal request for sewer service (Metropolitan Council 2002b, p. 26 and Appendix C). After Lake Elmo released its draft comprehensive plan, four property owners or their representatives wrote to object to Lake Elmo’s plan. Lake Elmo officials also indicate that some property owners are threatening annexation to Woodbury to the south. One former city official has cautioned that the lack of a sewer makes the corridor vulnerable to annexation by other cities, and thus could cause a complete loss of city control over the area. Another official calls the threat a scare tactic by land speculators.

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[20] Engstrom believes that with good planning, the value of smaller clustered lots with open space preservation can be higher than the value of the same number of units on larger lots spread across the same property. But he notes that many developers believe the reverse is true; thus the need for density bonuses. Lake Elmo originally made a number of bonuses available, but eliminated all but one (for historic structure preservation) in 2002. Research on the rationale for this change was not performed for this report.

Results/Status

Results include:

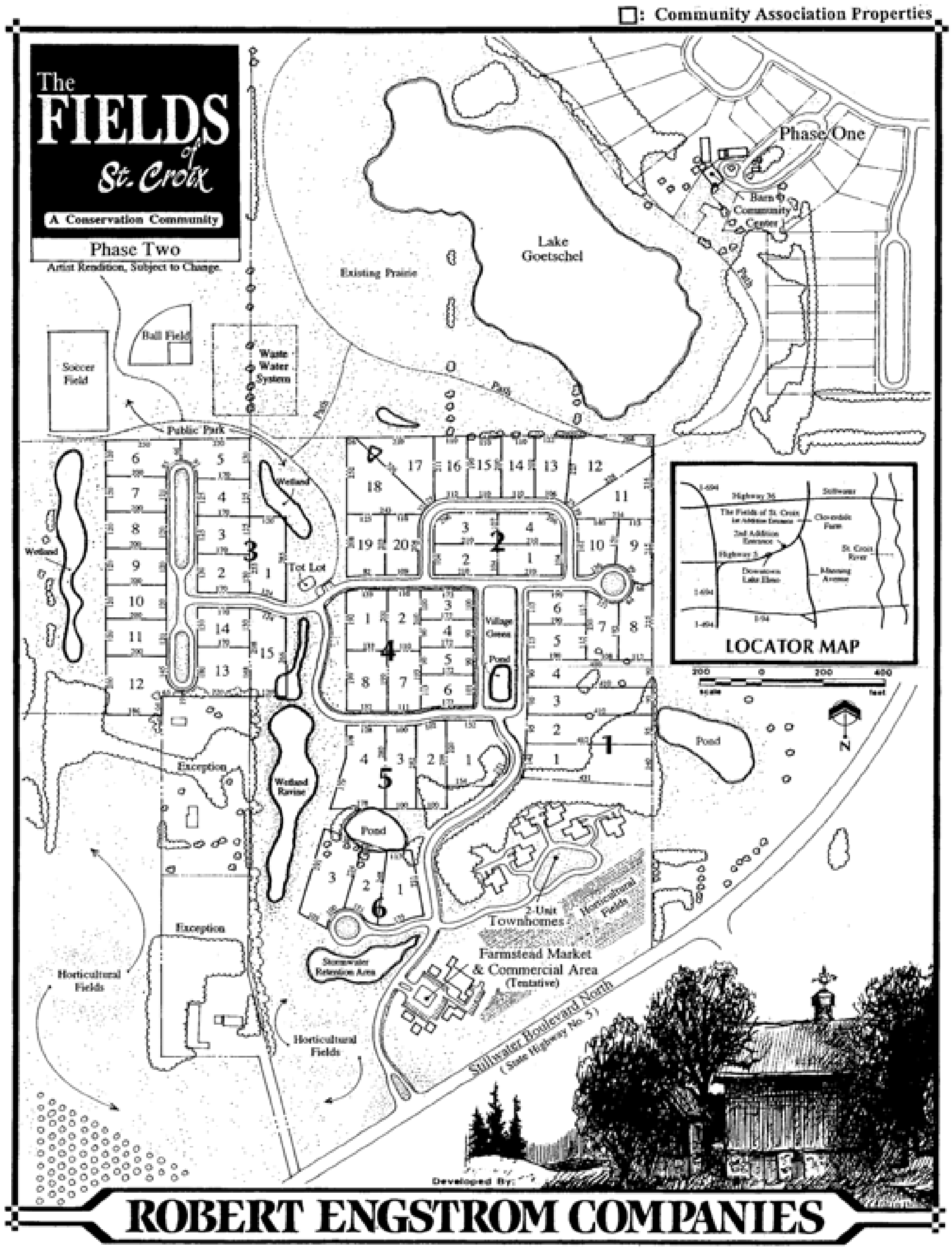
- Lake Elmo’s cluster subdivisions have been successful
- Engineered wetlands have allowed limited commercial development in some parts of the city
- Lake Elmo and the Metropolitan Council have very different visions for growth in Lake Elmo

Lake Elmo’s Cluster Subdivisions Have Been Successful

Construction of the first OP development in the city, The Fields of St. Croix, began in 1997. Phase II of The Fields began in 1999. The developed portion of the 241-acre site is located on level ground surrounding a lake and an area of restored prairie. Lots range from 0.35 to 1 acre, with 99 detached single-family homes and 14 attached single-family homes (twin homes). Dedicated open space totals 144 acres (60 percent) of the total land area (Figure 11-7). This open space includes:

- A 15-acre Community Supported Agriculture (CSA) organic farm
- A 15-acre city park
- A mature stand of oak trees and restored prairie land
- A “tot-lot” and ball field
- Two miles of interconnected trails
- A restored civil-war era barn now used as a community center
- A screened porch off the barn that overlooks a 13-acre lake
- Rain gardens and wetlands buffers for stormwater treatment and infiltration
- An engineered wetland wastewater treatment system (one for each phase)

Figure 11-7 shows the plan view of The Fields of St. Croix. The entire housing area for Phase II is shown along with a portion of Phase I’s housing. Not all of the open space for the development is shown.



Courtesy of Robert Engstrom Companies

Figure 11-7: Plan View of The Fields of St. Croix

In the environmental spirit of conservation development, and to save on development costs, gravel for interior roadways was mined on the site, dirt from excavation was used to grade ball fields, predominately native perennials and prairie grasses were used for landscaping, and open space surrounding the lake shoreline was left undisturbed. Although this development goes above and beyond other cluster subdivisions in Lake Elmo in terms of environmental stewardship, the spirit of each development is consistent: they boast a neighborhood atmosphere because houses are in closer proximity than they would be with standard 2.5-acre lot zoning, and the permanent preservation of natural lands and a rural setting add to the character.

The Open Space Preservation ordinance encourages the preservation of viewsheds along thoroughfare roads, so relative to driving through other nearby cities, Lake Elmo has a more rural appearance. In addition, cluster housing utilizes an internal road system, thus eliminating the proliferation of driveway entrances on main thoroughfares that typifies large lot developments. The Met Council gave an award to Lake Elmo for its leadership in conservation-oriented development.

Land and houses in Lake Elmo cluster developments fetch prices above the regional average. According to Robert Engstrom, The Fields of St. Croix was marketed as having a sewer system, which appealed to prospective homeowners moving from urban or suburban areas.

Engstrom summarizes cluster development as an environmentally friendly alternative to large-lot subdivisions that:

- Does a better job at creating a sense of community
- Retains natural features and allows more productive use of open space, for instance for parks and farmland
- Allows efficient, advanced treatment of wastewater

Engineered Wetlands Have Allowed Limited Commercial Development In Some Parts of the City

Lake Elmo officials have rejected regional sewer service for most of the I-94 corridor in order to limit development. According to one Lake Elmo official, a downside of the anti-sewer policy is the loss of desirable businesses interested in developing this portion of the city. However, Lake Elmo officials believe that EWTS or other cluster treatment systems using soil absorption could be used for limited commercial development. They point to the northeastern portion of the city, where a developer has constructed 109 single and attached residential units and 40,000 square feet of office space, all utilizing an EWTS.

Lake Elmo and the Metropolitan Council Have Very Different Visions for Growth In Lake Elmo

While Lake Elmo wishes to retain its rural character, the Met Council maintains that Lake Elmo must plan for substantial urbanization. Differences in predictions for population, the number of households, the number of sewered households, and jobs are shown in Table 11-8.

Table 11-8: Population and Infrastructure Projections for Lake Elmo by Lake Elmo and the Metropolitan Council

Year	Population	Total Households	Households on Regional Sewer	Total Jobs
2000 (actual)	6,863	2,347	0	1,636
2020 and later (build-out planned by Lake Elmo)	12,300	4,500	0	2,100
2020 (Met Council 2020 Regional Blueprint, 1996)	12,500	4,700	1,500	2,650
2030 (Met Council 2030 Regional Development Framework, 2004)	24,000	9,500	X	3,050

X = Not estimated.

Sources: City of Lake Elmo 2002, Metropolitan Council 2002b and 2004

The Met Council's 1996 projections were based on its estimates that the metropolitan region would need to accommodate 320,000 new households and generate 380,000 new jobs between 1995 and 2020. Additional needs would occur after 2020. The needs through 2020 were allocated across the region's municipalities based on a variety of local factors. Urban reserve areas to accommodate growth beyond 2020 were also identified based on local factors. In Lake Elmo's case, the Met Council in its 1996 regional growth strategy (blueprint) allocated 2020 growth and urban reserves for future growth in the city based on factors such as Lake Elmo's close proximity to core cities, the availability of the highest level of regional transportation infrastructure immediately adjacent to the city on both the north and south sides, and the ability to serve the city with cost-effective regional wastewater services.[21] (Metropolitan Council 2002b, p. 2)

[21] The *2030 Regional Development Framework* also included new forecasts for 2020 that were higher than the forecasts in the previous growth strategy, the *2020 Regional Blueprint.* The council's 2020 forecasts for Lake Elmo are now 15,200 total population, 6,000 total households, and 2,650 total jobs. According to the Met Council, its demand for changes to Lake Elmo's comprehensive plan is based on the forecasts in the 2020 blueprint planning cycle.

Table 11-8 shows that Lake Elmo and the Met Council are not far apart on the total amount of residential development through 2020. Lake Elmo plans for 200 fewer households than the Met Council's 1996 household forecast. The key differences lie in how wastewater services would be provided to that development and in plans for growth after 2020.

One of the Met Council's main objections to Lake Elmo's comprehensive plan was the city's failure to plan for any of the 1,500 sewered households identified in the 1996 wastewater system plan. Also, the Met Council called for 1,000 of the new jobs created in the city through 2020 to be served by regional sewer. The Met Council expects Lake Elmo to make use of the planned regional sewer. The new interceptor is planned primarily for Lake Elmo, and Lake Elmo connections will help pay for the project. Construction of the $10 million Lake Elmo Interceptor is scheduled to begin in 2007 (State of Minnesota Office of Administrative Hearings 2003) but reportedly could begin earlier due to the Highway Department moving up its timetable for the widening of I-94 where the interceptor would run.

Although the plans are not final, the Lake Elmo Interceptor is currently designed to handle 3.7 MGD, of which 70 percent is designated to serve Lake Elmo. This is enough capacity to support Met Council-projected sewered development through 2020 plus an additional 7,850 residential equivalent units after 2020 (State of Minnesota Office of Administrative Hearings 2003, finding 53). Lake Elmo is expected to set aside adequate urban reserve lands to accommodate future urban growth beyond 2020.

In contrast to the Met Council's plans for continued urban growth in Lake Elmo beyond 2020, Lake Elmo plans to be fully built-out in a semi-rural fashion by 2020. In its comprehensive plan, Lake Elmo rezoned the majority of its land for development as Rural Agricultural Density (RAD) at 16 units per 40 acres. Lake Elmo allows and encourages OP development of RAD zoned land (City of Lake Elmo 2002). Thus, while the city is proposing to accommodate essentially the amount of growth recommended by the Met Council through 2020, it is planning to do so using low-density lots and clustered developments throughout the city rather than within a limited area of high-density development. The city plan sets aside no urban reserve lands. Low-density development throughout the city will preclude future high-density development, which the Met Council intends for urban reserve areas. Further, placing the open space portion of OP developments into permanent conservation easements, as the city requires, precludes future development of that land.

Compromises proposed by the Met Council would allow Lake Elmo to maintain a higher proportion of its land in a rural state than the council called for in the 1996 blueprint and wastewater system plan, and they would allow the community to continue some use of cluster development. To date, Lake Elmo has stuck to its comprehensive plan. The state Supreme Court will ultimately decide whether Lake Elmo's right to self-determination or the Met Council's authority and duty to coordinate planning across local jurisdictions prevails, or the court could articulate the legal basis for a compromise between these principles.

Fairness and Equity

This section addresses the following:

- ***How was system architecture relevant to this issue?*** Lake Elmo's decision to limit urbanization and not utilize regional sewer service may increase infrastructure and other costs across the region and place an unfair burden on other communities.
- ***How was the issue addressed?*** The Met Council argues that Lake Elmo has long been identified as a location for urban growth. The council believes Lake Elmo is receiving regional benefits but that it is unwilling to accept costs of increased development. It demanded that Lake Elmo modify its comprehensive plan to allow more growth and regional sewer service.
- ***Did the issue resonate with the community?*** Regional equity and regional versus local control have been polarizing topics. Other local government officials have weighed in on both sides of the issue. Certain Lake Elmo property owners feel cheated by the city's anti-sewer planning and zoning policies.
- ***Results/Status:*** An administrative law judge has ruled that the Metropolitan Council has the authority to require uniform growth in the region. An appeals court affirmed the council's decision. Lake Elmo has appealed to the state Supreme Court.

How Was System Architecture Relevant to This Issue?

Lake Elmo has rejected additional regional sewer service based on objections to dense development. The Met Council argues that denser development in Lake Elmo, made possible by regional sewers, is necessary in order for the region to cost-effectively accommodate growth and to reduce impacts on other communities. Lake Elmo counters that new development within Lake Elmo is paying directly for its own wastewater needs by constructing and maintaining ISTS or EWTS, so a costly new regional interceptor will not be needed.

How Was the Issue Addressed?

The fairness and equity issue was addressed by the Met Council and the City of Lake Elmo regarding:

- Regional impact
- Regional benefits versus the costs of increased development

The Met Council Found Lake Elmo's Comprehensive Plan Substantially Impacts Regional Systems and Other Regional Communities

The Met Council found that Lake Elmo's comprehensive plan substantially impacts regional systems and other regional communities. The Met Council believes Lake Elmo's decisions create additional costs for the region as a whole to provide services to urban-density development that would have to go elsewhere if it does not occur in Lake Elmo. In the council's view, Lake Elmo has undeveloped lands that could accommodate a substantial number of homes at urban densities while leaving a significant portion of Lake Elmo in a permanent rural state. The council believes these lands can be urbanized and served more economically in terms of transportation, transit, parks and sewers than most other undeveloped areas in the region, and it points out that many of the investments to support urbanization have already been made.

In the case of sewer service, Lake Elmo does not argue that its comprehensive plan does not depart from regional system plans. Instead the city argues that its plan will not harm the metro sewer system because regional players would save $10 million by not requiring that an interceptor be constructed to serve the city (State of Minnesota Office of Administrative Hearings 2003). The Met Council states that according to an analysis done by its assistant general manager of environmental services, if Lake Elmo's projected growth were to occur elsewhere, "it would be more costly to add sewage treatment capacity to other areas of the metro area to accommodate that growth, than to build the Lake Elmo Interceptor." (State of Minnesota Office of Administrative Hearings 2003) Additionally, the Met Council claims that septage-tipping fees paid by Lake Elmo homeowners (and users from other communities) do not cover full costs of construction of receiving stations or the corrosion of downstream pipes resulting from the highly concentrated liquor (Metropolitan Council 2002c, p. 13). Likewise, communities with receiving stations must also bear increased truck traffic and odors. The Met Council does have authority to raise fees to recover its costs (State of Minnesota Office of Administrative Hearings 2003, Exhibit C).

The Met Council maintains that since at least the mid-1990s, during development of the 1996 regional blueprint and wastewater system plan, Lake Elmo has been identified as an area for urban growth. The council also cites investment of regional funds totaling $7.6 million since 1974 to acquire and develop the Lake Elmo Park Reserve as an example of even-earlier identification of Lake Elmo as a location for future urban development (Metropolitan Council 2002b, pp. 14–15).

Lake Elmo is under considerable market pressure because development has already "leapfrogged" the city to towns further east, including some Wisconsin border towns, as a result of the 18-month building moratorium and the lack of conventional sewer service. Met Council officials say Lake Elmo's policies will force development into other communities because Lake Elmo's typical net density for new development of 2.5 acres per housing unit consumes large areas of land for small amounts of growth. They say this results in inefficient use of public and private infrastructure, characterized by substantially higher per unit costs for highways, roads, sewers, electric service, phone service (land lines), cable service, natural gas service, transit service, school services (especially school bus service), fire and police services, and other services. They point out that neighboring Woodbury provides housing at a density of three to five units per acre, a rate of about 10 to 1 compared to Lake Elmo. Such development consumes far less land in meeting the region's growth needs.

Lake Elmo officials point out that there is a demand for the type of housing, subdivision, and community the city provides. City leaders suggest dense urban development targeted for Lake Elmo could be directed to other communities in the region that want such growth.

The Met Council Believes Lake Elmo Is Receiving Regional Benefits but Unwilling to Accept the Costs of Increased Development

According to the Met Council, Lake Elmo's proximity to regionally funded transportation and parkland is among the best in the region (Metropolitan Council 2002b, p. 22). Interstate 94 and State Highway 36, which border the south and north of the city respectively, are both principal arterials (the highest class of regional highway). In the three-mile section of I-94 along the southern edge of Lake Elmo, four interchanges have been constructed to serve residents of Lake Elmo and neighboring communities. The 2,200-acre Lake Elmo Regional Park Reserve was established with $7.6 million in regional funding. The Met Council believes that Lake Elmo should reciprocate these regional (and state and federal) investments in transportation and recreational amenities by accepting a certain amount of urban growth.

Lake Elmo officials point out that the city misses out on 2,200 acres' worth of property taxes because of the regional park. They also suggest that the federally initiated and largely federally funded Interstate 94 is not a regional investment that the city should have to repay.

Did the Issue Resonate With the Community?

The fairness and equity issue resonated with the community in the areas of:

- Regional versus local control
- Rezoning

Regional Equity and Regional Versus Local Control Have Been Polarizing Topics

This case study opens up an important topic encountered in many metropolitan areas, one of local versus regional control over what were once clearly local decisions, such as land-use, housing density, land preservation, and wastewater systems. Communities are often strongly affected by the land use and infrastructure decisions of neighboring communities and regional governmental entities.

The case has drawn much attention in the region. Some towns are in support of the local control that Lake Elmo is trying to maintain, while others are concerned about diversion of development pressure to their communities as a result of Lake Elmo's plan.

The Association of Metropolitan Municipalities (AMM), an organization that represents approximately 130 of the 189 cities and townships in the region, has gone on record supporting the council. Barry Johnson, the city administrator of neighboring Woodbury, criticized Lake Elmo's low-density development plan, asserting that allowing cluster housing for the entire city with ISTS and cluster wastewater systems "drives up the cost of housing, and results in growth leapfrogging over Lake Elmo to other communities that have full utilities." (State of Minnesota Office of Administrative Hearings 2003) Currently, border towns in Wisconsin are experiencing increased growth as a result of families that work in the Twin Cities area moving there, and officials in the border towns have publicly blamed Lake Elmo for the increased growth pressure.

I-94 Landowners May Not Be Able To Recoup Investments on Properties

As part of its plan to steer development to its Old Village, Lake Elmo is considering rezoning properties along I-94 from "general business" to "limited business." (Divine 2002) According to Mayor Lee Hunt, the aim of rezoning is to restrict the eligible land uses to office parks, supporting businesses, and higher-end restaurants—services that would not detract from planned commercial interests in the village. The city wants to avoid "fast-food restaurants and heavy-duty strip malls." Current businesses along I-94, which include an auto-body shop and a lumberyard, would be grandfathered in under a zoning change, but owners fear that they may not be able to expand or renovate in the future. One business owner has estimated that her business and land value would be cut by 50 percent by the rezoning, and described it as "devastating."

Results/Status

The Met Council has proposed a number of compromise land use scenarios that would allow the regional growth it expects while keeping much of Lake Elmo rural. To date, Lake Elmo officials have rejected these compromise offers. Lake Elmo's draft comprehensive plan sets out the city's view on accepting a limited degree of urbanization—it states that the result could be a "dual community" of two very different areas within one legal entity. These areas could have incompatible needs and expectations according to the plan (City of Lake Elmo 2002).

