Decentralized Sewer Unit Packages as an Alternative for Bulloch County to Manage Fast Growth

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Abstract

Throughout the state of Georgia, rural areas rely on septic tanks to dispose of bodily waste for small commercial, industrial, and residential construction. Septic tanks act as the most conventional system when properties fall outside the service areas of municipal and private wastewater treatment facilities. Bulloch County has a vast number of rural dwellings within its boundaries. Moreover, the County experienced a steady 3 to 5% annual growth over the last several years. Therefore, an examination of alternatives to the traditional septic systems is warranted if the County wishes to maintain continued sustainable growth.

This study focuses on the factors driving growth in Bulloch county including: population, housing, commercial and industrial development, subdivision development, assessed property values, and future development projections. Next, we compare two waste disposal systems that could substitute for traditional septic systems: a Small Diameter Gravity System (SDGS) and the Bioclere Onsite Wastewater Treatment System.

Our findings are summarized in the table below. This table gives a cost analysis of the initial setup cost and projected cost associated with each system under normal wear for a 200 community home. The first year includes the initial cost of setting each system up for the community. Again, the implicit advantages of the alternative systems to septic tanks is the ability to have a denser residential development.

Long Term Cost Comparison of Septic System Alternatives

Systems	1 Year	5 Years	10 Years	15 Years
Septic System	$1,580,000	$1,837,540	$2,095,080	$2,352,620
SDGS	$2,157,233	$2,508,862	$2,860,491	$3,212,120
Bioclere System	$2,107,233	$2,450,712	$2,794,191	$3,137,670

*** Assuming current inflation rate of 3.26% as of December 2004 (www.inflationdata.com)**

Our conclusions are nicely summarized by Mr. Stephen Dix in the following manner: "These [alternatives to septic] systems will provide attractive features for both developers and utilities focused on the needs of a dispersed or growing population in rural Bulloch County. While adverse topography encourages this approach, so do soils that demand more than a conventional septic system. Economy of scale lowers the peak design flows and reduces the total system size. Individual lots can also be smaller because the setback applies to the one community system no to each individual parcel. This shift allows developers to increase the number of lots and transfer much of the cost to the homebuilder. This more closely aligns the cash flow within a development that utilizes homebuilder financed onsite systems further defer the construction and cost of the individual neighborhood treatment system. The integrated clusters can be constructed, as treatment capacity is needed, benefiting all parties. These systems provide the homeowner with a very attractive and affordable water and wastewater service that supports the rural character."

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I. Introduction

Throughout the state of Georgia, rural areas rely on septic tanks to dispose of bodily waste for small commercial, industrial, and residential construction. Septic tanks act as the most conventional system when properties fall outside the service areas of municipal and private wastewater treatment facilities. Bulloch County has a vast number of rural dwellings within its boundaries. Moreover, the County experienced a steady 3 to 5% annual growth over the last several years.[1] Therefore, an examination of alternatives to the traditional septic systems is warranted if the County wishes to maintain continued sustainable growth.

A variety of community wastewater sewage package units can serve as alternatives to the traditional septic tank system. These units replace the use of septic tanks, and in some cases provide water as well. Furthermore, these units can handle wastewater for larger communities or subdivisions.

This study focuses on the factors driving growth in Bulloch county including: population, housing, commercial and industrial development, subdivision development, assessed property values, and future development projections. Next, we compare two waste disposal systems that could substitute for traditional septic systems.

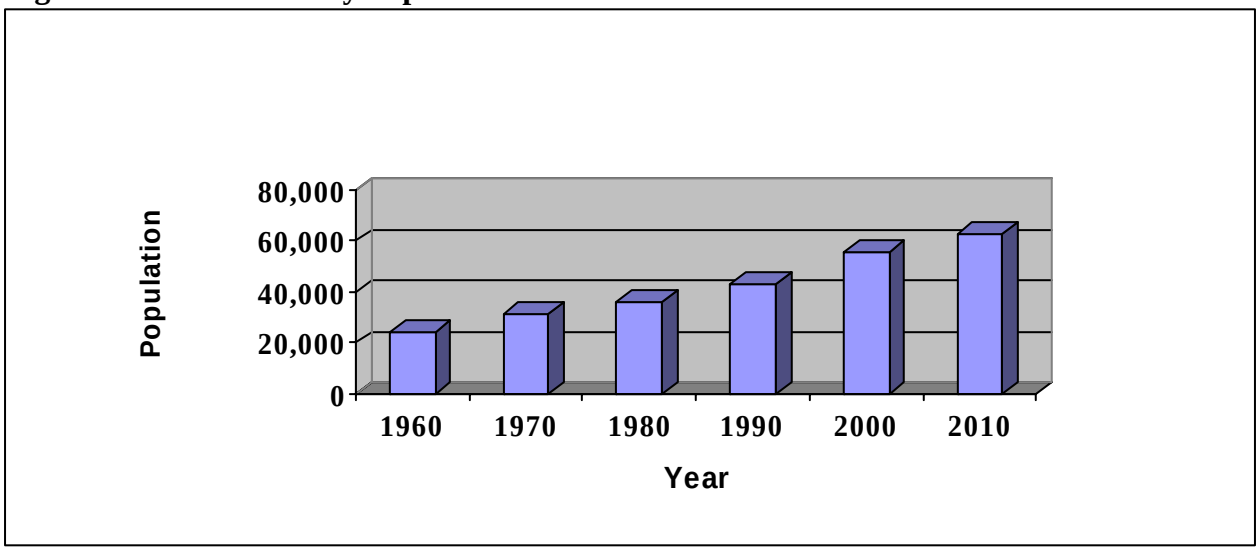
[1] US Census Bureau, Bulloch County, Georgia Quick Facts, 2003 Electronic document, accessed: May 18, 2005, < http://quickfacts.census.gov/qfd/states/13000.html >.

