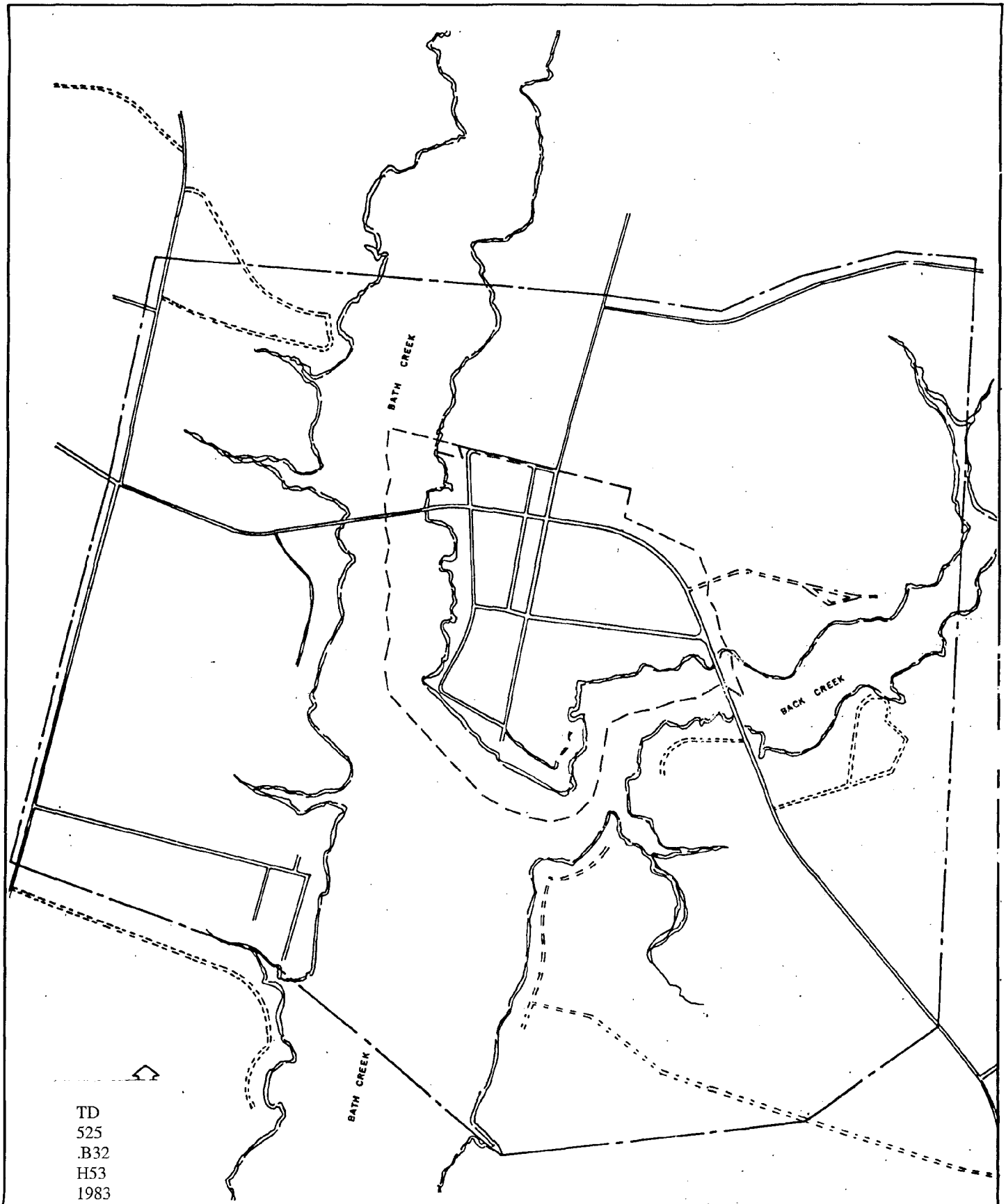

A Coastal Area Demonstration Project by:

PLANNING & DESIGN ASSOCIATES, P.A.

3515 Glenwood Avenue Raleigh, North Carolina 27612 Telephone(919)781-9004

HISTORIC BATH, NORTH CAROLINA

Alternative Wastewater System
Demonstration

INCORPORATED 1705

HISTORIC BATH
OLDEST TOWN IN THE STATE
BATH, NORTH CAROLINA 27808

BOARD OF COMMISSIONERS

Ray S. Brooks, Mayor
Judy Edwards, Mary Brooks, Ira Hardy II, M.D., Bruce Tankard
Bubbs Carson, Town Administrator

PREPARED BY: THE BATH PLANNING BOARD

James R. Edwards, Chairman
Erma Tankard, Rachel Tankard, Guy Cutler, Helen Brooks, Teeny Mason, Ed Swindel
Bubbs Carson, Town Administrator

WITH TECHNICAL ASSISTANCE FROM:

Planning and Design Associates, P.A.
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The preparation of this plan was financed in part through a grant provided by the North Carolina Coastal Management Program, through funds provided by the Coastal Zone Management Act of 1972, as amended, which is administered by the Office of Coastal Zone Management, National Oceanic and Atmospheric Administration. The Town of Bath contributed cash and in-kind services.

May, 1983

OUTLINE

CHAPTER I

INTRODUCTION

The purpose of this study is to develop a plan for small alternative wastewater systems for selected areas within the Town of Bath, that is easily adaptable to other coastal area communities.

The Town of Bath is characteristic of the North Carolina coastal region in that it is plagued by a complex set of wastewater treatment circumstances. The older sections of the Town are declining in population while the outlying area is experiencing growth largely due to the seasonal recreation demand. The entire town must rely on septic tank systems because a conventional centralized treatment system is not economically feasible. The prime development lands are along the Town's water areas (Bath and Back Creeks) where such lands are subject to periodic flooding and soils are often unsuitable for traditional septic tank and soil absorption field sytems. The area has a history of septic system failures and a potential for sewage pollution of the areas ground water, streams and areas of environmental concern.* Additionally, there is latent demand for some commercial development in the Town which cannot be realized unless the wastewater treatment problem is resolved.

The Town of Bath undertook earlier efforts which determined that the costs for construction of a new centralized wastewater treatment system for the Town of Bath was too expensive. The "Bath Wastewater Treatment Plant Feasibility Study," March, 1982 found that a centralized plant (to include collection and treatment of wastes) for lands within the corporate limits would total approximately $1.2 million. For lands within the entire Planning Area (i.e., lands within one-mile of the corporate limits), the facility costs would total $2.7 million. This equates to $9,000 and $14,000 per hook-up for the corporate limits and planning area respectively (based upon existing and future demand to 1990). The study concluded that:

1) A conventional waste treatment system is not economically feasible.

2) The majority of soils in the Town have severe limitations for acceptance of traditional septic tanks and aerobic field solutions.

3) Although the Town's water quality appears satisfactory at this point in time, increased development may cause an eventual load of the soil system, contaminating the Town's wells and creeks.

Therefore, the study recommended that the Town should:

1) Identify the legal and regulatory authority of local governments to develop and maintain small wastewater treatment systems.

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*As this document is being written, the school is being closed daily at 2:30 p.m. since its commodes are overflowing due to septic tank malfunctions from heavy rains.

2) Develop schematics and cost estimates for small innovative wastewater systems for targeted areas within the Bath Planning Area.

3) Identify funding sources and methods for financing small wastewater systems.

Alternative wastewater treatment systems utilize small waste flows technologies and management while optimizing the use of existing on-site septic systems. Examples of alternatives to a centralized waste treatment plant or the traditionally designed septic tank and field absorption system include low pressure pipe systems, mound systems, leaching chambers, alternating absorption fields, cluster systems and more (see Appendix A).

Most small communities have not been exposed to the full range of small innovative wastewater systems available nor are they equipped administratively and technically to either assist local developers or to undertake the projects themselves. The Bath town officials recognized that if they were to solve existing and potential septic system failures and accommodate their projected and desired growth, the Town must foster the development of small alternative wastewater systems. To this end, application was made to the North Carolina Coastal Resources Commission to help finance the development of this plan.

The plan is organized under seven principal headings which include: 1) Legal Constraints, 2) Target Area Selection, 3) Need and Demand Analysis, 4) Nitrification Field Analysis and Selection, 5) System Design and Cost Estimates, 6) System Management and Maintenance, and 7) System Financing. Each section contains a description of the methodology employed for use by other coastal area communities and a major findings and conclusions statement applicable specifically to the Town of Bath. Chapter IX, Demonstration Value for Other Coastal Communities, serves as a guide to other coastal communities desiring to undertake a similar planning effort.

CHAPTER II

LEGAL CONSTRAINTS

Prior to undertaking a project of this nature, it is essential to first identify the legal constraints within which one must plan. The following is a digest of the rules and regulations effecting on-site wastewater treatment systems in the State of North Carolina which are relevant not only to Bath, but other coastal communities considering the design of alternative wastewater treatment systems.

The regulation of on-site wastewater disposal systems for North Carolina is shared by the State Commission for Health Services and local health departments, and the Environmental Management Commission. The health services section comes under the administrative code of Department of Human Resources and the environmental management section comes under the administrative code of the Department of Natural Resources and Community Development.

North Carolina General Statutes governing the Regulation of septic tank systems include G.S. Chapter 130-166 to 130-203, known as the Ground Absorption Sewage Treatment and Disposal Act of 1981, G.S. Chapter 130-17, the Powers and Duties of local Boards of Health and G.S. Chapter 143-215, the Regulations of the Environmental Management Commission for systems not discharging to surface waters. Supplementing the Environmental Management Commission's rules and regulations are requirements set out under Rule no. 15 NCAC 2H .0400, applicable to Coastal Areas.

Ground Absorption Sewage Treatment and Disposal Act

The Ground Absorption Sewage Treatment and Disposal Act of 1981 (G.S. 130-166 to 130-203) requires a person either "owning" or "controlling" a dwelling (single or multi-family), business, or place of public assembly to provide a sewage treatment and disposal system. Approval for public or community sewage systems or systems which discharge to the land surface or surface waters, come under the authority of the Environmental Management Commission. (Note: the Act defines "public or community sewage system" as "a single system of sewage collection, treatment, and disposal owned and operated by a sanitary district, metropolitan sewage district, and water sewer authority, a county or municipality or public utility"). All private sewage treatment and disposal systems, to include approved privies, septic tank systems, incinerators, mechanical toilets, composting toilets, recycling toilets and similar systems which do not discharge effluent to the land surface water, are to be approved under the rules and regulations of the Commission for Health Services. Local Boards of Health may adopt regulations which are "more stringent," but not "less stringent" than the Commission's regulations. Such regulations are in the formulative stages for Beaufort County, but final rules and regulations have not yet been adopted, nor received the Department of Human Resources approval of compliance with State regulations.

An "improvements permit" must be obtained from the local health department prior to the construction, location or relocation of any residence, place of business or place of public assembly. This step allows for the review of the proposed system and a determination as to its adequacy. Once the system is installed, but prior to its being covered or placed into operation, a "certificate of completion permit" must be obtained, proving proper installation of the system. Only after these two permits have been issued can construction, location or relocation of a dwelling, place of business or place of public assembly begin.

Appeals conserving the interpretation and enforcement of the local Board of Health rules must be taken within 15 days of the challenge. Anyone contesting the decision of the local Board of Health has the right to appeal to the District Court having jurisdiction over this matter.

Rules and Regulations of the Health Services Commission

In conjunction with the recently revised Ground Absorption Sewage Treatment and Disposal Act of 1981, new rules and regulations were established (effective July 1, 1982), for the Commission of Health Services relative to sewage treatment and disposal systems (reference: 10 NCAC 10A .1934-.1968).

Included within these rules and regulations is a repetition of the improvements permit and certificate of completion permits required under this disposal act. Additionally, where systems are proposed to serve a condominium or other multi-family development and such systems will be under common or joint control, an agreement (tri-party) must be submitted with the improvements permit application. This agreement must be properly executed along the local health department, developer, and homeowners association which address ownership, maintenance, repairs, operation and performance and necessary funds.

Any sewage treatment and disposal system which exceeds a design capacity of three thousand gallons per day and other systems which are required to be designed by a professional engineer, must be inspected annually.

Prior to assurance of an improvements permit, the local health department must investigate each site and make an analysis based upon the following factors:

1. Topography and landscape position.
2. Soil characteristics.
3. Soil drainage.
4. Soil depth.
5. Available space.

Through this analysis, sites are classified (by the above factors) as either suitable, provisionally suitable or unsuitable. Generally, when adaptations can be instituted such as terracing of land for slopes greater than 30% or mounding of soil where high water tables exist, an unsuitable classification can be adjusted to provisionally suitable and hence a permit can be issued.

A new provision under "available space" requires an amount of land for both the proposed system and available space sufficient for an alternative site, should the initial system fail (those lots with evidence of existence, as filed with the local health department prior to July 1982 or those lots described in a recorded deed or plot prior to January 1983, are exempt from this latter requirement).

The rules and regulations also include standard sewage flow rates and minimum horizontal distance requirements between the septic tank and field absorption system and certain features. These minimum distance include:

1. Any private water supply -- 100 ft.;
2. Any public water supply — 100 ft.;
3. Streams classified as A-II -- 50 ft.;
4. Waters classified as S.A. — 100 ft. from normal high tide marks;
5. Any other stream, canal, marsh, or coastal waters — 50 ft.;
6. Any Class I or Class II impounded reservoir used as a source of drinking water -- 100 ft. from normal high water lines;
7. Any other lake or impoundment — 50 ft. from normal high water lines;
8. Any building foundation -- 5 ft.;
9. Any basement -- 15 ft.;
10. Any property line — 10 ft.;
11. Top of slope of embankments or cuts of two feet or more vertical height -- 15 ft.;
12. Any water line — 10 ft.;
13. Drainage system:
    A. Interceptor drains — 10 ft. up slope and 25 ft. downslope,
    B. Groundwater lowering and surface draining ditches — 20 ft.;
14. Any swimming pool — 25 ft.;
15. Any other nitration field (except repair area) -- 20 ft.

No system can be installed at sites where the seasonal high water table is within one foot of the ground surface at any time of the year. Under certain restrictive circumstances, the system can be located closer than 100 ft. from a private water supply but in no case closer than 50 ft. An areal fill may be used where at least one foot of natural occurring soil is present within the classification of either suitable or provisionally suitable. Finally, the septic tank system must not be located under paved areas or driveways. Systems which are in use or for which permits were issued prior to July 1, 1977, which are too small to meet the above regulations, are exempt from these requirements.

Additional regulations cover septic tank construction, prefabricated tanks, design criteria for conventional sewage systems and privy construction and maintenance.

In recognition of alternative wastewater systems, two sections have been added to established regulations for alternative wastewater systems such as nitration trenches, alternating dual field nitration systems, modified nitration lines and low-pressure pipe systems.

If an existing system falls into disrepair or the use is discontinued for any reason, the system must be brought up to the standards of these regulations before the system can be reused. If a determination is made by the local health department that a reuse will not create a health hazard, then compliance with these regulations can be waived.

Rules and Regulations of the Local Boards of Health

Under G.S. 130-17, the Local Boards of Health have the responsibility to ensure that sewage systems, as installed, are in compliance with the rules and regulations of the Commission for Health Services. As noted previously, these rules and regulations can be superseded by locally adopted provisions where there exists "an emergency, or peculiar local condition or circumstances." Such additional regulations must be "more stringent, but not less stringent," than those of the Commission.

An important provision of G.S. 130-17 authorizes the local boards of health to enter into contracts with local units of government and private agencies or persons, for the purpose of providing services in exchange for fees. This provision may be useful for long term maintenance agreements for innovative sewage treatment systems.

Rules and Regulations of the Environmental Management Commission

As noted above, all public or community sewage systems and any systems which discharge to the land service or surface waters, must be approved by the Department of Natural Resources and Community Development under the rules and regulations of the Environmental Management Commission. Title 15 (which is presently under revision), subchapter 2H, Section .0200 addresses directly the requirements for sewage systems not discharging to service waters. Under this section, a permit is required before constructing or altering any sewage system, treatment works or disposal system not discharging to surface waters.

These regulations outline the required supporting documentation and information, as well as requirements of various systems. Those requirements thought to be specifically applicable to the Bath situation have been included below:

For pumping stations:
a. design data;
b. plan and profile or force main;
c. plot plan;
d. specifications describing all materials to be used, methods of construction and means for assuring the quality and integrity of the finished project;

For septic tank — ground absorption systems:
a. percolation data on soil;
b. design data;
c. plans of complete system including plans for septic tank, system layout and cross section profile of nitration lines;

For spray irrigation or land application disposal systems and treatment works:

a. topographic map of disposal areas;
b. test borings and subsurface data adequate for site evaluation;
c. soil evaluation of the disposal site conducted by a recognized soil scientist and his recommendations concerning application rates for liquids, solids, minerals and other constituents of wastewater;
d. a project evaluation conducted by a recognized agronomist and his recommendations concerning cover crops and their ability to accept the proposed application rates of liquid, solids, minerals and other constituents of wastewater;
e. complete plans and specifications for entire system.

The regulations specify that the permit application must be signed by a consulting engineer or "other agent" when accompanied by a letter of authorization. For spray irrigation or land application disposal systems and treatment works, soil evaluations must be conducted by a "recognized soil scientist."