The administrative law judge addressed some of the issues of intra-regional equity in the distribution of growth (State of Minnesota Office of Administrative Hearings 2003, Memorandum Conclusion):

> The Metropolitan Council believes that this contested case proceeding is a direct challenge to the Metropolitan Land Planning Act and the concept of regional planning. It believes that if Lake Elmo is able to disregard regional planning guidelines that any city would be free to do so. It is the City's viewpoint that the Metropolitan Council is inappropriately extending its authority to force population growth through unwanted extensions of its wastewater system. It asserts that the local government, which does not choose to rely on the metropolitan sewer system for growth, has a right to determine its own destiny. It points out that it has planned for the population growth desired by the Council through 2020. But, if that growth occurs, Lake Elmo would be fully settled by that date and adjacent communities would be much more densely settled. It believes that the Council is encroaching upon its zoning authority and that the Council should revise its plans and forecasts to shift people and funding to communities [that] might welcome additional development.
>
> The record makes it clear that the Metropolitan Council is, as its resolution indicates, calling for substantial urbanization in Lake Elmo by 2040. The construction of a new

> interceptor to Lake Elmo will undoubtedly increase the pressure for development in the City. The Council sees the City's proposed land use as resulting in underutilization of planned metropolitan systems. The requirement for an Urban Reserve district, as well as the Council's forecasts for population, households, and employment, require the City to develop at a greater density than it desires.
>
> However, the legislative intent reflected in the statutes as they presently stand provide[s] the Metropolitan Council with authority to require modifications to comprehensive plans that depart from or have an impact on its system plans in a substantial manner. The City's plan substantially departs from the system plans. Although it may infringe upon a city's right to determine how it will grow, the MLPA authorizes the Metropolitan Council to require uniform growth in the metropolitan area if it is necessary to a planned, orderly and staged development. If this is not the legislative intent, then legislation will be needed to clarify that underutilization of metropolitan systems is not within the Council's authority.

An appeals court affirmed the Met Council's decision to require changes in Lake Elmo's comprehensive plan. Lake Elmo has appealed to the state Supreme Court.

Stakeholder Relationships and Trust

This section addresses the following:

- ***How was system architecture relevant to this issue?*** Historically, sewering has been a divisive issue within Lake Elmo. Regional sewer plans have also strained relations between the city and the Met Council.
- ***How was the issue addressed?*** The city engaged stakeholders in the community during formulation of open space and treatment wetlands policy. The Met Council did likewise during development of regional growth plans. Lake Elmo did not object to the council's plan. The Met Council solicited input from Lake Elmo during planning of a regional sewer interceptor, but the council and the city did not reach a clear agreement on the scale of sewering.
- ***Did the issue resonate with the community?*** Landowners in the past detached from the city in part over distrust arising from sewer service issues. Lake Elmo officials and citizens distrust the Met Council in part because it is not directly accountable to local communities.
- ***Results/Status:*** An atmosphere of distrust between Lake Elmo and the Met Council will require substantial effort to clear up.

How Was System Architecture Relevant to This Issue?

Sewer service has historically been a divisive issue within Lake Elmo. Regional sewers have also been problematic in terms of outside relationships. The Met Council solicited Lake Elmo's opinions and comments during its infrastructure planning process and planned for regional sewer extensions into the city. However, the Met Council and the city disagree on Lake Elmo's representations regarding sewer needs during development of the interceptor plan.

How Was the Issue Addressed?

Stakeholder relationships and trust were influenced by:

- Engaging local constituents in ordinance development
- Identifying Lake Elmo as a future urbanization area
- Participating in Met Council regional development planning
- Failing communications between Met Council and Lake Elmo

Lake Elmo Engaged Key Local Players When Drafting the OP Ordinance

Once Lake Elmo officials decided to pursue cluster development, they appointed a committee to draft the amendment to the comprehensive plan. The committee consisted of city officials, developers, planning commissioners, citizens, landowners, and business owners. According to one developer, the early inclusion of these parties in the decision making process eliminated fears and uncertainty surrounding cluster development, which was a new concept in the region at the time. By engaging these constituents, city officials were able to include provisions in the ordinance, such as housing density bonuses, that increased the incentives for the development community to pursue cluster subdivisions.

The Met Council Identified Lake Elmo as a Future Urbanization Area and Lake Elmo Did Not Formally Object

The Met Council maintains that Lake Elmo has long been identified as an area for substantial urban development and has either solicited or been subsidized by regional investments in infrastructure. Lake Elmo officials interviewed for this study emphatically maintain that Lake Elmo has always wished to retain both the rural and village components of its character. They cite the city's fight against routing I-94 through Lake Elmo as an example of the city's rejection of regional infrastructure.

In preparing its *2020 Regional Blueprint* in the mid-1990s, the Met Council included an 18-month public-participation process as required by the Metropolitan Land Planning Act. The council held numerous workshops, public meetings, and public hearings to gather comments and invited input from all 189 cities and townships, seven counties, the governor, numerous legislators, and special and public interest groups in the region. Lake Elmo took part in these deliberations. At the end of the public process, the *2020 Regional Blueprint* was drafted by the Met Council to outline how much development local communities should plan to accommodate. The council then provided infrastructure-specific "system statements" to each community that indicated the location, size, and timing of regional infrastructure that the Met Council will be constructing to support planned growth. Lake Elmo did not challenge the 1997 wastewater system statement or request a hearing regarding the statement, as allowed by state law. However, it should be noted that while metro-area municipalities sometimes disagree with the statements, none has ever requested a hearing (State of Minnesota Office of Administrative Hearings 2003, findings 68 and 69).

Lake Elmo Participated In a Series of Regional Services Planning Discussions With the Metropolitan Council but at Some Point Communications Failed

Soon after issuing the system statement, the Met Council began planning additional sewer capacity to serve Lake Elmo via the South Washington County Interceptor. Records of the planning process show that Lake Elmo city officials, including the mayor on some occasions, attended related advisory committee meetings in 1998 (Bonestroo Rosene Anderlik & Associates Inc. 2000, Appendix F). Met Council staff also attended two Lake Elmo city council meetings in 1998 to discuss interceptor planning (State of Minnesota Office of Administrative Hearings 2003).

City officials maintain that the city council was very clear during this process that Lake Elmo would accept some regional sewer service along the I-94 corridor if the service was brought in from west to east, was limited in scale to serving 320 additional acres (to meet the 440 acres requested in 1992), and was without specifications as to the type of development the city would hook up to it. The city council had only office-type development in mind. The final interceptor facility plan and advisory committee minutes (Bonestroo Rosene Anderlik & Associates Inc. 2000) show that Lake Elmo expressed its preference for sewer to be provided from west to east, but are unclear on Lake Elmo’s indications regarding capacity and type of development. According to some interviewees, it may have been the case that city staff participating in the process had a different view of the need for regional sewers than did the city council. Whatever the exact cause, it is clear from later disputes over the city’s comprehensive plan that at some point in the facility planning process communications failed, and the Met Council and Lake Elmo did not reach a clear agreement on the amount of sewer service that should be provided to Lake Elmo.

Did the Issue Resonate With the Community?

Stakeholder relationships and trust issues that resonate in Lake Elmo include issues related to:

- Sewer construction
- Loss of control to a regional authority

Sewer Construction Has Been a Divisive Issue Within Lake Elmo for Several Decades

These divisions became apparent during the federal 201 grant program and in the annexation of land by Oakdale.

Larry Bohrer of TKDA was the consulting engineer during the 201 grant program from 1980–1985, which resulted in the construction of individual and communal septic tank/soil absorption systems around the city. According to Bohrer, there was a core group of business owners in the village that lobbied strongly to use the grant money to fund a municipal sewer to remedy the failing systems, emphasizing future city growth and development. The 201 program, however, was intended for alternative technologies and only to solve existing problems. The grant money could not be used to construct any excess treatment capacity for future service. City officials could have chosen to raise other funds to construct a treatment plant or to purchase extra capacity for future service, but as several interviewees recalled, an anti-growth, anti-sewer atmosphere existed in city government at the time.

According to Mary Kueffner, a former city administrator, some citizens viewed the decision to replace septic tanks as a temporary fix and believed the city was avoiding the real issue of a need for sewers. She recalls that the issue caused several people to run for city council on a pro-sewer platform. These candidates lost.

City residents also recall an atmosphere of distrust created by the decision of certain landowners to detach from Lake Elmo and be annexed by Oakdale in the 1990s. Bohrer recalls the debate as a "what comes first, chicken or the egg…sewer or development stalemate." Wyn John recalls feeling frustrated that the developers did not try to work out a development plan with the city council prior to the annexation, and he recalls the "atmosphere of distrust" between the city council and landowners because of certain city council members' "keep sewer out at all costs" attitude. The position made compromise unattainable. The annexation forced the town to rethink its anti-growth stance, however, and to provide some regional service to that portion of the city soon afterwards.

Some Local Officials are Concerned About Losing Control to an Unelected Regional Authority

The Met Council is comprised of 16 representatives and one chairperson, all appointed by the governor. Although the Met Council takes pride in its public participation processes with city officials and citizens, cities like Lake Elmo that are trying to develop in a fashion that differs from regional blueprints say the council lacks accountability to local residents. One Lake Elmo official also views the Met Council's dual roles—as a regional planning agency and as a sewer and wastewater treatment plant operator—as an inherent conflict of interest. The argument is that the Met Council could inappropriately slant its planning policies in ways that support its wastewater business.

The Met Council points out that its decision regarding Lake Elmo was supported by two different councils appointed by an independent governor and a republican governor. They also note that the AMM, an organization that represents approximately 130 of the 189 cities and townships in the region, has gone on record supporting the council.

Results/Status

It is beyond the scope of this analysis to judge whether either party acted in bad faith during regional and local planning efforts or the wastewater facility planning process. Many have charged Lake Elmo with arrogance in not compromising with the council, while Lake Elmo officials charge the council with not compromising enough on regional land-use requirements. What the case study project team can decipher is that the tug-of-war between regional and local control over local land-use policy and associated wastewater service policies has resulted in an atmosphere of distrust that will have to be overcome with further discussions and negotiations.

Conclusions

Lake Elmo's OP ordinance is accomplishing what it was intended to do—allowing development while retaining the city's rural character; creating neighborhoods and a sense of community, protecting the environment and utilizing its services for flood control and wastewater treatment, and offering recreation and visual amenities. Had Lake Elmo not been located within a metropolitan area with a designated regional planning authority responsible for infrastructure, there would likely have been few problems associated with its cluster development approach. This case study points out the inescapable connection between wastewater infrastructure and growth, and the difficulties in long-term facility planning in regional situations. Much controversy has surrounded Lake Elmo's growth and wastewater policies, and much can be learned from its approach and the ensuing conflict. Here are some lessons:

- Engage all segments of the community early in planning and policy-making processes. The city engaged citizens early in the OP ordinance decision process, enacted a building moratorium to buy time to craft a solution, and developed a cluster development ordinance that served citizen desires to remain a semi-rural community. Lake Elmo then developed a comprehensive plan in line with this vision; however, a "geographic consensus" behind the plan was never reached. Property owners along I-94 had a different vision and requested sewer service. If local officials had addressed the concerns of all citizens and property owners before proceeding, some intra-community issues as well as some regional issues may have been avoided.
- Address land-use planning before wastewater planning. Shape wastewater system architecture around land-use decisions.
- Address performance and reliability concerns over a wastewater technology thoroughly. Find qualified experts to help your community understand the technology and its requirements. Lake Elmo could have used many different treatment technologies to serve cluster developments. It chose wetlands treatment because this technology offered low operating costs and synergistic aesthetics with open space preservation, and because an engineering firm thoroughly familiar with the technology was nearby.
- Make every effort to reach a consensus on performance and reliability issues. This becomes especially important when implementing an innovative or alternative solution. Broad political support is necessary to give the technology the time necessary to meet or fail to achieve expectations. Providing management (oversight) to ensure that operation and maintenance achieves a level of service that residents would receive with centralized sewerage can help to gain support.
- Consider how cluster development served by cluster-scale wastewater systems could serve the community. This approach can offer advantages over individual onsite systems. These include the ability to site wastewater systems in open spaces—thus avoiding system location limitations on individual lots and providing design freedom. Economies may be realized in treatment system costs and in O&M. Cluster systems also result in fewer treatment systems for a municipality or other entity to track and regulate. Be sure the community's consulting engineers thoroughly understand cluster systems and other decentralized wastewater concepts so they can do an adequate job of identifying and screening options.

- Use cluster development to simultaneously take advantage of and preserve the capacity of the natural environment to serve human needs. Take advantage of gradients for wastewater and stormwater collection. In The Fields of St. Croix, natural “rain gutters” (swales) collect rainfall from roadsides and convey runoff to small constructed stormwater treatment wetlands that naturally filter road pollution from the water before it is recharged back into the ground. Local soil discharge of treated wastewater also means all water is recharged into the basin.
- If the community wishes to go a different direction than the direction of neighbors or a regional planning agency, make those intentions very clear as early as possible. Identify and promote the advantages of the community’s approach to authorities early on to avoid redundant or conflicting plans. For instance, by treating wastewater at the site or neighborhood scale, new development in Lake Elmo largely pays its own way for wastewater infrastructure and places few demands on municipal or regional infrastructure (with the exception of septage management). Lake Elmo could have promoted these aspects of a decentralized approach when the Met Council was planning a regional interceptor to serve the community.
- Consider the impact the community’s plans may have on other communities, and assess the degree to which the community is dependent on outside support. This is a point on which interviewees for this study have widely divergent views. Met Council officials believe that Lake Elmo’s policies shift costs to other communities and its rural character is subsidized by infrastructure and services that other communities in the region and state and federal taxpayers have funded. Lake Elmo officials bristle at these assertions and say they have rejected or tried to reject many such investments. The disparate claims have complicated historical, economic, and political aspects that are beyond the scope of this study to sort out. What can be said is that a community should carefully consider inter-community equity issues that might be raised by its land-use and infrastructure policies. Such consideration may lead a community in many directions—to change its policies, to work more closely with its neighbors and other agencies, or to understand the issues in ways that allow a stronger defense of its policies.
- Attempt to recognize and address as early as possible other concerns of neighboring communities and other authorities with the community’s approach. For one, reliability is almost always a concern with decentralized wastewater systems. Develop a robust management program to assuage concerns over system failures.
- At the regional level, when pricing infrastructure services, be sure prices accurately reflect the true costs of septage on receiving stations and other infrastructure components. It is important to send the correct market signals to communities weighing wastewater architecture options.
- Ensure accountability, both financial and environmental. Consider and define how system failures will be addressed if they occur. If choosing to employ a decentralized architecture as Lake Elmo did, rather than to access regional infrastructure, accountability to regional and state authorities must still be provided.

- Likewise, accountability within the municipality should be articulated clearly. If HOAs are responsible for O&M, then financial and environmental assurances should be secured from them as well.
- Make sure systems are in place to properly oversee construction and operation of decentralized systems. Consider municipal ownership and/or operation of cluster systems. Lake Elmo may be moving in that direction. On the other hand, many models exist for successful private sector management of decentralized wastewater systems. However, they require careful structuring of incentives and liabilities, and some degree of public oversight. If relying on HOAs and the private sector for operation and maintenance, build municipal oversight into the system and maintain detailed records to alert city staff if lapses in management occur. Be aware that many experts in the decentralized wastewater management field do not consider HOAs to be appropriate management entities. They often do not have adequate technical, managerial, or financial capacity to effectively oversee decentralized systems and usually lack adequate enforcement power.
- Be sure that user charges cover all O&M costs *and* all capital replacement costs—not just O&M, but OM*&R*. Covering replacement costs not only assures the community of the economic sustainability of the approach, but also helps demonstrate to other authorities the community's accountability.
- Educate homeowners about the importance of wastewater treatment system "health," and educate them about their own financial and environmental interests in doing their part to maintain that health. This is particularly important if a cluster wastewater system is marketed as "having sewer service," as some have been in Lake Elmo. Cluster systems are in many ways like centralized sewerage, but require somewhat more care on the part of homeowners.

Other case studies in this report show how differing visions of the future can lead to difficulties in infrastructure planning within a community. This study clearly shows how in a metropolitan context, visions of growth can be fundamentally incompatible across multiple communities as well as within individual communities, leading to substantial disputes between entities responsible for planning a community or a region's future. Large regional investments take years to plan and decades to reach capacity. Once the infrastructure is in place, the effects on a region and its communities are irreversible. Likewise, a single community can have a substantial impact on growth beyond its borders. One has to credit Lake Elmo for defining a clear community vision and implementing it by finding a compatible approach to wastewater treatment. Hopefully, the dispute between Lake Elmo and the Metropolitan Council can be resolved to the benefit of current and future generations of local and regional citizens.

Sources

Sources for this case study include:

Personal Interviews

Steve DeLapp, City Council member

Caren Dewar, Deputy Regional Administrator, Metropolitan Council, St. Paul, MN

Chuck Dillerud, City Planner, Acting City Administrator

Robert Engstrom, President, Robert Engstrom Companies, Minneapolis, MN

Phyllis Hanson, Manager of Planning and Technical Assistance, Metropolitan Council, St. Paul, MN

Marc Hugunin, Principal, Pepin-Hugunin Associates, Stillwater, MN; former Representative to the Metropolitan Council for most of Washington County, including Lake Elmo

Lee Hunt, Mayor

Wyn John, former Mayor

Mary Kueffner, former City Administrator

Judy Lissick, Business Manager, North American Wetland Engineering (NAWE), Forest Lake, MN

Tom McElveen, former Public Policy Director, Builders Association of the Twin Cities, Roseville, MN; now with Hans Hagen Homes, Fridley, MN

William Moore, General Manager of Environmental Services, Metropolitan Council, St. Paul, MN

Judd Schetnan, former Public Affairs Liason, now Director of Government Affairs, Metropolitan Council, St. Paul, MN

Lee Sheehy, former Regional Administrator, Metropolitan Council; now with the City of Minneapolis, MN

Curt Sparks, President, NAWE, Forest Lake, MN

Jim Uttley, Planning Analyst, Metropolitan Council, St. Paul, MN

Gary Van Cleve, HOA member and former HOA President, The Fields of St. Croix

Scott Wallace, Vice President, NAWE, Forest Lake, MN

Phone Interviews

Larry Buhrer, TKDA Engineering, St. Paul, MN

Jeff Childers, President, AAA Pollution Control, Oakdale, MN

Mike Martindale, ISTS Soil Scientist, Minnesota Pollution Control Agency, St. Paul, MN

Tom Prew, TKDA Engineering, St. Paul, MN

Ann Pung-Terwedo, Senior Planner, Washington County, Stillwater, MN

Dave Sahli, Senior Engineer, Wastewater Permitting, Minnesota Pollution Control Agency, St. Paul, MN

Documents

In addition to the documents below, numerous city ordinances, meeting minutes, newspaper articles, and written correspondence with the City of Lake Elmo, Robert Engstrom, the Metropolitan Council, and North American Wetland Engineering contributed to the study.

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12 BROAD TOP TOWNSHIP AND COALDALE BOROUGH, PENNSYLVANIA

This case study addresses the following topic:

- Stakeholder Relationships and Trust

The Community

Broad Top Township and Coaldale Borough are situated in the northeastern section of Bedford County, located in south central Pennsylvania. The area is characterized by thick forest cover and a steep, mountainous topography carved by many creeks and streams. Broad Top Township has a land area of 48.5 square miles and encompasses the villages of Riddlesburg, Defiance, North Point, Finleyville, Round Knob, Kearney, Langdondale, Cypher, and part of Wood. The Borough of Coaldale is also located within the township. It is 0.2 square miles in size and has its own governing council and mayor.

Figure 12-1: The Location of Broad Top Township and Coaldale Borough in the State of Pennsylvania

All of Coaldale and approximately two-thirds of Broad Top Township are located on the Broad Top Mountain Plateau, part of the Appalachian ridge and valley system. The area was originally settled for its semi-bituminous coal reserves, and mining was the economic foundation for the region through the mid-twentieth century—but has since been in decline. Timber cutting is now a major industry, along with some agriculture on the higher elevations of the plateau. Otherwise, business is limited to small-scale, locally-oriented commercial establishments.

Mirroring the decline in the coal industry, total population in the municipalities has fallen dramatically since its estimated high of 4,365 in 1940 (Tatman & Lee Associates, Inc. 1995, p. II-5). The Army Corps of Engineers created Raystown Lake, a popular recreation destination, in 1970 for electric generation and flood control. Its location five miles north of the municipalities helped reverse the overall population decline and brought the combined population to 1,918 persons in 1990. The population has since declined slightly as shown in Table 1-1

Table 12-1: Broad Top Township/Coaldale Borough Population Trends

Area	1940	1980	1990	2000
Broad Top Township	4,092	1,805	1,918	1,827
Coaldale Borough	273	201	143	126

Source: Tatman & Lee Associates, Inc. 1995 and U.S. Census.

About 70 percent of the population resides in and around the villages and Coaldale Borough, at residential densities greater than one unit per acre. The remaining population is scattered across outlying rural areas in individual homes or clusters of a few homes in close proximity. A majority of residents earn below-average incomes, and the municipalities frequently qualify for community development block grants.

Three water companies serve area residents, supplying water to 130 households in and around Coaldale Borough and 70 households in the village of Defiance. They all rely on springs and wells for potable water. The remaining households depend on private springs and wells, and, in some instances, community springs.

Courtesy of Broad Top Township

Figure 12-2: The Main Street of Coaldale Borough

Wastewater Issues

The Broad Top Mountain Plateau is capped by resistant sandstone bedrock and drained by five major streams, all of which eventually enter the Raystown Branch of the Juniata River and flow to Raystown Lake. The area contains 15 different classified soil types, ranging from well-and moderately-drained soils to very poorly-drained soils. A significant portion of the area has shallow soil above bedrock, is located in a flood plain, or is constrained by seasonal high water tables (Tatman & Lee Associates, Inc. 1995, pp. II-9–II-12).

