“Septic Tanks   Good or Evil? The Future of Managed Decentralized Wastewater Treatment in New Mexico”

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ABSTRACT

"Septic Tanks – Good or Evil? The Future of Managed Decentralized Wastewater Treatment In New Mexico"

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The New Mexico Environment Department (NMED) received a demonstration grant from the Environmental Protection Agency (EPA) to develop an implementation manual for managed on-site wastewater treatment systems. To learn first hand what would be involved in the development of such a system, NMED offered to work with a small rural community in New Mexico and make grant funds available for construction. This paper summarizes the experience to date in soliciting community input into the facility planning process toward a management approach to wastewater solutions in a small rural New Mexican community. Options for management are reviewed, including the recently issued EPA Voluntary On-site Management Guidelines, as well as treatment technologies for individual and cluster wastewater treatment systems. This builds on the 1997 EPA Response to Congress on Use of Decentralized Wastewater Treatment Systems that declared that "adequately managed decentralized wastewater treatment systems are a cost-effective and long-term option for meeting public health and water quality goals, particularly in less densely populated areas." Cost estimate comparisons for three New Mexico communities are presented to illustrate the point, that in times of dwindling dollars for public infrastructure projects, decentralized wastewater management deserves serious consideration from public entities and consulting engineers as a cost effective solution.

Agua Es Vida - Water is Life A truism that is particularly relevant in the high desert climate of New Mexico. Water is a precious resource that must be protected. Most communities obtain their drinking water from ground water sources and the New Mexico Environment Department (NMED) is the lead agency in protecting this source. Several studies [*Anderhom, 1; Geohydrology Associates, 4; Molzen-Corbin, 7; and Summers, 8*] have documented contamination of ground water from failing septic tank systems. One study [*McQuillan, 5*] estimates there are 170,000 household septic tank and cesspool systems in the State and that these and other non-point sources are responsible for 61 percent of all supply well contamination incidents. The same study also found a disturbing number of contamination cases in areas where the depth to ground water was between 200' and 600', suggesting that depth to ground water provided less protection than formerly believed.

The traditional approach to remedy ground water contamination problems has been to construct a wastewater collection system and central treatment plant. Billions of dollars were spent in the 1970s and 1980s after passage of the Clean Water Act created the Construction Grants Program. The money was focused on larger municipalities, leaving out much of rural New Mexico. The Clean Water Grant Program has been replaced by a revolving loan fund, requiring communities to pay back money used in planning, design, and construction of wastewater systems. This has fostered a new look at the traditional approach. The U.S. Environmental Protection Agency (EPA) produced a report in response to Congressional inquiries evaluating the use of on-site wastewater treatment systems as an alternative to the traditional approach [*U.S. EPA, 10*]. The report concludes that "adequately managed decentralized wastewater treatment systems are a cost-effective and long-term option for meeting public health and water quality goals, particularly in less densely populated areas."

The idea of decentralized treatment has captured national attention and is promoted by the EPA in their recently released Guidelines for Management of Onsite/Decentralized Wastewater Systems [*U.S. EPA, 9*]. Before proceeding further it is necessary to define what it meant by "decentralized management". It is more than a choice between septic tanks and a central wastewater treatment plant (sometimes referred to as the "Big Pipe" option).

In a recent paper, David Venhuizen, P.E. provided these thoughts: "*Cut to its most basic, the idea is to treat-and reuse where practical and beneficial-the "waste" water as close to where it is generated as practical. Sure the "on-site" system is the most ubiquitous example of this strategy, but an individual system for each generator is not the only-and often not the best-way to organize the overall wastewater system. A treatment center might also serve a group of homes, a commercial center, a whole subdivision, or the central core of a community. Note that the latter might, in fact be considered a "centralized system". Clearly, we must differentiate between "centralized system" as a collection of hardware components and as an organizing paradigm. The former can be a part of a decentralized concept system, the latter excludes it.*"

Thus, the emphasis of the decentralized approach is on **MANAGEMENT**, not on hardware. The management approach considers the gamut of treatment possibilities, from septic tanks, advance on-site treatment systems, cluster systems, to collection and central treatment, used individually or collectively, to derive the most cost effective solution.