Two additional references are made relative to the small area wastewater systems. Specifically, the regulations referenced Section .0300, "septic tank systems" and Section .400, "coastal waste treatment and disposal." Under Section .0300 (which is presently under revision), the regulations are basically the same as those contained within the Ground Absorption Sewage Treatment Disposal Act of 1981 for septic tank systems. Section .0200 - coastal waste treatment disposal, contains regulations which are specific to coastal areas like Bath. These regulations are applicable to public and community sewage systems along the coast.

Most important is Regulation .0404(f) prohibiting the use of septic tank systems for "high density" areas. High density has been defined in these regulations as any development for use of more than 1200 gallons of water per acre per day or which contain more than 3 residential units per acre. Section .0404 (g) provides that where approved area-wide collection and treatment systems are not available, interim systems may be approved to include a subsurface disposal trench, low pressure distribution systems and rotary distributions (i.e., spray systems).

Additionally, according to Alton Hodge, Environmental Engineer, in order to comply with the Division's regulations, a replacment disposal field must be available (May 12, 1983 letter to Lee Fleming, et al).

Applications must be submitted to the Director of Environmental Management, NRCD, in Raleigh. The Director must complete his review and take final action within 90 days following receipt of the application. An applicant can request an adjutacatory hearing if the permit is denied or the applicant deems the conditions of approval are unacceptable.

Conclusions

Over the course of the last few years, gains have been made in amending State laws and rules to further accommodate alternative wastewater treatment systems.

The latest revision of the Ground Disposal Sewage Treatment Disposal Act is supportive of Alternative Wastewater Systems and at this point in time, is the controlling set of regulations. The Environmental Management Commission rules (i.e., Title 15, subchapter 2H) are presently being revised to comply with the Act.

The biggest stumbling block with 15 NCAC 2H to Bath and other coastal communities is Section .0404(f), which restricts septic systems in "high density areas" (more than 1200 gallons of water per acre per day demand or more than three residential units per acre). Under section .0400, if it is a publically or community owned system, septic systems are prohibited for high density development. If the septic system is privately owned, one can develop at high density provided design, soil suitability, etc. requirements are met.

Conversations with Environmental Management Commission staff (Dale Crisp) indicate that Bath could make application for the entire corporate limits and then perhaps meet the high density limitation through a city-wide density. Alternatively, a variance to Section .0400 (the procedure for which is presented in Section .0200) could be applied for constructing the case that Bath is an individual and not a community, for purposes of an areawide demonstration project like this. Or, more practically, the Town could give the entire system to a private individual (with proper assurances for maintenance, etc.) and then lease it from that individual for $1.00 per year, thereby meeting the letter of .0400.

Through this review of county and state regulations and discussion/correspondence with officials, the Town of Bath became aware that a variance may be required to Section .0404(f) and that a suitable nitrification field and a replacement field are required to obtain a non-discharge permit from the Division of Environmental Management.

With this understanding of that section, while keeping open the options for privately owned smaller systems, the Planning Board began the task for selecting target areas within the corporate limits.

CHAPTER III

TARGET AREA SELECTION

Since the aforementioned study of a Conventional community-wide system indicated exhorbitant costs, this study was begun on a target area basis.*

The selection process begins with a review of existing or easily obtainable data in the community. One of the most valuable sources of information is the CAMA Land Use Plan. Within the land use plan are inventories and survey results on existing land use, hazard areas such as floodplains, and areas likely to experience new growth. Detailed soil maps/descriptions from the Soil Conservation Service can be used to locate areas likely to have existing or potential septic system failures due to soil limitations. When this soil data is overlayed with the vacant land survey of the land use plan, lands suitable for future nitrification fields can be identified.

The local county health department sanitarian is also a valuable resource. His or her knowledge of the community will serve to pinpoint areas of existing and potential septic failures, the nature of those failures and needs for improvement. The local sanitarian can also help identify areas suitable for field absorption application.

The most suitable method for analyzing the data listed above is to plot each element (e.g., hazard areas, soils unsuitable for septic systems, growth modes, etc.) on a set of overlay maps. The next step is to select one or more target areas based upon a set of criteria. The following criteria was developed for use in the Town of Bath, but should be adjusted to suit each jurisdiction's needs and desires.

Target Area Selection Criteria:

1. Is the area designated either "developed" or "transition" in the adopted CAMA Land Use Plan (LUP)?

2. Does one or more of the areas include concentrations of septic failures or non-complying systems?

3. Does the area include lands having known or proposed changes in type of use, density, or otherwise targeted for specific uses which are supported by the LUP and highly desirable to the community in terms of job creation, income generation, increase in tax base, etc.?

4. Are the areas within reasonably close proximity to vacant lands suitable for field absorption systems?

5. Is the nature of the effluence (i.e., quantity and quality) generated within the area treatable through small waste flows technologies?

---

*It later came to recommend a community-wide land based system (see Chapters VII & VIII).

6. Is at least one of the areas feasible for immediate implementation following completion of this plan?

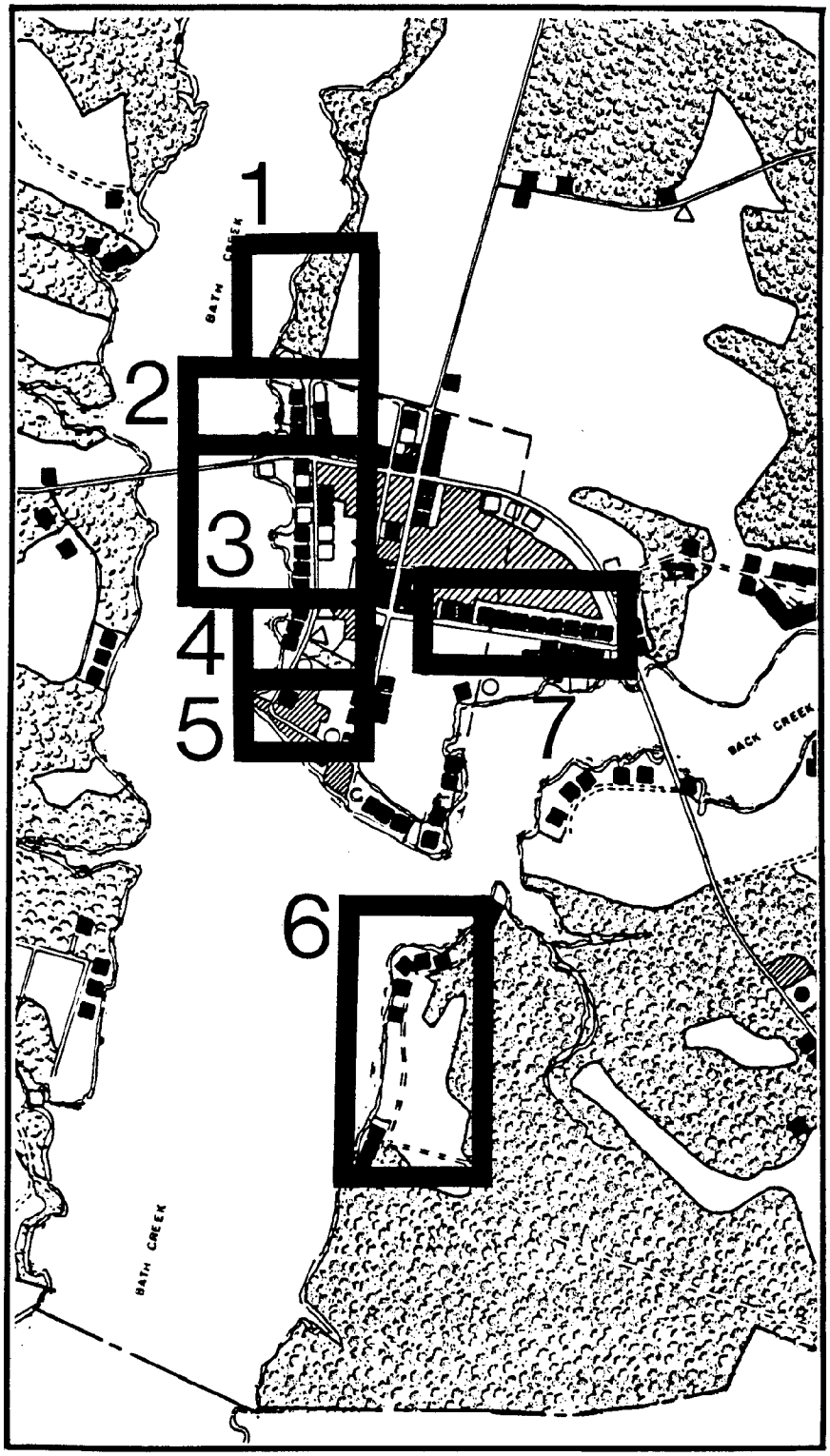
Based upon an analysis of local data in light of the above criteria, the local staff or consultant can identify from four to six potential target areas for public review. The local Town council or planning board can make the final selections from the alternatives presented at a scheduled meeting.

For the Town of Bath, a series of map overlays was developed to include existing land use, fragile areas, hazard areas, land classification, zoning, septic systems failure areas and areas suitable for drainage fields. This information was obtained through a reading of the "Historic Bath Land Use Plan, 1980 - 1990" and interviews with the Beaufort County Sanitarians, Bobbie O'Neil, Horace Moore and Donnie Woolard.

Four preliminary target areas were selected for review by the Bath Planning Board. See Exhibit A. These areas included: 1) lands generally at the intersection of Carteret and Main Streets, 2) lands along Main Street between Grover and Front Streets, 3) lands along the north side of Craven Street between King and Carteret Streets, and 4) lands within the extraterritorial area located across Back Creek opposite Handy's Point.

The Bath Planning Board met in September, 1982 and decided on a target area which combined the preliminary target areas identified as #1 and #2. The Planning Board selected an area targeted for application of the small area wastewater treatment systems to include the parcels and development along Main Street in the Town of Bath extending from the State Park at Bonners Point north to Bowen Avenue.

EXHIBIT A



HISTORIC

BATH

NORTH CAROLINA

Small
Alternative Wastewater System
Demonstration

PLANNING & DESIGN ASSOCIATES, P.A. 3515 Glenwood Avenue Raleigh North Carolina 27612 Telephone (919) 781 9004

DATE:	JOB NO.	GENERAL NOTES	REVISIONS	NOT RELEASED FOR CONSTRUCTION
		1. ALL WORK TO CONFORM TO APPLICABLE LOCAL AND STATE CODES. 2. ARCHITECT IS NOT RESPONSIBLE FOR MATERIALS OR CONSTRUCTION METHODS. 3. THESE DRAWINGS HAVE BEEN PREPARED FOR A PARTICULAR BUILDING IMPROVEMENT, ONLY WITH THE DISTINCT UNDERSTANDING THAT THEY ARE INSTRUMENTS OF SERVICE AND THEY ARE THE PROPERTY OF THE ARCHITECT. IF THESE DRAWINGS OR ANY OTHER PART THEREOF ARE USED IN ANY OTHER MANNER WITHOUT THE WRITTEN CONSENT OF THE ARCHITECT, THE USER THEREOF BECOMES INDEBTED TO THE ARCHITECT FOR FULL COMMISSION 4. THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS OF THESE PLANS AND HAVE ALL WORK FIT INTO POSITION. THE CONTRACTOR IS RESPONSIBLE TO VERIFY ALL CONDITIONS AT THE SITE DURING THE ESTIMATING STAGE.		

CHAPTER IV

NEED AND DEMAND ANALYSIS

Once the target area(s) have been selected, the septic system problems and opportunities for development must be identifed. The success of a program of this nature in small coastal area towns is dependent upon a proper blend of "need" (i.e., existing and potential septic system failures) and "demand" (i.e., opportunities for new development) for alternative wastewater treatment systems.

Need for Alternative Wastewater Treatment Systems

In order to optimize the use and operation of existing on-site septic systems, the performance of that system must first be documented. Reliable data on the various types of septic system failures is often scarce. Further, there is a conflicting bias between the local sanitarian and home owner regarding the frequency and potential for septic system failures. For these reasons, mailed questionnaires and on-site investigations with the local sanitarian are suggested.

The target area of Bath was surveyed during the month of October, 1982. A copy of the cover letter and questionnaire mailed to residents of the Bath target area is included in Appendix B, while the results of the survey are summarized below.

> There are 61 structures within the Main Street Target Area of Bath. The uses include 51 residences, 9 business (3 are combined residences and businesses), 1 church and 3 institutional uses. Returns from the households surveyed indicate about a 60% return rate (30 of 51 surveys mailed). Of those returned surveys, 87 percent (26) were year-a-round residences, 7 percent (2) were seasonal and 3 percent (1) were vacant. Families were predominately one and two person households (30%-8 and 26%-7, respectively) with 18% (5) having 3 person households, 18% (5) having 4 persons, and 4% each (1) with 5 and 6 person households.
>
> The majority of housing units had three bedrooms (45%, 13 total), followed by 2 bedroom houses at 28% (8) and 4 bedroom houses at 24% (7). Only 3% (1) had one bedroom houses.
>
> Fifty-five percent (16) of the houses had a single toilet, 38% (11) had two toilets, while 7% (2) had three toilets. For shower facilities, 65% (19) had one tub or shower, 28% (8) had two showers and 2% (2) had three shower facilities. Water conservation devices were being used in 20% (6) of the households, 83% of which were shower restrictors and 50% having both shower restrictors and low water volume toilets.

The entire Main Street area is on septic tank/field absorption systems. Twenty-nine percent (6) were installed over 30 years ago, 33% (7) installed between 20 and 30 years ago, 29% (6) were installed 10-20 years ago and only 9% (2) installed within the last ten years.

Nearly 40% (11) of the systems have had system failures. Sixty percent (13) indicated there has never been any maintenance. Only 11% (3) indicated they would like to expand their house if adequate wastewater treatment capacity was provided.

Of the nine businesses along Main Street, four returned their surveys. All four businesses were open year-around and indicated no problems with their existing septic systems. All were built in the 1970's. Only one business utilized water flow restriction devices. Three of the four businesses indicated a desire to expand their facility if additional waste treatment capacity was provided.

The next step in the "needs" definition phase is on-site investigation and analysis. Beaufort County Sanitarians, Horace Moore and Donnie Woolard, together with Dr. James Wang, P.E., of Wang Engineering, and Terry Alford, AIA, of Planning and Design Associates, P.A., conducted the on-site investigations. Their findings and conclusions are summarized below:

Sixty-one structures within the Target Area were placed into one or more of the following categories, according to their type of system problem and need for alternative system:

1. Inadequate space for drainage field.
2. Inadequate system design (i.e., too small).
3. Inadequate maintenance (i.e., requires regular maintenance).
4. Unsuitable soils for leaching field (this category was applied to vacant lots;

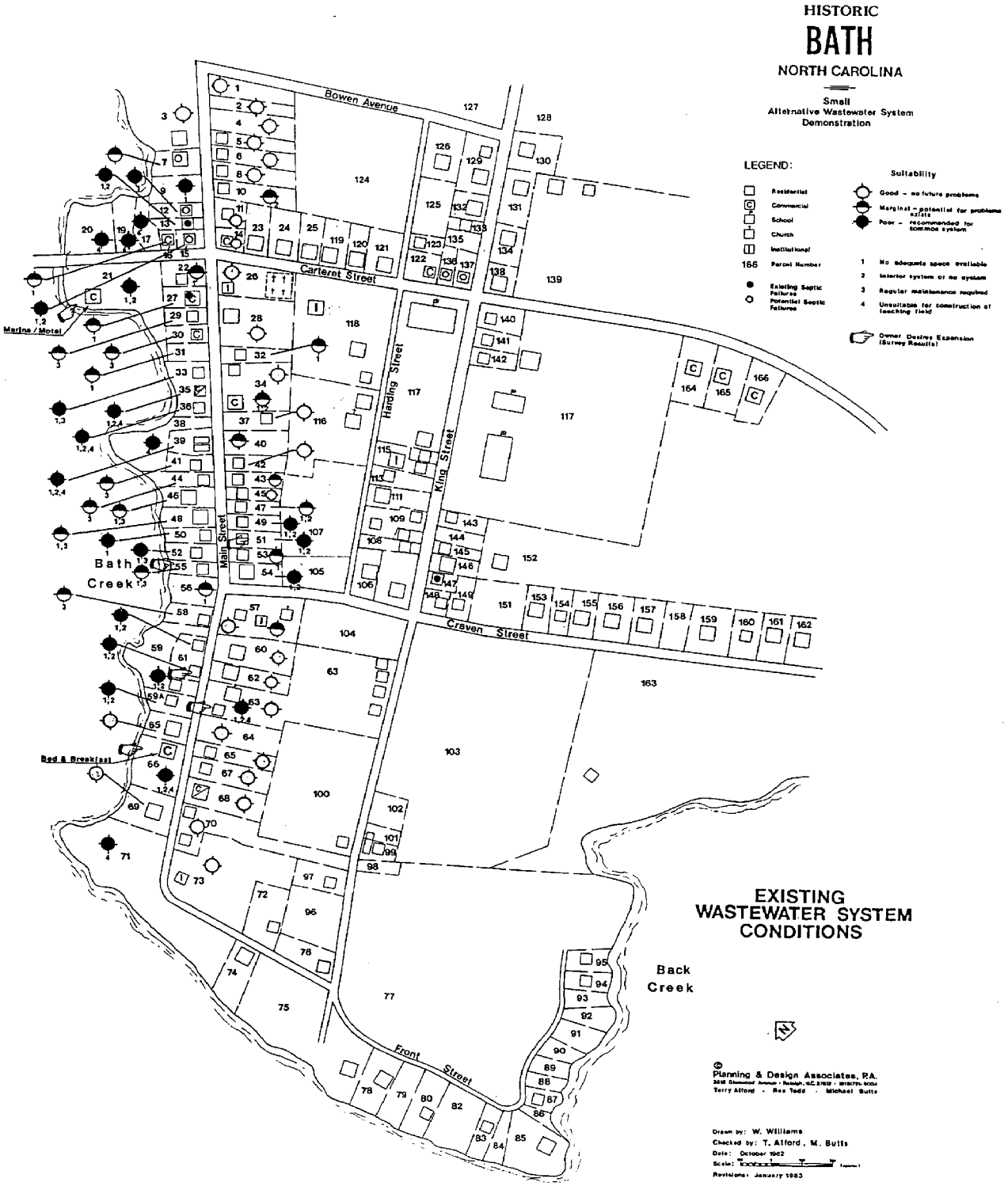
Of the 61 structures (lots), 26 rated as having inadequate space, 16 as having an inadequate design, 7 required regular maintenance to avoid system failure and 3 were located on sites with unsuitable soils.