Early settlement occurred within stream valleys and hollows adjacent to deep mine workings. Many residents remain in these places. Other homes are located on steep slopes and at elevations above the original settlements. A result of this timing and pattern of development has been the widespread practice of direct discharge of raw wastewater to streams and storm drains. Although environmental regulations prohibiting the practice were adopted long ago, the discharges were not stopped because lots were too small to support septic systems, because of the prohibitive cost of a centralized system, and because stream quality was already significantly degraded from acid mine drainage.

A small extended aeration package plant serves the local elementary school and nearby church. Approximately 56 households in the Village of Wood receive sewer service from the neighboring Village of Robertsdale (Tatman & Lee Associates, Inc. 1995, p. II-26 and Broad Top Township Secretary's Office). Otherwise, remaining residents into the 1990s depended on a combination of onsite septic tank/soil absorption systems (which the towns commonly refer to as "on-lot" systems), holding tanks, privies, and local creeks to dispose of wastewaters.

Potable water is a precious commodity in the region. A local effort to remediate mine spoils focused attention on inadequate sewage disposal as a major remaining water quality problem with potential impacts on public health. To protect the few potable water supplies, and to ease phosphorous loading into Raystown Lake, the township and borough combined resources to search for cost-effective wastewater management solutions.

Historical Overview

A comprehensive sewer and water plan was developed by Bedford County in 1973. It proposed a centralized wastewater system to serve all the villages in the township except Cypher, but no costs or schedule were developed. The county plan was updated in 1980, and identified Coaldale, Defiance, and Riddlesburg as areas warranting attention, but again no action was taken (Tatman & Lee Associates, Inc. 1995, pp. I-5–I-6). Costs were assumed to be project deterrents during this time period.

In 1981, the Broad Top Soil and Water Conservation Project prepared a study of the entire Broad Top Mountain Plateau. It identified water quality and quantity as key problems for the region. It also determined that inadequate wastewater systems were major contributors to surface and groundwater degradation.

The study made the following recommendations (Tatman & Lee Associates Inc. 1995, pp. I-7–I-8):

1. Existing adequate systems should be maintained
2. The possibility of low-cost biological treatment (no water) systems should be considered
3. The possibility of low-cost, small cluster systems for small groups of homes should be considered
4. Other sewage treatment facilities should be considered only if costs are low and affordable
5. Municipalities in the Broad Top region should join together with other rural areas and encourage Pennsylvania legislators to develop specific programs to subsidize alternative low-cost, low-water-using sewage disposal systems suitable to sparsely populated rural areas

The plan helped to put regional water issues in perspective so that county and municipal organizations could begin addressing the problem areas. Also, the plan increased recognition that improving water quality would require better wastewater treatment and disposal.

Both municipalities recognized their sewage problems. Small lot sizes in Coaldale Borough led to direct sewage discharge into storm sewers that led to ditches and streams—what one local official termed “wildcat sewers.” The borough’s small population was mostly low-income and could not support a centralized treatment system. Broad Top Township also had concentrated numbers of malfunctions and wildcat sewers in many of its villages, as well as malfunctioning on-lot systems in its large rural area. In 1990, borough officials approached township officials about combining their interests and resources in examining grant opportunities for wastewater treatment systems.

In January 1991, the two municipalities held a public meeting to discuss whether to pursue wastewater treatment. The citizens voiced concern over costs and expressed a desire for all areas, including outlying rural areas, to receive wastewater treatment services. Attendees overwhelmingly agreed to proceed. Soon after, the two municipalities formed a joint Sewage Advisory Committee (SAC) of public officials and residents to identify and address the extent of their sewage problem. The committee worked extensively with the Bedford County Planning Commission during this time. Approximately 800 homes were included in the potential service area.

The SAC spent considerable time crafting a request for proposals (RFP) that would accurately reflect the needs of residents in both communities. In 1992, the RFP was issued. It called for a comprehensive study of both municipalities to determine feasible sewage disposal and grant funding alternatives. One of the criteria stated in the RFP was the development of a management plan capping operation and maintenance fees for all residents at $10 per month. The RFP also specified that hookup and other initial fees must be kept low.

The municipalities received 50 percent planning reimbursement funds for the $27,000 study through the Pennsylvania Department of Environment Protection (DEP). The engineering firm Tatman & Lee Associates, Inc. of Doylestown, Pennsylvania was selected to prepare the Pennsylvania Act 537 wastewater facility plan.

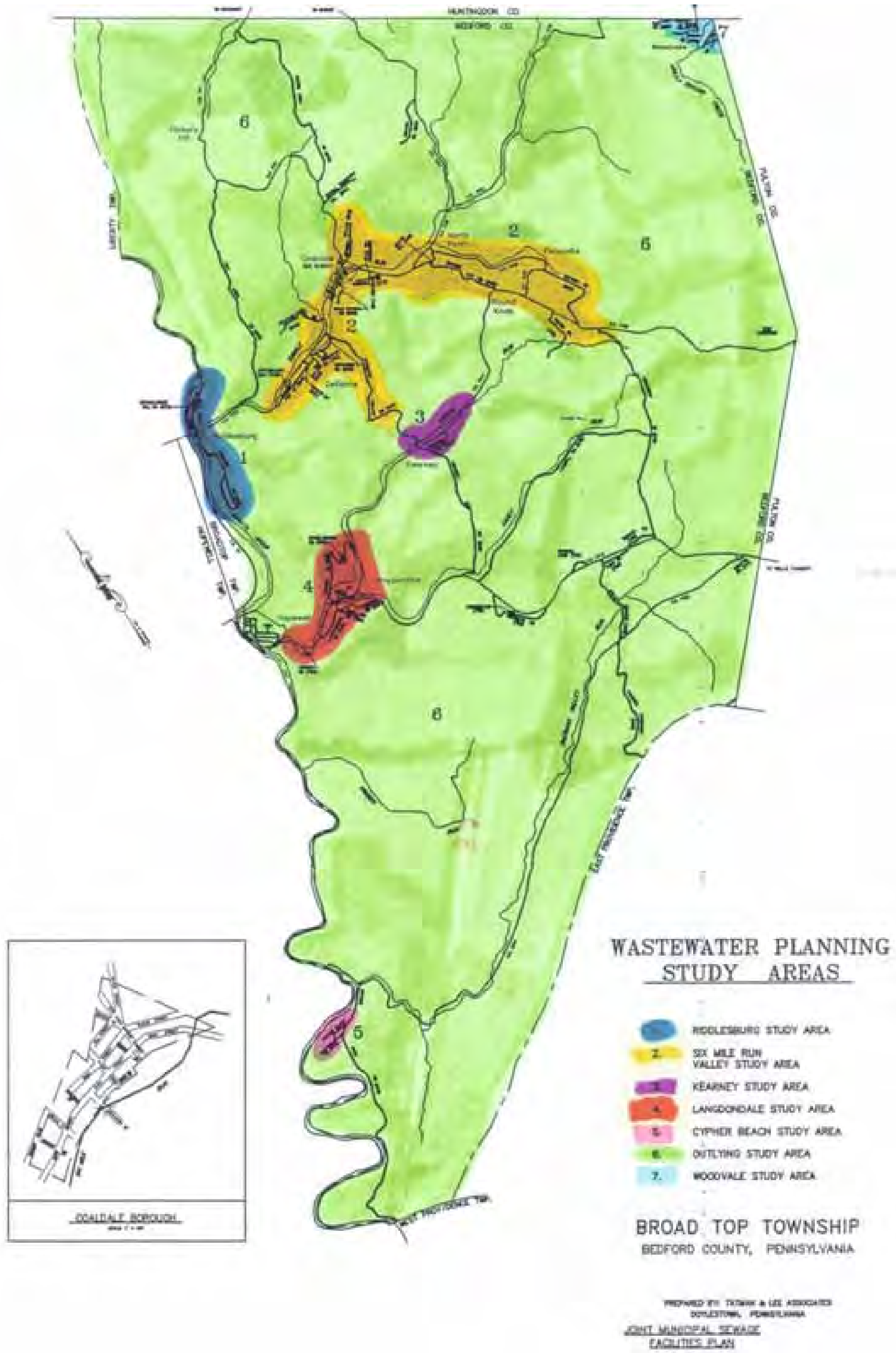
The engineers conducted a random survey of 101 homes and found that approximately 48 percent of systems evaluated did not properly dispose of wastewater (some local officials still believe the figure was actually closer to 80 percent). Besides on-lot systems, surveyed residences utilized a total of four holding tanks, five outhouses, and 39 wildcat sewers (Tatman & Lee Associates, Inc. 1995, p. II-27). In addition, water quality analysis indicated that a number of springs and wells had been contaminated by sewage effluent, particularly in the Village of Riddlesburg.

The construction of a single wastewater collection and treatment plant to serve the entire area was never considered. The study area, with its isolated villages, steep slopes, and rural outlying areas rendered this approach inappropriate and too expensive for low-income residents. Instead, the area was divided into six study areas, five of which concentrated upon population clusters; the sixth was devoted to outlying rural lands. A variety of collection, treatment, and disposal options and onsite treatment technologies were reviewed.

After conducting feasibility analysis of various configurations, the engineers found that village-scaled community wastewater collection and treatment systems were most cost-effective to serve Coaldale and the villages of Broad Top Township. A total of five community systems were proposed to serve roughly 600 households. The engineers proposed that the remaining 220 households in outlying areas continue to be served by on-lot systems under a management program. Figure 12-3 shows the study areas. Table 12-2 shows the configurations and estimated costs of the various systems proposed in the plan. The plan proposed that all residents, whether connected to a community system or utilizing an on-lot system, would pay the same monthly service fee of $10.

The DEP approved the plan on July 27, 1995. In March 1996, Coaldale Borough and Broad Top Township entered into an intergovernmental agreement establishing Broad Top Township as the management agency for all community systems and for the on-lot management program. The agreement also formally established an advisory committee of 13 members, three from the borough and 10 from the township, to provide input for the planning design process, which the SAC fulfilled.

The DEP promoted the plan as an innovative/alternative solution, and the municipalities applied for and received Section 313 U.S. Army Corps of Engineers funding for a demonstration project designated to resolve area-wide sewage problems in rural communities. Funding from the 313 program came in several installments. Funds were also received from the Community Development Block Grant (CDBG) program through the Bedford County Commissioners, and from the DEP, as shown in Table 12-3.



Courtesy of Broad Top Township

Figure 12-3: Wastewater Study Planning Areas in Broad Top Township and Coaldale Borough

Table 12-2: Broad Top/Coaldale Sewage Systems and Facilities Plan 1994 Cost Estimates

Study Area	Existing Equivalent Dwelling Units (EDU)[1]	System	Construction Costs per EDU ($)	Operation and Maintenance Costs per EDU ($/year)
Riddlesburg	100	Modified Gravity Sewer Collection to Aerated Lagoon; Sand Filter; UV Disinfection; Stream Discharge	$6,579	$114
Six Mile Run Valley[2]	305	Modified Gravity Sewer Collection to Aerated Lagoon; Sand Filter; UV Disinfection; Stream Discharge	$7,292	$119
Kearney	18	Modified Gravity Sewer Collection to Small Flow Treatment Facility; Stream Discharge	$6,975	$115
Langdondale	70	Modified Gravity Sewer Collection to Lagoon; Sand Filter; UV Disinfection; Stream Discharge	$11,420	$163
Cypher Beach	46	Modified Gravity Sewer Collection to Septic Tank; Sand Filter; Subsurface Discharge	$5,895	$79
Outlying Areas[3]	220	On-lot systems as appropriate for site	$2,273–$10,909	$85 - $439

[1]Each EDU was estimated to have wastewater flow of 170 gallons/day. All systems were designed with 20 percent extra treatment capacity.

[2]The Six Mile Run Valley and Riddlesburg systems have since been combined. Villages included in the service area include Riddlesburg, Coaldale, Defiance, Round Knob, Finleyville, and North Point.

[3]Cost estimates for on-lot systems were based on a range from conventional to more advanced systems.

Source: Tatman & Lee Associates, Inc. 1995, pp. V-35–V49 and Broad Top Township Secretary's Office

Table 12-3: Project Funding Received

Year	Money Received ($)	Funding Agency
1995	$1.75 million	US Army Corps of Engineers 313
1996-2003	$4.62 million	US Army Corps of Engineers 313
1998 & 2000	$177,000	Bedford County Commissioners (CDBG)
2002 & 2003	$180,000	Bedford County Commissioners (CDBG)
1995-2003	$100,000	PA DEP

Source: Broad Top Township Secretary's Office

The 313 program requires that beneficiaries contribute 25 percent matching funds. Given the dire financial status of both municipalities, the Army Corps of Engineers allowed for the matching funds requirement to be satisfied by the DEP, with local abandoned mine reclamation projects as part of a larger watershed restoration project. Construction began in 1997 and has progressed in phases concurrent with grant disbursements.

Community Treatment Systems

Buildings within 150 feet of one of the village-system sewer mains are required to connect. Those in excess of 150 feet can pay to cover the additional span or participate in the on-lot sewage management program. The municipalities inspect the interior plumbing of all structures to ensure proper connections have been made and that no stormwater drains or sump-pumps are connected to the sewer system. Grant funding covers the full costs of community treatment systems, sewer mains, laterals, and pumps for all occupied structures built prior to January 1, 1995. Property owners are responsible for costs associated with interior plumbing work, if any, and electrician and energy costs for grinder pump and alarm systems if required. For new construction, owners pay all of their construction costs plus a $3,500 capacity charge to the township. All property owners also pay the township an initial participation fee of $120 and monthly fees of $10 (increased to $11 in 2001) for the township's operation, maintenance, and management services.

On-Lot Management Program

Properties in existence and at least partly occupied during 1994 were eligible to participate in the on-lot management program. Those participating voluntarily turn over ownership and control of their on-lot systems to Broad Top Township, which in turn inspects the systems and repairs or replaces them at no cost to the property owner. Annual inspections, periodic pumping, and maintenance and operation of the lateral, treatment, and disposal systems become the responsibility of the municipalities. Property owners are required to enter into a maintenance agreement and provide a permanent easement to enable unhindered access to the systems. Property owners needed to elect to participate prior to December 31, 1999 to be eligible for the full program benefits (the deadline has since been extended).

Those eligible property owners electing not to participate in the on-lot management program must have their systems inspected annually by the municipality or a private inspector, and required system repairs or replacements become their responsibility. Any property owner can join the management program at any time by bringing their systems up to code through out-of-pocket expenses. New homeowners constructing on-lot systems must pay for construction of their system and are required to join the management program. Depending on the future maintenance requirements of the on-lot systems built, these new homeowners may be required to pay an additional fee from $357 to $11,378 to fund the extra maintenance costs and future reconstruction costs of their chosen system (Broad Top Township Secretary's Office). All participants in the on-lot management program pay the same $120 initial participation fee and monthly fees as participants in community treatment systems.

Either a free-access sand filter with an absorption area 1.33 times the size of a conventional absorption field, or an alarmed septic tank outlet screen, is required for all new or reconstructed on-lot septic systems participating in the management program. On-lot systems using absorption areas must have a replacement area on the site. If site characteristics prohibit a standard septic system, the following pretreatment methods are analyzed for use in the following order of preference:

1. Free-access sand filter to at-grade bed
2. Sand filter to sand mound discharge
3. Peat filter to at-grade bed
4. Sand filter to stream discharge
5. Constructed wetlands to stream discharge
6. Holding tanks as a last resort

Analysis

This section presents an analysis of stakeholder relationships and trust in relation to this case study.

Stakeholder Relationships and Trust

This section addresses the following:

- ***How was system architecture relevant to this issue?*** Municipal leaders recognized that an effective solution would require the support of citizens and regulators. Using a variety of systems increased support by keeping costs low and satisfied the different physical and social needs of the area.
- ***How was the issue addressed?*** Officials involved citizens, regulatory authorities, and funding agencies early in the planning process. Special attention was paid to drafting the RFP and selecting a consultant that met the needs of the community. Technology and management concerns were addressed so that the community could proceed with an innovative solution. Extensive grant funding made the project possible.
- ***Did the issue resonate with the community?*** Equity concerns arose over the cost of on-lot systems. Consensus made the community attractive to funding sources. Outside funding made the project possible. Dedication of local officials was essential to see the project through.
- ***Results/Status:*** There has been high participation in the on-lot management program. Construction has proceeded along with grant disbursements. Fees have remained stable. Utilization of the municipal workforce has kept project costs in-line with estimates. The sewage advisory committee has evolved along with the project.

How Was System Architecture Relevant to This Issue?

Broad Top and Coaldale officials needed to address the initial concerns of citizens before proceeding with facility planning. Officials then needed a wastewater solution that would fit within the parameters defined by the community. A mix of semi-centralized and decentralized treatment systems under a single management agency provided cost-effective solutions for both the higher- and lower-density areas.

How Was the Issue Addressed?

In order for the project to be a success, municipal officials needed to maintain a transparent decision-making atmosphere for citizens, county and state officials, and funding agencies through:

- Regulatory and public involvement
- Incorporation of community needs in the RFP
- Project engineer selection
- Technology selection

Early and Continued Regulatory and Public Involvement Was Essential

Municipal leaders realized the importance of involving county and state regulatory agencies early and throughout the planning process to avoid enforcement actions. Bernie Hoffnar, who served as a Broad Top Township Supervisor at the time, contacted the DEP concerning wastewater pollution in the Township. According to Hoffnar, he told the DEP that the township would step-up enforcement of existing regulations as applied to new structures and that the municipalities would begin a process to address existing pollution. The DEP was thankful for the township's proactive stance and agreed to delay any regulatory action in hopes that the municipalities would undergo a facility planning process.

An initial public meeting was held on January 28, 1991. More than 200 hundred citizens from both municipalities discussed sewage treatment needs. The discussion focused upon the question of whether sewer service should be provided within the towns, and what areas should receive it.

Jeff Kloss, Executive Director of the Bedford County Planning Agency, and a representative from the Rural Community Assistance Corporation were asked by local officials to attend the meeting. Kloss recalls speaking to the public about state wastewater sewage facility planning requirements and potential sources of funding available for the project, including Community Development Block Grants, which he administered throughout the county.

The result of the meeting was a consensus that everybody in the township and borough should be offered sewer service and that monthly operation and maintenance (O&M) costs should be kept below $10. More than 95 percent of the citizens in attendance asked the township and borough to proceed with a joint feasibility study under these terms.

Leaders established a citizen SAC, published information and project updates, and held numerous question and answer sessions with citizens to address their concerns and inform them of progress. The SAC was established to advise the municipalities in selecting a consultant and throughout facility planning. The SAC, demanded that consultants keep the community informed and involve the SAC in the planning process. The result was that the public was kept aware of where the municipalities were at every stage of the planning process. Officials from both Broad Top and Coaldale appeared in front of their constituents upon the completion of project milestones to discuss the results and ask for approval in proceeding further. These milestones and associated decisions included:

- Completion of drafting the RFP and deciding whether to advertise it; citizens approved.
- Sewage alternatives and the draft sewage plan concept, which included the mix of centralized and decentralized systems. Citizens agreed, but insisted that outlying areas be dealt with fairly.
- Completion of draft facility plans and again later upon completion of the final facility plan.
- Discussion and approval of plans for phased construction of the project.
- Design review. Prior to the start of construction, public meetings were held at each village to review the design.

- Initial implementation of the on-lot program. A technically qualified employee was hired to work individually with homeowners to explain the on-lot program and help design each on-lot system.

Citizens were kept so well informed that, according to one former local official, when the consultants showed up to legally and formally present the wastewater plan to the public, “nobody showed up” because everybody already knew of the plan. He went on to say that the legal presentation is “where the fight usually starts” in many communities, but in their case the community had already reached consensus.

Certain citizens were asked by municipal officials to serve on the SAC because of technical expertise or previous experiences, but all citizens were encouraged to volunteer. There were no limits on the number and location of residents on the committee. More than a dozen citizens were initially involved, consisting of municipal officials and citizens with backgrounds ranging from schoolteacher to construction worker to local merchant. SAC participation has since fluctuated but has averaged “around a dozen.”

The committee operates under a “round table” concept, where the thoughts and concerns of all committee members are given equal weight, and all votes are counted equally when deciding an issue. Bernie Hoffnar, a Supervisor of Broad Top Township, served as the facilitator during the facility planning effort. The committee met every two to three months on average, but often in greater frequency during the planning process.

While it was officially an advisory committee, the SAC essentially assumed control of the facility planning effort—researching wastewater technology and management alternatives, drafting the RFP, and recommending a project engineer. The SAC also become the primary liaison between the municipalities and county and state officials.

> “We wouldn’t let the public not be involved! Citizens who had concerns or who were unsure about certain aspects were asked to be on the Sewage Advisory Committee. It [the SAC] helped the community reach a consensus.”
>
> Bernie Hoffnar, former Broad Top Township Supervisor, SAC member

The SAC met frequently with county planner Jeff Kloss for assistance in drafting the RFP. The SAC also worked closely with the DEP regional office from the beginning, meeting with them both in Harrisburg and in the Broad Top area. When the DEP raised questions or concerns during the planning process, the SAC worked to address and resolve the issues. There was constant and direct communication and close coordination between these parties throughout the project’s implementation.