One other myth that must be dispelled is that septic tanks are inherently evil and are only installed as a temporary measure until a wastewater collection system can be constructed. In fact, septic tanks can be considered an engineering marvel. Think of it, a wastewater treatment system that is simple and relatively inexpensive to install, a system that has no moving parts or power requirements, requires little maintenance, and has performed successfully for decades. They are often maligned as the cause of water contamination and frequently cited as the need for a water or wastewater construction project. Further investigations have found that cesspools and **failing** septic tank systems are, more accurately, the cause of the problem. The most common causes of failing septic tank systems are improper site evaluation and design, improper construction, and inadequate maintenance. Which brings us to the point of this paper – why should we broaden the scope of wastewater projects to include septic tanks and other on-site systems and how best to approach it.

Two reasons address the first point: 1) the decentralized management approach addresses the entire planning area and 2) on-site systems offer the potential for considerable savings in construction costs over the traditional approach. Too often engineering reports conclude with a recommendation to construct sewers for only a portion of the planning area, limiting the area to be served by citing excessive costs, or recommend the sewer construction be phased as funding becomes available. In either case, the entire planning area has not been fully addressed. If only a portion of the planning area can be economically sewered, why not manage the remaining septic tank systems to ensure they function properly and are adequately maintained? This could present a long term solution, providing protection for ground water and the environment. An exciting development is the variety of on-site treatment systems available on the market today. These systems (summarized below - Table 1) provide a wide array of secondary and tertiary wastewater treatment options at the household level. Installed costs range from $5,000 to $15,000.

TABLE 1 – ON-SITE WASTEWATER TREATMENT AND DISPERSAL OPTIONS	
TREATMENT	
Septic Tank Effluent Filters	
Suspended Media Aerated Treatment Units (ATUs) –	
	Sequencing Batch Reactors (SBRs)
	Activated Sludge ATUs
Fixed Media ATUs –	
	Intermediate and Recirculating Sand Filters
	Textile Media ATUs
	Synthetic Media ATUs
(Note: At Least 20 Vendors marketing various systems)	
DISPERSAL	
Standard Gravel Trenches	Chambers
Synthetic Rock Systems	Pipe and Geofabric Systems
Shallow Half-Round Pipes	Drip Irrigation Systems
Mound Systems	Evapo-Transpiration Systems

As for the second point regarding costs, the results of engineering studies [*Engineers, Inc., 2 & 3 and Molzen-Corbin, 6*] for three New Mexico communities that considered on-site and big pipe options are summarized in Table 2. The collection system can account for 75% of the construction costs of a wastewater project. It stands to reason that reducing or eliminating the amount of pipe that is put in the ground can have a substantial affect on project costs.

TABLE 2 NEW MEXICO COST COMPARISON			
YEAR	**COMMUNITY**	**BIG PIPE**	**ON-SITE**
1986	Peña Blanca	$3.1 M	$1.2 M
Small diameter sewers with facultative ponds and sand filters vs. new septic tanks and leachfields			
1995	Columbus	$4.21 M	$1.19 M
Gravity sewers with areated ponds and wetlands vs. new septic tanks and leachfields			
2000	Willard	$1.6 M	$0.97 M
Gravity sewers with facultative ponds vs. SDGS cluster sand filters and advanced treatment septic systems			

The New Mexico experience mirrors the projections contained in EPA's Response to Congress [*U.S. EPA, 10*] that are summarized in Table 3. **The differences in costs are dramatic enough to merit serious consideration and evaluation.**

TABLE 3 EPA COST COMPARISON [*U.S. EPA, 10*]			
OPTION	**CAPITAL COST**	**ANNUAL O & M COST**	**ANNUALIZED COST**
Centralized System	$2,321,840	$29,740	$216,850
SDGS & Clusters	$598,100	$7,290	$55,500
On-site Systems	$510,000	$13,400	$54,500