Based upon these findings and local knowledge of the individual systems performance, a judgement was made relative to the present wastewater system suitability. The following suitability rating system was applied to each site.

A. Good, adequate with no future problems anticipated.
B. Marginal, either has had problems or potential for problems.
C. Poor, in need of redesign and/or connection to community system.

As shown in Exhibit B1, given the above rating system, 20 houses were judged "good;" 16 marginal and 16 poor. This shows that a significant number of houses (62%) are either in need of a new or redesigned wastewater system or will be in such need within the near future.

EXHIBIT B1


HISTORIC
BATH
NORTH CAROLINA
Small
Alternative Wastewater System
Demonstration
LEGEND:
Residential
Commercial
School
Church
Institutional
166 Parcel Number
Existing Septic Failures
Potential Septic Failures
Suitability
Good – no future problems
Marginal – potential for problems exists
Poor – recommended for common system
1 No adequate space available
2 Interior systems or no system
3 Regular maintenance required
4 Unsuitable for construction of leaching field
Owner Desires Expansion (Survey Results)
Bowen Avenue
Carteret Street
Harding Street
King Street
Main Street
Craven Street
Front Street
Bath Creek
Back Creek
Marina / Motel
Bed & Breakfast
EXISTING
WASTEWATER SYSTEM
CONDITIONS
© Planning & Design Associates, P.A.
Terry Alford · Rex Todd · Michael Butts
Drawn by: W. Williams
Checked by: T. Alford, M. Butts
Date: October 1982
Revisions: January 1983

The nine businesses along Main Street were analyzed against the same standards. Five of the businesses' wastewater systems were judged to have inadequate space for drainage fields, three had an inadequately designed system, one required regular maintenance to ensure against failure and two had sites with unsuitable soils for leaching fields. The nine businesses were evenly distributed with three each judged good, marginal and poor. The one church had no treatment system and the three institutional structures all rated as good.

The final step in the "needs" definition phase is a comparison of the results from the questionnaires and on-site surveys. Of those sites judged good, surveys showed that one (#14) was in need of more drain lines and therefore was reclassified as B2.

Of the nineteen sites classified as marginal, nine questionnaires were received. Five of the returned questionnaires indicated system failures and four had no problems. Only one indicated a desire to expand if additional capacity was provided.

Nineteen sites were classified as bad. Of this group, fourteen questionnaires were returned. Only three indicated problems, while five indicated a desire to expand.

Conclusions:

The return rates for categories A, B and C (i.e., good, marginal and bad) were 39 percent, 53 percent and 74 percent respectively. Although there is a low correlation between questionnaire results and on-site investigations, there is a strong correlation between the judged severity of the problem and interest on the part of the residents as exhibted through the returned questionnaires.

Based on the age of existing systems and the documented number of system failures and/or deficiencies, the Town of Bath has a substantial need for improved wastewater treatment.

Demand for Alternative Wastewater Treatment Systems

It is essential, in the planning and design of any municipal wastewater treatment system to differentiate between Need and Demand.

Need, as presented in the preceding section, is characterized by documentation of existing and potential septic system failures, including ability of the target area to accommodate present and projected wastewater discharges within limits of existing environmental and program constraints.

Demand, is most often characterized by those economic forces in the marketplace that result in the willingness to spend money to meet desires as well as needs. In most small coastal communities, as in Bath, community needs far exceed the real marketplace demand.

This can be best illustrated from the Bath questionnaire results in which 62% of residents indicated a need for a new or redesigned wastewater system; yet, only 11% of residents indicated a desire to expand their house or business if adequate wastewater capacity was provided.

In the absence of a major and immediate threat to their health, safety, and personal goals, Bath residents are less likely or able to spend the additional money required to individually upgrade their existing systems. In a community dominated by older residents, living on fixed incomes, there is little tolerance for additional monthly costs due to hook-up to a central wastewater system.

Within this socio-economic climate, demand for a central wastewater system must be derived from the individuals desire to achieve community-wide goals.

The active public participation, over the past three years, in the development and adoption of a community Land Use Plan has generated community-wide interest in an adequate wastewater system. This improved wastewater system would overcome the potential environmental health problems presented by the present system as well as foster appropriate develoment desired by the community. Specific development desires include recruitment of light industry, residential construction on in-town agricultural land, and limited addition of commercial uses along highway 92 and Main Street.

The challenge in Bath, as with many small coastal communities, is to accommodate the discrepancy between individuals inability to pay vs. community goals of growth and improved quality of life. The challenge for the Planning Board and its consultant is, therefore, to identify commercial development opportunities within the target area that would reduce individual residential hook-up charges, while achieving community growth goals. That is, can new income-generating projects be developed as a means of financing a significant proportion of the total hook-up costs.

In order to identify potential new development opportunities in Bath, a public meeting was held at the Bath Town Hall on October 18, 1982 to solicit community input. Prior notification was provided via letters to property owners, town officials, and key individuals.

Exhibit B2 provides a summary of the input derived from this brainstorming session with over thirty community residents.

Exhibit B2

PLANNING BOARD WORKSESSION - BATH TOWN HALL
OCTOBER 18, 1982

A. Overview: Provided by Consultants (Alford, Todd, Butts and Wang)

1. Identify the Problem: Need (current failures; future failures)
   Demand (opportunities for commercial/residential development, etc.)
   Supply (potential sites for absorption fields

2. System Alternatives: Design of Solutions - cost/benefits (what each system is).

3. Systems Maintenance: What it takes to keep it working, over time. Costs.

4. System Financing: What is the cost? How share it?

B. Suggested Opportunity Projects & Recommendations from Community

1. Plot 20 - Farmer's Market for Fisherman (via town lease).

2. Plot 66 - Expanded Bed and Breakfast Guest House, to include Lunch and Dinner.

3. Plot 3 - Convert the Barn, near amphitheatre, to a restaurant/lounge to accommodate theatre patrons.

4. Cluster Swindel's Grocery, Harbour Hotel & Property N. of 92 into single wastewater system.

5. Plots #77, #103 and #163 could accommodate additional housing (e.g., on Craven St. "Clustered Development") as incentive to development of central nutrification fields.

6. A playground for children is desired for one of the in-town vacant lots.

7. Target initial projects to utilize publicly owned land (e.g., Beaufort County schools owns 13 acres).

8. Explore ways to use wastewater byproducts, via recycling/reclamation

9. Explore techniques for segregating waste categories.

10. Include more commercially zoned areas in Target Area.

11. Provide wastewater systems for existing marinas.

12. Plot #127 - would be suitable for Light Industry, if changed from R1.

13. Encourage the State to let the Town percolate town wastewater on their land.

14. Vacant lots on waterfront could be developed with adequate wastewater system (e.g., Parcels 3 & 163).

15. Consider using available land on existing residential/commercial/institutional sites to assist adjacent property.

C. Related issues: Parking

Improved parking would be essential for area development. Areas outside target area also have future development potential (e.g., Back Creek Marina restaurant).

Parcels #34 and #37, and #36/#38 are conducive to restaurant development (Jim Middleton).

Real demand for development within the target area appears to cluster into three major categories: Restaurant, Housing, and Light Industry. A summary of impact of these proposed future uses on construction of a town wastewater system and is as follows:

Restaurants:

Broad community consensus exists to encourage development of an in-town restaurant. Five (5) specific sites were identified from the community meeting:

1. Ampitheatre Barn
2. Swindel's Grocery
3. Bath Guest House
4. Parcels 34/37
5. Parcels 36/38

There exists an apparent market for a modest family restaurant, to seat 50 to 75 persons during tourist season, operating with a 15 to 25 seat capacity during the off season. The narrow margin of profit affordable by a class A or B restaurant in this seasonable marketplace would negate any significant contribution of capital to a clustered wastewater system. That is, a restaurant would more likely follow, rather than lead the development of improved municiple wastewater capacity.

Housing:

A total of eleven vacant parcels, suitable for residential construction were identified within the target area. Available residential in-fill sites for single family detached or duplex units, on scattered parcels will not generate sufficient volume of construction to significantly contribute to capital costs of a central wastewater system. Rather, like the restaurant, scattered site residential infill would most likely occur <u>after</u> installation of a central system.

Parcels 77, 103, and 163 are suitable for clustered "patio home," duplex townhouse, or single-family detached units. With a phased development plan, parcels 103 and 163 could easily accommodate thirty (30) single-family units on quarter acre lots, with sufficient land remaining to serve as nitrification field for the entire town (See Wastewater Schematic Design 4). Assuming the Town's willingness to provide development incentives to the Developer/Owners of this property, the Developer may be able to provide significant private capital contribution to construction of a central wastewater system.

Light Industry:

Parcel #127, north of Bowen Avenue, was identified in the community meeting as a potential site for light industry. With appropriate incentives from the Town, the owner of this parcel has expressed an interest in developing a small apparel manufacturing facility at this location. Assuming an expanded

employment base of 50 to 75 workers, attributable to this project, a significant capital contribution to the cost of a central wastewater system might be gained; especially due to the projects potential for leveraging other sources of public capital due to job creation.

Other Opportunities Considered:

Other projects identified in the community meeting included a "Farmers Fish Market" (Plot #20) and the need to accommodate wastewater at existing marinas (Plot #21). Neither of these projects would generate sufficient revenue to contribute, beyond their direct costs, to the construction of the overall target area wastewater system.

Conclusions

Real demand for a centralized wastewater system in Bath, measured by the ability of the marketplace to recruit private capital in its construction, is likely to be derived from new development rather than from existing residential and commercial uses. New development potentials identified include a moderate density residential subdivision and addition of a small scale, light industry.

Upon completion of the system, pent-up market demand for residential and commercial in-fill will result in additional scattered site development, as an aid to reducing operating costs of the central system.

Individual acceptance of the additional dollar costs of central wastewater treatment must be tied to that individual's desire to achieve larger goals of community development.

New development within the community must make a significant capital contribution to construction of the central system, to reduce operating costs to existing residents.

CHAPTER V

NITRIFICATION FIELD ANALYSIS AND SELECTION

Once the need and demand for wastewater treatment has been determined, "potential" nitrification fields must be selected and detailed soil analysis conducted.

Based upon the need to identify one or more nitrification fields within close proximity to the target area, ten alternative sites were selected in Bath. These sites were selected through a review of the vacant land survey and interviews with the Beaufort County Sanitarians. The local sanitarian has knowledge not only of the soil characteristics of the area, but also knows the location of existing drainage fields.

Following the selection of the potential nitrification fields, the County Sanitarians conducted on-site investigations and soil boring tests. Based upon their findings, and in accordance with State regulations, the fields were judged either suitable, unsuitable or provisionally suitable (see Chapter II for definitions). The results of this analysis are listed below:

EXHIBIT C

NITRIFICATION FIELD SUITABILITY CLASSIFICATIONS

Site Number	Suitability as Nitrification Field
124	Suitable
118/28/26	Unsuitable
107/105	Provisionally Suitable
104/63/100	Provisionally Suitable
71	Unsuitable
72	Unsuitable
77	Suitable
103/163	Provisionally Suitable
117	Suitable
152	Suitable

Those sites identified as "suitable" (See Exhibit D) were next subjected to additional soil borings and tests by Dr. James Wang, of Wang Engineering. His findings indicate that the Town of Bath has potential wastewater nitrification field soil types 2A, 26 and 43 (See Exhibits E & F below):

EXHIBIT D

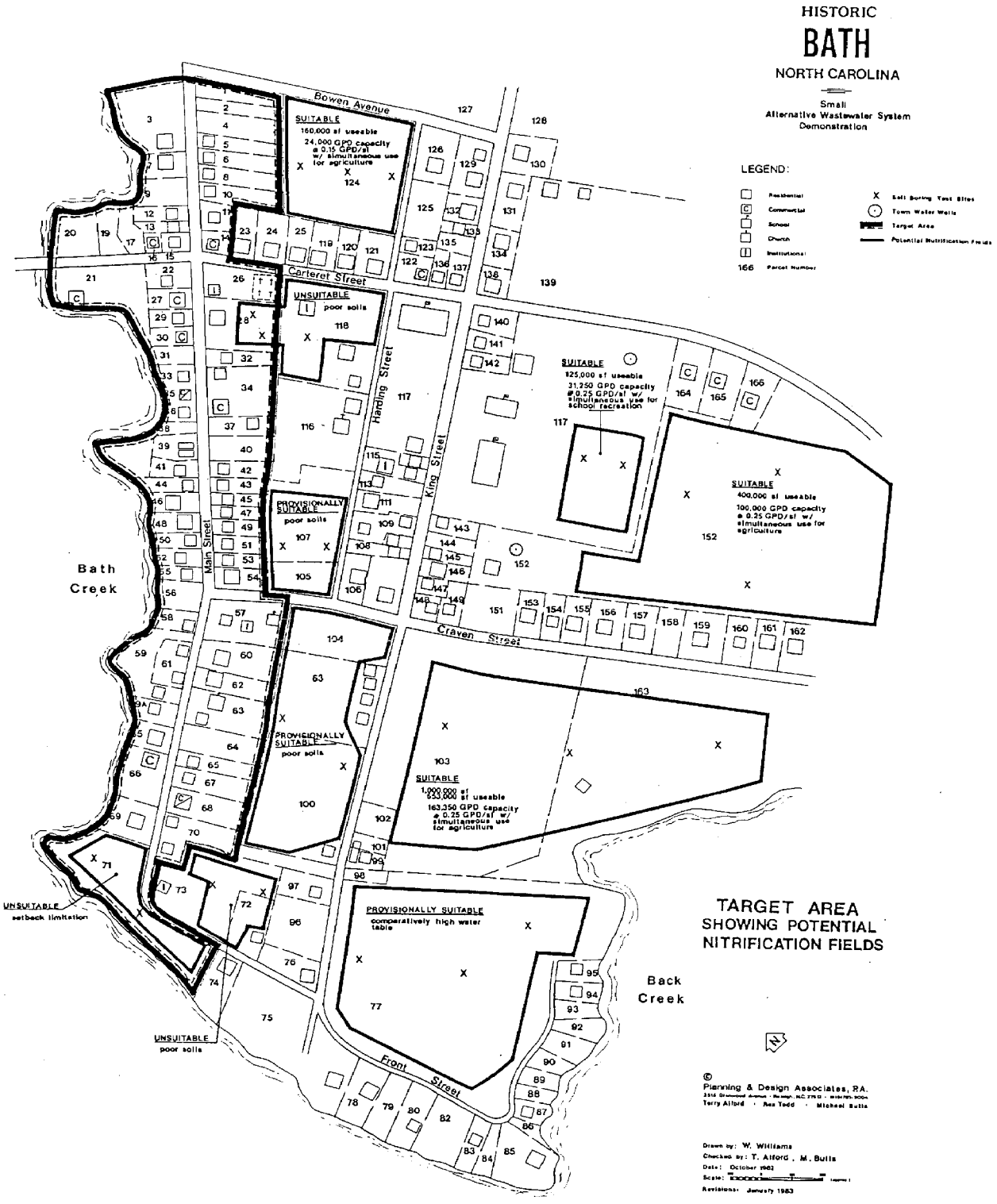

HISTORIC
BATH
NORTH CAROLINA
Small
Alternative Wastewater System
Demonstration
LEGEND:
Residential
Commercial
School
Church
Institutional
166 Parcel Number
Soil Boring Test Sites
Town Water Wells
Target Area
Potential Nitrification Fields
Bowen Avenue
Carteret Street
Craven Street
Front Street
Main Street
Hanbing Street
King Street
Bath Creek
Back Creek
SUITABLE
160,000 sf useable
24,000 GPD capacity
@ 0.15 GPD/sf
w/ simultaneous use for agriculture
UNSUITABLE
poor soils
SUITABLE
825,000 sf useable
31,250 GPD capacity
@ 0.25 GPD/sf w/
simultaneous use for
school recreation
SUITABLE
400,000 sf useable
100,000 GPD capacity
@ 0.25 GPD/sf w/
simultaneous use for
agriculture
PROVISIONALLY SUITABLE
poor soils
SUITABLE
1,000,000 sf
833,000 sf useable
163,250 GPD capacity
@ 0.25 GPD/sf w/
simultaneous use
for agriculture
UNSUITABLE
setback limitation
PROVISIONALLY SUITABLE
comparatively high water table
UNSUITABLE
poor soils
TARGET AREA
SHOWING POTENTIAL
NITRIFICATION FIELDS
© Planning & Design Associates, P.A.
Terry Alford · Rex Todd · Michael Butts
Drawn by: W. Williams
Checked by: T. Alford, M. Butts
Date: October 1982
Revisions: January 1983

EXHIBIT E
CHARACTERISTICS OF SOIL TYPE 2A

Name: Typical Pedon: State silt loam on a 3% slope
Taxonomic Class: Fine loamy, Mixed thermic typic hapludults

Depth (in)	Clay (%)	Moist Bulk Density (G/CM^3)	Permeability (in/hr)	pH
0-10	5-15	1.25-1.40	0.6-6.0	4.5-5.5
0-10	10-18	1.20-1.35	0.6-2.0	4.5-5.5
0-10	2-8	1.35-1.45	2.0-6.0	4.5-5.5
10-45	18-34	1.35-1.50	0.6-2.0	4.5-5.5
45-60	2-15	1.35-1.50	2.0	4.5-6.0

Soil Type 2A has a large range of soil characteristics for top soil of 0-10".