In addition, municipal officials consulted with the Rural Community Assistance Corporation and Farmer’s Home Administration when drafting the RFP in order to increase the likelihood of funding from these organizations and thereby achieve the goal of keeping monthly O&M costs below $10. Officials from both of these organizations, as well as the county planning commission, were given the opportunity to review all proposals received from the RFP process and to make recommendations to the SAC regarding consultant selection.

Community Needs Were Incorporated Into the Request for Proposals

The criteria for choosing the project engineer focused on best meeting local needs and conditions. These conditions included parameters set by the citizenry, most notably the low monthly O&M cost and a desire that all areas receive treatment services and be charged equitable amounts.

SAC members realized that the high costs associated with a single centralized treatment system would be infeasible and impractical. There were also concerns that a central system would exacerbate local water quantity issues by conveying locally withdrawn water to a treatment plant "down-basin." A combination of onsite treatment systems and village-scaled collection and treatment systems would most likely be necessary. The SAC incorporated these early conclusions into the RFP.

The RFP requested engineers be qualified to perform the following services:

- Evaluate appropriate alternative treatment methods that can function within the area and are compatible with its economy
- Consider the existing pattern of land use, such as the numerous isolated and small clusters of dwelling units, which need to be included within any area-wide treatment solution
- Identify a set of alternative treatment methods that can function as a system to serve all residents and be operated and maintained under a single management entity
- Design a system that could be operated and maintained at approximately $10 per month per household
- Establish and maintain a strong interactive relationship with all parties throughout both planning and implementation

The municipalities also wanted a consultant to proceed in a timely manner to avoid being mandated by the DEP to conduct the planning study.

The Chosen Project Engineers Had Proven Experience Working With Innovative/Alternative Systems

Nine responses to the RFP were received. According to Hoffnar, there were only four "responsible bids." He labeled the other proposals as "cookie-cutter bids" because they did not incorporate any requests from the RFP. Each SAC member individually ranked all the proposals before any discussion commenced so that they would not influence each other. Two firms were ranked high by all members and discussed in depth. Committee members agreed that Tatman & Lee Associates, Inc. was preferred, and the committee agreed to recommend the firm if it lowered its bid, which it later did.

According to SAC members, even though grant money had not yet become available, bid price was not the key factor when evaluating consultants. The successful firm was selected because it had what Hoffnar described as an "awareness" of alternative systems and knew "what would be needed to make it all work." They also gave numerous examples of alternative "low-tech" systems that the municipalities could consider.

The choice of consultant was perceived as a critical step towards finding the right solution, and the decision paid off. The SAC consulted with Tatman & Lee continuously throughout the facility planning process on matters of technology selection, service boundaries, and municipal policy needed in order for a management agency to function.

A Mix of Technologies Was Chosen To Address Concerns In the Community

Many residents occupy housing on slopes in excess of 15 percent. The Pennsylvania Department of Environmental Resources (DER) requires modified designs for wastewater soil absorption systems constructed on slopes between 15 percent and 25 percent. In addition, Coaldale Borough and many of the township villages are within the 100-year floodplain, further constraining the use of septic treatment systems and the siting of treatment plants. Many areas also have shallow soil on bedrock, meaning that onsite systems used in these areas might have to employ pretreatment and disinfection systems and discharge to a stream. The right mix of technologies was necessary to provide low-cost wastewater treatment in this challenging terrain.

The SAC established decision criteria for evaluating technologies. Options were graded on the following scale in order of importance (Tatman & Lee Associates, Inc. 1995, p. V-1):

1. Protection of public health

2. Ease and cost of operation and maintenance

3. Prevention of groundwater and surface water pollution

4. Capital cost

The importance of grant funding became apparent during these deliberations. Ease of maintenance, low manpower requirements, and low operating costs were given higher priority than capital costs in the hopes of gaining outside funding to cover capital costs. Indeed, all parties interviewed agreed that the project could not have gone forward without some type of outside support.

The SAC was extensively involved in the technology selection process. Committee members wrote numerous letters to other communities inquiring about their success with certain wastewater technologies. Jack Decker, former chairman of the SAC and current Broad Top Supervisor, traveled around the state to examine different technologies, including lagoons, sand mounds, at-grade systems, conventional septic systems with sand filters, septic systems with spray irrigation, and other innovative technologies.

The SAC's information quest became important in the selection of technologies for community systems and for preferred on-lot systems should pre-treatment be required. Committee members received what one local official described as a "crash course" on wastewater management from this correspondence. Advice ranged from recommendations on technology suppliers to the importance of proper construction.

Project engineers recommended lagoons for primary treatment at three of the community systems (Figure 12-4). SAC members had corresponded with other communities about lagoons and some still had concerns about the technology. During a public meeting held to discuss facility plan progress, residents also voiced concerns over odors from the lagoons. To address concerns, the municipalities organized a bus tour for residents and SAC members. The tour consisted of a visit to a distant town that utilized lagoons, as well as a question and answer session with that town's wastewater manager. Eight people attended. According to local officials, the trip, in particular a chance to speak directly with the wastewater manager, did a great deal to relieve concerns over use of the technology.

Courtesy of Broad Top Township

Figure 12-4: Construction of the Aerated Lagoon Treatment System for Riddlesburg and the Six Mile Run Valley

Did the Issue Resonate With the Community?

Stakeholder relationships and trust resonated in the community in the areas of:

- Equity concerns
- Consensus building
- Low costs to residents made possible by grant funding
- Effective decision making without the necessity of technical literacy
- Dedication of local officials

Equity Concerns Arose Over Ownership and Management of On-Lot Systems

The disparity in per-unit cost estimates between the community collection systems and on-lot systems created some tension in the community. Some more advanced on-lot systems were estimated to cost nearly twice as much as connecting to a community collection system. According to several SAC members, some community members felt like the decision to charge the same connection and O&M fees to all parties would result in the villages essentially subsidizing the on-lot management program.

According to Raymond Taylor, former President of the Coaldale Borough Council, the cost disparity was discussed at length at several different meetings, and research was conducted to estimate how long an on-lot system would function and how long a community system would function. Taylor also asserts that officials wanted to serve all residents and realized that gaining control of malfunctioning on-lot systems and bringing them up to state code would go a long way towards solving the wastewater problem.

Bernie Hoffnar points to the strong position taken by the SAC on the equity issue. The SAC was given approval by municipal residents at a public meeting with the condition that "outlying areas be dealt with fairly." The SAC held fast to the goal of working as a community to the benefit of all and maintaining equal costs for all residents, regardless of location. Lengthy discussions eventually put the issue to rest, but the topic still "pops up now and again," according to one SAC member.

On a similar note, some residents placed in the on-lot management program area were disappointed over not receiving sewer service. The SAC asserted that those in the on-lot management program essentially *were* receiving sewer service, because the town assumed responsibility for all operation and maintenance of wastewater disposal. The high cost deterrent of running sewer mains to low-density areas was also explained to those residents.

Broad Top and Coaldale are unique in Pennsylvania. Rarely do you find local officials who will take over responsibility for once-private residential on-lot systems. Jack Decker described the decision as a necessity, given the area's physical constraints. Inadequate topsoil has required that many on-lot systems use pretreatment and disinfection technologies and discharge to nearby creeks. The fact that advanced systems are being used, and that nearly everybody uses individual drinking water wells, made system reliability critical, and strict municipal oversight a necessity.

> "We didn't chase the money, the money found us. They realized that this community came together, defined what it needed, knew what it needed to do, and had full support. This was a community project that, if implemented, would be fully supported by the community. There would be no backlash. There was virtually no dissent, because we proceeded in a way that involved the community."
>
> Bernie Hoffnar, former Broad Top Township Supervisor, SAC member

Building Consensus Among Citizens Made the Municipalities Strong Candidates to Receive Grant Funding

According to many of the early participants in sewage planning, the municipalities initially had "no idea" where they would get funding. Bernie Hoffnar and Jack Decker checked federal and state grant websites often, and engaged the DEP, the Farmer's Home Administration, and county planning officers. According to Hoffnar, these funding agencies tracked their planning effort "quite closely because what we were doing was something they wanted to encourage."

The importance of establishing early community dialogue and consensus among citizens on the need to address the towns' wastewater problems became evident when meeting with funding agencies. Upon learning of the federally funded Army Corp 313 program, SAC members contacted their local congressman, Representative Bud Shuster, about obtaining funding from the program. According to Hoffnar, they were "well prepared" when they met with Shuster, having already completed their Act 537 facility plan in a way that contained costs and benefited all citizens. This went a long way towards making the community an attractive funding recipient, especially to an elected official.

Low Costs to Residents Made Possible by Grant Funding Increased Buy-In

According to one DEP official, the grant money that made possible the low monthly fee was instrumental in gaining popular support for the program, in particular with residents relinquishing ownership of their on-lot systems. He describes this as usually "a very tough sell in Pennsylvania." He noted that normally in a community without funding there would be enforcement actions, orders, appeals, and lengthy litigation. He stated that the municipalities' access to state and federal funding, made possible in large part by their influential state senator, made the project a success. Also, DEP's agreement to provide the local funds match required by the federal grant enabled the municipalities to meet the monthly O&M cost ceiling.

Technical Literacy Was Not a Necessity for Effective Decision Making

Some members of the SAC had little technical experience. This lack of technical literacy never presented and continues to pose no problems when discussing wastewater technologies and making key infrastructure decisions, according to one former local official. He states: "If people are committed to it, they can do anything." Technical literacy was not a necessity for effective decision making.

The Dedication of a Few Municipal Officials Was Instrumental to Seeing the Project Through

According Jeff Kloss of the Bedford County Planning Commission, the dedication of several local officials was critical in seeing the project through from conception to construction. Kloss remembers that many problems, setbacks, and criticisms were encountered along the way, and that mistakes were put "under the microscope." Many roadblocks were also encountered at the state level, despite continued interaction between state officials and the municipalities, which SAC members described as "institutional problems."

Kloss credits the community with "having the vision and ability to take a large project and break it down into manageable pieces." He continues: "Other people in the area think Broad Top got some special break, and I tell them they got special help because they broke their backs to go out there and get it."

Results/Status

To date, 120 residences have officially volunteered to join the on-lot management program. Forty-three individual on-lot systems have been (re)constructed, and six cluster systems serving between two and nine residences have been built. Figure 12-5 shows the township's first repair/replacement of a failing system. Two 1,000-gallon septic tanks were installed (as shown) plus automatic siphon-dosed sand filters and disinfection with a stream discharge.

Courtesy of Broad Top Township

Figure 12-5: Construction of an On-Lot System

Table 12-4 shows the different types of systems that have been constructed. The costs of the systems vary depending on the technology necessary for the site. Elevated sand mounds have proven most expensive, more than $10,000 (not including design costs and permit fees). Costs for the two larger cluster systems noted in Table 12-4 averaged about $7,000 to $8,000 per connection (also not including design and fees). These costs (except for new homes built since 1995) are covered by the grants obtained by Broad Top Township.

Table 12-4: On-lot Treatment Systems Under Management

On-lot treatment System	Number of Systems
Sand filter with stream discharge	22
Elevated sand mounds	7
At-grade bed systems	5
Conventional septic tank/soil absorption	2
RSF2: Recirculating sand filter treatment system with soil discharge	1 (serves 6 connections)
Enviroserver: Recirculating plastic media treatment system with stream discharge	1 (serves 9 connections)

Source: Broad Top Township Secretary's Office

The deadline for homes built in 1994 or earlier to join the program and receive the full financial benefits has been extended, and there is a waiting list for construction. As more grant funding becomes available, more systems are reconstructed. Seven newly constructed houses have joined the on-lot management program in recent years as well, as required by the town ordinance.

Construction of community sewer system projects has proceeded in line with grant funding disbursements. Ernest Fuller, Broad Top Township Secretary, has indicated that besides a cost estimation oversight for one collection system, construction costs have been in-line with consultant estimates when adjusted for inflation.

Phase I of community system construction included design and construction of the Kearney and Langdondale collection and treatment systems. Phase II of the project has included engineering and construction of the Six Mile Run (SMR) Valley treatment system, which has been re-sized to accommodate flows from Riddlesburg and thus avoid a separate treatment plant for Riddlesburg flows. The combination of the Riddlesburg and Six Mile Run Valley systems has been the most significant design change for the project, and it has required project engineers to utilize a more active type of sand filter system rather than the anticipated passive flow system. Collection systems in the villages of Riddlesburg, Defiance, and Coaldale have been constructed and are sending flows to the SMR plant.

Table 12-5 shows the number of connections constructed in each community and the equivalent dwelling units (EDUs). In Defiance, the local elementary school represented eleven EDUs. The collection systems were also extended beyond the originally proposed service areas (which included all homes within 150 feet of a collection main) when cost-effectiveness analysis indicated it would be less expensive to extend collection lines than to build an advanced on-lot system.

Table 12-5: Community Treatment System Connections

Treatment System	Current Connections
Kearney	26 (26 EDUs)
Langdondale	70 (70 EDUs)
Six Mile Run (SMR) – Riddlesburg	92 (93 EDUs)
SMR – Defiance	52 (63 EDUs)
SMR – Coaldale	42 (42 EDUs) (Partial Funding received)
SMR – Northpoint	Awaiting funding
SMR – Finleyville	Awaiting funding
SMR – Round Knob	Awaiting funding
Cypher Beach	Awaiting Funding

Source: Broad Top Township Secretary's Office

CDBG funding has been allocated for the Coaldale collection system. As funding is obtained, sewer mains will connect the remaining Broad Top villages of Northpoint, Finleyville, and Round Knob. The project has progressed more slowly than anticipated, as the community is entirely dependent on yearly funding disbursements from the 313 program and CDBG program. According to Jeff Kloss, the community is at a disadvantage to receive funding from other sources because of its low monthly cost requirement. Kloss indicates that U.S. Department of Agriculture–Rural Utility Service funding was available, as were competitive CDBG funds, but both would have required raising monthly fees to around $35.

Monthly fees remained stable until a $1 raise in 2001 brought total fees to $11. The increase was in-line with inflation. Eighty percent of monthly fees and 100 percent of each property's $120 connection fee are put into a revolving fund dedicated to operation and management. As the responsible management entity, Broad Top Township collects all fees directly from township and Coaldale Borough residents receiving service.

Twenty percent of monthly fees collected is budgeted and set aside in a long-term capital replacement fund. This is uncommon for communities in need of outside financial assistance. Decades from now, when some systems are in need of major renovation or replacement, the township's foresight may allow these costs to be paid for without further outside assistance.

For fiscal year 2004, the township has budgeted 29 hours per week for operation and maintenance of the community systems and the on-lot systems in the management program. This includes 24 hours for actual operation and maintenance, and five hours for billing and reporting. Three township employees have sewage operator's licenses. The budget in Table 12-6 reflects an anticipated 100 extra connections through 2004, or a total of approximately 400 sewer connections and 51 onsite/cluster connections. The frequency and amount of grant funding have delayed construction of collection and lateral systems, resulting in a small customer base relative to constructed treatment plant capacity. To offset the revenue shortfall, Broad Top Township currently subsidizes the program. Build-out over the next two years is expected to balance expenses with revenues.

Table 12-6: Fiscal Year 2004 Estimated Budget for Sewage Management and On-Lot Management

Budget Item	Amount
Personnel	$33,000
Electricity	$13,000
Supplies	$10,000
Contracted Services (lab work)	$8,000
Communications	$2,000
Insurance	$1,000
Miscellaneous	$1,000
Total	**$68,000**

Source: Broad Top Township Secretary's Office

For new construction in proximity to a sewer main, the municipalities have adopted a $3,500 connection charge, which is the actual average cost to replace treatment capacity used by new construction. New construction connection charges are put into a savings fund for the future purchase of new capacity should a community outgrow its treatment system. Also, $3,500 is considerably less than what it costs to construct a new on-lot system. The rationale behind setting the connection fee lower than a new on-lot system was to steer development towards the villages, and "in-build" rather than sprawl out. It has worked to an extent—five new residences have been constructed and connected to the collection system in Langdondale, which had previously not seen a new structure for "quite some time." Talks regarding light commercial development are also underway. Providing for economic development was an important element of the initiative.

Likewise, newly constructed buildings utilizing an on-lot system must pay an additional fee to the township to fund the indefinite maintenance costs and anticipated future reconstruction costs of long-term ownership. After considerable deliberation by Broad Top Township Supervisors, it was decided that the fee would be paid in advance, so that new homeowners could include the additional costs in mortgage loan applications. The fees collected are set aside in a special account to earn interest over time for continuing expenses.

The township has established a one-time fee for the systems shown in Table 12-7. The fee structure reflects the cost of ongoing maintenance and repair as well as system replacement, so fees are higher for more complex on-lot systems. The fee structure is also intended to encourage building on land that can support more conventional types of on-lot systems According to Secretary Fuller, no new homeowners have constructed a sand-filter-to-stream-discharge system.

Table 12-7: New On-Lot Systems Long-Term Maintenance Fees

System Type	One-time Fees ($)
Conventional septic tank and at-grade bed	$120 (no increase over connection fee)
Free-access sand filter to at-grade bed	$357
Peat filter to at-grade bed	$856
Sand filter to sand mound discharge	$3,349
Sand filter to stream discharge	$11,357

Source: Broad Top Township Secretary's Office

As the responsible management entity, Broad Top Township is the primary contractor for all system construction. The township owns construction equipment and leases it to the sewage project. Persons hired for construction work are placed on the municipal payroll, and the wages are consistent with local prevailing wages. According to Kloss, this easily saves the town ten percent of project costs over having an outside contractor come in because the town would then have to pay prevailing regional rates. The municipal roadmaster is the project manager. Besides the cost savings, Broad Top and Coaldale realize many benefits by doing the work themselves: they gain an intricate understanding of the sewer systems, treatment systems, and on-lot systems, and there is more incentive to perform high-quality construction work. It has also worked as a local economic development tool as many locals are now on the payroll.

Sewage flows have turned out to be dramatically less than estimated. In Langdondale and Riddlesburg, river discharges from the community sand filter treatment systems are infrequent to date. Much of the flow evaporates in the lagoons. According to a local official, this has not caused any operational problems other than the need to flush sewers more often. Fewer discharges in fact save the communities considerable money on discharge sampling and measurements.

The SAC is still functioning well. Over the course of the project, as planning and construction of sewers and treatment systems have moved from village to village, SAC membership has also changed to reflect the communities directly impacted by construction. For instance, during construction in Kearney, many residents from that village took an active part in the advisory committee. In 1998, the SAC became the Watershed Advisory Committee (WAC); the chair of that is now a local chemistry teacher. The WAC continues to participate actively in the sewer project, but has also expanded its scope to address other pollution issues in the watershed.

Conclusions

Broad Top Township and Coaldale Borough approached wastewater facility planning by going to the citizens first and then slowly building a solution that met the social and environmental needs of the community while retaining widespread support. Other communities can benefit from the lessons learned:

- Ensure that citizens thoroughly understand the need for wastewater facility planning. Have outside public officials address the public on the need if necessary. Reach consensus before going forward. Popularly supported projects have much better survival rates and are more attractive to funding and lending agencies.
- Include citizens' input when drafting RFPs. Incorporate any social constraints, such as avoiding high monthly service fees, into RFPs. Require that all proposals include an examination of the role that onsite and cluster systems, and other innovative/alternative technologies, can play in meeting wastewater needs. This examination should include approaches to management of wastewater systems.
- Be wary of engineering firms that offer "one size fits all" solutions. A diverse system architecture may yield the most cost-effective solution. Try to determine what system architecture might be most appropriate for the community. As one Broad Top official puts it: "You really need to do your homework to find out what you want, and go for that. Don't be afraid to stick to your guns."
- Go for quality rather than cost in selecting a consultant. Not everyone knows small-scale and mixed architecture systems well, so cost should not be the primary consideration.
- Look at what other communities have done to solve their own wastewater problems. A concerted effort to gain understanding of a certain technology or management program, or advice from a facility engineer from another community can go a long way toward finding a solution to fit your needs while at the same time revealing nuances associated with construction and operation.
- Cooperate across municipal lines. This often occurs in regionalization of wastewater systems, but it can be just as appropriate for small communities, especially those wanting to gain economies of scale in management and those wanting to ensure system/management consistency.
- Pursue funding assistance aggressively and from the beginning. Not every community can expect to get grant funding. If the community really needs it, get competitive. Develop and utilize potentially helpful relationships with appropriate funding organizations and politicians. Broad Top officials included funding agencies when drafting the RFP and selecting a consultant.
- Work closely with regulatory officials at all levels from the beginning. This can help avoid enforcement actions while crafting solutions. Solid relationships with regulatory officials also make the community more attractive to potential providers of financial assistance.
- Reduce costs and boost community income by utilizing the municipal work force. Find a consultant willing to make local economic development part of the solution. Broad Top Township engineers provide project and construction management and utilize municipal

employees and local laborers in construction. This helps both the responsible management entity and locally hired individuals to gain a better understanding of system construction and ensures that the quality of work is high.