II. Growth in Bulloch County

Many citizens once believed that zoning, enacted on November 4, 1994, would mark the end of growth for Bulloch County. However, housing data show that since the adoption of zoning there has been more growth when compared to the "pre-zoning" era. Not surprisingly, assessed property values have increased significantly—an indirect effect of zoning.

As shown in Figure 1, the population of Bulloch County more than doubled between 1960 and 2000.[2] The population projections for 2010 are 62,464.[3]

Figure 1. Bulloch County Population Estimates



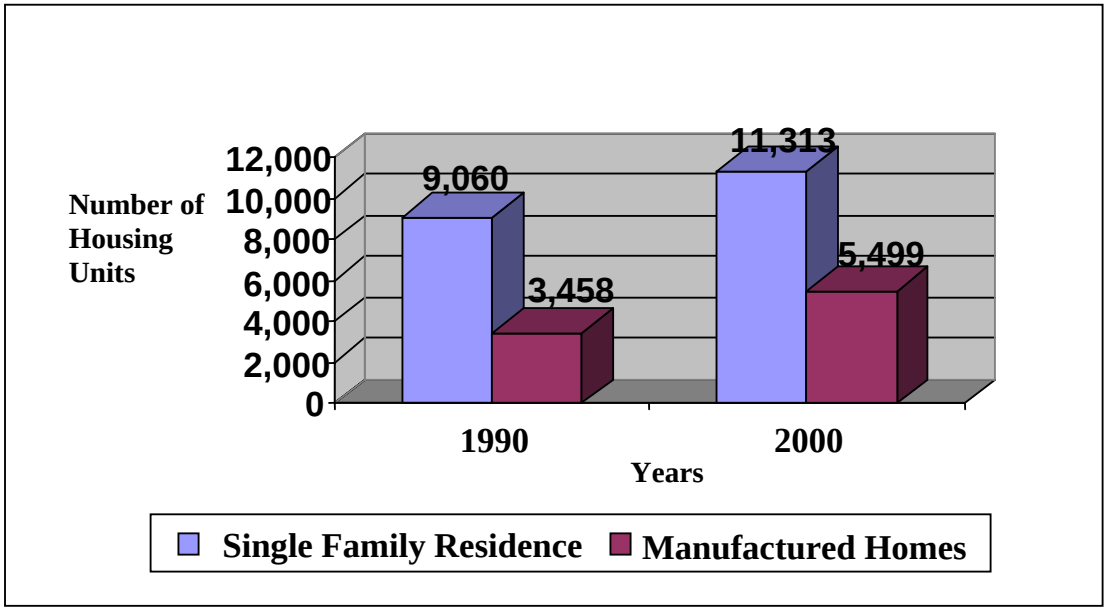
Source: US Census Bureau

Figure 2 examines the change in housing permits over the 1990s. The period between 1990 and 2000 shows a significant increase in permits for both single family dwellings (24.8%) as well as manufactured homes (59%). Thus, refuting the concerns that zoning would inhibit growth in the county.

[2] US Census Bureau, *Op.Cit*., 2003. (Bulloch County population numbers do not include most of the 15 thousand students at Georgia Southern University.)
[3] Center for Agribusiness and Economic Development, Georgia County Guide, 2003, Electronic document, accessed: April 24, 2004, <www.georgiastats.uga.edu>.

The increase in manufactured homes from 1990 to 2000 may be attributed in part to the population growth at Georgia Southern University.[4] Another reason for the increase in manufactured housing during this period may be the relative cost compared to site-built homes. Many people seek less expensive housing during adverse economic conditions.