EXHIBIT F
CHARACTERISTICS OF SOIL TYPES 26 and 43

Typical Pedon: Altavista fine sandy loam - cultivated
Taxonomic Class: Fine loamy, mixed thermic acquic hapludults

Depth (in)	Clay (%)	Moist Bulk Density (G/CM^3)	Permeability (in/hr)	pH
0-12	7-15	1.4-1.6	2.0-2.0	4.5-6.0
0-12	10-24	1.3-1.5	2.0-6.0	4.5-6.0
12-42	18-35	1.3-1.5	0.6-6.0	4.5-6.0

Soil codes No. of 26 and 43 are the same type except No. 26 indicates more surface cover by development.

Additionally, a laboratory test for saturated soil hydraulic conductivity was conducted at the potential nitrification field (lot numbers of 72, 103, 117 and 124) with soil samples collected at the depths of 0-12", 12"-24", and 24"-48." The hydraulic conductivity test results indicated that lot no. 72 is not suitable for wastewater treatment due to low permeability less than 5 cm/hr on the average. The other lot numbers of 103, 117 and 124 are suitable for wastewater treatment with the average saturated hydraulic conductivcity about 20 cm/hr.

Based on the soil type, permeability, water table depth and location of the sites, the wastewater loading rate for a low pressure system was designed to be 0.15 gpd/ft^2 for lot no. 124, 0.25 gpd/ft^2 for lots no. 103 and no. 117.

This data led to the calculation of the nitrification field acreage requirement for treating the domestic wastewater, and system design was developed, as presented in Chapter VI.

CHAPTER VI

SYSTEMS DESIGN & COST ESTIMATES

Data regarding need, demand and constraints of the soils were incorporated into the following schematic design studies prepared for the target area. Preliminary engineering designs were also prepared by James Wang, PhD., P.E. and Terry Alford, MRP, AIA based on both conventional collection system technology and low pressure nitrification field layout derived from Dr. Wang's soils analysis.

Cost estimates were derived from actual construction data on projects built in the North Carolina and South Carolina coastal region within the past two years.

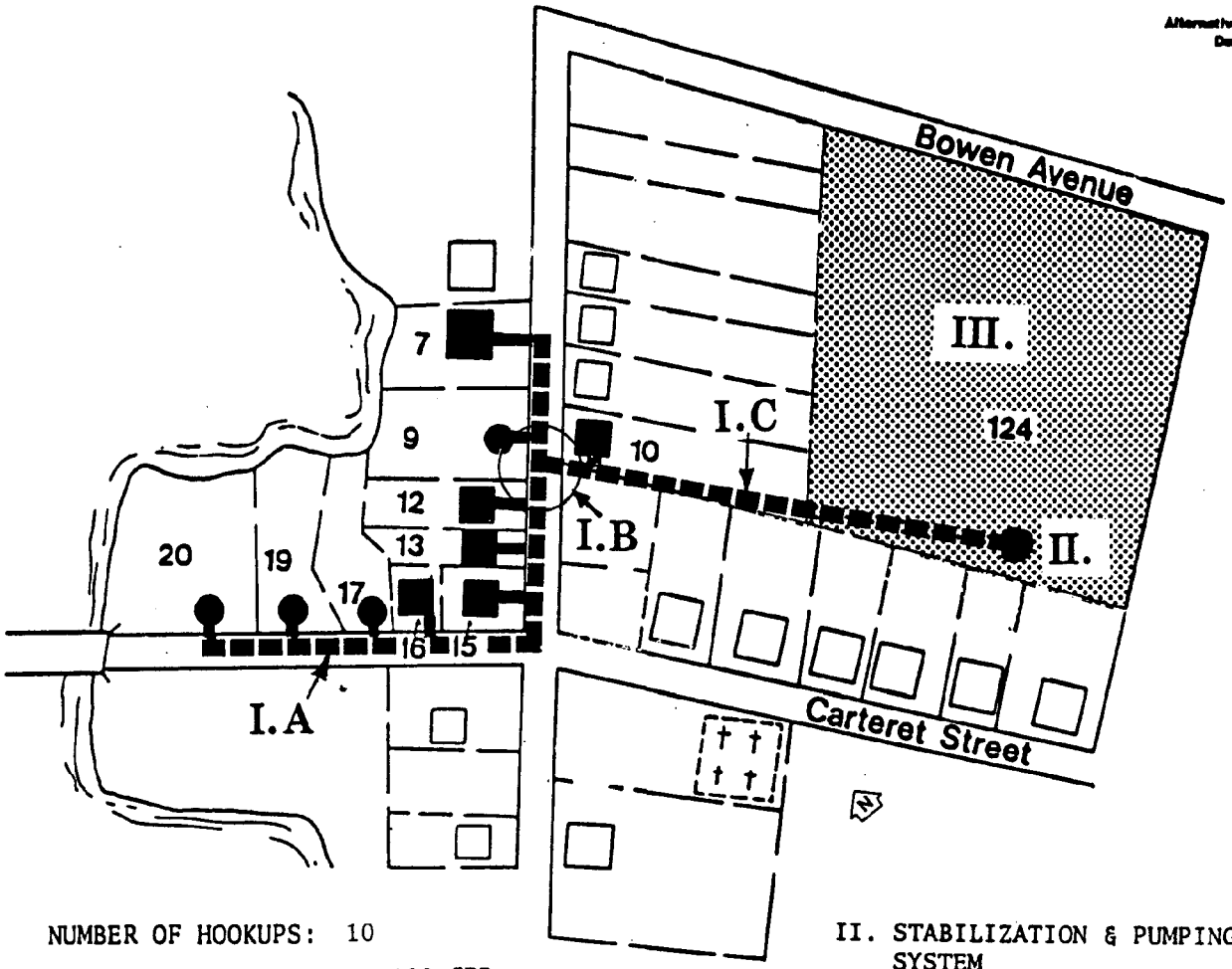
Four alternative geographic layouts were evaluated. Design criteria, cost estimates and schematic layouts for each are provided in the following Schematics 1 - 4.

A comparison of each of these schematic designs indicates the lowest cost per hook-up for construction of a single system to serve the entire target area.

SCHEMATIC WASTEH$_2$O DESIGN 1

HISTORIC
BATH
NORTH CAROLINA
Small
Alternative Wastewater System
Demonstration

FISHERMAN'S MARKET CLUSTER



NUMBER OF HOOKUPS: 10

TOTAL GPD DISPERSED: 4,100 GPD
(future demand)

COST ESTIMATE:
$75,000-$100,000

I. COLLECTION SYSTEM

A. 6" GRAVITY LINE
625 lin.ft.

B. INTERMEDIATE PUMP SYSTEM

C. 6" FORCE MAIN
500 lin.ft.

II. STABILIZATION & PUMPING SYSTEM
Septic Tank/Pumping Tank

III. DISTRIBUTION SYSTEM
(PARCEL 124)

Area Useable: 160,000 sf
Capacity: 24,000 GPD
@ .15 GPD/SF with
Simultaneous use
for Agriculture.

PLANNING & DESIGN ASSOCIATES, P.A. 3515 Glenwood Avenue Raleigh North Carolina 27612 Telephone: (919) 781-9004

GENERAL NOTES

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2. ARCHITECT IS NOT RESPONSIBLE FOR MATERIALS OR CONSTRUCTION METHODS.
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4. THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS OF THESE PLANS AND HAVE ALL WORK FIT INTO POSITION. THE CONTRACTOR IS RESPONSIBLE TO VERIFY ALL CONDITIONS AT THE SITE DURING THE ESTIMATING STAGE.

REVISIONS

NOT RELEASED FOR CONSTRUCTION

SCHEMATIC WASTEH_2O DESIGN 1

FISHERMAN'S MARKET CLUSTER

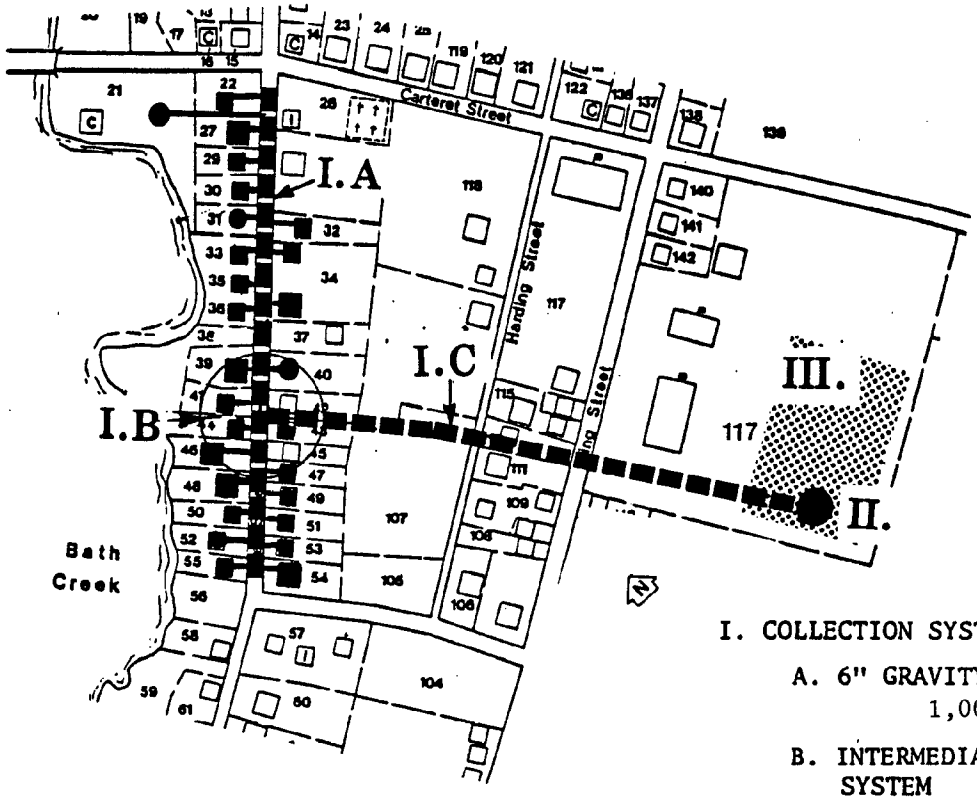
Existing and Projected System Demand

Parcel No..	Existing Use Description	GPD	Proposed Use (MAX) Description	GPD
7	Residence	300	Same	300
9	Vacant	___	Two-family Residential	600
12	Residential	300	Same	300
13	Residential	300	Same	300
15	Residential	300	Same	300
16	Commercial (Auto service station)	500	Same: 25% gal/H_2O closet or unused x 2 equals 500 gpd	500
17	Vacant	___	17, 19, 20 combined into Public Farmer's Fish Mkt., Fisherman's Public Wharf. (Assume 5 gpd per visitor for max. of 40 visitors/ day + 250 gal ea. for 5 H^2O closets or urinal	1500
19	Vacant	___		
20	Vacant	___		
10	Residence	300		300
TOTAL		2000 GPD		4100 GPD

SCHEMATIC WASTEH$_2$O DESIGN 2

HISTORIC
BATH
NORTH CAROLINA
Small
Alternative Wastewater System
Demonstration

MARINA MOTEL/MIDTOWN CLUSTER



I. COLLECTION SYSTEM

A. 6" GRAVITY LINE
1,000 lin.ft.

B. INTERMEDIATE PUMP SYSTEM

C. 6" FORCE MAIN
1,300 lin.ft.

II. STABILIZATION & PUMPING SYSTEM
Septic Tank/Pumping Tank

III. DISTRIBUTION SYSTEM
(PARCEL 117)

Area Useable: 125,000 sf
Capacity: 31,250 sf
@ .25 GPD/SF with
Simultaneous use for
School Recreation.

NUMBER OF HOOKUPS: 27

TOTAL GPD DISPERSED: 10,380
(future demand)

COST ESTIMATE:
$85,000-$120,000

PLANNING & DESIGN ASSOCIATES, P.A. 3515 Glenwood Avenue Raleigh North Carolina 27612 Telephone (919) 781-9004

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REVISIONS

NOT RELEASED FOR CONSTRUCTION

SCHEMATIC WASTEH$_2$O DESIGN 2

SCHEMATIC WASTEWATER DESIGN

MARINA MOTEL/MIDTOWN CLUSTER
Historic Bath, N.C.

EXISTING & PROJECTED SYSTEM DEMAND

Parcel No.	Existing Use Description	GPD	Proposed Use (Max.) Description	GPD
		MARINA MOTEL		
21	Marina/Motel 10 gpd/Boatslip for 20 slips 120 gal/room/day	200 720	Existing + 8 Additional rooms @ 120 gal/room/day	1,880
22	Residence	300		
27	Commercial - Grocery Store @ 200 ga/1000 S.F.	400	Existing + small Delicatessan/ Restaurant w/ 20 seats at 40 gal. per seat/day	1,200
29	Residence	300	Same	300
30	Commercial	400	Same	400
31	Vacant	-	Single Family Residence	300
32	Residence	300	Same	300
33	Residence	300	Same	300
34	Commercial	300	Same	300
	Residence	300	Same	300
35	Residence/Commercial (sail shop)	300	Same	
36	Residence	300	Same	300
	Residence	300	Same	300
	SUBTOTAL:	4,420 GPD		5,880 GPD

(continued)

SCHEMATIC WASTEH$_2$O DESIGN 2

SCHEMATIC WASTEWATER DESIGN

MARINA MOTEL/MIDTOWN CLUSTER
Historic Bath, N.C.

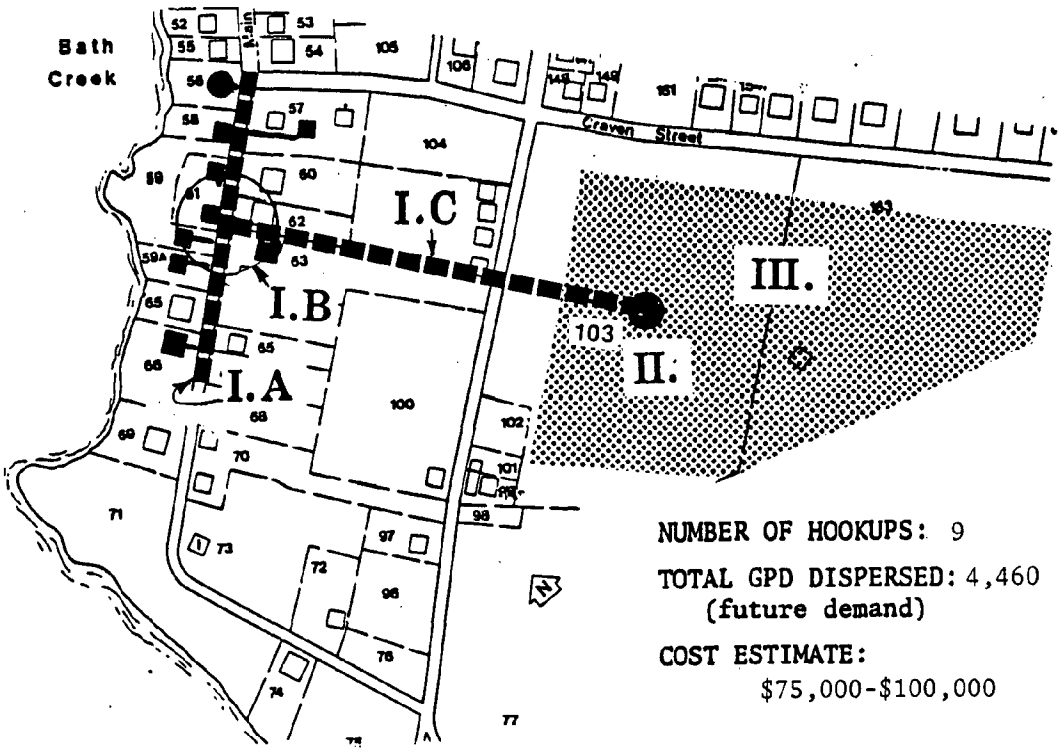
MIDTOWN

38	Vacant	-	Vacant	-
39	Residence	300	Same	300
40	Vacant	-	Residence	300
41	Residence	300	Same	300
43	Residence	300	Same	300
44	Residence	300	Same	300
46	Residence	300	Same	300
47	Residence	300	Same	300
48	Residence	300	Same	300
49	Residence	300	Same	300
50	Residence	300	Same	300
51	Residence	300	Same	300
52	Residence	300	Same	300
53	Residence	300	Same	300
54	Residence	300	Same	300
55	Residence	300	Same	300
	SUBTOTAL	4,200 GPD		4,500 GPD
	TOTAL	8,840 GPD		10,380 GPD

SCHEMATIC WASTEH$_2$O DESIGN 3

HISTORIC
BATH
NORTH CAROLINA
Small Alternative Wastewater System Demonstration

BED & BREAKFAST (South End) CLUSTER



NUMBER OF HOOKUPS: 9

TOTAL GPD DISPERSED: 4,460
(future demand)

COST ESTIMATE:
$75,000-$100,000

III. DISTRIBUTION SYSTEM

(PARCEL 103)

Area Available: 1,000,000sf
Area Useable: 660,000sf
Capacity: 163,350GPD
@ .25 GPD/SF with
Simultaneous
Agricultural use.