- When assuming ownership of on-lot systems, incorporate long-term operation, maintenance, and replacement costs into the fee structure. Broad Top Township established a one-time up-front fee for new buildings with on-lot systems so that occupants could include the fee in loan applications and so the township is guaranteed operating capital before the system comes on-line. Per Secretary Fuller, this is better than having to go back to the property for periodic fees time after time.
- Also set aside funding for long-term capital repair, replacement, and system expansion of community collection systems. The municipalities set aside 20 percent of monthly revenues for long-term capital replacement. Connection fees for new construction are set aside for future system expansion.
- Do not neglect the need for long-term financial planning, even if the community is financially strapped. Many communities with financial hardships do not set aside funds for future system expansions and replacements. Even if the community receive grants to cover initial capital costs, it might not be so fortunate in the future. Broad Top and Coaldale, by setting aside funds as noted in this case study, are planning ahead so they are not dependent on outside assistance when capital is needed in the future.

The most important aspect of Broad Top and Coaldale's success was their ability to gain the trust of their citizens and maintain that trust throughout the planning and construction process. The creation of the SAC, in which anyone could participate, went a long way toward nurturing that trust. Recently transformed into the WAC, the group has an ongoing purpose in the community. Local water quality is improving. Just as a poor public process can hamper community decision making for years, a good public process can provide an example from which to grow.

Sources

Sources for this case study include:

Phone Interviews

Jack Decker, Supervisor, Broad Top Township; Sewage Advisory Committee (SAC) member

Ernest Fuller, Secretary, Broad Top Township

Bernie Hoffnar, former Supervisor, Broad Top Township; SAC member

Jeff Kloss, Executive Director, Bedford County Planning Commission, Bedford, PA

Leon Oberdick, Water Management Program Manager, South Central Regional Office, Pennsylvania Department of Environmental Protection, Harrisburg, PA

Raymond Taylor, former Council President, Coaldale Borough; SAC Member

Documents

Numerous municipal policy documents, ordinances, newsletters, minutes from Sewage Advisory Committee Meetings, and written correspondence with Bernie Hoffnar and Ernest Fuller contributed to the study as well as the document that follows.

1. Tatman & Lee Associates, Inc. 1995. *Joint Municipal Sewage Facilities Plan for Broad Top Township and Coaldale Borough, Bedford County, Pennsylvania.* Prepared in conjunction with the Broad Top Township and Coaldale Borough Joint Sewage Planning Committee. Doylestown, PA. February 1995. Revised July 13, 1995.

13 WASHINGTON ISLAND, WISCONSIN

This case study addresses the following topics:

- Incremental Capacity Provision
- Performance and Reliability
- Growth, Development, and Autonomy
- Fairness and Equity
- Stakeholder Relationships and Trust

The Community

Washington Island is 22 square miles in size and located 90 miles northeast of the city of Green Bay. It lies seven miles off the tip of the Door County Peninsula. The waters of Green Bay border the island's western shores, and Lake Michigan laps its eastern side. In summer it is accessible by small planes and ferry across the Death's Door channel; in winter, there is only one ferry equipped to cut through the ice to the mainland. The island has a gently rolling topography. Seventy percent of it is wooded, with the remaining lands dedicated to agriculture and natural shoreline.

Figure 13-1: The Location of Washington Island in the State of Wisconsin

The Town of Washington was incorporated in 1850, and today has a year-round population of approximately 700, of which many are third-generation islanders. These residents live primarily in the island's interior.

Washington Island has been a popular leisure destination since the early 1900s. In the short summers, it becomes a vacation hub and the population swells substantially. Tourism is the primary economic engine. Lodging and vacation homes are located mostly along the abundant shorelines and offer easy access to fishing, boating, kayaking, swimming, and nearby Rock Island State Park. Much of the island's recent growth has come from vacation home construction, and many of these new property owners are expected to live on the island year-round in the coming decades.

Wastewater Issues

Washington Island is characterized by shallow soils and a fissured dolomitic (limestone) bedrock. Spring runoff often disappears down sinkholes in farm fields. On about two-thirds of the island, the bedrock is within 30 inches of the surface. Soils on the island consist mainly of loam and sandy loam till, and silty clay or clay loam till.

Older structures in the island interior have long been served by conventional septic tank soil-absorption systems. Mostly newer structures are found along the shoreline on small lots with shallow soils. Wisconsin's onsite wastewater code until recently required a minimum 36 inches of separation to groundwater or bedrock for the use of soil-absorption systems, so many shoreline homes built in recent decades employed wastewater holding tanks.

The proliferation of houses with holding tanks in the 1970s and 1980s created concern among town officials about the long-term capacity and viability of their field spreading sites. Holding tank wastes were, and still are, pumped by wastewater haulers and applied to fields on the island. In the 1980s certain spreading sites were becoming saturated. They were also too close to residential areas. In addition, it became apparent that many onsite soil absorption systems were not compliant with state codes. Concerns increased that such systems might create health risks. Enforcement of state codes would require conversion of many systems to holding tanks, exacerbating the field spreading problem. Holding tank waste has a much higher volume and lower level of treatment compared to septic tank septage, which is also field-spread. The situation prompted Town of Washington elected officials to examine wastewater management.

Figure 13-2 shows the Town of Washington with its key wastewater-related sites numbered as follows:

1. Treatment plant and spray irrigation site proposed in the first facility plan

2. Alternative treatment plant site of the first facility plan, with discharge to Coffee Swamp or Lake Michigan

3. Coffee Swamp

4. Location of the fixed activated-sludge treatment (FAST) system

5. 30-acre site leased by the utility district for field spreading of septage and holding tank waste.

Figure 13-2: The Town of Washington, Located Just off the End of Wisconsin's Door County Peninsula

Historical Overview

Discussion of wastewater system needs on Washington Island began as early as 1964, when a comprehensive plan for Door County warned that the heavily creviced limestone could easily lead to the pollution of free-flowing groundwater. The plan recommended public water and sewage systems for six resort communities in Door County, including Washington Island. In 1968, the potential for groundwater pollution became reality for town residents when 44 cases of infectious hepatitis (affecting 10 percent of the population) were diagnosed on the island. A 15-year-old female high school student died. Every case could be traced to drinking water from a high school well that had been contaminated by septic tank effluent.

Study and Rejection of a Centralized Treatment System

Beginning in 1972 and through the 1980s, town officials discussed at length the need for a sewage treatment system. At one point, a sanitary district was formed but later rescinded, and lengthy discussions about the construction of a lagoon for wastewater treatment produced no action. In 1984, the town board met with a firm that wanted to engineer wastewater facilities on Washington Island with 60 percent outside funding; however, the matter was tabled.

Throughout the 1980s, other small municipalities in Door County constructed centralized wastewater facilities, and island officials became increasingly concerned about the long-term viability of field spreading. In 1986 the town board signed a $40,000 contract with the engineering firm Brey, Stuewe, & Braun to conduct a feasibility study and create a facilities plan for wastewater management. The State of Wisconsin funded $28,000 of this study (Greenfeldt 1990). The study included soil testing and analysis, review of sanitary permits, holding tank records, pumping records, and other data to document wastewater needs and infrastructure feasibility. The engineers found that:

- Approximately 15 percent of wells that had been tested for bacterial contamination did not have safe drinking water.
- Of 96 onsite septic systems that were tested with property owner permission, 84 were considered failing. Of those, 58 required holding tanks and 26 might have been able to install mounds.
- Based on sampling and soil overlay maps of properties on the island, an estimated 243 new holding tanks and 56 new mounds would have been required under then-current state onsite code requirements (Brey, Stuewe, & Braun, Inc. Undated, p. 1.2).
- The engineers noted during the facility planning process that the practice of field spreading of holding tank wastes in winter would no longer be allowed by the state and might not be viable at other times of the year as well. They stated in the draft facility plan, "The possibility of pollution through fracture traces, probable future changing regulations, and the need for treatment or storage of the winter wastewater flows, prompted the persons attending a public meeting on August 30, 1988 to vote against field spreading of holding tank wastewater directly onto fields." (Brey, Stuewe, & Braun, Inc. Undated, p. 6.33) Thus, all holding tank waste would have to be treated prior to release.

The construction of a sewer collection system on the island would require extensive excavation through the shallow soils and hard limestone bedrock. Preliminary estimates for the higher-density areas were in excess of $23,000 per household, so a sewer option was quickly dismissed. The engineers proposed that all existing septic tank/soil absorption systems that were functioning properly be kept in operation, and that all failing systems be replaced by a conventional or mound onsite system if soil conditions allowed, and that holding tanks be used where soils were inadequate. To accommodate the wastewater from the projected increase of holding tanks, a large recirculating sand filter treatment facility was proposed. Residents and town officials described this plan as a "pump and haul" system, since pumper trucks, rather than a collection system, would be used to bring waste to the treatment facility (Figure 13-3). The plan proposed spray irrigation for effluent disposal. Sludge from the plant and septage from remaining code-compliant onsite systems would be land-applied.

Courtesy of Jorgenson Sanitation

Figure 13-3: Pumping a Holding Tank on Washington Island

The cost of the pump and haul system, shown in Table 13-1, immediately raised concerns, and other problems were soon to surface.

Table 13-1: Estimated Wastewater System Costs per 1988 Facility Plan

System Component	Capital Costs	Annual Costs	Total Present Worth*
Holding tanks	$1,642,680	$237,810	$3,872,820
Recirculating sand filter	$567,980	$40,800	$928,050
Spray irrigation	$159,910	$5,000	$203,070
Total	$2,370,570	$283,610	$5,003,940

*Assuming 20-year planning period and 8.625 percent discount rate

Source: Brey, Stuewe, & Braun, Inc. Undated, p. 1.4

Because preliminary soil tests raised some questions about the suitability of the proposed spray-irrigation site, the facility plan included a disposal alternative —discharge to the lake. This option had an estimated capital cost of $455,000 and high operating costs, bringing the estimated present worth of total system costs to $5,280,690.

In 1988, the engineers presented the facility plan to the public. The consultant was ready to proceed with design once a location for the treatment plant was chosen, a discharge point secured, and the plan approved by the Department of Natural Resources (DNR). During the hearing, Monika Wulfers, a member of the local group Washington Island Taxpayers Alliance, insisted that the town reserve the right to explore alternative systems if any obstacles were encountered, and an addendum stating so was added to the facility plan. The timeliness of this request was important, as the hearing was to finalize the facility plan with the intent of proceeding with the centralized facility.

Agreeing on a discharge point for the central treatment plant proved difficult. Soil tests for the spray irrigation site near the islands' school showed inadequate capacity to support the proposed volumes. This option was also ruled out because of proximity to children. Two separate wetland sites were examined but ultimately rejected because of ecological concerns, including phosphorous loading. Lake discharge was more expensive and considered inappropriate and too risky by residents. Islanders included commercial and recreational fishermen, and the vitality of tourism is directly linked to lake water quality.

The facilities planning process had stalled. The lack of an economically and environmentally agreeable discharge site forced the town to explore other options, and Monika Wulfer's earlier insistence that the town retain the right to do so enabled the town to begin separating from the consultant's plan.

On June 4, 1990, the town board appointed a Wastewater Committee. The committee was charged with evaluating proposed treatment options and all other approved systems, researching funding, bringing correct information to the public, and developing per capita cost data for various alternatives. The committee met every two weeks through November 1990 in open meetings at the community center. Guest speakers were invited to inform the committee and the citizenry of potential wastewater treatment options.

One invitee, the Onsite Sewage Section Chief for the Wisconsin Department of Industry, Labor, and Human Relations (DILHR), notified the committee of ongoing high-level discussions about changing the state's prescriptive onsite wastewater code so that it was more performance-based. Such a code might let the town consider more options than holding tanks and mounds. To explore this possibility, the committee invited David Venhuizen, a wastewater engineer specializing in decentralized systems, to discuss his experience with municipal management of onsite systems. Based on a subsequent recommendation of the committee, the town board terminated the contract with the initial engineer and hired Venhuizen to investigate an onsite treatment system strategy.

Development of a Decentralized Approach

A plan for the centralized treatment facility had already been submitted to the Wisconsin DNR, so the facility planning process was under their jurisdiction. Yet DILHR had jurisdiction over onsite systems. DNR and DILHR were not used to working together, but agreed the facility planning effort could be expanded to include a decentralized strategy. However, DNR mandated that Washington Island develop a demonstration project to prove that at least one technology could achieve the nitrate standards of the state groundwater code (10 ppm) and operate in Wisconsin's winter climate. For its part, DILHR wanted to use the demonstration results to help move forward its performance-based code initiative.

Venhuizen developed a demonstration plan to evaluate onsite recirculating sand filter systems. The town then successfully lobbied DNR for grant funding of the $650,000 project. From the fall of 1991 through the summer of 1992, seven onsite recirculating sand filter systems, coupled with low-pressure dose absorption fields, were installed: five on private residences, one serving a marina office building, and one serving the island's grocery and butcher shop (Figure 13-4).

The "denitrifying sand filters" were designed to remove the majority of the nitrogen from the wastewater. Property owners who received the demonstration projects paid the construction costs, which averaged $10,000 per property owner. This private money fulfilled a 10 percent grant match required of the town, so in the end, taxpayers paid nothing for the demonstration project. The sand filter systems were monitored through 1994 and performed very well.

Courtesy of Donna Briesemeister

Figure 13-4: Construction of a Demonstration Denitrifying Sand Filter System for the Grocery Store on Washington Island

In the spring of 1995, DILHR approved for statewide use the denitrifying sand filter technology, thereby assuring there would be a legal technology available to accommodate any property not meeting code requirements for conventional onsite systems. Anticipating this approval, in January 1995 Venhuizen submitted to DNR a revised facility plan incorporating the proven technology to replace most holding tanks. Venhuizen revised the centralized system costs and developed costs for a decentralized alternative that incorporated widespread use of the demonstrated sand filter system. The revised costs are shown in Table 13-2. The plan identified considerable economic advantages and other benefits to using onsite denitrifying sand filter systems, along with a town-run management program, versus the construction of more holding tanks and a centralized treatment plant. As in the original centralized plan, septage from onsite systems would continue to be field applied.

Table 13-2: Estimated Wastewater System Costs per 1995 Facility Plan

Cost Item	Net Present Worth*	
	Centralized Option	Decentralized Option
Treatment system(s) capital cost	$1,653,879	$3,003,918
Holding tank installation	$2,035,226	$457,924
Water meter installation	$138,832	$54,796
Subtotal net present worth (capital costs)	*$3,827,937*	*$3,516,638*
Treatment system(s) O & M	$481,657	$367,731
Holding tank pumping	$1,372,150	$354,042
Water meter reading	$22,879	$7,724
Subtotal net present worth (O & M)	*$1,876,689*	*$729,479*
Total Net Present Worth	**$5,704,623**	**$4,246,135**

*Assuming 20-year planning period, 8 percent discount rate

Source: David Venhuizen P.E. Engineering and Planning 1995, p. C-5

DNR approved the revised facility plan and municipal management program in November 1995. The town then formed the Washington Island Utility District, a legally separate government entity, to oversee operation of the management plan. However, the enabling ordinance also specified that the utility board would be composed of the members of the town board. The intent of this was to make the management of the two small government bodies efficient. The town also entered into an agreement with Door County. This agreement enabled the utility district to employ the enforcement powers of Door County in the operation of its own management plan.

Implementation and Evolution of the Decentralized Approach

The Washington Island Municipal Wastewater Management Plan became effective on July 1, 1996. Developed by the town using guidelines from the consultant, the plan emphasizes making sure all island systems have proper soil treatment—whether onsite or by land spreading—or have pretreatment. DNR gave the town 10 years to inspect all existing onsite systems on the island. An evaluation by the town sanitation manager and county sanitarian determines the adequacy of an existing system or the type of replacement system permissible. The town's goal is to reduce the amount of field application of holding tank waste from present levels; therefore, holding tanks are an option to replace failed septic systems or for new systems, but only in extreme circumstances.

In an August 1998 revision of the plan, preferred systems are ranked as follows, as each property allows, for both new construction and system upgrades (Town of Washington 1998, p. 5):

1. Conventional septic system
2. In-ground pressure system
3. Pressure mound system
4. RSF/LPD [Recirculating (denitrifying) sand filter/low-pressure dose system]
5. Future onsite systems as approved by the Wisconsin Department of Commerce (DILHR's new incarnation) or DNR
6. Holding tanks (only as a last resort)

While the facilities plan anticipated widespread use of onsite sand filter systems, this has not occurred because of regulatory changes stemming from statewide battles over the performance-based code proposal. Two sand filter systems were installed on Washington Island after the demonstration project. Subsequent installations were precluded when a court enjoined implementation of the proposed performance-based code and subjected it to an Environmental Impact Study (EIS) and additional rule making. The end result of the EIS, lawsuits, rule making, and involvement of the state legislature (described in the Growth, Development, and Autonomy section) was liberalization of the nitrate limitation in the state groundwater code. Because of this change, new and upgraded onsite systems on the island have been able to meet regulatory requirements with conventional and mounded soil absorption systems that were previously considered inadequate. The management plan has been amended to reflect these changes in the state code, replacing the preference list with a simple requirement for a code-compliant system. The plan still states that holding tanks are to be used only as a last resort.

Field spreading of holding tank waste does not face previously expected regulatory barriers. The management plan's inspection regime and guidelines for new and replacement systems have reduced installations of holding tanks on the island, but holding tanks are now expected to remain a substantial part of the wastewater picture for some time.[22] Therefore, management of land spreading of holding tank waste has taken on increased importance.

In 1999, to address spreading concerns in the winter, the utility district installed a large high-strength fixed activated-sludge treatment (HighStrength FAST®) system, manufactured by Bio-Microbics, to accept and treat holding tank wastes and septage. The system consists of a 20,000-gallon surge tank where holding tank waste and septage enters the system. This waste is ground up and sent to the HighStrength FAST aeration unit at a rate of 2,000 gallons per day

[22] From 1996 through 2002, 39 holding tanks were installed, a rate of 5.6 per year, compared to 66 holding tanks in the previous seven-year period (1989-1995), a rate of 9.4 per year, and 60 in the 1982-88 seven-year period, a rate of 8.6 per year. Holding tank pumpage on the island has held steady between 1.23 to 1.35 million gallons per year from 1998 through 2002. Septage pumping has also held steady through this period, averaging 0.30 million gallons per year.

(GPD), after which the effluent drains to a conventional septic tank. The tank effluent is then distributed in a stone trench and an Infiltrator® chamber absorption field sized for 3,000 GPD capacity. The system can accept all holding tank waste during winter months when many holding tank users are off-island.

The spreading-field relief afforded by the HighStrength FAST system as well as the acquisition of additional field spreading sites has allowed the utility district to stop using fields identified by the town as saturated or too close to residences. This in turn reduces the town's liability from saturated fields in relation to citizens' health and safety. The town has gained additional managerial control over field application, along with better tracking of onsite system inspection results, by implementing an innovative, web-based electronic database (described in the Performance and Reliability section).

Legal fees to set up the utility district came to $14,000. This covered writing the necessary ordinance, developing the intergovernmental agreement with Door County, and other services.

The utility district's expenses ranged from $33,000 to $38,000 per year from 1997 through 2002, except in 1999, when the HighStrength FAST system was purchased. This compares to the overall town budget of more than $2 million per year. Fees collected by the utility district cover 20 percent of the salaries and benefits of the sanitation manager and the utility district secretary, both town employees with other duties for the Town of Washington. Other principal expenses in the current budget include lease payments for field spreading sites, operation and maintenance costs for the FAST system, rental fees for computers and software, reimbursements to Door County for system inspections, backhoe costs for certain inspections, and small amounts for office equipment, phone service, postage, and other expenses. The district owns a greens chopper and a forage box. It uses a town-owned tractor for spreading-field maintenance; in exchange the district pays for the pumping of privies at the town beach.

From 1999 through 2001, the budget included loan payments to the town for the FAST system. This system cost $120,000, including engineering. The utility district borrowed the necessary funds from the town, and paid off the loan in three years using reserve funds and current revenues.

The utility district's revenues come from spreading fees paid by onsite system owners, spreading-field rents paid by pumpers, permit and inspection fees, plus various other charges. District income ranged from $20,000 to $56,000 per year from 1997 through 2002, again, with the exception of 1999, when a large infusion of reserve funds to pay for the FAST system occurred. Smaller withdrawals from the reserve fund occurred in 2000 and 2001. The utility district has had higher revenues than expenses since 2000. Excess revenues are put into the reserve fund for future system investments. The town does not have a separate account for eventual replacement of assets such as the FAST system once their service lives are completed.

Costs to onsite system owners include permit and inspection fees listed in the Performance and Reliability section. Pumping costs paid to private pumpers average $60 for a holding tank and $55 for a septic tank. Onsite system owners also pay 1.5 cents per gallon to the town for field spreading, plus a $4.00 lime fee per load. Capital costs of new systems on Washington Island reflect its remote location and shallow soils and range from $8,000 to $19,000, depending on the site and system.

As of January 2003, there were 1,007 wastewater systems on the island. These include 448 conventional (non-pressurized) absorption fields, 109 mound systems, 214 holding tanks, and a variety of other onsite systems.