So, how could decentralized systems be managed and how can interest be generated in the communities? There are many options in New Mexico under existing organizational structures. All municipalities as defined in Chapter 3 NMSA 1978; such as Village, Town, City, or County; have the necessary legal authorities to establish an on-site wastewater management district. Other entities; such as Mutual Domestic Water Conservancy Districts incorporated under the Sanitary Projects Act – 3-29-1 to 3-29-20 NMSA 1978, County Special Districts formed under the Special District Procedures Act – 4-53-1 to 4-53-11 NMSA 1978, and Water and Sanitation Districts formed under the Water and Sanitation District Act – 73-21-1 to 73-21-54 NMSA 1978; can also serve as on-site wastewater management districts. Options for the intensity of management are considered in the EPA guidelines [*U.S. EPA, 9*], ranging from an inventory of systems to actual ownership and operation. A summary table from the EPA guidance document regarding management options is attached (EPA Table 1). Based on successful models from other areas of the country, the final responsibility for operation and maintenance of the wastewater systems must rest with the public entity, as it does for centralized treatment plants.

Involving the community and generating interest in alternative solutions to wastewater problems can be a lengthy and time intensive process. Identification of respected leaders within the community is important in laying the groundwork for disseminating information. These leaders may not be associated with any governing body, but are people that others within the community respect and trust. There may be factions within the community that think independently of other groups. It is important to look for these factions and seek leaders from each group. Educating the leaders is an effective way to disseminate information. Public meetings, newsletters, flyers, and posters can also be used to spread the word. These are "lessons learned" from an NMED demonstration project in the Village of Willard that is currently in the design phase. A dozen meetings were held in the community to explain potential water quality problems and the planning process used to identify and evaluate alternative solutions. Potluck dinners and raffles were used to attract people to the meetings. Flyers were delivered to every household recounting the public discussions and charting progress.

In the end, two issues attracted the largest public debate 1) how can we protect our drinking water for our children and 2) how much will it raise our monthly utility bill? The Village reached a consensus during a council meeting and decided to raise their utility bills by $3 per month in the interest of protecting their drinking water source and proceed with the engineer's recommendation.

After the decision was made, a different group of people, that had not been involved in prior meetings, protested the decision. Further debate ensued and the Village council decided not to change their decision. Their engineer is currently completing the design of a small diameter gravity collection system and cluster treatment units for Phase 1 of the project. Construction costs will be paid from an EPA hardship grant and Clean Water State Revolving Fund loan. Project completion is expected in early 2002. The Village is in the process of adopting an ordinance that will establish regulations for inspection, operation, and management of the cluster and on-site wastewater treatment systems.

In conclusion, decentralized management has captured national attention and is promoted by EPA because of the potential for substantial reduction in wastewater construction costs. It can provide both short and long term protection of the environment and does not preclude "Big Pipe" options in the future. Funding for the decentralized approach is available from mainstream funding agencies, such as NMED and USDA Rural Utility Service. The future looks bright for those willing to invest a little time in exploring and learning more about *Managed Decentralized Wastewater Treatment*.

WHERE TO GO FOR MORE INFORMATION	
NMED Construction Programs Bureau Richard Rose 505-827-9691 richard_rose @nmenv.state.nm.us	National Small Flows Clearing House 800-624-8301 www.nsfc.wvu.edu
National Association of Wastewater Transporters (NAWT) 800-236-6298	National Onsite Wastewater Recycling Association (NOWRA) 301-776-4768 www.nowra.org
U.S. Environmental Protection Agency Website www.epa.gov/owm/decent/	