I. COLLECTION SYSTEM

A. 6" GRAVITY LINE
650 lin.ft.

B. INTERMEDIATE PUMP SYSTEM

C. 6" FORCE MAIN
700 lin.ft.

II. STABILIZATION & PUMPING SYSTEM
Septic Tank/Pumping Tank

PLANNING & DESIGN ASSOCIATES, P.A. 3515 Glenwood Avenue Raleigh, North Carolina 27612 Telephone (919) 781-9004

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REVISIONS

NOT RELEASED FOR CONSTRUCTION

SCHEMATIC WASTEH$_2$O DESIGN 3

BED & BREAKFAST (SOUTH END) CLUSTER

Existing & Potential System Demand

Parcel No.	Existing Use Description	GPD	Proposed Use (Max.) Description	GPD
56	Residence	300	Same	300
58	Residence	300	Same	300
61	(two) residences	600	Same	600
59	Residence	300	Same	300
59A	Residence	300	Same	300
63	Residence	300	Same	300
66	Commercial (Bed & Breakfast) (8 rooms @ 120/room)	960	Expand restaurant to 20 seats 860+800	1260
57	Episcopal Church 5 gal/seat @ 120 seats	600		600
		3060		4460

TARGET AREA TOTAL:

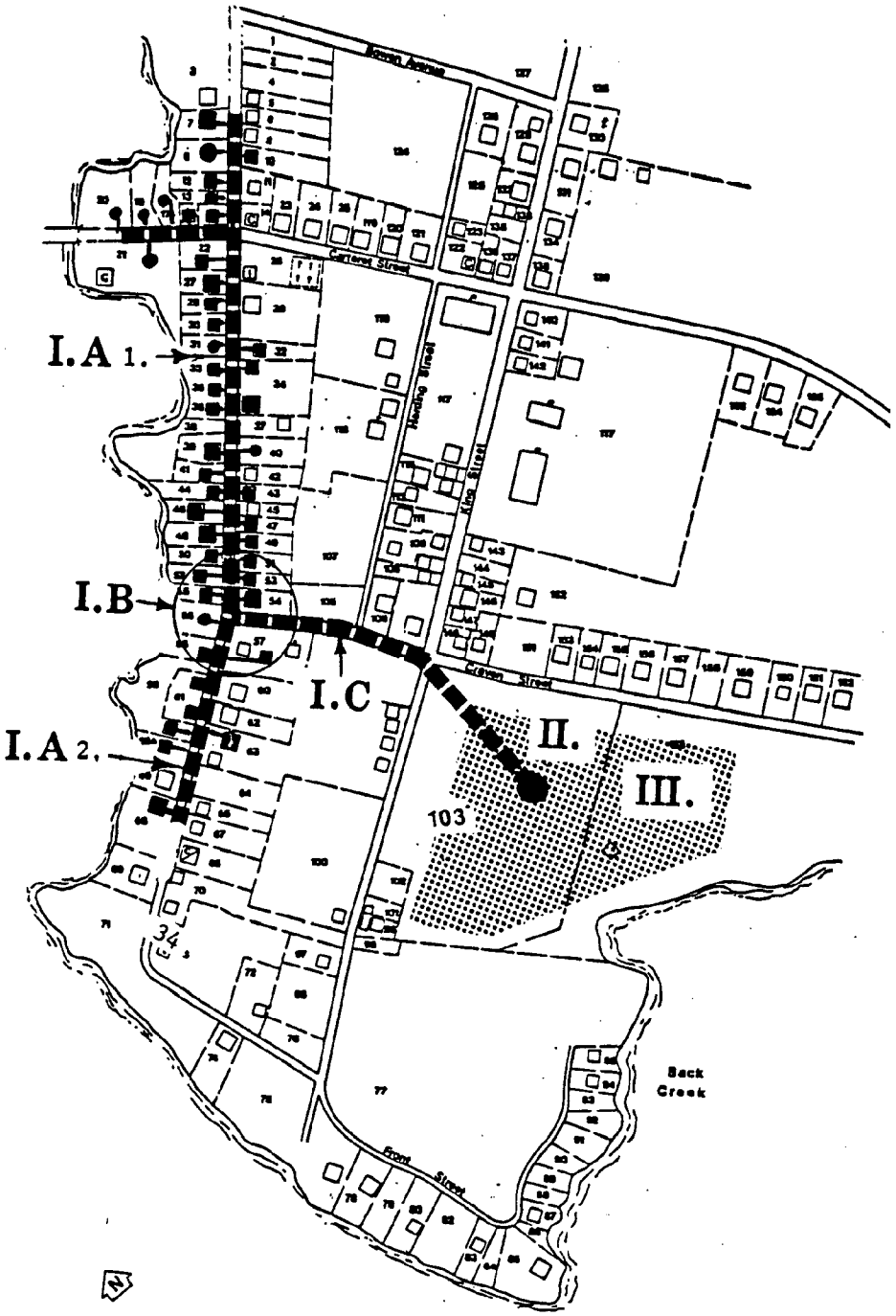
Design #	Sub-Area Cluster Name	Existing Demand (GPD)	Future Demand (GPD)
1	Fisherman's Market Cluster	2,000	4,100
2	Marina Motel/Midtown Cluster	8,840	10,380
3	Bed & Breakfast Cluster	3,060	4,460
	TARGET AREA TOTAL	13,900	18,940

SCHEMATIC WASTEH$_2$O DESIGN 4

COMPREHENSIVE CLUSTER

HISTORIC
BATH
NORTH CAROLINA

Small
Alternative Wastewater System
Demonstration



NUMBER OF HOOKUPS: 46

TOTAL GPD DISPERSED: 18,940
(future demand)

COST ESTIMATE:
$175,000-$200,000

I. COLLECTION SYSTEM

A. 6" GRAVITY LINE
1.North Section:
1500 lin.ft.
2.South Section:
650 lin.ft.

B. INTERMEDIATE PUMP SYSTEM

C. 6" FORCE MAIN
750 lin.ft.

II. STABILIZATION & PUMPING SYSTEM
Septic Tank/Pumping Tank

III. DISTRIBUTION SYSTEM
(PARCEL 103)

Area Available: 1,000,000sf
Area Useable: 660,000sf
Capacity: 163,350GPD
@.25 GPD/SF with
Simultaneous
Agriculture use.

PLANNING & DESIGN ASSOCIATES, P.A. 3515 Glenwood Avenue Raleigh North Carolina 27612 Telephone (919) 781 9004

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REVISIONS

NOT RELEASED FOR CONSTRUCTION

SCHEMATIC WASTEH$_2$O DESIGN 4

Preliminary Cost Estimate

	Components of Cost		Estimated Cost	
I.	COLLECTION SYSTEM			
	A. 6" Gravity Lines:			
	1. North Section: 1500 lin. ft. @ assumed average depth of 9 ft. @ $14 per lin. ft.	$21,000		
	2. Tunneling below Highway 92	1,200		
	3. South Section: 650 lin. ft. @ assumed average depth of 6 ft. @ $12.50 per lin. ft.	8,125		
	SUBTOTAL		$30,325	
	B. Intermediate Pump Station			
	1. Pumping Tank w/2 pumps	12,000		
	2. Standby Power generator	7,000		
	3. Pump House & Accessories	18,000		
	SUBTOTAL		37,000	
	C. 6" Force Main			
	1. Home Run: 750 lin. ft. @ assumed average depth of 3 ft. @ $8.00 per lin. ft.	6,000		
	SUBTOTAL		6,000	
	COLLECTION SYSTEM TOTAL			$73,325
II.	STABILIZATION & PUMPING SYSTEM	20,000		
	A. Septic Tank (assumed 20,000 gallons), and			
	B. Pumping Tank (assumed 10,000 gallons).			
	STABILIZATION & PUMPING SYSTEM TOTAL			20,000
III.	DISTRIBUTION SYSTEM			
	A. Distribution lines for 20,000 gpd field @ 2½ ft. depth for agricultural use above.	30,000		30,000
	B. Land Lease: Assumes allocation of of 200,000 sq. ft. from parcel 103.	NONE		
	SUBTOTAL I, II, III			$123,325

SCHEMATIC WASTEH$_2$O DESIGN 4

	Components of Cost		Estimated Cost	
IV.	FEES & PERMITS			
	A. Engineering, Topographic, utility, soils & property survey	$8,000		
	B. Planning & Engineering Design, Construction & Bid Documents, & Construction Administration.	15,000		
	C. Attorney/Accountant Fees	5,000		
	D. Miscellaneous Permits, Reimbursable Expenses, & Town Admin. Costs	3,000		
	TOTAL FEES & PERMITS		$31,000	
	SUBTOTAL I - IV			154,325
V.	CONTINGENCY @ 15% (I - IV)		23,150	
	GRAND TOTAL:			$177,475
VI.	ILLUSTRATIVE FINANCING			
	A. Base Costs[1]	177,500		
	B. Misc. Admin. & Closing Costs @ 4%	7,100		
	C. Assumed Loan Principal	$184,600		
	D. Loan Assumptions			
	PV = 185,000			
	%I = 5%			
	Term = 30 years			
	E. Monthly Payments	993		
	F. Annual Payment	11,917		
	G. Monthly Cost/Hook-up assuming 50 hook-ups	19.86		

Notes

[1]Base costs do not include estimated average unit initial hook-up charges of $400/unit.

CHAPTER VII

SYSTEM MANAGEMENT AND MAINTENANCE

After delineating alternative schematics and considering costs, an assessment of local ordinances, and of system management and maintenance alternatives must be conducted.

1. Local Ordinances.

First, towns should determine what changes in local ordinances would be required to accommodate (or control) the proposed system. In Bath, a community-wide system will serve the R1, R2, B1, and B2 Zoning Districts. All of these districts already have densities, etc. established at levels desirable when the town gets public sewer. No changes in that ordinance are necessary. The town will consider a sewer ordinance to establish permitted types of hook-ups, types of waste permitted in the system, rates, etc. The Town of Bath does not have subdivision regulations.

Next, the town should consider what easements will be required to allow the system to cross private property outside of the public right-of-way, and perhaps for the subsurface use rights in the nitrification field itself. In Bath, these easements will be drawn by the local attorney and will be financed as an allowable cost under FmHA (see Chapter VIII).

2. Management and Maintenance.

The Town should estimate the management and maintenance systems which will be required. In the case of Bath, Schematic #4 was used as a basis for estimating the management and maintenance for a community-wide system. (It is important to emphasize that a considerable amount of planning and engineering is yet required in order to determine the final cost of any community-wide system. The numbers shown in this chapter and in Chapter VIII are preliminary estimates).

The community should determine what agency will oversee the management and maintenance. For Bath, Mr. Donnie Woolard, sanitarian, and Mr. Richard Clayton, Head Sanitarian, Beaufort Co. Health Department, were contacted regarding the Bath Management Alternatives. Assumed for discussion purposes was 18,940 gallons per day (GPD), with 46 units, pumps and septic tank (for the target area) and 60,500 GPD for 121 units for the whole community.

Mr. Woodard stated that if the system is publicly owned, the regional engineer of the Department of Natural Resources and Community Development (Roger Thorpe, whose office is in Washington, N. C.) will determine the classification of operator required. If it is privately owned, the County Health Department will monitor the operator of the private company. The law separates oversight according to ownership category (rather than technology, flow, etc.).

Since the proposed system is to be publicly owned, Mr. Thorpe was contacted to determine the class of operator required. He stated that both the target area system and community-wide systems would require only a Class I operator, based upon a point system which allocates points for pumps, flow and tank. From the aforementioned assumptions, Mr. Thorpe said that the Bath system would get no more than 10 points for the target area and only slightly more for the extra flow from a community-wide approach. The bracket for Class I is 1 to 25 points. Class II goes from 26 to 36 or so, on up to a Class IV. Any Class higher can operate a lower class system.

Next, the community should determine the organizational arrangement that is to manage the system. Class I provides that a local official of the Town of Bath (or someone with experience in operating a system) can operate the system. Mr. Ed Warren, training director for NRCD in Washington, said that someone without experience could acquire a temporary certificate and attend classes, take an exam and gain the required experience under the temporary certificate, thereby qualifying upon passing the exam. Mr. Warren stated that there are several contracting firms that communities can contact for terms, fees, etc. He provided the NRCD computer list of Class I and Class II operators and Commercial Laboratories in North Carolina which communities may choose to contact in designing their own management and maintenance systems (see Appendix D).

Finally, communities should talk with qualified operators and other experts to determine the type and level of management and maintenance required on site and determine what types of maintenance contractual arrangements are best suited for the Town. In the Bath instance, Mr. John Melvin (of Environment I, Greenville), Dr. Jim Wang, P.E. (Wang Engineering) and PDA were consulted.

Since Bath has capable and trainable local administrative personnel, and contracting engineers with lab facilities are nearby (Greenville, etc.), a two-tier management process is recommended. Tasks (Exhibit G) and preliminary budget (Exhibit H) for a community-wide system are as follows:

EXHIBIT G
PRELIMINARY MANAGEMENT TASKS, BY PERSONNEL TYPE

Assumptions:	System consists of collection lines, 3 collection pumps, interceptor line, 1 interceptor pump, two rectangular septic tanks and the septic field. 121 units served.
Local Land Management Tasks:	Preventive maintenance, minor repairs, monitoring and reporting. Maintain warranty: each day monitor the pumps and the second rectangular tank (water); check first tank (sludge decomposition and sand accumulation) periodically. Make judgements and reports to consulting engineer. Supervise pumpout as needed.*
Contracting Engineer (Operator Company):	Assure initial operation of system. Visit site monthly. Review report Intervene to trouble-shoot as requested. Take samples; analyze and respond.

EXHIBIT H

PRELIMINARY BUDGET, BATH ALTERNATIVE WASTEWATER TREATMENT

Item	Mo. Cost	Annual Cost
Local Operator	$250	$3,000
Bookkeeping	20	120
Contracting Operator	300	3,600
Lab Services	30	360
Electricty to run pumps	200	2,400
Pump out honey-wagon* (per visit)	25	300
Contingency for repairs, etc.	50	600
	$865	$10,380

According to FmHA, the cost of $10,380 dollars per year would compute to cost of $7.88/month. Average for comparable systems in N. C. ranges between $5 and $10 (See Chapter VIII for complete preliminary budget, for which management and maintenance is one line item.)

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*It is recommended by Alton Hodge, NRCD Environmental Engineer, that this system be pumped out more often than a single family system, possibly on a two to three year period. This should prevent solids from clogging the system.

CHAPTER VIII

SYSTEM FINANCING

In earlier days, even small coastal communities could engage in sophisticated waste treatment systems,financed heavily by Environmental Proection Agency (EPA) funds. This practice has been drastically curtailed by federal cutbacks in EPA (in FY'83, North Carolina was allocated only $35 million, financing approximately 8 projects per year), and by moratoria from dumping municipal wastes into surface waters (e.g., the Chowan, Trent and Neuse Rivers). Thus, communities interested in alternative wastewater treatment systems must engage in creative financing strategies.

The Town of Bath found that the constraints (i.e., eligibility requirements, timing, etc.) of several funding sources posed particular problems for small communities.

One of the most significant factors in Bath is the need to develop an alternative system for the entire community, rather than for a particular target area.

Below is the array of funding sources developed for Bath by extrapolating Schematic 4 to cover the entire community. Each source is considered in turn, enumerating critical points which led to its selection in or exclusion from the recommended course of financing, and its preliminary dollar amounts.