Analysis

This section provides information about:

- Incremental capacity provision
- Performance and reliability
- Growth, development, and autonomy
- Fairness and equity
- Stakeholder relationships and trust

Incremental Capacity Provision

This section addresses the following:

- ***How was system architecture relevant to this issue?*** A phased process of inspecting all onsite systems and reconstructing failing or substandard systems with appropriate technologies eliminated the need for a large centralized treatment system. The high up-front costs of a centralized system could not have been financed by the town, given its small population and economic base.
- ***How was the issue addressed?*** Advanced onsite treatment systems were not considered in the initial facility plan due to the state's previous reluctance to permit them. As the facility planning process progressed, state officials granted Washington Island money to determine the suitability of advanced onsite treatment systems. A revised facility plan highlighted the cost savings and reduced financial risks of a decentralized and incremental approach.
- ***Did the issue resonate with the community?*** Many islanders were not comfortable with the cost of a centralized approach. The relative savings of developing decentralized treatment capacity over time clearly interested community members.
- ***Results/Status:*** The town has proceeded with a decentralized approach while also acquiring more land for field spreading and incorporating small-scale community treatment systems to reduce field spreading liability.

How Was System Architecture Relevant to This Issue?

The initial cost estimate for a centralized system was $2.4 million for capital costs or $5 million if the net present worth of 20 years of operation and maintenance is included. However, the town did not have such capital available, and believed it was unlikely to obtain the funding through grants or other aid—in 1990 Washington Island was 54th on a Wisconsin list for low-interest Clean Water Act loans. Bonding the project would be difficult due to the town's small size. Even if financing could be secured, the total project cost—more than $6 million at anticipated interest rates—could not be supported by the tax base.

A decentralized architecture allowed the town to deal with its wastewater treatment needs in an incremental manner. It also slowed the proliferation of holding tanks. The town avoided large, up-front capital expenditures for a centralized treatment and discharge system and relied on property owners to pay for their own treatment systems.

How Was the Issue Addressed?

This section addresses incremental capacity provision relative to the:

- Original facility plan
- Revised facility plan

Decentralization and Project Financing Were Given Little to No Attention In the Original Facility Plan

During the original facility planning process, a degree of decentralization was considered. Three separate cluster systems with mounded soil absorption systems were proposed for high-density harbor areas to serve 20 permanent residences and 39 seasonal residences. They were quickly dismissed as cost-ineffective compared to the holding tank/central treatment scenario. In addition, the consultant claimed that community soil absorption systems were less able than conventional treatment systems to respond to regulatory change. The plan stated that centralized systems allow expansion or modification at the end of the 20-year design period, whereas community soil absorption systems could not be easily modified to meet stricter effluent limits.[23] (Brey, Stuewe, & Braun, Inc. Undated, p. 6.37)

Islanders involved in wastewater planning at the time stated that the consultant was reluctant to explore alternative onsite treatment systems, despite numerous requests from the town. However, such systems were not permitted by the state at the time, and it was not until the state expressed interest in the onsite system management concept, and approved funding for a demonstration project, that a decentralized architecture became a viable option.

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[23] The modifiability of both centralized and community systems depends on the particulars, especially the level of treatment required, the space available, and the cost of adding treatment units.

Neither financing costs nor any phasing of construction were discussed in the original facility plan. The chosen alternative, the trucking of holding tank wastes to a centralized treatment plant, meant that the town would have to assume ownership of all new holding tanks in order to receive funding. All residents with functioning soil absorption systems would continue using those systems, and failing systems would be reconstructed with new soil absorption systems when possible. The facility plan did not address splitting costs for the centralized system between residents with holding tanks and residents with functioning private soil absorption systems. This turned out to be a crucial issue with implications for financial viability and community equity, both discussed in subsequent sections

The Revised Facility Plan Focused on Decentralized Management and Showed the Advantages of an Incremental Approach

Venhuizen's 1995 decentralized facility plan revealed many financial problems with the centralized system. For instance, under the centralized proposal, if holding tank users paid for construction of the treatment plant on a per-gallon or fee basis, the operating costs and therefore the lifetime costs of holding tank use would increase dramatically. This would make shifting to onsite systems economically attractive to property owners wherever possible. Such shifts would undermine the fiscal integrity of a user-pays funding scheme. Politically, using an approach that charged all property owners was unpalatable because of equity issues between property owners who depended on a centralized treatment system and property owners who had functioning onsite systems.

Based on planning assumptions that were generous (probably low) on central system costs and conservative (probably high) on decentralized system costs, Venhuizen's plan estimated a decentralized approach would be 34 percent less expensive than a centralized treatment system. Sensitivity analysis showed the decentralized option was still 21 percent more cost-competitive, even if all decentralized systems were installed in the beginning rather than over time as would actually occur. These conclusions were also conservative because they did not account for an additional decentralized system advantage: reduction in financing costs. A decentralized approach would not involve paying interest on a large, up-front investment.

The revised facility plan also addressed the financial risks of centralization, pointing out that "a decentralized management strategy can typically respond to the actual needs as they occur, while centralized facilities must typically be sized for projected flows. These may or may not come to pass, putting a considerable investment at risk." (David Venhuizen P.E. Engineering and Planning 1995, p. C-9) Further, the plan noted that a centralized system would lock in a particular technology, while decentralized technologies could evolve and accept technology options that are more cost-effective in the future:

> … those particular strategies [recommended in the plan] merely describe one specific technological approach to implementation of the generic decentralized management concept. In the future, other methods of on-site/small-scale treatment and disposal may be found capable of adequately protecting environmental quality and public health in a more cost-effective manner. Those methods may be "plugged in" to the decentralized management strategy (David Venhuizen P.E. Engineering and Planning 1995, p. A-4).

Did the Issue Resonate With the Community?

The financial implications of the centralized proposal hit the town hard. One islander recollected that the debt for a centralized system would have doubled the town budget. Another recalled that he had to publicly chastise the project engineer for a lack of sensitivity to financing costs and the impact these costs would have on the town. Islanders knew that the tax base to support the necessary debt did not exist. The project would have required increasing the tax base through new development, which the town did not want.

The public became aware of decentralized options only after the state expressed interest in a demonstration project and the town brought in a knowledgeable consultant. The primary financial drivers for residents' interest in a decentralized strategy were overall cost savings and placing responsibility for costs on those with failing systems or holding tanks. Inspection and system replacement over a 10-year period, and individual financial responsibility for private systems, eliminated the need for municipal borrowing. Other aspects of the incremental approach, such as reduced financial risk and the value of maintaining future options, reportedly received little attention among islanders and regulators.

Results/Status

In the years since completion of the facility plan, Washington Island has in fact done just what Venhuizen predicted: the utility district has incorporated small-scale technologies not specifically foreseen in the plan. The FAST system has enabled the utility district to eliminate field spreading in the winter when the soil is less able to absorb wastes and to meet DNR regulations that now forbid winter septage spreading. It also reduces field spreading needs in summer months. While this system is a centralized one, it is much smaller than the original centralized treatment proposal, and provides a highly cost-effective solution to a specific wastewater management need.

The utility district is considering building additional, larger FAST systems at other locations on the island to further reduce land-spreading and reduce waste hauling distances. Such a "semi-centralized" approach would be considerably less expensive than the original centralized proposal. This proposal raises interesting issues about the relative costs and financial risks of different-sized wastewater treatment systems. Proponents of additional FAST systems, built in a modular approach at strategic locations around the island, argue that more such systems are needed because development will eventually encroach on current spreading fields, increasing the town's liabilities. Others counsel a go-slow approach. They note that any system over 12,000 GPD may increase in unit cost as much as fourfold. The Wisconsin DNR regulates any wastewater system over this threshold, and the DNR permitting process is more intensive than that of the Department of Commerce. An argument is also made that as more holding tank users move to the island full-time, as is expected in coming years, the economics of continually pumping those tanks will prompt more users to switch to onsite and cluster systems. Thus, the customer base for centralized FAST system capacity could decline over time, turning FAST systems into unnecessary, stranded assets.

Performance and Reliability

This section addresses the following:

- ***How was system architecture relevant to this issue?*** Environmental and public health risks from onsite systems were a key justification for the centralization proposal. However, centralized discharge of treated wastewater raised a different performance issue: no suitable disposal point could be identified.
- ***How was the issue addressed?*** Lack of adequate state regulation of advanced onsite systems precluded their inclusion in the initial discussion of alternatives. The town conducted a demonstration project to prove adequate technology existed. The second consultant developed a wastewater facilities plan based on the demonstrated technology. The town prepared a municipal wastewater management plan. The town utilizes the county sanitarian's department to provide oversight and credibility.
- ***Did the issue resonate with the community?*** Island residents and vacation homeowners recognized the inadequacies of existing systems. They also had reliability concerns about centralized systems based on the experiences of nearby towns.
- ***Results/Status:*** Citizens eventually accepted public management of decentralized systems as a necessary and practical solution. The utility district has implemented a database tracking system to ensure that systems are properly maintained, holding tank wastes reach intended field spreading sites, and spreading sites are not overburdened.

How Was System Architecture Relevant to This Issue?

Perceived and real environmental and public health risks from existing, substandard onsite systems and concerns over field spreading of untreated holding tank waste drove the facility planning process. As discussed in the following section, both regulators and the first consultant considered onsite systems to be very limited technologies and inadequate for the needs of Washington Island given its poor soils. At first, a centralized treatment system appeared to be the best solution.

A number of centralized collection and treatment alternatives were considered before recommending the centralized sand filter treatment system. It was chosen because of its resilience to variable wastewater flows, a result of the seasonal island population, as well as its cost effectiveness. However, the concentrated discharge of a centralized system represented an environmental and public relations liability that could not be overcome—no satisfactory effluent disposal scheme could be identified.

When advanced decentralized systems became a potential solution, anticipated performance—specifically nitrogen removal—made the denitrifying sand filter system attractive. However, the town needed to demonstrate the real-world performance and reliability of these systems before the state would approve their use as part of an onsite management plan.

How Was the Issue Addressed?

This section provides information about performance and reliability relevant to:

- The initial facility planning process
- The centralized treatment approach
- Proven technology for onsite management
- Onsite wastewater management plan adoption

The Initial Plan Dismissed Decentralized Systems as Unreliable

Other than conventional and mounded soil absorption systems, onsite treatment units were quickly dismissed as unreliable during the initial facility planning process. The plan stated, “The approving authorities in Wisconsin have been reluctant to approve anything that has to be maintained and operated by an individual. They have had some bad experiences in the past where they depended upon individuals to maintain mechanical equipment.” It also noted, “In preliminary contacts with the DNR, it is questionable if any of these alternatives would be approvable.” (Brey, Stuewe, & Braun, Inc. Undated, p. 6.32) The plan also questioned the reliability of community soil absorption systems, citing testimony from the Farmers Home Administration that the systems had not been performing as intended: “Drain fields have become clogged and saturated, ponding has occurred, and in one case, effluent has surfaced.” (Brey, Stuewe, & Braun, Inc. Undated, p. 6–32)

The town asked the consultant to prepare an addendum to the original facility plan; the addendum would evaluate a decentralized alternative that might include the use of modified mound systems and advanced treatment units rather than holding tanks. The consultant raised issues such as the lack of monitoring methods and requirements, the lack of a municipal management board to ensure compliance, proper operation and maintenance, and responsibility and liability if failures were to occur (Brey, Stuewe, & Braun, Inc. Undated, Addendum #2, p. 1.2). The consultant’s reluctance to pursue decentralized alternatives eventually led to the town to find another consultant more experienced in the design and management of onsite wastewater systems.

Reliability and Resilience Were Key Factors in Selection of a Proposed Centralized Treatment System

In the initial facility planning process, a number of centralized treatment alternatives were considered, including field spreading, an activated-sludge plant, an oxidation ditch, waste stabilization ponds, aerated lagoons, and recirculating intermittent sand filters.

The town’s initial decision (it has since been overturned) to end the practice of field spreading of holding tank wastes on the island meant that the wastewater treatment system would have to be capable of accommodating the disparity in flow volumes that the island experiences between its high summer tourism season and its lightly populated, frigid winters.

The central treatment plant option, which included the construction of a holding pond capable of storing 180 days' wastes (from winter), was perceived as less vulnerable to disruptions and more adaptable to extreme flow changes than other treatment options. The other two alternatives extensively considered, an activated-sludge plant and an oxidation ditch, were both cited as being more vulnerable and less resilient to the wide variation in wastewater flows and to "a possible slug of a toxic material that could kill off their bacterial growth." (Brey, Stuewe, & Braun, Inc. Undated, p. 7.75)

Regarding the sand filter, the facility plan states (Brey, Stuewe, & Braun, Inc. Undated, p. 7.76):

> Because it is not as dependent upon mechanical means and bacterial growth, it should be simpler to operate and maintain, it should be less susceptible to being upset by possible overloading either hydraulically or organically.

A Centralized Approach Could Not Satisfy Environmental or Health Concerns

The town studied options for treated wastewater discharge to two separate wetland sites on the island: Big Marsh and Coffee Swamp. Big Marsh was ultimately rejected due to phosphorous loading and algae concerns at the lake outlet. A consulting ecologist, James Zimmerman, was retained to determine potential effects of treated wastewater discharge into Coffee Swamp, a calcareous peat fen, which the Wisconsin DNR had listed in their Scientific Areas Long Range Plan as a potential State Natural Area (which it now is). Zimmerman concluded that wastewater discharge, even treated wastewater discharged to soil upland from the wetland, should not be permitted as it might alter the ecology and affect rare plant species in the fen (Brey, Stuewe, & Braun, Inc. Undated, Appendix E). Ultimately, no disposal site could be found that was affordable and did not compromise key environmental values (such as swamp or lake discharge) or raise public health concerns (such as spray irrigation near the school).

The Town Proved that Adequate Technology Existed for Onsite Management

In order to pursue an alternative, decentralized approach, the state mandated that Washington Island demonstrate that at least one technology could meet groundwater standards. Up to this point, the state's code presumed that onsite systems meeting certain prescriptive requirements (such as, soil depth) protected water quality. Washington Island, in its effort to use advanced technologies in situations that could not meet the prescriptive requirements, presented both a local need and an opportunity to prove to the state that advanced systems could protect water quality. Such systems, therefore, should be allowed under a new state code.

Thus, DNR and DIHLR allowed the town to expand its facilities planning process to evaluate performance of an alternative onsite system. Fortunately for the town, this effort essentially piloted the state's proposed performance-based code, so the state funded the demonstration project. Still, it fell to the town to carefully design the project and to ensure that proper sampling and other protocols were followed. The town was exposed to substantial financial risk as it was required to repay demonstration grant funds if the project was not well-executed.

The systems were sampled twice weekly from January 1992 to July 1994. The county was charged with ensuring proper installation of the denitrifying sand filter systems and proper sampling. Wastewater Committee member Donna Briesemeister was hired by the town as the project coordinator for the period of the demonstration project and was paid through the grant. She and town crewmember Glenn Jorgensen performed the sampling over the two-year period. The samples were sent to a laboratory at the University of Wisconsin in Green Bay. Nitrogen removal rates averaged more than 70 percent. Dr. Ronald Stieglitz noted (Boyer and Boyer 1994):

> … the systems have actually produced bacterial action at lower temperatures than we expected. The systems are viable alternatives to a septic system. They seem to function very well as we've found in the winter in the colder months. We even see that the start-up time … appears to be fairly good as well.

This resiliency and the relative simplicity of operation were among the factors that lent to the successful demonstration of the denitrifying sand filter system on Washington Island.

The Town Adopted an Onsite Wastewater Management Plan

At the request of the town, Door County passed an overlay ordinance applying the onsite wastewater management plan to all wastewater systems on the island. The county then entered into an intergovernmental agreement with the town. A county sanitarian would "implement, administer, and enforce the ordinance" in cooperation with the town's utility district sanitation manager. The town reimburses the county for all costs of the county sanitarian.

In approving the plan, DNR gave the utility district ten years (to 2006) to perform an initial inspection of all systems on the island, and required the district to tackle pre-defined problem areas around the harbors by July 1, 2001. Other shoreline properties were given high priority, as well as properties without documentation of soils or system construction. Washington Island must have all systems on the island functioning properly by 2006, or else face a daily fine.

The inspections include a thorough soil analysis and test of all septic systems and soil-absorption fields. If a system is failing, the homeowner has one year to modify, repair, or replace the system with a code-compliant system. Existing holding tanks need not be replaced unless the tanks are failing.

Aside from the initial inspections, inspections also are required during property sales or upgrades, for new construction, and at regular intervals as shown in Table 13-3. For new construction, the state requires a Sanitary Permit with an approved site plan; the permit fee ranges from $180 to $395 and is paid to the county. New systems also require a town Site & System Permit, with fees of $200 per installation paid to the town (or $400 per 2,500-gallon holding tank to create additional incentives to use other systems).

Table 13-3: Inspection Frequencies and Costs

System Type	Inspection Frequency	Cost
All systems	Initial (one-time)	$60, plus backhoe and other costs as necessary
Recirculating sand filter/low pressure dose	Quarterly	$50 per year plus $25 the third year
Holding tanks; systems operated with pumps (mounds, in-ground pressure); conventional septic/drain field systems	Every 3 years	$25 every three years
Future onsite systems	As required by DNR or Commerce	To be determined

Source: Town of Washington 1998

The pumping of solids from septic systems is required every three years or when the tank is one-third full of solids. Property owners are responsible for the maintenance costs of their own systems, and must engage appropriately licensed persons as required by the management plan. Owners of existing holding tanks were given three years to install water meters. Meters are required on all new holding tank installations. Pumpers are required to record water usage and submit readings to the utility district to verify the holding tanks are not leaking.

Did the Issue Resonate With the Community?

Town leaders, and apparently many residents as well, clearly understood that something needed to be done about substandard systems on the island. Many remembered the hepatitis outbreak of 1968. The rejection of continued field spreading at a meeting regarding the facility plan in 1988 indicated a desire to substantially improve the environmental and public health performance of wastewater management. However, community members could not be persuaded that the proposed central treatment system would adequately protect the proposed discharge sites, whether the lake, local swamps, or spray irrigation.

Concerns about the reliability of a centralized system emerged as well. Articles in the county newspaper, the *Door County Advocate*, provided the town invaluable information by highlighting financial and technical problems with centralized systems that had occurred in other Door County towns. For example, freeze fissures in the nearby Town of Ephram municipal collection system led to considerable groundwater and lake pollution and a substantial financial burden for repairs. Other towns in Door County also experienced problems with their central treatment facilities that required expensive repairs and upgrades.

As the decentralized approach was developed, the need for public management to ensure reliability of onsite systems resulted in extensive community discussions, as described in the

Stakeholder Relationships and Trust section. Ultimately the community accepted the need for substantially increased public oversight of private onsite systems.

Results/Status

According to the Door County Assistant Sanitarian, inspection results as of 2003 indicate that 40 to 50 percent of systems installed before 1974[24] are not compliant with the current code. Of post-1974 systems, approximately 20 percent exhibit some type of hydraulic failure. Non-compliant and failing systems are being upgraded as required. The initial inspections are scheduled for completion by 2004, two years ahead of schedule.

Other results include:

- Additional spreading fields and a fast system increased treatment performance
- A new database system provided information needed to verify compliance

The Town Acquired Additional Spreading Fields and a FAST System to Increase Treatment Performance

Since opting for the decentralized approach, Washington Island has taken additional steps to ensure there will be adequate treatment sites for its holding tank waste. To ease concerns about the long-term capacity of field spreading, on January 1, 2000 the utility district secured a 20-year lease on 30 acres of privately owned property approved by DNR to accept 1,053,000 gallons of holding tank and septic tank waste per year. Spreading is limited to 39,000 gallons per acre per year. The fields are divided into sub-sections to avoid over-spreading and the town requires pump-truck operators to keep detailed records.

The FAST system enables the town to discontinue field spreading of holding tank waste and septage in winter. Since its inception, the system has been able to accept nearly 600,000 gallons of wastes per year, more than one-third of annual pumped wastes. Effluent from the FAST system is dispersed through an Infiltrator subsurface soil absorption field, while residuals are land-applied at the town's field spreading site during the summer.

A New Database System Provides the Transparency of Information Needed to Verify Compliance

In 2002, Washington Island contracted with Carmody Data Systems, Inc. to provide a fully automated system for tracking onsite system inspections and management of waste from septic systems and holding tanks. The program is web-based, and essentially links liquid-waste carriers, owners, and government agencies in a comprehensive reporting system. Service providers, inspectors, and regulators have access to the system, and enter information from all onsite system activities: inspection, maintenance, repair, pumping, and disposal. In addition, property owners

[24] The state in 1974 required soil testers to be licensed; many pre-1974 systems are undocumented.

have full access to this complete service history in one convenient place. The system is also equipped to accept credit card payments from homeowners for inspection fees. The system:

- Provides real-time notification of systems that have missed inspections, maintenance, and/or pumping events
- Enables the sanitary manager to accurately track where wastes are treated and disposed, and thus direct waste away from saturated fields
- Provides inspectors with schematics to accurately locate a system on a property
- Serves as an inventory mechanism for new and previously undocumented systems
- Displays technical information for advanced systems, such as parts and warranties
- Enables inspectors, plumbers, and liquid-waste carriers to quickly transmit required information, including EPA 503 requirements for land application of septage, to government agencies

Besides the managerial functions noted above, the system offers the town a number of benefits. By having pumpers enter information, the town is no longer liable to the county for data manipulation errors (previously the town transposed data from manifests). Information from the system can be easily downloaded into spreadsheets by the town and by service providers for billing. In addition, the database is backed up regularly at a highly reputable data storage facility.