TABLE 1. SUMMARY OF EPA GUIDELINES FOR MANAGEMENT OF ONSITE/DECENTRALIZED WASTEWATER SYSTEMS

Model Program	Typical Application	Management Objectives	Benefits	Limitations
1	Areas of low environmental sensitivity, where conventional onsite systems are adequate to protect water quality and public health.	**SYSTEM INVENTORY AND AWARENESS OF MAINTENANCE NEEDS** To ensure conventional onsite/decentralized systems are sited and installed properly in accordance with appropriate State/tribal/local regulations and codes and are periodically inspected, maintained, and repaired as necessary. Regulatory agency is aware of the location of systems and periodically provides owners with operation and maintenance information.	Relatively easy and inexpensive to implement and maintain. (Programs are based upon conventional, prescriptive system designs that rely upon conservative site criteria and system design requirements promulgated in codes.)	No mechanism to ensure operating compliance of systems. No mechanism to identify problems before failures occur. Limits building sites to those meeting prescriptive requirements.
2	Areas such as wellhead or source protection areas, where sites are marginally suited for conventional systems, requiring alternative, enhanced treatment systems to be implemented.	**MANAGEMENT THROUGH MAINTENANCE CONTRACTS** To allow the use of more complex mechanical treatment options in areas of higher density or some environmental sensitivity. Requires maintenance contracts to be maintained between the owner and equipment manufacturer/ supplier or service provider over the life of all systems.	Reduces the risk of failure through the requirement for routine maintenance of mechanical components by skilled personnel.	State/tribal/local agency may have difficulty tracking and enforcing compliance with the maintenance requirements and/or contract.
3	Environmentally sensitive areas, such as where conventional systems are a potential threat to drinking or shellfish growing waters. Engineered designs are needed, to meet specific performance requirements based on site characteristics.	**MANAGEMENT THROUGH OPERATING PERMITS** To allow the use of onsite/decentralized treatment on sites with a greater range of characteristics than allowed by prescriptive codes. Establishes specific and measurable performance requirements, renewable operating permits, and regular compliance monitoring reports, in addition to requiring maintenance contracts.	Increases the range of sites suitable for onsite/ decentralized treatment. Avoids problem of owner not managing system adequately and continues to operate a non-compliant system. Reduces the risk of failures by requiring that performance requirements be met to renew limited term operating permit.	Needs a higher level of technical/engineering expertise to implement.

TABLE 1. SUMMARY OF EPA GUIDELINES FOR MANAGEMENT OF ONSITE/DECENTRALIZED WASTEWATER SYSTEMS (CONT.)

Model Program	Typical Application	Management Objectives	Benefits	Limitations
4	Areas where there is suspected impairment of receiving waters such as sole source aquifers, critical aquatic habitats, outstanding natural resource waters, or other areas where the environmental and technology concerns require reliable, long-term system operation and maintenance.	**UTILITY OPERATION AND MAINTENANCE** To ensure that onsite/decentralized treatment systems consistently meet their performance requirements through the creation of public or private utilities that are responsible for the performance of systems within the service area. The utilities are issued operating permits for the systems and maintain them, but system ownership remains with individual property owners.	Responsibility for operation and maintenance is transferred from the owner to a professional utility that has an economic incentive to comply with the operating permit. Routine inspections may identify obvious problems before system failure occurs. Reduced number of permits requiring oversight by regulatory agency.	Additional regulatory oversight needed to evaluate and ensure that the utility is technically and financially viable. Potential conflicts between owner and operator. Requires authorizing legislation.
5	Same environmental and public health conditions as under Model Program 4. EPA recommends applying Model Program 5 in areas of new, dense development.	**UTILITY OWNERSHIP AND MANAGEMENT** To provide professional management of the siting, design, construction, operation, maintenance, etc. of onsite/decentralized systems through the creation of public or private utilities that own and manage systems within the service area.	Simulates the municipal model of central sewerage by transferring all responsibility from the property owner to a professional entity, reducing risk of non-compliance to lowest level. Allows effective area-wide wastewater planning through integration of onsite/decentralized systems with conventional sewerage. Avoids conflicts between owner and operator.	Property owner may oppose utility's easement to property for the system. Additional regulatory oversight needed to evaluate and ensure that the utility is technically and financially viable. Greater financial investment by utility due to purchase of systems and components. Requires authorizing legislation.

