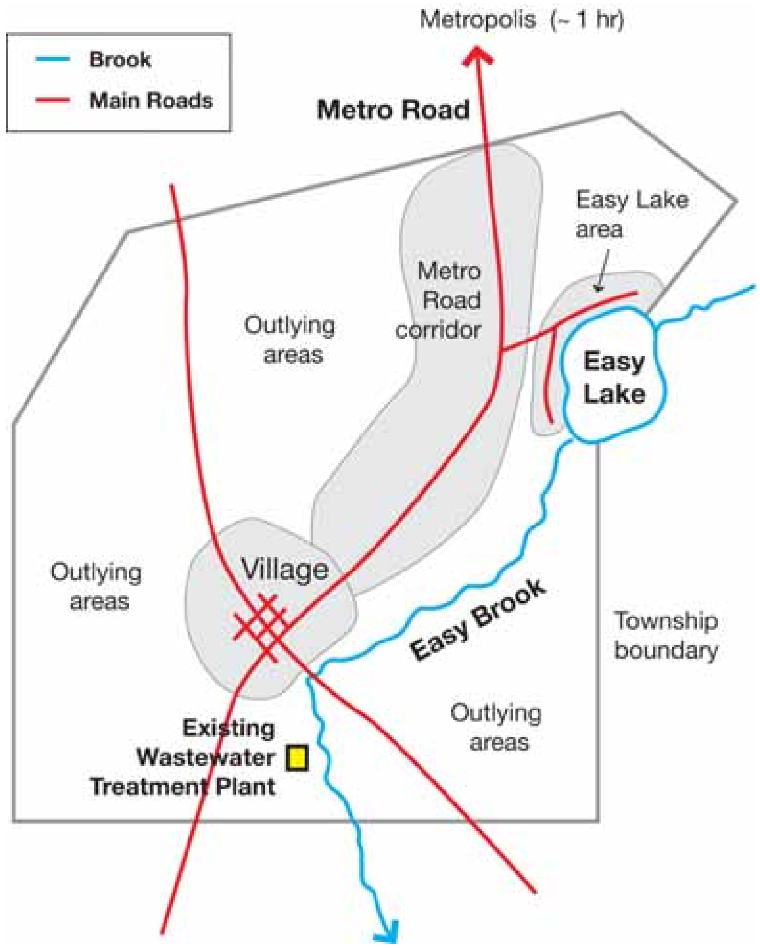
National Decentralized Water Resources
Capacity Development Project

Executive Summary



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

Rocky Mountain Institute
Snowmass, Colorado

December 2004

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

Submitted by Rocky Mountain Institute
Snowmass, Colorado

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Final Report, December 2004

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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.

- 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

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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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