Alternative Funding Sources

The funding sources considered by the Town of Bath include the following:

1. Sale of Revenue Bonds backed by the Tax Base of the Community or use of Tax Increment Financing.

Tax increment financing could be used, in which case a bond referendum could be held and bonds sold with which to undertake the project. As lots are sold and reassessed for higher taxes (that is, improved), the tax "increment" (value of the improved property minus previous value times the tax rate) will be used to retire the bonds. It is doubtful, however, that a place as small as Bath with a project cost of less than $500,000 would be marketable under this option. Pay back may be unsure as well, with a limited municipal budget ($18,000), indicating the type of situation which led the State to get into the Clean Water Bond business in the first place.

2. Developer Incentives

Real demand (that is, ability and propensity to pay by private individuals) is often required by third party funding sources (such as Farmers Home Administration (FmHA), which requires that each household on the wastewater treatment system pay $100 per year for debt service). Also, actual growth and development of opportunity projects is often a fundamental piece of generating a strong base from which to generate sources of revenue (whether user fees or taxes).

In the latter case, the Town's cost of acquiring land may be foregone by accepting dedication of land by the developer for the treatment field.

Other public/private partnership options available for towns which select alternative systems include involving the land owner in the deal, such as leasing the field rather than purchasing it; leasing the land or selling the owner the wastewater as fertilizer during periods of simultaneous agricultural uses (aereation systems only); or acquiring leasehold interest (easements) for the use rights on the sub-surface.

Alternatively, a town may engage the landowner in a form of "value increment financing." In this case, a developer's lots are enhanced in value (first, by making them marketable and second, by generating a higher price) largely through the spillover effect of the use of public funds (FmHA, Division of Environmental Management (DEM), local taxes, etc.) to plan and install the community septic system. Upon sale of the lots, the developer would "pay back" part of this increased value by paying part of the local share of the financing package (that is, the money could go to help amortize a FmHA loan, for instance). In this case, the buyers get a dependable septic system at a cost under that of an individual rate, the developers get a better return on their land, and the Town gets a portion of its wastewater treatment cost paid.

In contrast to these advantages, the disadvantages include the fact that the vacant land which is centrally located and near enough to residences to reduce the cost of the collection system, may be inappropriate for agricultural use of the pretreated waste. Also, the issues of fair market value of the lease or dedication would have to be adequate to entice a land owner to participate at rates comfortable to the town. This could be proceeded upon a case by case basis.

3. Farmers Home Administration Community Facilities Program

The Farmers Home Administration Community Facilities Program provides both loan and grant opportunities to communities like Bath, but for community-wide programs rather than for target areas or partial-community programs. The loan programs will cover up to 75% of the total project costs, except for operation and maintenance and individual hook-up fees. To qualify for the loan, a town must have a median family income below 85% of the State's median family income level. The 1980 census indicates that Bath does qualify, with a median family income of $10,000 which is below the required amount (NC $15,249 x .85 = $12,961.65). This median income level also qualifies the town for the intermediate interest rate of 7-3/8%, rather than the full rate

Additionally, if Bath meets two additional criteria, namely, median family income below the national poverty level (now $9,300) and presence of a health problem related to wastewater treatment, the Town would qualify for a 5% loan. In either case, the Town must pay $100 per year per household for debt service (based upon $1.00 per thousand dollars of median family income).

FmHA also provides a combination of the loan and grant program. Allowable costs and logistics of the grant portions of FmHA are explained in Exhibit I below.

Advantages of the FmHA program include that it is conveniently available and well suited for small communities, and it caters to innovative and alternative systems.

Disadvantages include FmHA's requirement of a community-wide approach rather than a portion or target area. (However, small areas with few units served are rarely cost effective, regardles of the type of financing used).

4. Community Development Block Grant.

Development Planning Grants (of up to $10,000) and Community Revitalization Grants (CR) (of up to $750,000) are competitively available through the NC Department of Natural Resources and Community Development, Division of Community Assistance. The former will finance the preparation of a full CR application for wastewater treatment in which the analysis would be expanded from the target area to a broader based program (increased number of units).

The larger Community Revitalization Grant will pay for planning and administration, and construction of the system in a target area of 80% low-to-moderate income persons, with a local option of up to 20% of the total dollar amount used to benefit persons 50% of whom are classified as low-to-moderate income.

Advantages of using the CDBG Small Cities Program include that the timing for this application is excellent, with the application deadline of May 2. The fact that Bath has never received CDBG funds before is consistent with State's priorities for the Development Planning Grant. Additionaly, the extensive work placed into the CAMA Demonstration for the target area may be adequate to develop a full application for the target area (Schematic 4) if the cost per household is cost effective.

Disadvantages include high monthly costs per unit, based upon only 46 units. The CDBG staff considers the grant amount per unit served and the grant amount per low-and-moderate unit served. In both cases, the basis cost of the target area system ($177,745 plus hook-ups (400 x 46 = $18,400)), plus (15% for planning and administration) warrants a CR Block Grant of $245,181. For 46 units in Schematic 4, this renders a grant amount of $5,330 per recipient, which may not be competitive with other systems using larger numbers of recipients (for example, a city-wide system, assuming 100% less low-to-moderate income residents, would qualify $411,765 divided by 121 = $3,403, a 56% reduction in cost per household).

This latter determination of grant per unit served indicates that a Development Planning Grant may be in order to better design the project, especially in light of the CDBG requirements of leveraging other public and private funds, which FmHA and DEM, plus the developer incentive posture above, avail to the Town of Bath.

Advantages of the Development Planning Grant ($10,000) include their low cost of preparation and their utility in marshalling additional funds. Disadvantages are minimal, if any.

Advantages of the larger grant include the fact that 100% of the costs are allowable to low and moderate income. It also provides an attractive opportunity to pay for only the connection fees as referenced above.

5. Clean Water Bond Act of 1977.

The state previously had two accounts for wastewater funds: one for localities (counties, etc.) which would have funded collection lines, and a separate statewide account which only funds the interceptor system and treatment systems. In Beaufort County, $25,000 lapsed into the statewide account last year, and there are no other funds available for collection, etc.

In a February 8, 1983 interview, Herb Davis of the Division of Environmental Management (DEM) indicated the following regarding Clean Water Bond funds:

In order to qualify for Clean Water Bond Funds, Bath must have a federal grant (either FmHA or CDBG will do). Clean Water Bond funds will not pay for any collection lines within the town limits but will pay for the interceptor if it's inside. If there are pumps on the interceptor line or preliminary treatment (septic) tanks, they will pay for them as well.

The DEM money will pay for the lesser of 25% of the eligible costs or one-half of the non-federal share.

The Clean Water Bond application must go through both A-95 (state and regional) review (regional means the Mid-East Commission in Washington and the State means the NRCD office (Mr. Roger Thorpe) in Washington). This includes an impact statement, an engineering assessment, etc.

Clean Water Bond funds are available only if the system receives a permit, and only if the other funding sources show firm commitment.

There may be new Clean Water Bond money from the State if the sales tax (new bill) passes, or if there is a general referendum statewide for such purposes.

Advantages of the Clean Water Bond funds include the fact that they are in grant form rather than loan, and in this case, pay for a major portion of the system's cost (Bath's system is treatment heavy rather than collection heavy).

Disadvantages are minimal, the requirement for receiving another federal grant may be critical however, though minimized in this case by the FmHA grant (see Exhibit I).

6. Coastal Area Management Act Implementation Demonstration.

In its new regulations for Local Planning and Management Funds (February 7, 1983), the Office of Coastal Management establishes highest priority for "demonstration projects which can be used by more than one local government."

The second category (50% to 67% grant funded) includes projects which are coastally dependent (water-related) or projects to implement the land use directing policies in the approved local land use plan such as public facilities planning.

Since CAMA has invested in the preparation of the Bath Land Use Plan and the current demonstration project for facilities planning, there is a good basis for applying for continuation funds to expand this demonstration to the total area of Bath. Coordinating benefits among funding sources is worth demonstrating, as is the continuation of this on-going planning program, and this work related directly to implementation of an officially adopted CAMA Land Use Plan.

Advantages include the timelines of the funding cycle and the value of continuing a planning process already in process. Disadvantages are minimal.

Barriers to Financing

Time frames for many of the aforementioned funding sources do not lend themselves to coordination. For example:

Funding Source	Application Date	Award Date
CDBG	May 2	July 2
FmHA	April 1	June
Clean Water Bond	March 1	July

The problem comes when the CDBG program requires creative leveraging (in this case, of FmHA and CWB), which means that firm letters of commitment from these sources must be in-hand at least by May 2, a month or two prior to the FmHA decision (June). The meeting of the Coastal Management Commission (July).

The Recommended Course of Financing

Based upon the foregoing consideration of financial strategies, it is recommended that the Town of Bath apply for several sources of financing simultaneously. These include the FmHA and Clean Water Bond (Strategy 1), the CDBG Community Revitalization Grant (Strategy 2), and the CAMA Grant (Strategy 3).

Strategy 1 is illustrated in detail in Exhibit I. Discussions with Mr. John Soles, FmHA (919-755-4640), strongly suggests that proposal to FmHA be for community-wide system. This means that Schematic 4, (see Chapter VI), is actually either the first phase of such a program or the basis for expansion in a community-wide system design using the latter approach, extrapolating costs and revenues for the target area to a preliminary community-wide budget. It is important to emphasize that this budget is preliminary and that considerable planning and engineering work is yet required to finalize this attractive financial strategy.

Strategy 2 consists of applying for a CDBG Development Planning grant with which to finance the estimated $48,400 for hooking up the homes of low-to-moderate income households and related planning and administration. The Town may also apply for a smaller Development Planning Grant of up to $10,000 to plan a more comprehensive application for subsequent CDBG cycle.

Strategy 3 consists of applying for a $7,000 CAMA Demonstration Grant for expansion of the original analysis to the rest of the community. This analysis could provide the basis for a full CDBG application next cycle.

EXHIBIT I

FINANCIAL STRATEGY 1
FmHA/DEM

P R E L I M I N A R Y O N L Y

		One-time	Annual	Monthly
Use of Funds:	Total Construction Costs[1]	$350,000	-0-	-0-
	Debt Service on $154,000[2]	12,174		8.39
	Operation and Maintenance[3]	10,380		7.15
	Subtotal	22,562		15.54
	Hook-up Costs of $400 per Household (times 121)	48,400		
Source of Funds:	FmHA Loan[1]	154,000		
	DEM Grant (Clean Water Bond)[4]	61,000		
	FmHA Grant[5]	135,000		
	Subtotal	350,000		
	Hook-up payments of $400 per Household (times 121)	48,400		

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[1]Total Project Costs for this budget are assumed at $350,000. The following is a sample budget for this amount, and for $451,000:

Construction	$271,618	$350,000
Legal: Bond Attorney, N.Y.	3,104	4,000
Local Attorney	3,104	4,000
Interest (on $154,000 loan)	8,538	11,000
Land Cost (right of way acquisition)	3,880*	5,000
A/E Fees	32,594	42,000
Contingency (based upon .10 of Construction Costs	27,162	35,000
Total Project Costs	350,000	451,000

If the project cost goes to $451,000, then the FmHA Grant would be expanded to make the average monthly user costs in line with other comparable systems or better (here, better is $15.44)(see Note 6).

*This line item may increase to include additional funds from FmHA/DEM for acquisition of easements or fee simple purchase.

Notes to Strategy 1 - FmHA/DEM

[2]The Amount required by FmHA for debt services, given median family income of $10,000 is $100 per household per year, or 100 x 121 users = $12,100. This $12,100 will amortize a loan amount of $153,068 (at 7-3/8% interest). FmHA requires that loan amounts be rounded up to the nearest thousand dollars, rendering the $154,000 as shown. It also requires that having adjusted the loan amount, a debt service factor of $79.05/1000 be applied, to render the debt service amount at $12,174 as shown. The maximum loan under FmHA is 75% of the construction costs (in this example, $271,618 times .75 or $203,714. Note: since the loan is to a local government, it is deemed part of the local (non-federal) share).

[3]See Chapter VII.

[4]Clean Water Bond (CWB) pays only for the treatment system, including the interceptor, inceptor lines, preliminary treatment tanks and if critical, acquisition of the treatment field. CWB will grant the lesser of 25% of eligible costs or one-half of the non-federal share, whichever is less. 69.7% of the $350,000 is 244,000 x .25 = $61,000. Half the non-local share is $154,000 divided by = $77,000, therefore rendering the lesser amount $61,000) as the grant amount.

[5]Determined by subtracting the subtotal $215,000 (loan = $154,000 + grant $61,000) from total construction costs ($350,000)).

FmHA has a maximum allowable grant of 75% of the allowable costs in this case $203,714 (determined by multiplying construction costs of $271,618 times .75). In this case, with the average monthly rate of $15.44, it is unlikely that Bath would get a higher grant amount,if the total costs remain $350,000.

[6]The Town of Bath will have to issue General Obligation Bonds to qualify for the FmHA Loan. A public referendum is required. FmHA will purchase the Bonds with the loan amount (here, $154,000) and the tax base of Bath will stand behind the bonds.

Maximum amount of the FmHA loan is usually 8% of the tax value (which for Bath may be between $5 and $10 million. At any rate, a waiver can be easily achieved to get the FmHA loan.

FmHA makes sure that the systems it loans to are self-sufficent. If in the event it is not, the city will, under the GO bonds regulations, levy taxes to pay for the system.

The town will have to issue bond anticipation notes in order to finance the initial construction of the system (estimated that a six month period will expend half of the construction budget). FmHA will lend the Town funds at 8% to 10% to pay the interest on the six months of borrowing (say $7,000 or $8,000), plus, the amount required to pay for the bond anticipation notes, totaling $18,000 to $20,000.

[7]Hook-up fee: This cost is an eligible cost under the FmHA loan program. However, this will require clear easement on each of the 121 properties (signed by the homeowner, storeowner, etc.) and either brought by the Town or donated to the Town.

Developing the easements will increase the legal fees associated with land acquisition shown under Note 1.

Normally, the cost of connecting the house to the collector is left to the individual homeowner, with the city acting as an organizer. The city may let a contract to one plumbing company to do the entire area, thereby gaining economies of scale and passing them on to the homeowner, etc. in the form of reduced connection charges.

Connection fees are eligible under the CDBG program, usually as part of a housing rehabilitation project.

CHAPTER IX

DEMONSTRATION VALUE FOR OTHER COASTAL COMMUNITIES

INTRODUCTION

This year, the Office Coastal Management of the Department of Natural Resources and Community Development funded five coastal demonstration projects. The Town of Bath's Alternative Wastewater Treatment Plan is one of them.

This chapter is an epilogue which reflects upon the wastewater treatment situation in Bath and the technical work undertaken to address that situation. It highlights the strengths of that work which other communities may wish to replicate, and exposes points upon which other communities may wish to improve as they apply methods used in the Town of Bath.

Much of the demonstration value of the Bath Wastewater Treatment project lies with its analysis of the situation, selection of planning methods, and techniques of carrying out those methods. Additional value is found in its emphasis upon making the plan become a reality (that is, establishing the goal of installing an alternative system in Bath as a result of this, and preceding work).

This chapter examines each of the Plan's chapters primarily from a methodological standpoint. To gain the most from this chapter, it is best to have read the entire document, and to refer to it while working through this chapter.

ARTICULATION AND ASSESSMENT OF DEMONSTRATION VALUE

Chapter I--Introduction

Prior to this project, the Town of Bath had proceeded through a model planning sequence, beginning with its land use plan, update of its zoning ordinance, amending its plan as necessary, undertaking a feasibility study of a conventional treatment system, and then the study of alternative wastewater systems. While it is not necessary to have completed all of these steps to undertake this last study, it is important to realize that much of the information upon which this report is based had been collected and digested in a community-wide process before the wastewater treatment alternatives were explored.

Thanks to the Coastal Area Management Act, many communities in North Carolina have sustained planning efforts over time and, therefore, will be better prepared to replicate this demonstration. Others may wish to emphasize the public involvement mechanisms used in the Bath project (such as active networking among private developers to stimulate commercial demand for the

wastewater treatment system, open worksessions with the Planning Board, and interim presentations to the Town Board) to prepare the community for this type of study.

Chapter II--Legal Constraints

The consideration of legal constraints is always important where innovation is required. For this reason, a detailed collection and analysis of the North Carolina General Statutes and regulations regarding septic systems was undertaken at the outset.

The objective of putting this research "up-front" was to determine to what extent the scope of work, planning techniques, and wastewater treatment alternatives would be shaped by law. This procedure exposed communication channels through which the planners and engineers later moved, and identified strategies through which to meet (or challenge) the constraints presented by the regulations.

This assessment exposed that, while gains have recently been made in amending state laws and rules to accommodate alternative wastewater treatment systems, continued work needs to be done on 15 NCAC 2H (Section .0400) which restricts septic systems in "high density areas." Apparently, this provision is more suited to urban settings and is in great need of performance criteria vs. prescriptive standards. A variance may be required for the coast to use alternative systems.

This method of examining legal constraints early can help other communities avoid the pitfall of focusing too heavily upon technical aspects while leaving the political or financial aspects until later. (More on the financial pitfall later in this chapter).

Chapter III--Target Area Selection

The method in which data was collected and analyzed, and criteria established for target area selection presented in Chapter III is replicable in other communities.