Figure 2. Bulloch County Housing Permits



Source: Bulloch County Housing Department

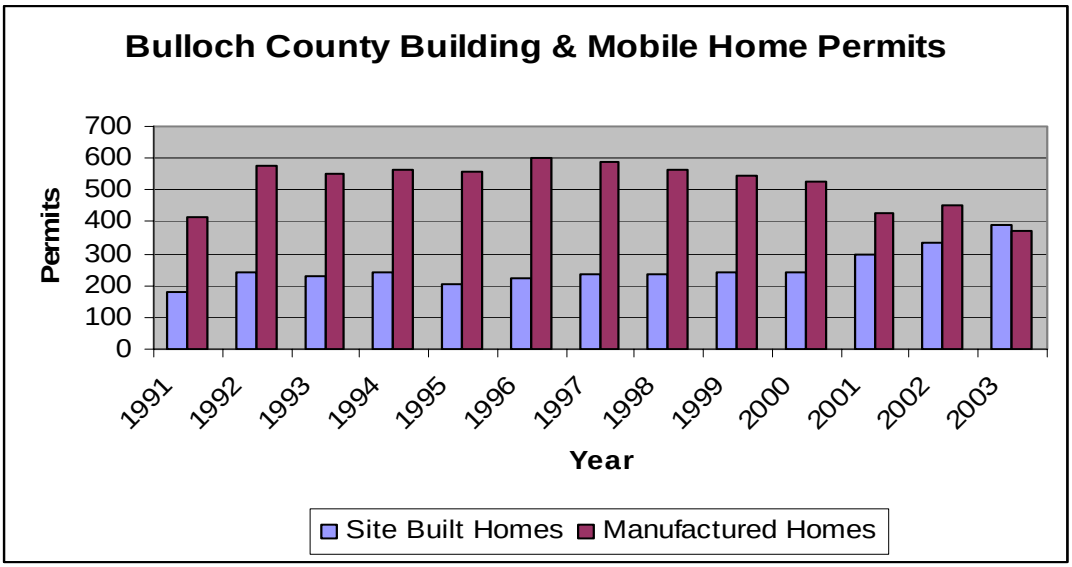
The housing permits examined are for the unincorporated area of Bulloch County, which excludes the municipalities of Brooklet, Portal, Register or Statesboro. As shown in Figure 3, manufactured housing has been on the decline since 2000, while site-built homes have steadily increased during this same period.[5]

Zoning has not slowed commercial and industrial development in Bulloch County, as seen in Figure 4.[6] Industrial growth since the adoption of zoning includes the Wal-Mart

[4] Bulloch County Building Inspections Department, March 2004, Building Inspections Reports.
[5] Bulloch County Building Inspections Department, *Op. Cit.*, 2004.
[6] Bulloch County Building Inspections Department, *Op. Cit.*, 2004.

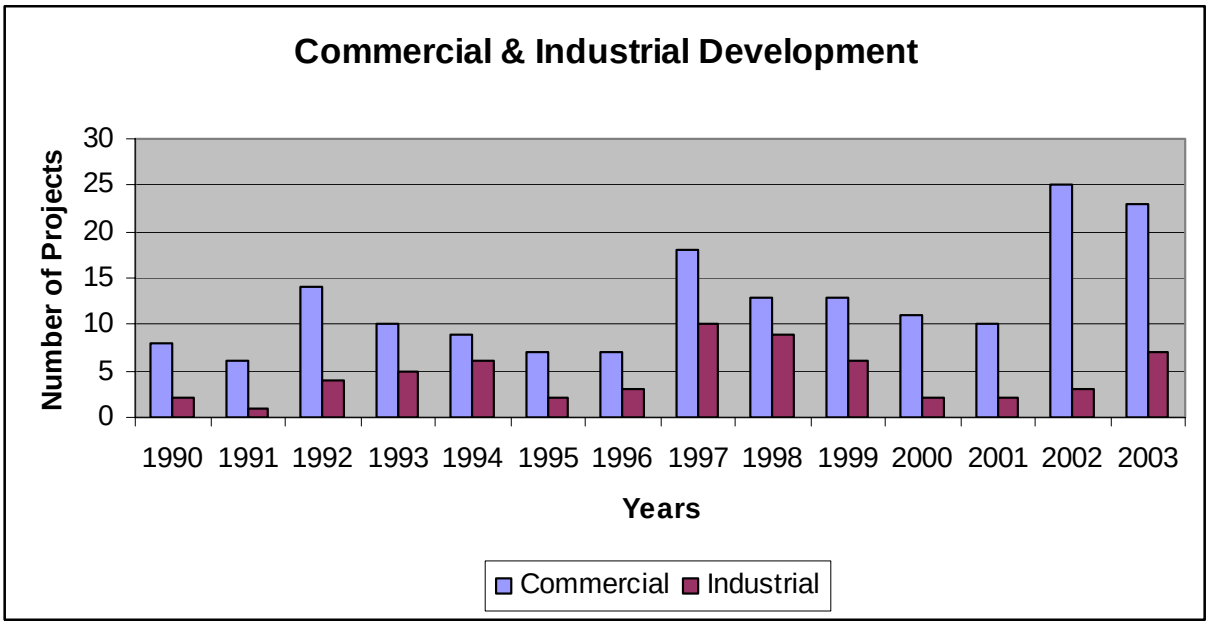
Distribution Center, Briggs and Stratton, and Viracon to name a few. These companies have most likely contributed to the housing and manufactured home growth in Bulloch County.