REFERENCES

1. Anderholm, Scott K. *Reconnaissance of Hydrology, Land Use, Ground-Water Chemistry, and effects of Land Use on Ground-Water Chemistry in the Albuquerque-Belen Basin, New Mexico*. U.S. Geological Survey, 1987.

    "Dissolved-iron concentrations in water in the Rio Grande valley near Albuquerque are greater than dissolved-iron concentrations in areas adjacent to the valley.

    Recharge associated with residential land use (onsite waste-disposal effluent) is relatively reduced and contains organic carbon, biological oxygen demand, and chemical oxygen demand. The constituents in onsite waste-disposal effluent cause reducing conditions in the aquifer and dissolution of iron and manganese oxides."

2. Engineers, Inc., *Facility Plan, Wastewater Collection and Treatment, Village of Willard*, December 2000.

    The facility plan provides and evaluation of potential contamination of the Village drinking water well and presents alternative collection and wastewater treatment options. The engineer divided the Village into zones based upon the distance from the domestic well. Those homes within Zone A (the closest to the well) should treat wastewater to reduce total nitrogen to at least 10 mg/l, Zone B to at least 20 mg/l, and Zone C to normal septic tank effluent levels. The recommended alternative is to collect wastewater in Zone A and treat it in small cluster treatment plants located in Zone B and provide advanced on-site treatment systems for homes in Zone B. The estimated cost for the recommend alternative is $970,000 compared to $1,600,000 for collection and central treatment.

3. Engineers, Inc., *Village of Columbus Proposed Sewer System RUS/RECD Preliminary Engineering Report*, December 1995.

    The engineering report evaluates collection system and treatment system options for the Village of Columbus. Estimated costs are presented for various centralized treatment options as well as replacement of all existing on-site treatment system with new septic tanks and leachfields. The alternative recommended is a Village-wide gravity collection system with aerated ponds and constructed wetlands at a cost of $4,210,000. The estimated cost to replace septic tank systems was $1,190,000.

4. Geohydrology Associates, Inc. *Lot Size Evaluation for Bernalillo County Health Department, New Mexico*. April 1989.

> "Historical data and modeling predictions indicate that high-density development in unsewered areas will result in water-quality degradation in excess of recommended limits.
>
> Liquid Waste Ordinance 88-1 and existing waste-disposal practices are not adequate to protect against contamination in the inner valley. Sufficient technical and historical data are available to show that sites and levels of contamination can be accurately predicted.
>
> This illustrates that contamination from liquid waste persists many years after septic tanks have been abandoned. Once an area is contaminated, natural reclamation is extremely slow.
>
> New subdivisions in the valley should be required to have a minimum lot size of two acres when the subdivision is not served by a community sewage system."

5. McQuillan, Dennis. *Ground-Water Contamination and Remediation in New Mexico: 1927 - 1992*. New Mexico Environment Department.

> "Non-point sources, predominantly the estimated 170,000 household septic tanks and cesspools, are responsible for 61% of all supply well contamination incidents.
>
> These discharges have caused widespread nitrate or anoxic pollution in Albuquerque, Belen, Bernalillo, Bosque Farms, Carlsbad, Chamita, Corrales, Espanola, Hobbs, Los Lunas, Lovington, Nara Visa, Pojoaque, Santa Fe, and Tesuque.
>
> A disturbing number of contamination cases are being discovered in areas where the depth to groundwater is between 200 and 600 feet, suggesting that depth to water may not be as important for aquifer protection as is widely believed."

6. Molzen-Corbin & Associates, *Peña Blanca Water and Sanitation District, Final Wastewater Facility Plan,* September 1986.

> The final wastewater facility plan compares alternative collection and treatment options for the community of Peña Blanca. The recommended alternative is replacement of all septic tank/leachfield systems at a cost of $1,200,000 compared to a small diameter gravity sewer with facultative ponds and sand filters at a cost of $3,100,000.