Growth, Development, and Autonomy

This section addresses the following:

- ***How was system architecture relevant to this issue?*** It was feared that a centralized system would remove constraints on development. The high costs of the centralized proposal also raised concerns about driving out long-time residents, changing the overall character of the island.
- ***How was the issue addressed?*** The first consultant did not evaluate the respective growth and character impacts of the centralized treatment system proposal. Subsequently, citizens discussed their ideas for the future of Washington Island. Concurrent to implementation of a decentralized wastewater architecture, the town updated zoning laws to address growth concerns.
- ***Did the issue resonate with the community?*** Concerns over changes in community character from increased growth and trucking of holding tank waste were a key focus of centralized treatment system opponents.
- ***Results/Status:*** Washington Island has maintained its special, rural character. The town’s “experiment” contributed to statewide debate regarding the growth impacts of proposed changes to the state onsite wastewater code that would allow advanced onsite treatment systems.

How Was System Architecture Relevant to This Issue?

The proposed centralized and decentralized approaches were very different in their potential impacts on the growth and character of Washington Island. Both, in principle, allowed most any lot to be developed, regardless of soil conditions. But in practice the centralized system, with its pump and haul approach to wastewater collection, facilitated the use of holding tanks, allowing even the smallest shoreline lots to be developed. The proposed use of advanced onsite treatment systems, on the other hand, carried a higher capital cost per lot and required more space. While holding tanks were still allowed as a last resort, the decentralized approach tended to discourage development of some lots. Perhaps more importantly, centralizing treatment would have greatly increased pumper truck traffic, interfering with the quiet character of island life. Further, building a centralized system would have necessitated increased development to pay off debt required by the system's high upfront costs.

How Was the Issue Addressed?

The issues of growth, development, and autonomy were influenced by:

- Extraneous costs
- Residents' values and ideas
- Land-use impacts
- Zoning revision in concert with decentralized wastewater planning

Extraneous Costs Were Not Adequately Addressed in the First Facility Plan

The first plan did not address potential economic and character impacts of increased pumper truck traffic, which a resident later estimated to be one truck every 20 minutes during the summer. The 1995 plan estimated that a centralized approach would require 6.4 times as many truck trips as the decentralized proposal (David Venhuizen P.E. Engineering and Planning 1995, p. E-4). The inevitable increase in road maintenance was ignored in the first plan's cost estimate for the centralized plant. It was mentioned but not quantified in the 1995 plan. Although the first consultant stated the private sector would fulfill the need for trucking, the first plan also discussed (but did not quantify) potential costs to the town of purchasing additional trucks. This suggests that private pumpers may not have been consulted or were not willing or able to invest in the necessary equipment. The first plan made no mention of potential effects on local growth.

Leaders Asked Residents for Their Values and Ideas

As the town began to search for alternatives, getting a handle on what residents wanted and would accept for the future of the town was a key objective of the Wastewater Committee. The committee knew it had to begin by articulating the community's values. This process of defining values and consensus building is discussed further in the section on Stakeholder Relationships and Trust.

The Second Facility Plan Qualitatively Addressed Land-Use Impacts

The 1995 plan addressed head-on the suggestion that advanced decentralized systems would allow development where it was previously not possible. It pointed out that holding tanks already allowed development virtually anywhere, and direct land-use regulation was needed under any wastewater management scheme. The plan also noted that the decentralized approach was "growth neutral" in that it accommodated development only as building occurred, while a centralized scheme might lead the town to spur growth in order to ensure the upfront investment could be paid for.

> "The first step in finding that solution was for our community to define its basic values. Only then could we collectively make the wise decisions that would defend rather than degrade those values. On Washington Island, this united vision included a love of the natural environment, a commitment to local control of land use regulation, and a sense of mutual respect and fair play."
>
> Donna Briesemeister, Wastewater Committee member (Briesemeister 1996)

The Town Revised Zoning In Concert With Decentralized Wastewater Planning

Town officials could not mandate "no holding tanks." If a holding tank was the only available option for developing a property, that rule would constitute a taking. But the increase in holding tanks seen through the 1980s was threatening long-term field spreading capacity. In addition to developing a wastewater facility plan that discouraged holding tanks, town leaders recognized the need to establish land-use controls to ensure the island would not "outgrow" its ability to biologically assimilate wastes.

The town has for many years maintained a minimum lot size of 60,000 square feet for shoreline development, where holding tanks are most likely to be needed due to poor soil conditions. In an effort to maintain the rural character of the island, the town in 1995 revised its zoning. Existing lots were grandfathered from the new regulations. Any new divisions of property, however, were required to meet the new zoning designations, including 10-acre lots in certain woodlands, 20-acre lots used for general agriculture, and five-acre lots in certain other areas. The town drew the zoning map in ways that recognized the needs of certain residents. Zoning Committee officials talked with residents individually and shaped the regulations around their concerns. Some people, for instance, wanted their property down-zoned to reduce development pressure. The end result, according to several residents, is a land-use plan that should help slow growth and maintain the rural character of the island. To date town officials have resisted requests to change zoning to allow increased density.

Did the Issue Resonate With the Community?

The issue resonated with the community, which resulted in:

- Concerns that the centralized plan was incompatible with the island's character
- Fears of high costs and inflated land values

The Centralized Plan Was Incompatible With the Island's Character

Many people moved to Washington Island for its look and feel: the country setting of the island interior, the clean lakefront waters, and the friendly people. The island depends on that character for its economic well-being. Many residents considered the proposed centralized treatment system incompatible with community character. Residents and merchants were concerned about potential impacts of the increased pumper truck traffic on tourism. Large trucks running over narrow roads were seen as a traffic hazard and potentially detrimental to the tourist industry. One resident described the trucks as "aesthetic liabilities." Also, the idea of a lake discharge for the wastewater plant "just did not sit well" with many residents. Waters around the island constitute a very valuable sport fishery, which is also an important element of the town's economy. Fishing is also an important sustenance activity for many islanders.

Residents Feared High Costs and Inflated Land Values

Some officials and citizens promoted the central plant to expand the island economy, but many islanders were wary of the potentially high costs and effects on the community. Funding the centralized plant would have required an increase in the tax base. That would require bringing more people in, and that would inflate land values. Inflated land values and high costs might have driven out long-time residents.

Results/Status

Local residents interviewed for this study seemed to be generally satisfied with current rates and patterns of growth on the island. It appears that the decentralized management plan and the new zoning code work well together. The community has largely maintained its rural, special character.

Washington Island's Decentralized Plan Contributed to Statewide Debate Over the Relationship of Onsite Systems to Growth

The island's decentralized plan depended upon proposed changes to the state onsite wastewater system code; specifically, on the use of advanced onsite treatment systems that were not allowed under the existing code. However, a number of statewide advocacy groups strongly opposed the proposed code changes. Substantial lobbying and litigation over the proposed changes took place through much of the 1990s. The Wisconsin Alliance of Cities and the Wisconsin Environmental Decade Institute sued to enjoin enactment of the new code. One of their concerns was the possible secondary effects that DILHR's move to a performance-based code would have on development and land-use planning in rural areas. They feared that advanced systems would allow more growth outside Wisconsin's urban and suburban areas. They also feared the new technologies would reduce the usefulness of municipal annexations, based on sewer extensions, as a tool for growth management and augmentation of local revenues. The presiding judge halted enactment of the new code pending completion of an EIS and additional rule-making procedures.

The final EIS for the proposed regulations documented that 8.9 million acres of land previously incapable of supporting onsite soil absorption systems would now be eligible for development. However, it went on to point out that these lands were already being developed using holding tanks. With the increased lands available for soil absorption systems, the ability of a local government to create de facto zoning by restricting or prohibiting the use of holding tanks, as was allowed under the existing onsite code, would be circumvented. Thus, local governments that had relied upon the previous wastewater system siting requirements as land-use controls would have to create and adopt new land-use plans and zoning ordinances. The potential impacts to Door County were articulated as follows (Wisconsin Department of Commerce 1998, p. 202):

> The biggest deterrence to development with onsite sewage systems in this area under the current code is the prevalence of fractured bedrock at a shallow soil depth. The accelerated development that would be allowed by new types of onsite sewage systems that require less soil depth for treatment could lead to a loss of rural character that could adversely affect the tourism industry. On the other hand, development in Door County is occurring currently with the use of holding tanks. Many new and existing facilities and businesses serving the tourists could benefit from the availability of options other than holding tanks for meeting their wastewater treatment and disposal needs.

To combat potential changes in development location and increased density in areas citizens wanted preserved, local governments were given the option of banning certain systems indefinitely and of delaying or limiting the issuance of sanitary permits for certain other systems for up to 18 months in order to make desired changes in zoning ordinances. In addition, the EIS cited examples of ways local governments can mitigate the impacts of development in sensitive areas, such as restricting driveway lengths and limiting the construction of new public roads.

Meanwhile, the Wisconsin legislature became involved in the process by responding to widespread concerns about the cost of advanced systems. These concerns were often based on misinformation: it was widely reported that advanced systems would cost $40,000 per property. The legislature sought to eliminate advanced systems from any niche that could not be served by already approved systems, such as mounded absorption fields. To do so, the legislature loosened the nitrate limits of the groundwater code, allowing a 40 ppm standard for onsite systems, instead of the previous 10 ppm standard, which was the primary reason advanced treatment units were demonstrated on Washington Island.

For Washington Island, the end result of Wisconsin's legal and political battles over onsite wastewater regulation is that while the new regulations—known as "COMM 83" because DIHLR has been absorbed into the Department of Commerce—allow advanced systems such as the demonstrated denitrifying sand filter technology in the island's facility plan, they provide little "push" toward such systems. Since the legislature liberalized the nitrate loading groundwater requirements, conventional onsite systems and mound systems can meet code requirements in most cases on the island.

Fairness and Equity

This section addresses the following:

- ***How was system architecture relevant to this issue?*** A decentralized approach focused on individual system responsibility. User-fee based community treatment (field spreading) sites allowed the town to avoid equity issues arising from the diversity of treatment needs among property owners.
- ***How was the issue addressed?*** Equity issues were not addressed in the first facility plan. The later proposal for a decentralized approach did address equity concerns.
- ***Did the issue resonate with the community?*** Concerns over equity resonated considerably among both seasonal and full-time residents.
- ***Results/Status:*** Residents are responsible for their individual systems. Further, the town chose a fee-based utility district as a management institution rather than a tax-based sanitary district. Some individuals using holding tanks still believe the user-pays scheme is unfair.

How Was System Architecture Relevant to This Issue?

Since the decision on where to build one's house and how one maintained a septic system had been up to each individual for many years, there was general agreement on the island that everybody should be responsible for their own systems. This belief supported the search for decentralized solutions. Centralized treatment, on the other hand, required a degree of socialization of costs that made many people uncomfortable.

How Was the Issue Addressed?

The fairness and equity issue was not fully addressed, which is demonstrated by:

- The original facility plan did not address equity issues
- The town board was sympathetic to individual responsibility over failing systems
- A decentralized approach helped the town to avoid equity issues raised by the centralized proposal

The Original Facility Plan Did Not Address Equity Issues

The original facility plan proposed that the town accept ownership of all holding tanks to be constructed under the program in order to get outside funding (Brey, Stuewe, & Braun, Inc. Undated, p. 4.8). However, the plan did not address whether those who needed holding tanks would reimburse the town, or whether the whole community would ultimately pay. Indeed, cost sharing between those requiring new systems and those with adequate systems was not addressed at all in the facility plan.

The Town Board Was Sympathetic to Individual Responsibility Over Failing Systems

Upon the appointment of the Wastewater Committee, the town board made it clear that it “does not support town ownership of any private waste disposal systems,” and that “each should be responsible for replacing his failing systems.” (Greenfeldt 1990)

A Decentralized Approach Helped the Town to Avoid Equity Issues Raised by the Centralized Proposal

By agreeing upon individually owned treatment systems, Washington Island avoided equity disputes that would have made financing the centralized plant very difficult. For instance, should all residents have to pay for the treatment plant, even those with functioning onsite systems? Should a per gallon charge at the proposed treatment plant require year-round residents to pay more than seasonal residents even though seasonal residents with holding tanks were driving the need for the treatment facility? Questions like these became moot. Individual treatment systems reward those who take wastewater into account when siting a house or business, and place financial responsibility on those who do not by requiring they utilize advanced treatment systems, with holding tanks only a last resort.

Also, as noted in the 1995 facilities plan, the decentralized approach rewards those property owners that have properly maintained their systems over the years. Likewise, it appropriately penalizes those who do not maintain their systems by placing the burden for individual treatment system replacements on the individual property owners. This way, future costs of inadequate systems are not spread to all residents, as they likely would be if a centralized system was determined to be inadequate.

Did the Issue Resonate With the Community?

The fairness and equity issue resonated with the community as revealed by:

- The proposed central system raised fairness issues between full- and part-time residents
- Individual responsibility was seen as the most equitable solution

The Proposed Central System Raised Fairness Issues Between Full- and Part-Time Residents

Long-time year-round residents of Washington Island built on land in the island interior, which has adequate topsoil for soil-absorption systems. One resident described the original island people as “land rich and money poor.” Newer residents predominately built upon small lakefront lots that were unable to biologically assimilate sewage, and thus utilized holding tanks. During the wastewater facility planning process, there was a sentiment among old-timers that building on property unable to assimilate wastewater was reckless. It challenged the notion of individual responsibility that has been an underlying ethic of life on Washington Island since its settlement.

The shoreline lots were also much more expensive, and many of these property owners were seasonal visitors or lodging operators. This disparity between new, higher-income, seasonal residents and long-term, lower-income residents created an interesting dynamic when the community decided on a wastewater treatment system. Owners of both failing conventional septic systems and owners of holding tanks created the need for wastewater management. But owners of holding tanks stood to gain much more from the construction of a centralized treatment solution, as fewer options were available to them given their poor soil and small lot sizes. At the same time, seasonal residents also questioned "why should we pay all this money for something we only use six weeks per year?"

> "They're very independent up here. I think that having your own system, where they are responsible themselves, really maintains that feeling of independence, even if they do have to answer to the county or the state."
>
> Lynn Utesch, former Town Board member

Individual Responsibility Was Seen as the Most Equitable Solution

Some participants in the planning process recalled that an "us and them" mentality began to emerge between full-time and seasonal residents. The Wastewater Committee worked hard to head this off. To facilitate discussion about equity issues, the Wastewater Committee introduced an analogy to the automobile catalytic converter, which is used to remove pollutants from auto emissions. The argument went like this: "Every car needs a catalytic converter. If you have five cars in your driveway, should I have to pay for your catalytic converters, or do you have to buy five catalytic converters?" The ensuing discussions led the town down the path of individual responsibility for wastewater treatment needs, and support of a decentralized approach became predominate.

There was also a link between costs and fairness on the one hand, and system management on the other. Public oversight of onsite systems was eventually seen by most people to be less onerous than sharing the costs of an expensive centralized system.

Results/Status

Results include:

- The town chose and still maintains a user-pays approach to wastewater management
- Some people feel the user-pays approach is inequitable

The Town Chose and Still Maintains a User-Pays Approach to Wastewater Management

The user-pays approach has been a principle on the island since the beginning of the demonstration project. Each owner of a demonstration system paid for its construction in its entirety. These construction costs satisfied the 10 percent local match required by the demonstration grant. Having the property owners pay this match seemed equitable since they would benefit from their new systems.

Equity considerations also entered into the choice and funding of the management institution. Wisconsin law offers two legal options to underwrite municipal wastewater management: a sanitary district or a utility district. The town board disliked the sanitary district option because districts have the authority to tax in Wisconsin, and the board wanted to avoid the cost-spreading implicit in taxes. The board established a utility district and a user-pays fee structure. This method of funding management activities ensures that users of services pay according to their level of use. Field spreading, for instance, is paid for on a per-gallon basis. Further, the cost of the FAST system was assigned to those who use it most through increases to land-spreading fees.

Some People Feel the User-Pays Approach is Inequitable

Some interviewees maintain that municipal management of field spreading and other shared systems (such as the FAST system) benefits all residents by protecting public health and the environment, and therefore these costs should be shared. This appears to be a minority view. However, it is also worth noting that many holding tank users are seasonal residents and cannot voice their opinions by voting in Washington Island elections.

Stakeholder Relationships and Trust

This section addresses the following:

- ***How was system architecture relevant to this issue?*** A decentralized architecture, managed by the town, needed willing participants in order to be an effective wastewater strategy.
- ***How was the issue addressed?*** Community discussions and consistent, transparent information exchanges enabled a consensus to be built in favor of decentralized management. This process also eased the concerns of state regulators over the alternative approach that was being considered.
- ***Did the issue resonate with the community?*** Many concerns arose and were addressed. Residents became willing participants of municipal management.
- ***Results/Status:*** Residents are still willing participants in the program, although there have been some continuity lapses in utility district leadership and concerns about affordability have arisen.

How Was System Architecture Relevant to This Issue?

Compared to going down the centralized path, the effort to research, propose, and implement a decentralized municipal management plan in the early 1990s was a risky proposition for Washington Island. There were no models to follow, no knowledgeable local consultants, no state guidelines (worse, the state onsite code was under revision), and any mistakes could have resulted in serious financial consequences. Ensuring plan viability required community "buy-in." Obtaining that support necessitated a concerted public participation effort.

How Was the Issue Addressed?

Stakeholder relationships and trust were addressed through:

- Community involvement
- Effective leadership
- Frequent communication
- Relationship building with government authorities

Town Leaders Involved the Community Early in the Planning Process

The town board created the Wastewater Committee, and the committee in turn encouraged everybody to help search for alternatives. Someone heard of local management of septic systems at Stinson Beach in California, which provided "inspiration" that the town could take control of its wastewater problem. Another person found out that small municipal recirculating sand filters had been used successfully in upstate New York, which had a similar climate. Many creative solutions were proposed, including the purchase of a large tanker to fill with septage. Any idea, any outside information source, was considered worth exploring.

> "If there's anything that I could ever say to anybody else doing this, it's don't ever take anything for granted about how the people feel. Find out by asking them."
>
> Donna Briesemeister, Wastewater Committee member

Capable Leadership Provided a Strong Foundation

Many people on the island praised the early leadership of former Town Board Chair Arbutus Greenfeldt, who had the courage to commit the town to the demonstration project and put her signature on the $600,000 grant. The long-term efforts of Monika Wulfers and Donna Briesemeister in leading the search for solutions were also regarded as essential.

The Washington Island story, however, shows that good leadership is not about "directing," but rather "involving," other stakeholders. People working on the wastewater plan carefully attended to building consensus. Participants recall that no one's opinion was ever discounted. People's opinions were respected. This inclusive approach built consensus around a decentralized solution.

Frequent Meetings and Updates Occurred

In addition to the frequent Wastewater Committee meetings, which often drew 30 to 40 people, there were frequent updates on wastewater-related matters at town board meetings. An article appeared in every issue of the island newspaper, explaining the wastewater "over and over again." Persons interviewed for this study noted that disseminating information frequently helped combat rumors and kept the public interested and involved. There were also special community gatherings. These were often held to celebrate progress and to congratulate the community on that progress.

The Town Worked Hard to Maintain Relationships With Higher Government Authorities

Throughout the second facility planning process, Washington Island representatives kept in contact with officials from DNR, DILHR, and Door County. This was trying at times; local participants described the overlapping jurisdictional and oversight responsibilities of the various governments as a "morass." But the effort paid off. Under Wisconsin regulations and programs at the time, Washington's Island's solution could not have happened without flexibility and innovation on the part of other government agencies. These innovations included DILHR's support of the Washington Island approach, DNR's funding of a demonstration project promoted by DIHLR, and an intergovernmental agreement between the Town of Washington and Door County. To legally execute municipal decentralized wastewater management, it was necessary for the town and county to enter into an agreement whereby the town would utilize Door County's resources and legal powers over wastewater systems in exchange for the town accepting responsibility for handling its own affairs.

Did the Issue Resonate With the Community?

The estimated cost of the central treatment system concerned both younger and older full-time residents and got them involved in the planning process. The additional cost of living expense would have affected them the most. Equity and growth issues brought other people into the planning process.

The tradeoffs involved in a decentralized management plan were often of interest. Lot owners might have to relocate a proposed building to accommodate a drain field instead of putting in a holding tank. Inspections would require property owners to grant access.

Residents Had the Necessary Information to Make Informed Decisions

Continual communication of the implications of proposed actions was essential to community involvement and the development of consensus. The real decisions on Washington Island are said to happen over coffee, at the grocery store, in line at the post office, and so on. This informal communication is how the town reaches consensus on issues. Town leaders made sure these discussions were based on good information.

> "Information is a big thing. Get it out there and listen. We used to have a meeting a week it seemed like, and every meeting there was a wastewater update. The information was out there, and people knew what was going on. Especially in a small community, it's so easy to get misinformation out there. You have to make sure it's the correct information. You don't want it to be rumors, you don't want it to be hearsay. You want it to be factual."
>
> Lynn Utesch, former Town Board member

Results/Status

Washington Island benefited from a conscientious, effective effort at public participation as the town worked toward its decision to adopt a decentralized wastewater strategy. The town obtained the participation of property owners necessary for inspections and other aspects of the decentralized management program. Since that time, some difficulties have emerged, including programmatic continuity and affordability of decentralized system upgrades.