Figure 3. Bullock County Building & Mobile Home Permits



Source: Bulloch County Zoning Department

Figure 4. Commercial & Industrial Development



Source: Bulloch County Building Inspections

When zoning commenced in 1994, 139 subdivisions and 117 mobile home parks existed in Bulloch County.[7] Early 2004 records show 215 subdivisions and 118 manufactured home parks in the county.[8] Manufactured home parks have not increased substantially, due in part to more stringent regulations for new parks. In addition, manufactured homes are going into subdivisions rather than in manufactured home parks. There are 38 subdivisions in Bulloch County that allow manufactured home.[9]

New subdivision utilized over 2,000 acres in 2003, as shown in Table 1.[10] Population growth projections indicate that subdivision growth will continue in the near term. Therefore, alternatives are being studied by the Bulloch County Zoning Department which allow for continued growth, yet limit the number of acres being consumed by subdivisions. In some subdivision locations, lot sizes range between 1 to 10 acres. While smaller lot sizes would encourage development with a much smaller amount of land, smaller lot sizes are restricted by current sewage disposal standards.

Table 1. Subdivision Lots and Acreage

Year	Number of Lots	Total Acres
1995	226	261
1996	36	109
1997	21	14
1998	185	498
1999	439	944
2000	340	664
2001	385	886
2002	200	668
2003	434	2587
2004	316*	331*

*** Data as of March 2004**
Source: Bulloch County Tax Assessors

[7] Bulloch County Building Inspections Department, *Op. Cit.*, 2004.
[8] Bulloch County Building Inspections Department, *Op. Cit.*, 2004..
[9] Bulloch County Building Inspections Department, *Op. Cit.*, 2004.
[10] Bulloch County Building Inspections Department, *Op. Cit.*, 2004.

Prior to zoning, agricultural land prices sold for approximately $2,500 per acre.[11] In 2004 the same land would sell for $2,300 per acre,[12] indicating a transition in land use from agriculture to other activities. Lots inside a subdivision such as Hunters Pointe sold for $12,500 per lot prior to zoning. The price of a lot in Hunters Pointe now runs approximately $23,412, nearly doubling in value over the past decade.[13] Even the subdivisions that allow manufactured homes have increased in value. Prior to zoning, the land inside one of these subdivisions cost approximately $12,000 for a five acre lot. This same property in 2004 cost $17,857.[14]

Indeed zoning has not hindered growth in Bulloch County. Even during times of economic downfall, Bulloch County has continued to grow. Part of this growth may be attributed to the increased student enrollment. Part of the growth may be attributed to the commercial and industrial growth in our area. Some of the growth may even be attributed to the new East Georgia Regional Hospital. Whatever the reason, one thing is certain, with growth comes a need for additional housing. Much of this housing development falls outside of the incorporated areas in the Bulloch County. In other words, this new residential development must rely on waste disposal systems other then those provided by cities in the County.

[11] Bulloch County Tax Assessors Department, March 2004, Tax Assessors Reports.
[12] Bureau of Labor Statistics, 2000, Electronic document accessed: April 24, 2004, http://www.bls.gov. Prices are in real dollars.
[13] Bulloch County Tax Assessors Department, *Op. Cit.*, 2004. Prices are in real dollars.
[14] Bulloch County Tax Assessors Department, *Op. Cit.*, 2004. Prices are in real dollars.

III. Waste Disposal Systems

Bulloch County's steady population growth brought about an increase in wells, small community water systems, and septic systems. Consequently, concern has increased regarding the potential impacts to the county water supply from either contamination or the amount of water available. Issues include failure of systems adequately maintaining performance, environmental impacts, public health, and public safety.

A. Traditional Septic Tank Systems

A septic system is, simply put, a private sewage treatment plant receiving all wastewater from a household.[15] Most are composed of a tank, a network of perforated pipes called the leaching bed, and billions of microscopic organisms. The heavy solid material settles in the tank while the lighter scum floats to the top and flows into the leaching bed where it filters into the ground. The system relies on natural decomposition processes to breakdown waste material.[16]

The average cost of a septic system for a single home differs due to numerous variables in a given region such as cost of supplies and labor, as well as the geology and topography of the specific location. The cost of a septic system for a three bedroom-two bathroom home in the Bulloch County area is shown in Table 2.[17] The per-unit cost $3 950 does not include social costs or externalities for environmental damage or oversized lots (due to septic tank regulations).