The Bath Land Use Plan (CAMA) was a fundamental source of that data, as was personal contact with the local county health department sanitarians. Through using an overlay technique of maps prepared for the land use plan (hazards, unsuitable soils, land classification map, etc.) the areas suitable for application of land intensive wastewater treatment systems were identified.

Establishment of criteria helped narrow the field to a few sites which, after preliminary workups, were presented to the Planning Board. The Planning Board selected a target area which became the focal point of the demonstration project.

Chapter IV--Need and Demand Analysis

Many communities can learn from the manner in which the Bath project was undertaken with attention to both public need and private demand for solution of the community's problem.

Need, as defined in Chapter IV, revolves around public issues such as adequacy (capacity and performance) of existing conventional septic tanks, areas of known malfunction, etc. Much of this information was collected by a house-to-house survey of 61 structures in the Target Area, a step which removed the project from a paper-work study to a serious attempt to implement a program. The consultant devised methods of classifying this information and later rating the suitability of the existing systems with regard to the future.

It was important to compare the results of the questionnaire with those of the on-site surveys. This disclosed a low correlation, leaving discernment of severity and interest on the part of the residents to other mechanisms, such as the Planning Board meetings and follow-up phone calls and interviews.

In contrast to need, demand was characterized by the economic forces in the marketplace that result in the willingness to spend money to obtain better wastewater treatment facilities. Demand in Bath, as expected, is constrained by fixed incomes (as reflected in a low median family income of $10,000 per year). Thus, the Planning Board and the consultant began to search for pockets of demand (opportunity projects) which could, through being commercial users, finance a larger share of the system and thereby make it more financially feasible for residential users. This produced three types of demand: restaurant, housing and light industry, at five sites.

This initial concern for demand (as well as need) became of paramount importance in later considerations of financial responsibility (See Chapter VIII, in the document).

Chapter V--Nitrification Field Analysis and Selection

Having defined need and demand, the analysis shifted to the supply side of wastewater treatment. Chapter V presents the method applied to ten alternative sites for the nutrient field in Bath, ranking those sites as "suitable," "provisionally suitable," or "unsuitable," based upon soil boring tests.

From this information, the nitrification field acreage requirements for treating domestic wastewater was calculated as the basis for system design.

Any communities preparing to undertake a similar project should plan on a considerable amount of on-site soils testing and related engineering work at this stage (see document, Chapter V). Development of a good working relationship with the county sanitarian is also fundamental to any such effort.

Chapter VI--Systems Design and Cost Estimates

Four detailed alternatives showing the collection system, stabilization and pumping systems, distribution systems, fees and permits, and contingency costs were designed and evaluated.

A comparison of these schematics indicated an obvious cost savings in of developing a single system to serve the entire target area, rather than serve a sub-target area.

Communities desiring to conduct this type study should carefully review the level of detail required at this stage. See schematics in the document.

Chapter VII--System Management and Maintenance

Having selected the system which best served the target area, efforts were undertaken to determine need to amend local ordinances and to determine the most appropriate operation and maintenance arrangement.

Assessment of the local zoning ordinance indicated that the Town is prepared to handle the densities, etc. which the wastewater system will bring. A sewer ordinance will be considered to regulate types of waste, etc. No other ordinance changes are necessary.

Additionally, easements will be required to install the system. These are to be drawn by the local attorney.

Contacts at the state, regional and local governmental levels, and contractors within the private sector, exposed the types of operators required and identified persons licenses as operators. Opportunities for training local people and for use of contracting engineers became apparent and were later adopted into the recommended organizational arrangement.

Chapter VII goes to considerable detail to articulate the actual management and maintenance tasks required and to derive a budget for this aspect of the system. This level of effort again exemplifies the concern for the system actually being developed in the Town of Bath.

As the project evolved, it was discovered that the major funding source (FmHA) is interested in community-wide (not target area size) systems. This awareness was incorporated into Chapter VII.

At this point, the consultant adjusted the management and maintenance requirements for the target area to derive that for a larger system and confirmed those estimates with the consulting engineer. Hence, the $10,380 estimate presented in Chapter VII and the budget in Chapter VIII.

Chapter VIII--System Financing

One of the major learnings for other communities was discovered in the late stages of the Bath project development. Within Chapter II above, we cautioned other communities to follow suite and explore, early on, possible legal constraints which may be placed upon the project. Even political constraints were mentioned as part of the pre-planning homework requirement. The same overview (scan) of funding sources should have been undertaken at the beginning of the project, at which time it would have been discovered that FmHA was interested only in community-wide systems and the scope of work could have been adjusted. As it turned out, about 80% of the information needed for the whole town was collected for the demonstration project, requiring some remedial work in order to write the last chapters for a community-wide system and to collect additional information for funding applications.

With this word of caution, other demonstration value in Chapter VIII is found in the surveying of alternative funding sources (such as, developer incentives). From this search came one budget based upon a project cost of $350,000 and another based upon a larger system totalling $451,000. This provided a range within which to talk with FmHA and DEM officials regarding feasibility and availability of funds.

Variations in funding timelines and eligible expenses were discovered, as expected, during the financial design phase of this project. One item of demonstration value in this section is a financial design which seeks to leverage as much and as diverse financing as possible.

Other communities are encouraged to enhance the feasibility of their systems by increasing the number of units to be served, and to creatively seek diverse funding sources from the public and private sectors.

CONCLUSION

As outlined in this final chapter, the Bath project on Alternative Wastewater Treatment Systems exposed several points which other communities should emphasize in planning for alternative wastewater systems.

The Planning Board Chairman and the consultant will be happy to answer any questions regarding the text or the outlined demonstration value articulated here.

Hopefully, the wastewater treatment system will soon become a reality in the Town of Bath. We hope that reality itself will serve as a "demonstration by example" for other alternative wastewater treatment studies in Coastal North Carolina.

APPENDIX A

The following examples of alternative waste treatment systems are published in a pamphlet printed by the United States Environmental Protection Agency titled, "Small Wastewater Systems, Alternative Systems for Small Communities and Rural Areas," January, 1980.

Small Wastewater Systems

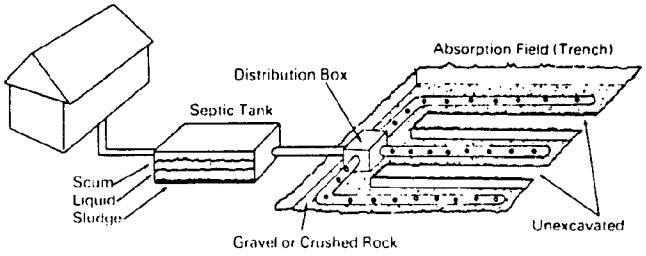
Alternative Systems for Small Communities and Rural Areas

EPA

FRD-10

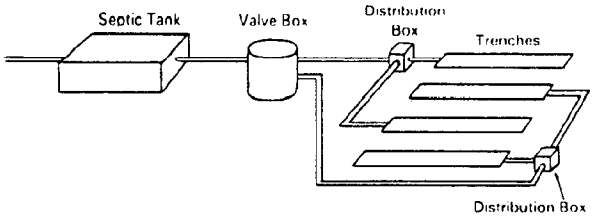
1 Septic Tank & Soil Absorption Field (Trench)

Sewage bacteria break up some solids in tank. Heavy solids sink to bottom as sludge. Grease & light particles float to top as scum. Liquid flows from tank through closed pipe and distribution box to perforated pipes in trenches; flows through surrounding crushed rocks or gravel and soil to ground water (underground water). Bacteria & oxygen in soil help purify liquid. Tank sludge & scum are pumped out periodically. Most common onsite system. Level ground or moderate slope.



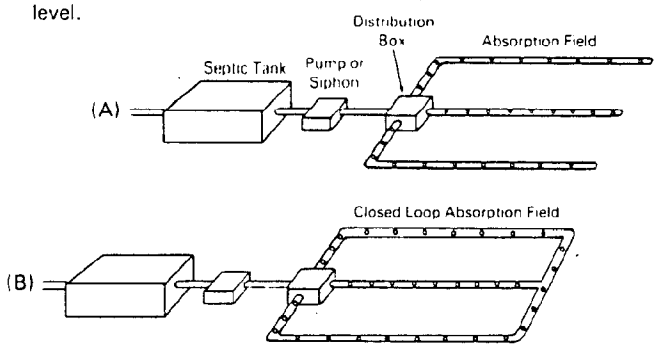
4 Septic Tank with Alternating Absorption Fields

One field rests while other is in use. Allows field to renew itself. Extends life of field. Provides standby if one field fails. Valve directs sewage liquid to proper field. Fields usually switched every 6-12 months.



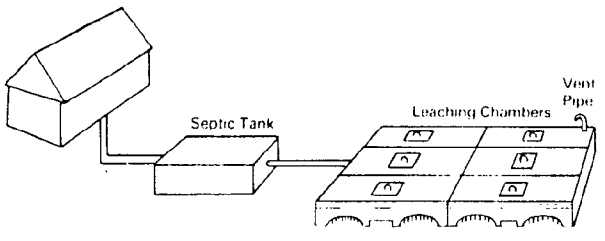
5 Septic System Refinements: (A) Dosing (B) Closed Loop

(A) Pump or siphon forces liquid to perforated pipes in controlled doses so all pipes discharge liquid almost at same time (dosing). Spreads liquid more evenly & gives field chance to dry out between dosings. (B) Variation of Sketch 1 absorption field. Can be used for dosing & where ground is level or nearly level.



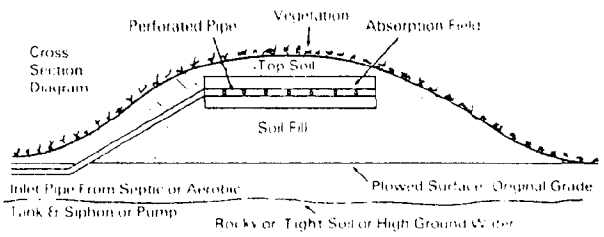
8 Septic Tank & Leaching Chambers

Open-bottom concrete chambers create underground cavern over absorption field. Liquid is piped into cavern & spread over field by troughs, splashplates, or dams. Liquid filters through soil. Chambers replace perforated pipe, trenches, & rocks of conventional absorption field. Access holes at top allow maintenance & soil inspection.



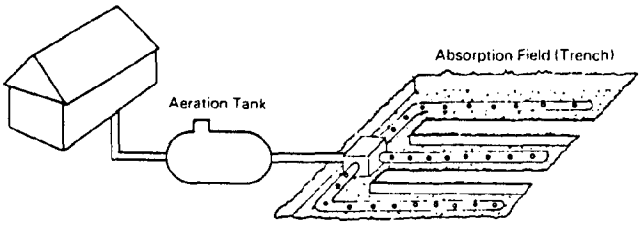
9 Mound System (Used with Septic or Aerobic Tank)

Liquid is pumped from storage tank (as in Sketch 21) to perforated plastic pipe in sand mound that covers plowed ground. Liquid flows through rocks or gravel, sand, & natural soil. Mound vegetation helps evaporate liquid. Rocky or tight soil or high water table.



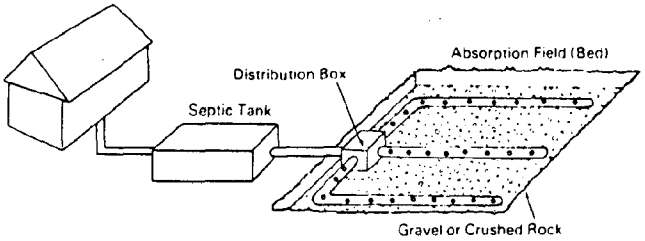
2 Aerobic System & Soil Absorption Field

Air and wastewater are mixed in tank. Oxygen-using (aerobic) bacteria grow, digest sewage, liquefy most solids. Liquid discharges to absorption field where treatment continues. Can use same treatment & disposal methods as septic tank. Maintenance essential. Uses energy.



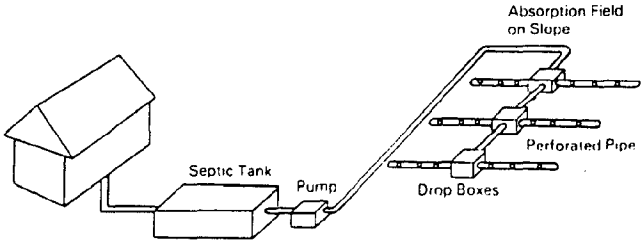
3 Septic Tank & Soil Absorption Field (Bed)

Similar to Sketch 1 but smaller field. Total field excavated. Used where space limited. Nearly level ground.



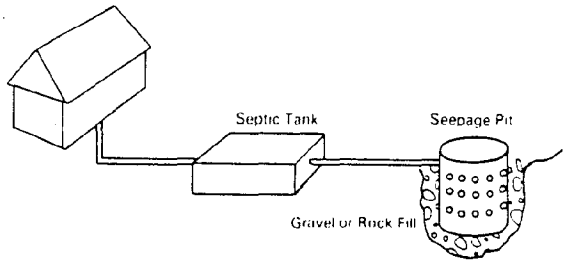
6 Septic Tank with Sloping Field—Serial Distribution

Pump forces liquid to perforated pipes in contoured absorption field. Drop boxes regulate liquid flow so highest trench fills up first, second fills up next, & lowest fills up last. Plastic fittings can be used instead of drop boxes to regulate flow. Used on slopes.



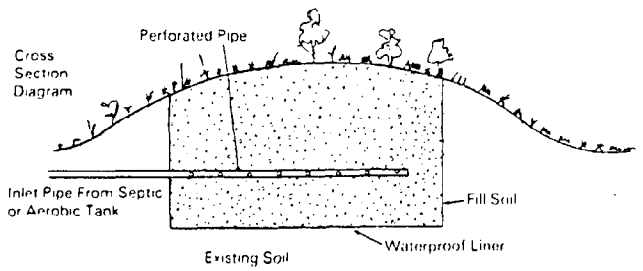
7 Septic Tank with Seepage Pit

Liquid flows to pit that has open-jointed brick or stone walls surrounded by rocks. Precast tanks with sidewall holes can also be used. Liquid seeps through walls & rocks to surrounding soil. Pit sides are cleaned periodically to prevent clogging.



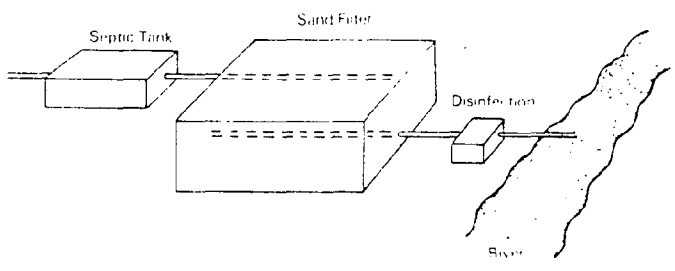
10 Evapotranspiration Bed (Used with Septic or Aerobic Tank)

Similar to Sketch 9 but sand bed is lined with plastic or other waterproof material. Bed could be mound or level. Liquid evaporates because liner prevents it from filtering through natural soil. Plants speed evaporation by drawing moisture from soil & breathing it into the air. Used where conventional absorption field not possible.



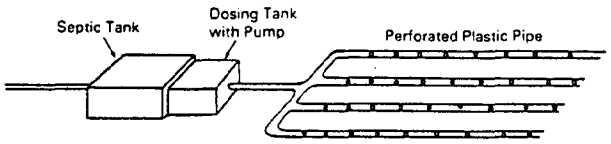
11 Septic Tank, Sand Filter, Disinfection & Discharge

Filter is ground-level or buried sand pit. Liquid enters perforated pipe at top & filters through sand & gravel to bottom pipe. Bottom pipe conducts liquid to disinfection tank. Liquid discharges to stream or ditch. Variations are intermittent sand filter & recirculating sand filter. Used where soil absorption field not possible.



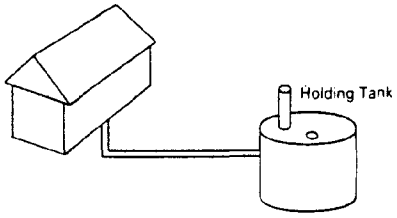
12 Low-Pressure Subsurface Pipe Distribution

Network of small-diameter perforated plastic pipes are buried 6"- 18" in 4"- 6"-wide trenches. Pump forces liquid through pipes in controlled doses so liquid discharges evenly. Site & soil determine pipe layout & pipe-hole size & number. Absorption field is same size as conventional field. Rocky or tight soil or high water table.



13 Holding Tank

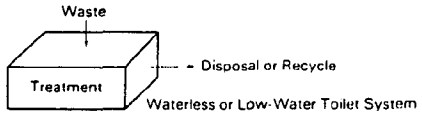
Sewage flows to large, underground, watertight storage tank. Tank is pumped periodically & sewage hauled away. Isolated or remote areas where absorption field not possible. Sewage hauling cost high.



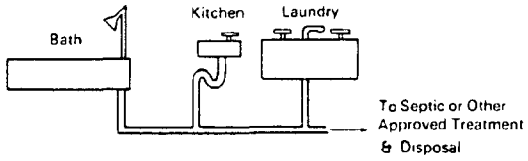
16 Dual Systems: Blackwater & Graywater

Many systems. In this one: (A) toilet wastes (blackwater) are handled by waterless or low-water toilet system [Sketch 15]. (B) Other household wastewater from kitchen, bath, laundry (graywater) needs separate treatment & disposal.