Maintaining Programmatic Continuity Has Been Challenging

Long-term accountability for moving the wastewater management program forward has been a problem for Washington Island. The difficulty is that different town boards (members are elected every two years and generally serve only a few terms) have different levels of interest in the wastewater program. The management plan took effect in mid-1996, and key elements of the plan were soon implemented. Over time, however, some of the plan's provisions languished as the board's interest in wastewater issues waned.

A few years later, as the spreading issue became acute, two new board members were elected. They worked hard to resolve that problem, then they left the board. At one point the board and the town manager set up a Wastewater Advisory Committee, but they later disbanded it. Town management did not act on a revision to the management plan proposed by that committee. A new Wastewater Advisory Committee was formed in late 2002. Soon afterwards, however, the committee was placed on "inactive" status by new town officials.

Constantly changing town leadership creates continuity issues that islanders admit need to be addressed. A former board member suggests that the town and utility boards should be separated, so people interested in the utility but not general governance could maintain seats on the utility board for a longer period of time.

Affordability of Decentralized System Upgrades for Some Residents is a Continuing Concern

Given the wealth of some island residents and second homeowners, onsite system affordability for low-income residents is easily overlooked, especially by outside agencies that might be approached for assistance. As one resident put it, "We don't live on average incomes."

After focusing first on shoreline properties where soils are poorest, the initial inspection process is now concentrating on inland properties where the majority of full-time residents live. Although the town agreed on individual responsibility for wastewater system costs, lower-income islanders are concerned about costs of onsite system upgrades. Town officials made promises to explore funding opportunities for less-advantaged households. However, this was not done, leading to anxiety and resentment by some lower-income residents.

Conclusions

After a false start down a path inappropriate for the community, Washington Island eventually developed an approach to wastewater management that appears to work well, though some aspects, such as continuity of leadership, have been problematic. Other communities may benefit from these lessons:

- Take control and initiative to address wastewater problems. Washington Island had to get a handle on the proliferation of holding tanks and how that was driving the town toward a potentially expensive solution. Al Theile recalls putting it this way to fellow town board members at the time: “If the board doesn’t address wastewater, the community will dictate wastewater systems to the board, by what people put in.”

- Enlist the community in the search for solutions. While some aspects of the facility planning process can only be accomplished by technical experts, the problem-scoping and idea-generation steps benefit from public participation. Useful ideas may arise and, at the very least, the community will feel greater ownership of the eventual solution.
- Find a consultant willing to innovate—not for innovation’s sake, of course, but to solve problems. Persons interviewed for this study said Washington Island’s first consultant was reluctant to explore alternatives when conventional solutions proved inadequate. The second consultant was able to technically and financially evaluate the centralized treatment plant option and compare it to the innovative denitrifying sand filter concept.
- Work closely with regulators. Washington Island developed positive relationships with state regulators who came to see the town as genuinely interested in doing the right thing, rather than trying to “get away with something.”
- If your community is breaking new ground for your state, be prepared for a long effort. For instance, be prepared to demonstrate any new technologies. These days, this step should not often be necessary, as so many wastewater technologies have been well-researched, but state onsite regulations are in flux. Regulators often want to see a technology “proven” in their own state.
- Be aware that some innovations may raise issues that go well beyond a service area boundary. Washington Island’s push for advanced onsite systems got embroiled in statewide debates over the growth impacts of state code changes necessary for the town’s plan.
- Define a consensus vision of the community’s future before developing a wastewater plan. Washington Island was able to revise its zoning and develop a wastewater management plan at the same time. This may have been possible because of the small size of the community; other case studies show that effective general plans should be in place before wastewater planning proceeds.
- Develop a process that will encompass all key issues and yield a consensus solution. As part of that process, ask community members for their ideas, opinions, and values. Do not assume answers. Issues of growth, fairness, community character, and fiscal responsibility all became part of the process on Washington Island.
- Be sure consultants pay careful attention to the values of the community and have the expertise to understand and reveal the impacts of technical choices on community values. The first facility plan focused on facility options and regulatory considerations. It appears the plan was developed with little attention to discerning and accommodating qualitative concerns of local residents. The second facility plan is replete with qualitative discussion of environmental impacts, impacts on tourism, fiscal integrity, equity issues, concerns over management schemes, and so on. The second consultant apparently listened more carefully to the community, and more importantly, led the community to an understanding of how these matters would be impacted by the centralized and decentralized approaches.

- Identify and assist leaders interested in the issue and process. While broad public participation is important, it must be orchestrated by one or a few people with the requisite abilities. This could be an outside consultant. When this leadership comes from inside the community, so much the better. Long-term dedication is required to see the process through. It helps to have one or more champions to keep the effort going.
- Keep the public informed. Recognize that informal discussion in the community shapes opinions and decisions. Be sure these discussions are based on sound information. This requires a continual effort to inform citizens of all the issues, facts, problems, and opportunities identified in the facility planning process. This effort is also necessary in order to maintain the public's trust in the process.
- Avoid spending too much time and too many resources studying solutions that will not work. Washington Island might have benefited from a screening process that could have quickly shown that a centralized approach would not be appropriate given concerns over cost, pumper truck traffic, fairness, and other issues.
- Use what the community has. Both plans envisioned continued use of code-compliant onsite systems, including conventional septic systems where soils were adequate.
- Develop a flexible scheme. The 1995 facility and management plans envisioned widespread use of denitrifying sand filters. When the state changed policy, the town was able to re-focus on managing field spreading of the waste from remaining holding tanks.
- Include financing considerations in the facility planning process. Large up-front costs are difficult for a community. Wastewater options that spread costs over time are more likely to be acceptable.
- Be aware of economic dynamics that can undermine the financial viability of a large-scale system. The first plan did not account for a dynamic identified in the second plan: high operational (pump and haul) costs for holding tanks would prompt replacement of tanks with onsite systems (due to their lower operational costs), undermining the customer base for the proposed central treatment plant. Recall that at the time, it was assumed that all holding tanks would either have to have centralized treatment or be replaced by onsite systems. While this dynamic was later nullified by relaxation of state regulations, it was an important financial planning consideration that the first plan overlooked.
- Determine if the community is guided by a user-pays or a cost-sharing ethic. This philosophical difference is central to development of financing schemes. Further, because different system architectures spread or concentrate costs in different ways, knowing the community's beliefs may help determine what type of architecture is most appropriate. Note, however, that adopting a user-pays approach should not be used as a way to avoid management. Proper oversight of decentralized systems is still required to ensure proper performance and guard against system failures. Otherwise, compliant system owners may ultimately be penalized because their neighbors fail to maintain their systems, resulting in problems that lead to the installation of sewers. Washington Island adopted a system of initial and periodic onsite system inspections by the utility district in cooperation with the county sanitarian, and a variety of measures to properly manage holding tanks and disposal of their wastes.

- When adopting a user-pays scheme, recognize that not all persons will agree with this approach, and some may face financial hardships because of it. Develop ways to mitigate those hardships, and be sure to follow-through on promises.
- After implementing the plan, keep an eye on the future, but do not act prematurely. As Washington Island continues to develop, field spreading may become more problematic. This would suggest additional centralized treatment capacity, such as additional FAST systems. However, high costs may cause more holding tank owners to adopt onsite treatment systems, which would reduce the need for centralized treatment. The key is to identify the point at which certain decisions must be made, and beyond which certain options will no longer be available.
- Develop the necessary information infrastructure to ensure proper management. Washington Island has purchased a database system that should facilitate the proper management of both onsite systems and field spreading sites.
- Structure wastewater management institutions in ways that will ensure continuity of leadership. Once a facility plan is accepted, community leaders may want to "take a break." But continued effort is necessary to ensure all aspects of the plan are implemented and to respond to new challenges and opportunities. Structure decision-making and advisory bodies in ways that will keep knowledgeable people involved. This is particularly important for small communities where staff capacity is limited.
- Create a rate structure and a depreciation account that generates and sets asides funds for eventual replacement of key assets. While in recent years the utility district has had higher revenues than expenses, and the excess receipts are put into a reserve fund, these funds could be used (and have been) for new assets or other purposes. At present, the town has no dedicated account that is building funds for eventual replacement of assets such as the FAST system once their service lives are completed.

Perhaps the most important lesson from Washington Island is the necessity of building and maintaining trust in order to make good choices and pursue innovation. This is perhaps easier in small communities, but the general lesson is widely applicable. Even on Washington Island there were substantial and difficult interpersonal politics that dampened the process at times. Even here, and perhaps more importantly in larger communities, the way around those pitfalls was what the Wastewater Committee did throughout the second facility planning process: it communicated openly, frequently, and transparently to the community; more than that, the committee genuinely and vigorously sought out and listened to the ideas and opinions of community members.

Sources

Sources for this case study include:

Personal Interviews

Bill Baudhuin, President, Baudhuin Inc., Sturgeon Bay, WI

Donna Briesemeister, Wastewater Committee member, former town employee

Scott Carmody, Carmody Data Systems, Inc., DeForest, WI

Mark Finger, soil scientist, Luxemburg, WI

Terry and Ginny Foster, seasonal residents

Arbutus Greenfeldt, former town board Chair

Laura Jack, resident

Duane Jacobsen, former Town Assessor

Amy Jorgenson, former town board member, owner of Jorgenson Sanitation

Glenn Jorgenson, former Utility District Sanitation Manager, now residing in Sturgeon Bay, WI

Barry McNulty, resident

Louis Munao, former town board member

Janette Munao, former Utility District Secretary

Bill Olson, resident

Greg Thiede, Door County Assistant Sanitarian, Sturgeon Bay, WI

Al Thiele, former town board member

Lynn Utesch, former town board member

Douglas A. Young, former town board member and Chair

Phone Interviews

Bennette Burks, former Section Chief for Wisconsin Department of Industry, Labor, and Human Relations; now with Consolidated Treatment, Inc., Franklin, OH

Ron Overdahl, former Wastewater Advisory Committee member

John Unkefer, former town board Chair

David Venhuizen, engineer for the 1995 facility plan, Austin, TX

Monika Wulfers, former Wastewater Committee Chair; now residing in Chicago, IL

Documents

Additional documents reviewed included budget and wastewater system data from the Town of Washington and Town of Washington Utility District; utility district meeting minutes; correspondence to the RMI project team from Donna Briesemeister; and miscellaneous newspaper articles.

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Briesemeister, D. 1996. "Cooperative Action Is Key to WA Island Project's Success." *Small Flows.* 10(4), 3.

David Venhuizen P.E. Engineering and Planning. 1995. *Town of Washington: Wastewater System Facility Plan.* Austin, TX. January 1995.

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Town of Washington. 1998. *Municipal Waste Water Management Plan.* Washington Island, WI. August 6, 1998.

Wisconsin Department of Commerce. 1998. *Final Environmental Impact Statement for Proposed Changes to Chapter Comm 83, 85 and Other Related Rules Regulating Private Onsite Wastewater Treatment Systems (POWTS).* Division of Safety and Buildings, Madison, WI. August 24, 1998.

14 LIST OF ACRONYMS AND ABBREVIATIONS

AL	Alabama
ATU	Aerobic Treatment Unit
BCC	Board of County Commissioners
BOCC	Board of County Commissioners
BOD_5	Biochemical Oxygen Demand, 5-day
CA	California
$CBOD_5$	Carbonaceous Biochemical Oxygen Demand, 5-day
CDBG	Community Development Block Grant
CIDWT	Consortium of Institutes for Decentralized Wastewater Treatment
CSA	Community Supported Agriculture
CSO	Combined Sewer Overflow
DEIS	Draft Environmental Impact Statement
DEP	Department of Environmental Protection
DNR	Department of Natural Resources
EDU	Equivalent Dwelling Unit
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
ERC	Equivalent Residential Connection
FAST	Fixed Activated-sludge Treatment
FC	Fecal Coliform
FL	Florida
GPA	Gallons Per Acre
GPD	Gallons Per Day
HOA	Homeowners Association
I/I	Infiltration and Inflow

ISTS	Individual Sewage Treatment Systems
KS	Kansas
LPS	Low-Pressure Sewer
MA	Massachusetts
MGD	Million Gallons per Day
mg/l	milligrams per liter
MN	Minnesota
NDWRCDP	National Decentralized Water Resources Capacity Development Project
NH_3	Ammonia
NH_3-N	Nitrogen in the form of ammonia
NOWRA	National Onsite Wastewater Recycling Association
NPDES	National Pollution Discharge Elimination System
O&M	Operation and Maintenance
OM&R	Operation, Maintenance, and Replacement
PA	Pennsylvania
POTW	Publicly Owned Treatment Works
ppm	parts per million
RFP	Request For Proposals
RSF	Recirculating Sand Filter
SDEIS	Supplemental Draft Environmental Impact Statement
SRF	State Revolving loan Fund
SSO	Sanitary Sewer Overflow
STEP	Septic Tank Effluent Pump (or) Pressure(ized)
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TP	Total Phosphorous
TSS	Total Suspended Solids
US EPA	United States Environmental Protection Agency
WEFTEC	Water Environment Federation Technical and Educational Conference

WI	Wisconsin
WWTP	Wastewater Treatment Plant

Case-Specific Acronyms and Abbreviations

Mobile, AL

ADEM	Alabama Department of Environmental Management
MAWSS	Mobile Area Water & Sewer System
SWAT	Severe Weather Attenuation Tank

Paradise, CA

CLASS	Citizens Looking for Affordable Sewer Systems
K/J/C	Kennedy/Jenks/Chilton Consulting Engineers
PID	Paradise Irrigation District’s
WDAD	Wastewater Design Assessment District

Charlotte County, FL

BEBR	Bureau of Economic and Business Research
CCHD	Charlotte County Health Department
CCU	Charlotte County Utilities
CDM	Camp Dresser & McKee
EAR	Evaluation and Appraisal Report
FDCA	Florida Department of Community Affairs
GDC	General Development Corporation
GDU	General Development Utilities

Johnson County, KS

AIMS	Automated Information and Mapping System
JCED	Johnson County Environmental Department
JCW	Johnson County Unified Wastewater District
CMSD	Consolidated Main Sewer District
CS	Community Septic

Metropolitan Boston, MA

CWMP	Comprehensive Wastewater Management Plan
CWRMP	Comprehensive Water Resources Management Plan
DEM	(Massachusetts) Department of Environmental Management
DITP	Deer Island Treatment Plant
EMMA	Eastern Massachusetts Metropolitan Area
EOEA	(Massachusetts) Executive Office of Environmental Affairs
MEPA	Massachusetts Environmental Policy Act
MWRA	Massachusetts Water Resources Authority

Lake Elmo, MN

AMM	Association of Metropolitan Municipalities
EWTS	Engineered Wetland Treatment Systems
MCES	Metropolitan Council Environmental Services
MLPA	Metropolitan Land Planning Act
MPCA	Minnesota Pollution Control Agency
NAWE	North American Wetland Engineering, Inc.
OP	Open space Preservation (ordinance)
RAD	Rural Agricultural Density (zoning)
TKDA	Toltz, King, Duvall, Anderson & Associates, Inc.

Broad Top and Coaldale, PA

DER	(Pennsylvania) Department of Environmental Resources
SAC	Sewage Advisory Committee
SMR	Six Mile Run
WAC	Watershed Advisory Committee

Washington Island, WI

DILHR	Department of Industry, Labor, and Human Relations
RSF/LPD	Recirculating Sand Filter/Low-Pressure Dose

Smallside, USA

CWTS	Centralized Wastewater Treatment System
OWNRS	Onsite Wastewater Nutrient Reducing System
OWTS	Onsite Wastewater Treatment System

A KEY PARAMETERS OF THE ENGINEERING AND FINANCIAL ANALYSIS FOR THE HYPOTHETICAL COMMUNITY OF SMALLSIDE, USA

Key Parameters Assumed in the Engineering Analysis

After Rocky Mountain Institute roughed-out the characteristics of Smallside, engineers at Hazen and Sawyer developed estimates of capital, operations, maintenance, and management costs for the three options. The estimates are based on unit costs for the recommended technologies drawn from actual studies done in Florida. Please note: as explained in Chapter 4, the accuracy of these numbers or the degree to which a community could support these costs is not especially germane to the point of the analysis. Other cost databases could be used and the same methodology applied. The methodology was to use reasonable numbers as a basis for a hypothetical community for which the net present value of capital, operations, maintenance, and management costs could be equalized. This enabled the isolation of the affect on financing costs of differences in the pattern of expenditures over time between centralized and decentralized systems.

Table A-1: Key Parameters Assumed in the Engineering Analysis

Capital cost of a new mound system	$7,075
Capital cost of replacing an existing onsite system with a new mound system	$8,075
Capital cost of a new OWNRS	$15,510
Capital cost of replacing an existing onsite system with a new OWNRS	$16,510
Cost of decommissioning an onsite system, in CWTS scenario	$700
Capital cost per gallon for 1st WWTP expansion of 250,000 gpd	$6.40
Capital cost per gallon for 2nd WWTP expansion of 150,000 gpd	$6.00
Capital cost of vacuum station for entire Metro Road area	$1,241,300
Capital cost of force main to WWTP	$617,000
Capital cost of vacuum collection system per existing connection	$7,760
Capital cost of vacuum collection system per new connection	$6,300

Capital cost of low pressure collection system per existing connection	$12,040
Capital cost of low pressure collection system per new connection	$10,490
Annual O&M cost for a mound system	$145
Annual O&M cost for an OWNRS	$974
Annual O&M cost per vacuum system connection	$105
Annual O&M cost per low pressure system connection	$181
Management and administration costs for onsite systems	10% of total O&M costs
Management and administration costs for centralized system	5% of total O&M costs

All figures are in 2002 dollars.

Key Parameters Resulting From the Financial Analysis

The assumed financing mechanisms were different for each scenario, and are described in Chapter 4, *Smallside, USA: A Hypothetical Analysis of the Financial Benefits of Incremental Capacity Provision*. The calculated centralized wastewater treatment system (CWTS) impact fee and annual fees for CWTS and for onsite wastewater treatment systems (OWTS) are reported in Table A-2, and are based on financial models developed by Rick Giardina and Associates (assumptions are noted in Chapter 4). These fees are not directly comparable to the engineering costs reported in Table A-1 as they include debt service; the engineering costs in Table A-1 do not. See Chapter 4 for further explanation and Appendix B for detailed annual data. In addition to the fees noted in Table A-2, homeowners have mortgage payments (to pay the capital costs of a wastewater system) under OWTS Resident-Owned and CSTS, but not under OWTS Township-Owned (in which the capital costs are included in the annual fee charged by the township).

Table A-2: Calculated CWTS Impact Fee and CWTS and OWTS Annual Fees

Impact fee for CWTS (set to recover all capital costs and interest and finance charges on township debt service)	$12,440
CWTS, user fee (“sewer rate”) per 1,000 gallons (varies over time)	$3.22 – $8.22
OWTS Resident-Owned, annual management fee (varies over time)	$22 – $40
OWTS Township-Owned, annual O&M / management / debt service recovery fee (varies over time)	$225 – $1,219

B APPENDICES B TO F: DETAILED WORKBOOKS FOR THE SMALLSIDE ANALYSIS

Excel workbooks for each of the base case and sensitivity case analyses for the analysis of the financial benefits of incremental capacity provision are included in Appendices B through F. Each analytical case consists of several Excel workbooks.

- “OWTS_OWNER” workbooks present the analysis for the OWTS Resident-Owned scenario
- “OWTS_TOWN” workbooks present the analysis for the OWTS Township-Owned scenario
- “CWTP” workbooks present the analysis for the CWTP Township-Owned scenario

The workbooks are available electronically with this report on the CD and online at www.ndwrcdp.org. The workbooks are in separate file folders, one for each particular analytical case as noted below:

Appendix B – Smallside Base Case:

Smallside_FinOWTS_OWNER_Base.xls
Smallside_FinOWTS_TOWN_Base.xls
Smallside_FinCWTP_Base.xls

Appendix C – Smallside Low Growth Sensitivity Case:

Smallside_FinOWTS_OWNER_S1.xls
Smallside_FinOWTS_TOWN_S1.xls
Smallside_FinCWTP_S1.xls

Appendix D – Smallside Inflation Sensitivity Case:

Smallside_FinOWTS_OWNER_S2.xls
Smallside_FinOWTS_TOWN_S2.xls
Smallside_FinCWTP_S2.xls

Appendix E – Smallside Increased Mortgage Rate Sensitivity Case:

Smallside_FinOWTS_OWNER_S3.xls
Smallside_FinCWTP_S3.xls

Appendix F – Smallside Unit Costs (all the engineering estimates of capital, O&M, and management costs):

Smallside_Onsite_Capital_and_O&M.xls
Smallside_Low_Pressure_Capital.xls
Smallside_Vacuum_Capital.xls
Smallside_Centralized_O&M.xls

The easiest way to access the various components of the analysis for each case and alternative is to select the “PRINTING” worksheet in each workbook, then click the “PRINT ALL TABLES” macro button. If this does not work, each worksheet can be viewed and printed independently.

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Tel: (800) 624-8301 • WWCDCS25

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