In a subdivision with 200 homes, the installation cost is calculated by multiplying the per-unit cost by 200. While some economies of scale might be observed when purchasing in bulk, these would be offset by the storage costs of such a volume of materials.

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[15] De Cloet, Sharon, 1995, "Septic System and Ground Water," Natural Life Magazine # 46, Electronic document accessed: April 13, 2004, http://www.life.ca/nl/46/septic.html.
[16] De Cloet, Sharon, *Op. Cit.*, 1995.
[17] Adams, Tim, 2004, "Septic System Cost Information," Project Manager, McLendon Enterprises (Personal Communication, July 1, 2004).

Table 2. Traditional Septic System

Materials	Single Home	200 Home Comm.
1000 Gal. Tank Installed	$1,500	$300,000
Rock/Gravel Installed	$1,200	$240,000
Drain System	$400	$80,000
Land Preparation and Development	$1,200	$240,000
Labor	$850	$170,000
Sub-Total	$5,150	$1,030,000
Environmental Costs		
New Drilled Water Well	$1,250	$250,000
Soil Repair	$1,500	$300,000
New Septic System	$5,150	$1,030,000
Total	$7,900	$1,580,000

* **All prices include installation costs**

Source: Tim Adams, 2004, McLendon Enterprises.

Over time a septic tank accumulates solid material that must be removed. If not, the sludge reaches the outlet level and begins to flow into the leaching bed where it will plug the pipes. Moreover, raw sewage and potentially toxic chemicals will drain into the soil, contaminating wells, lakes, and streams. The environmental hazard affects property values as well. While, septic systems do properly dispose of waste for a given amount of time, it has been proven in many areas that over time these systems fail. If the tank is not properly maintained, ground and surface water sources could become contaminated**.** As more septic systems are being placed into the ground the chance of contaminated water increases.[18]

The septic system itself has had very few technical improvements since its inception. The average life expectancy of a septic tank, under a normal residential home use, is 20 years before the tank needs to be pumped out. However, this takes into consideration that no natural disasters or disruptions to the process of the system occur during the 20 year period. Once the tank is pumped, the system should again be fully functioning. In some cases where the drainage fields contain large quantities of clay, additional maintenance and pumping may be needed.

[18] De Cloet, Sharon, *Op. Cit.*, 1995.

Environmental factors and worst case scenarios affect the cost of the replacement or repairs of a septic system. Depending on the factors that may be affected such as well contamination, or dangerous impediments in the soil; the system my have to relocate in a different location, or there is a possibility a new well will have to be drilled in another location. The Environmental Protection Agency notes that between 10 and 30% of septic systems fail on an annual basis.[19] Moreover, 50% of operational systems are over 30 years old. Sadly, most systems do not satisfy the EPA Clean Water Act goals.

Bulloch County presently does not provide community water or sewer system services outside the incorporated areas. To date, private developers in the County take the lead in providing their own water and sewer systems to developments outside of current service districts. This has resulted in several residential areas with multiple septic systems within a small geographic area.[20] Because much of the population utilizes ground water in this area of the State,[21] it is imperative to minimize contaminate discharges into the ground.

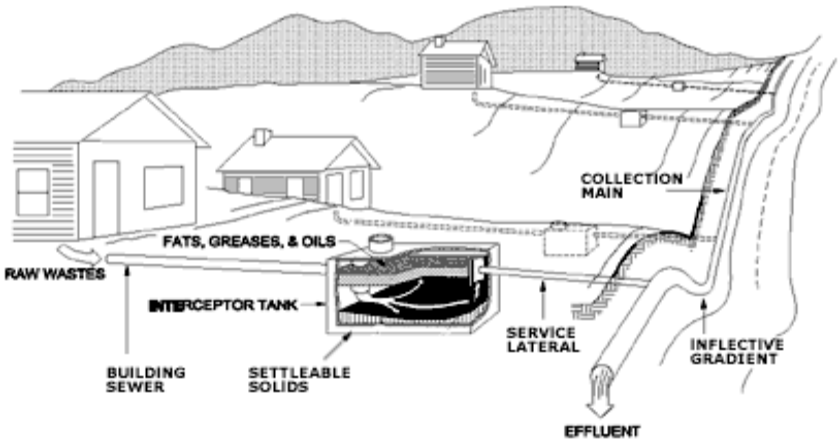
B. Small Diameter Gravity Sewer System

A variety of community wastewater sewage package units exist. These units minimize the use of septic tanks in some cases provide potable water.[22] More importantly, these units can maintain wastewater for larger communities or subdivisions. Figure 5 illustrates a Small Diameter Gravity Sewer System (SDGS).[23] Approximately 250 SDGS have been partially