7. Molzen-Corbin and Associates and Lee Wilson and Associates. *Bernalillo County East Mountain Area Water System Feasibility Study - Final Report*. January 1991.

"However, wastewater disposal in the EMA is intimately related to groundwater quality since conventional septic tanks and drainfields are by far the most common method used to manage household wastes. There is evidence of sewage pollution of the groundwater at certain sites in the area in the form of elevated levels of nitrate-nitrogen.

This approach, while extremely simplistic, indicates that development at a density of 1 household per acre would pose a substantial risk of causing groundwater pollution, if domestic sewage is discharged to the local aquifers without advanced treatment.

However, if one sets as a target that nitrate-nitrogen should be kept below 10 mg/l, then if several (5+) miles of adjacent lots dispose of sewage on-site, it would take an average lot size of 15+ acres to meet that target.

High nitrate levels in the EMA have been a concern for many years. A 1961 USGS memo reported on an infant boy from Carnue who was admitted to a hospital with an illness suspected to be caused by high nitrates.

The nature of EMA aquifers is such that wastewater can move rapidly, but the exact direction of movement in any one area is difficult to predict. Thus it is almost impossible to site a well and be sure that it is not down gradient of a wastewater source.

Nitrate is a conservative pollutant - not readily removed by natural soil processes - so that nitrate can move rather easily into local wells."

8. Summers, W.K. *Draft - Septic Tank Systems in Bernalillo County, New Mexico, and Their Effect on Ground-Water Quality: A Status Report*. Ground Water Scientist, Public Works Department, Albuquerque, New Mexico. October 1991.

"To ground-water scientists and engineers the evidence says clearly 'Septic-tank systems have polluted the ground-water'.

The recommended density of septic-tank systems range from one system per two acres in the South Valley (Geohydrology Associates, Inc. 1989) to one system per 15 acres in the East Mountain Area (Lee Wilson and Associates, Inc. 1991).

Developers have platted more than 8,000 lots in the East Mountain Area. In Bernalillo County where we have chemical analyses of the water from wells and where wells and septic-tank systems cluster, the indicators of pollution are evident. Concentrations of nitrates or iron and manganese, chlorides, and total dissolved solids are larger than those in nearby pristine waters. The South Valley and the Carnue Area stand out as classic examples of the effect of septic-tank effluent on ground water in their terrains. The limited work on the North Valley argues that conditions there match those in the South Valley. Evidence hints at a pervasive problem in the East Mountain Area where septic-tank systems cluster."

9. U.S. Environmental Protection Agency. *Draft EPA Guidelines for Management of Onsite/Decentralized Wastewater Systems*. Office of Water. September 26, 2000.

The draft guidelines propose five levels of management ranging from a system inventory and awareness of maintenance needs to ownership and maintenance of all on-site systems by a public utility.

10. U.S. Environmental Protection Agency. *Response to Congress on use of Decentralized Wastewater Treatment Systems*. Office of Water. April 1997.

Report addressing the Congressional House Appropriations Committee's request for EPA's progress on 1) The Agency's analysis of the benefits of decentralized wastewater system alternatives compared to current (i.e. centralized) systems; 2) The potential savings and/or costs associated with the use of these alternatives; 3) The ability of the Agency to implement these alternatives within the current statutory and regulatory structure; and 4) The plans of the Agency, if any, to implement any such alternative measures using funds appropriated in fiscal year 1997.

The report summarizes barriers to implementing decentralized wastewater treatment and methods to overcome the barriers. A cost estimate is presented for a hypothetical rural community to provide traditional gravity sewers and centralized treatment compared to the decentralized approach. The costs for the traditional approach were estimated to be between $216,850 and $342,500. The costs for the decentralized approach were estimated to be between $54,500 and $55,500. The report concludes that "adequately managed decentralized wastewater treatment systems are a cost-effective and long-term option for meeting public health and water quality goals, particularly in less densely populated areas."