[19] Environmental Protection Agency (1), Office of Wastewater Management, 2004, "Decentralized Approaches to Wastewater Management," Electronic document accessed: May 26, 2005, http://www.epa.gov/owm/septic/pubs/septic_presentation.pdf.
[20] Thomas & Hutton Engineering Co., February 6, 2004, "Request For Proposals-Consulting Services for Bulloch County Water/Sewer Study."
[21] Fisher, D. K., et al, 2003, "Coastal River Basins Water Resource Assessment An Evaluation of Water Use and Availability in Seven Coastal River Basins," Water Policy Working Paper 2003-005.
[22] Analysis of the cost of providing drinking quality water is beyond the scope of this paper.
[23] Environmental Protection Agency (2), September 2000, "Decentralized Systems Technology Fact Sheet, Small Diameter Gravity Sewers" Office of Water, Washington, D.C., Electronic document, accessed: April 24, 2004, www.epa.gov/owm/decent/download/sd_gravity_sewers.pdf.

financed through the United States Environmental Protection Agency (EPA), Construction Grants Programs.[24] The cost of this system ranges in price depending on the site area, type of soil, number of consumers, and disposable area. The Environmental Protection Agency estimates the system will cost $57.89 per foot.[25]

Figure 5. **Small Diameter Gravity System**



Source: Environmental Protection Agency, Office of Water

In the SDGS, a pipeline connects each dwelling to an interceptor tank. The interceptor tanks at each home serve to catch all suspended solids. The collected waste includes minimal solids, reducing potential clogs. The solids are pushed to the bottom of the tank, while fats, greases and oils flow through the service lateral to the collection main. In some cases, water can be purified and redistributed to the homes if the treatment facilities are properly equipped. If not, the waste flows to a drip field. Minimal contamination transfers to the ground because sand filters break down the waste.[26]

[24] Environmental Protection Agency (2), *Op. Cit.*, 2000.
[25] Environmental Protection Agency (2), *Op. Cit.*, 2000.
[26] Environmental Protection Agency (2), *Op. Cit.*, 2000.

The SDGS allows for fast construction, making it attractive to developers. Other advantages include the fact that unskilled personnel can operate and maintain the system. The system's appeal increases due to minimal manholes, lower excavation cost of digging trenches for pipelines, and reduced material cost because of the small pipelines and one treatment center versus many separate operating septic systems. The operation and maintenance requirements for the SDGS system are similar to the septic system.

Disadvantages include limited experience with the system. Large commercial wastewater with high grit and large settleable solids levels cause the system to fill faster than it can break down the waste. Moreover, highly corrosive soils deteriorate pipes which results in inadequate system performance. More importantly, odors have been a problem in areas with less compacted soil.

Port Royal Estates, an 80-home subdivision in Texas, installed this system after conventional septic systems failed due to infiltration problems. The cost per residence was roughly $3,500; however the long term investment has paid off by alleviating the filtration problem.[27]

In areas where lift stations are needed to pump waste up a slope, additional monitoring is required to ensure a constant flow. Table 3 shows the estimated cost of an SDGS for a 200 home community. The per-unit cost is $10,786, not including any potential EPA subsidies. In terms of maintenance, the tanks must be pumped out between three to ten years depending on the quantity of waste. The primary advantage of the SDGS over traditional septic systems is that only one drainage field is required per 80-200 homes. This allows for smaller lot sizes, which appeals to developers.

[27] Environmental Protection Agency (2), *Op. Cit.*, 2000.

Table 3. Small Diameter Gravity Sewer System (SDGS)

Materials	Price Per Unit/ Measurements	200 Homes
Interceptor Tank	$1,500 per 1,000 gal. Tank @ 200	$300,000
4 in. Sewer Pipe	$8 per ft @ 33,000 ft	$264,000
4 in. Service Lateral	$8 per ft @ 120 ft per Home	$192,000
Man Holes	$2193 ea. @ 500 Man Holes	$1,096,650
Clean Outs	$147 ea. @ 200 Homes	$29,400
Lift Station	$105,139	$105,139
6 in. Force Main $per/ft	$8 per ft @ 500 Force Main	$4,000
4X4 in. Service Wye	$130 ea. @ 200 per Home	$26,044
Total		$2,017,233

* **Prices include installation costs of the system, excludes the cost of preparing the land for installation of the system and the drip field.**
Source: McLendon Enterprises

C. Bioclere System

Bioclere Onsite Wastewater Treatment System produced by Aquapoint Company, is another alternative for sewage treatment in residential areas. It is designed to handle commercial, residential, institutional, community, and light industrial wastewater. While this system functions quite differently than the SDGS, the distribution of waste is similar.

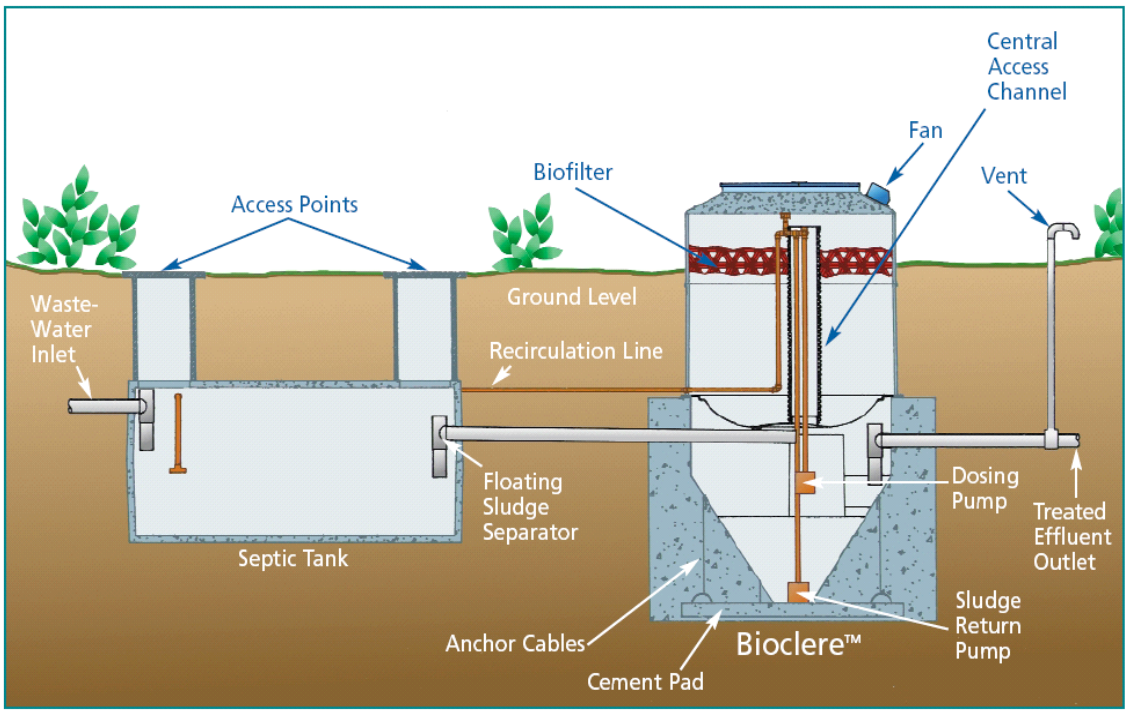
Figure 6 illustrates the system operations. Wastewater enters the septic tank from the pipelines within the community and separates floating sludge from solids. The waste is then transported to the central access channel of the Bioclere System where it is broken down by the biofilter. After the wastewater is purified it can be pumped into a drip field.[28]

This system has several advantages. The system is easy and inexpensive to install, and has a quiet treatment process. When installed it is sealed and insulated for cold weather environments. One of the best features is that it can handle heavy solid and grit waste. It can be applied to commercial, residential, institutional, community, and light industrial use. A potential

[28] Aquapoint Company (2), September 5, 2001, "Bioclere Onsite Wastewater Treatment Systems," Electronic document, accessed: April 24, 2004, http://www.aquapoint.com/products/PDFs/bioclere.pdf

disadvantage is the limited experience with long term functionality of the system. Furthermore, the high demand for these systems has resulted in a waiting list for installation.[29]

Figure 6. Bioclere System



Source: Aquapoint Co. Bioclere Onsite Wastewater Treatment Systems

Operation and maintenance involve merely checking a few times a week to ensure the system is functioning properly. Table 4 illustrates the cost of this system for a 200 home community, with a per-unit cost of $10,536.

The increased demand for homes in small communities and lower density settings like rural Bulloch County make it costly to provide sewer access. Available land suitable for conventional septic systems has become increasingly rare. Development in marginal soil forces the use of costly, land-intensive and often complex on-site systems which require additional management. At the same time, local governments and developers must pay for the total sewer

[29] Aquapoint Company (2), *Op. Cit.*, 2001.

costs, previously subsidized by the Federal Government.[30] These decentralized wastewater systems fill the gap between central sewer systems and septic tanks, providing a means to develop in more restrictive environments and with more cost-effective systems that can be managed economically.[31]

Table 4. Bioclere System

Materials	Price Per Unit/ Measurements	200 Homes
2 Bioclere Units	$80,000 per Unit @ 30,000 gal.	$160,000
Septic Tank	$80,000 per tank @ 55,000 gal. Tank	$80,000
4 in. Sewer Pipe	$8 per ft @ 33,000 ft	$264,000
4 in. Service Lateral	$8 per ft @ 120 ft per Home	$192,000
Man Holes	$2193 ea. @ 500 Man Holes	$1,096,650
Clean Outs	$147 ea. @ 200 Homes	$29,400
Lift Station	$105,139	$105,139
6 in. Force Main $per/ft	$8 per ft @ 500 Force Main	$4,000
4X4 in. Service Wye	$130 ea. @ 200 per Home	$26,044
Freight	$5,000 per Unit	$10,000
Total		$1,967,233

Total including Maint.

***** All prices are assumed to have installation cost included and excludes the land and drip field cost**

Source: Mclendon Enterprises and Carl Lindell

The SDGS and Bioclere system provides a way for Bulloch County to manage the rapid growth in unincorporated areas. These systems are typically located on land owned by the developer. If the developer provides the system, the housing density can be increased, thus allowing the costs to be spread across more lots; costs often passed directly on to the homeowners. The initial cost of these systems at first look seem very expensive to consumers. However, the per-unit costs to the individual consumer may not change significantly. The overall benefits to society of a more environmentally friendly system must be taken into account. The benefits far exceed the drawbacks of developing one of these systems to eliminate the proliferation of septic systems in the area.

[30] Environmental Protection Agency (2), *Op. Cit.*, 2000.

Developers who install these systems provide potential residence assurance of appropriate water and wastewater capabilities. This replaces the cost of residence having to install septic systems for each lot and potentially contaminating the area. The developer benefits because residence will be attracted to this area as it allows them to hook up to the system inexpensively and quickly. Other appealing benefits of these alternatives include increasing development density and the ability to overcome soil-based limitations compared to issues associated with traditional septic systems.[32]

Table 5 compares the cost of each system. It is up to the developer to decide which system is best suited for their area. As stated previously, the life expectancy of each system varies from region to region. External factor include construction of the systems, soil types, weather conditions, maintenance, skill of labor, technology, and research and development affect the cost and life expectancy of each system.

Table 5. Sewer Disposal System Comparative Analysis

	Septic System	SDGS	Bioclere
Cost Per Household	$7,900	$10,786	$10,536
Total (200)homes	$1,580,000	$2,157,233	$2,107,233

Where there is clear evidence of maintenance and depreciation of the septic system, there is no data on maintenance and depreciation of the Bioclere system over a 50 year period. However, with the data available and what we currently know about the system, the major cost and life span of this system directly relates to the specific type and quantity of sewage being pumped through the system. The principle maintenance concern is pumping heavy slug from the holding tank. While septic systems still appear to be the low cost alternative, even after

[31] "Dix, Stephen P., 1998, "Are Cluster Treatment Systems the Key to Implementing Effective Decentralize Wastewater Management?" Infiltrator Systems, Inc.
[32] Dix, Stephen P., *Op. Cit.*, 1998.

considering environmental costs, the advantage of the other systems is that they allow for a more dense development because of smaller lot size requirements.

Table 6 gives a cost analysis of the initial setup cost and projected cost associated with each system under normal wear for a 200 community home. The first year includes the initial cost of setting each system up for the community. Again, the implicit advantages of the alternative systems to septic tanks is the ability to have a denser residential development.

Table 6. Long Term Cost Comparison of Septic System Alternatives

Systems	1 Year	5 Years	10 Years	15 Years
Septic System	$1,580,000	$1,837,540	$2,095,080	$2,352,620
SDGS	$2,157,233	$2,508,862	$2,860,491	$3,212,120
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*** Assuming current inflation rate of 3.26% as of December 2004 (www.inflationdata.com)**

IV. Summary

"These [alternatives to septic] systems will provide attractive features for both developers and utilities focused on the needs of a dispersed or growing population in rural Bulloch County. While adverse topography encourages this approach, so do soils that demand more than a conventional septic system. Economy of scale lowers the peak design flows and reduces the total system size. Individual lots can also be smaller because the setback applies to the one community system no to each individual parcel. This shift allows developers to increase the number of lots and transfer much of the cost to the homebuilder. This more closely aligns the cash flow within a development that utilizes homebuilder financed onsite systems further defer the construction and cost of the individual neighborhood treatment system. The integrated clusters can be constructed, as treatment capacity is needed, benefiting all parties. These systems provide the homeowner with a very attractive and affordable water and wastewater service that supports the rural character."[33]

If Bulloch County decides to use one of these alternate systems, the growth in the rural areas will be equipped with systems that cause minimal environmental damage in the future. There is no doubt that it will benefit this county, from a governmental, developer, environmental, and residential standpoint. No matter which alternative is chosen, Bulloch County will continue to grow.

[33] Dix, Stephen P., *Op. Cit.*, 1998.

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