(A) Blackwater (Toilet Wastes)

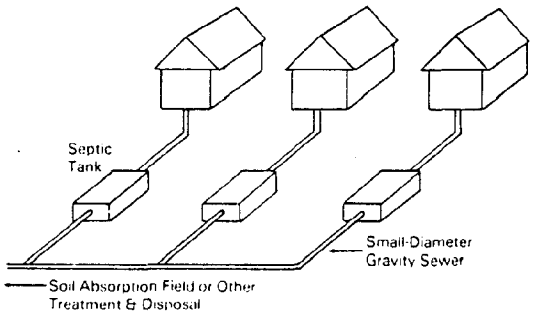


(B) Graywater (Other Household Wastewater)



17 Small-Diameter Gravity Sewers (Collection System)

4"- 6" pipe is sloped so liquid from septic or aerobic tank flows through pipe to treatment & disposal. Treatment & disposal system can be conventional or alternative. Small pipe costs less than conventional 8" pipe.



19 Land Application

Sewage liquid is applied to land to nourish vegetation & purify liquid. Methods:

1. **Irrigation**—Liquid is applied to crops or to forests (silviculture) by sprinkling, flooding, or ridge & furrow. Liquid is sometimes disinfected before application.

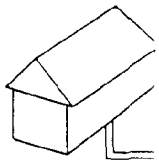
2. **Overland flow**—Liquid flows through vegetation on graded slope. Runoff is collected at bottom & reused or discharged to river or stream. Suitable for tight soils.

3. **Rapid infiltration**—Partly treated sewage is applied in controlled doses to sandy soil. Solids break down. Liquid purifies as it seeps to ground water (underground water) or is collected & may be reused.

Aquaculture:

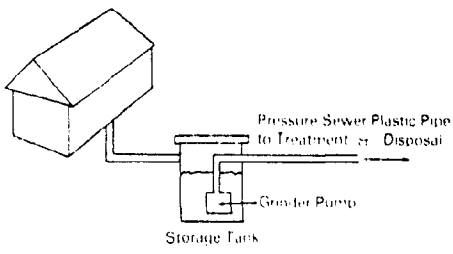
Plants & animals that grow in wastewater help purify water by digesting pollutants. Harvest is used as food, fertilizer, etc.

20 Pressure Sewers, GP (Grinder Pump)

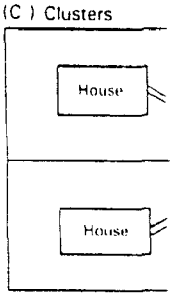


Unit grinds sewage & pumps it through small-diameter plastic pipe to central or alternative treatment & disposal. Doesn't use septic tank but existing tank (B) may remain for emergency storage. Used for one or several homes (C).

(A) No Septic Tank

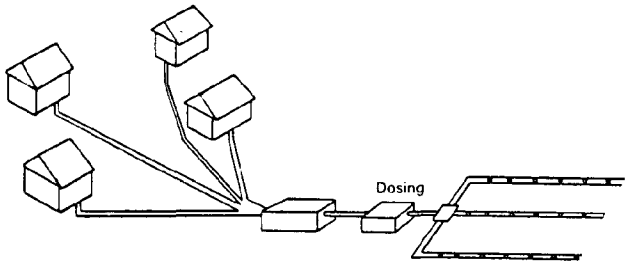


(C) Clusters



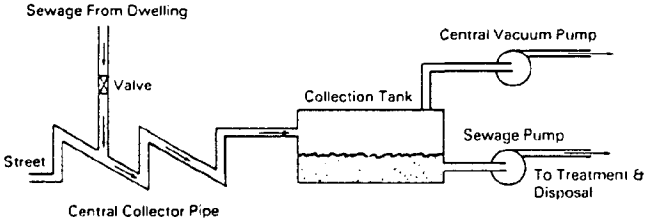
14 Cluster System
(Two or More Users on One Alternative System)

Several houses are served by common treatment & disposal system. Houses could also have onsite septic or aerobic tanks with liquid conducted to common absorption field. Clusters of houses can also use other alternative systems, such as mounds (Sketch 9), pressure & vacuum sewers (Sketches 18, 20, 21), & sewage treatment lagoons.



18 Vacuum Sewers
(Collection System)

Vacuum pump creates vacuum in collector pipes. Valve opens when sewage from dwelling presses against it. Sewage & plug of air behind it enter pipe. Air forces sewage to collection tank. Sewage pump forces sewage from tank to treatment system. Needs standby electric power & failure alarm system. Can be used with large cluster systems (Sketch 14).



15 Waterless or Low-Water Toilet Systems*

Composting: No water.
Large & small systems. Converts toilet wastes & most food wastes to compost. Electric vent fan & heating element optional on large systems; essential on small systems. Proper care vital.

Incinerating: No water.
Electricity, gas, or oil burns solids & evaporates liquid. Small amount of ash is removed weekly. Roof vent. Proper care essential.

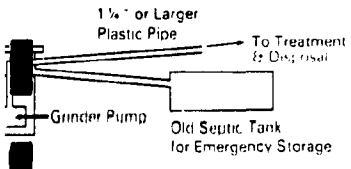
Recycling Oil Flush: No water.
Similar to water-flush toilet but uses oil for flush. Oil & wastes go to large storage tank where wastes settle at bottom & oil rises to top. Filtered oil recycles for flush. Storage tank is pumped & oil replaced periodically. Uses electricity. Proper care essential.

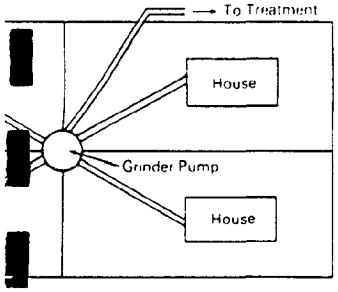
Recycling Chemical: Low water.
Water-chemical flush mixture is pumped into toilet bowl. Mixture & wastes go to storage tank. Filtered liquid recirculates for flush. Permanent or portable types. Permanent needs water hookup. Storage tank is pumped & chemicals added periodically. Uses electricity. Proper care essential.

Recycling Water: Low water.
Various systems. Some reduce wastes to water, gas, & vapor. Treated wastewater recycles to flush toilet. System vents to outside. Multiflush commercial units available. Most systems use electricity. Professional maintenance essential.

**Treat toilet wastes (blackwater). Other household wastewater (graywater) needs separate treatment & disposal system.*

ld Septic Tank Left in Place



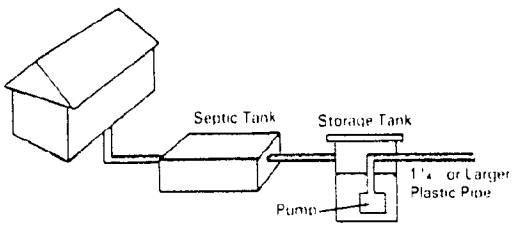


21 Pressure Sewers, STEP
(Septic Tank Effluent Pump)

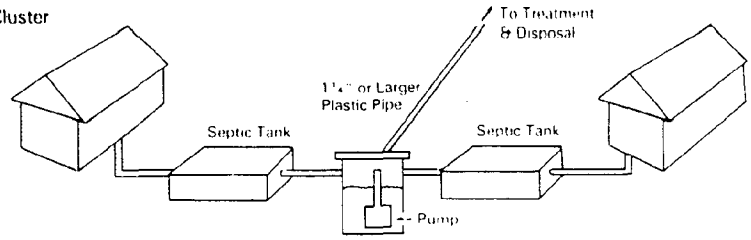
(A) One dwelling. Pump forces liquid from septic tank through plastic pipe to further treatment & disposal. Sludge is pumped from septic tank periodically.

(B) Cluster system. Liquid from several septic tanks flows to one pumping tank. Pump forces liquid through plastic pipe to treatment & disposal.

(A) One Dwelling



(B) Cluster



APPENDIX B

HISTORIC BATH
OLDEST TOWN IN THE STATE
BATH, NORTH CAROLINA 27808

October 6, 1982

Dear Property Owner on Main Street and portions of Highway 92:

You are specially invited to a public meeting on Monday, October 18, 1982 to be held by the Bath Planning Board at 7:30 p.m. in the Town Hall on Harding Street. The general public is invited as well.

The Town has received a demonstration grant from the Office of Coastal Management for the development of alternative wastewater treatment systems for the Town, which are also appropriate for other coastal communities.

Preliminary work on the project ranked areas in particular need of alternative systems. At our September 29 meeting, the Planning Board selected a "target area" running from the Outdoor Drama Ampitheatre down Main Street to Bonners Point, including properties fronting on Highway 92 and Main Street within that area.

At the October 18 meeting, our consultants will present alternative projects identified within the target area, collect your ideas on others you may want considered, hold an informal discussion regarding different types of package systems for groups of stores and houses, and other alternatives to individual conventional septic tanks. At the end of this discussion, the Planning Board intends to identify projects for detailed study by the consultant.

As you know, our last study showed that traditional community-wide wastewater collection and treatment systems are too expensive for a small community like Bath. This project provides us with a real opportunity to develop smaller scale solutions to our long-standing wastewater treatment problem.

We look forward to seeing you and your neighbors at this important meeting.

Sincerely,

James R. Edwards/dkt

James R. Edwards
Planning Board Chairman

JE/dkt

cc: Terry W. Alford
John Crew
Bubbs Carson
Planning Board Members: Erma Tankard, Rachel Tankard, Guy Cutler, Helen Brooks, Teeny Mason, Ed Swindel

TOWN OF BATH
SMALL AREA WASTEWATER SYSTEMS STUDY
HOUSEHOLD SURVEY

As noted in our cover letter, the Town of Bath has received a state grant through the Office of Coastal Management to develop an alternative wastewater treatment system program.

We ask that you help us by answering the following questions:

1. How many bedrooms does your home have? _____ (no. of bedrooms) OR if you have a business in this area, what is the total number of square feet? _____ (no. of sq. ft.)

2. Do you use your home/business fronting on Main Street in this area year-around or seasonal? _____

3. How many occupants/employees normally live/work in your home/place of business?
_____(no. occupants) _____(no. employees, including yourself)

4. If you know your building lot dimensions, please specify below:
_____ ft. (wide) x _____ ft. (deep), OR _____ total square feet.

5. Please indicate the number of plumbing facilities you have:
number of toilets_____; number of tubs/showers _____; garbage disposal (if any) _____.

6. Does your home/place of business have any special water conservation devices such as low volume toilets, flow restriction devices for faucets or shower heads, etc.?
_____(yes) _____(no) If yes, please specify: _____
_____

7. If you know when your septic tank system was installed, would you please indicate the year? _____(please estimate)

8. Has your on-site septic system shown any signs of failure such as plumbing back-ups, clogged pipes, drainage field seepage, or any odor? _____(yes) _____(no). If yes, please specify: the type of failures _____

_____;

annual number of occurrences _____ OR total number of occurrences since the system was installed _____.

9. Would you please specify any maintenance (such as periodic inspection or pumping of your septic tank) or repairs completed on your on-site septic system?

(date or dates)	(Maintenance or repair work)
_____	_____
_____	_____
_____	_____
_____	_____

10. Finally, would you like to add-on to your house or expand your place of business but can't due to septic limitations? _____(yes) _____(no)

Since it's important to be able to match your comments with specific parts of the area, would you please provide your name & address:

_____ (Name) _____ (Address)

PLEASE COMPLETE THIS SURVEY AND BRING IT TO OUR OCTOBER 18, 1982 PLANNING BOARD MEETING.

IF YOU CANNOT ATTEND, EITHER DROP IT BY OR MAIL IT TO:

Jim Edwards, Chairman
Bath Planning Board
P. O. Box 3
Bath, NC 27808

JE/dkt

Ed Warren

APPENDIX C

CLASS I AND CLASS II OPERATOR'S LIST AND COMMERCIAL LABORATORIES IN NORTH CAROLINA

19-JAN-83

KEY #	NAME	REN#	DATE	CERT#	GRD	OPERTWO AND OPERADD TMP-DT	ADDRESS	CITY	RG	CO	ST&ZIP
009003	ADAMS, DANIEL G	2751	8401	748	2		RT 2 BOX 361	WASHINGTON	E	013	NC27889
215303	ADAMS, DANIEL G	2751	8401	748	2		RT 2 BOX 361	WASHINGTON	E	013	NC27889
216305	AMOS, LORIS B		7806	2818	1			WASHINGTON	E	013	NC27889
604405	ANDREWS, TERRY D	4662	7906	1998	4		RT 1 BOX 438	CHOCOWINITY	E	013	NC27817
232303	BRADSHAW, HANSEL D	1492	8401	5733	2		P O BOX 365	AURORA	E	013	NC27806
850505	BUNCH, DEBORAH	2663	8401	4308	2		221 GEORGE ST	BELHAVEN	E	013	NC27810
628605	CARROW, KESTER L	2736	8401	2561	2		RT 1 BOX 573	PINETOWN	E	013	NC27865
207303	CLARK, RONNIE L	9559	8301	4580	1		RT 1 BOX 324	CHOCOWINITY	E	013	NC27817
149903	CLARK, RONNIE L	9559	8301	4580	1		RT 1 BOX 324	CHOCOWINITY	E	013	NC27817
079103	CUTLER, DOTTIE RAWLS	2664	8401	3771	2		RT 1 BOX 601	WASHINGTON	E	013	NC27889
113303	CUTLER, JERRY D	1323	8401	908	4		RT 2 BOX 452	WASHINGTON	E	013	NC27889
189003	DAVIS, MICHAEL LEE	7006	8301	3755	2		PO BOX 1219	WASHINGTON	E	013	NC27889
887405	DAVIS, TED W	3201	8401	4689	2		RT 1 BOX 362	AURORA	E	013	NC27806
200603	FLEMING, GEORGE R	2672	8401	3777	3		PO BOX 278	CHOCOWINITY	E	013	NC27817
832905	FORSTER, EDWARD E	1098	8401	706	3		PO BOX 1834	WASHINGTON	E	013	NC27889
996507	GAVIN, MAXIE	1570	8401	2825	1		111 HARDING DRIVE	WASHINGTON	E	013	NC27889
685105	HOLLAND JR, PETE T	9785	8301	698	3		RT 4 BOX 330-A	STATESVILLE	E	013	NC28677
6916051	POCK, BILLY E			131	2		RT 4 BOX 296	WASHINGTON	E	013	NC27889
864105	JONES JR, ALBERT M	2796	8401	6005	4		P O BOX 1375	WASHINGTON	E	013	NC27889
098103	MELVIN, JOHN S	2273	8401	5562	4		BOX 7085	GREENVILLE	E	013	NC27834
106403	MERCER, DOUGLAS G	3202	8401	GC538	4		105 LAWSON ROAD	WASHINGTON	E	013	NC27889
106503	MERCER, DOUGLAS G	3202	8401	GC538	4		105 LAWSON ROAD	WASHINGTON	E	013	NC27889
106303	MERCER, DOUGLAS G	3202	8401	GC538	4		105 LAWSON ROAD	WASHINGTON	E	013	NC27889
720109	MOORE JR, TROY LEE		8401	6149	3		RT 1 BOX 315A	CHOCOWINITY	E	013	NC27817
832605	NORRIS, TOMMIE R		8001	4111	2		PO BOX 203	CHOCOWINITY	E	013	NC27817
123505	PICKENS JR, HARRY E	2893	8401	RC1335	4		RT 2 BOX 1728-WESTERLY PARK RD	EDEN	E	013	NC27288
741709	RAY, DENNIS TROY	2735	8401	3456	2		RT 4 BOX 626	WASHINGTON	E	013	NC27889
005403	REESE, REBA			TC2189	1	122273	RT 1 BOX 14	AURORA	E	013	NC27806
979205	ROBERSON, H CLYDE	1975	8401	5729	1		P O BOX 1867	WASHINGTON	E	013	NC27889

KEY #	NAME	REN#	DATE	CERT#	GRD	OPERTWO AND OPERADD TMP-DT	ADDRESS	CITY	RG	CO	ST&ZIP
746705	ROSCOE, EDWARD ODELL	0373	7706	2557	1		1406 HARRINGTON	WASHINGTON	E	013	NC27889
753905	SHEPPARD, WILBUR			829	2		RT 4 BOX 218	WASHINGTON	E	013	NC27889
215103	TAYLOR, MICHAEL D	3027	8401	4072	2		E FRONT STREET	BELHAVEN	E	013	NC27810
885705	1ETTERTON, EMORY L	4931	8201	CE75	1		RT 5 BOX 219	WASHINGTON	E	013	NC27889
772705	THOMAS, ROBERT M			1763	2		PO BOX 191	WASHINGTON	E	013	NC27889
775505	TOOLEY, JOHN C	2750	8401	1338	2		805 E MAIN	BELHAVEN	E	013	NC27810
818405	WARD JR, BOBBY E		7906	3774	2		117 N BONNEY	WASHINGTON	E	013	NC27899
786807	WILEY, JOHN WAYNE	3149	8101	2558	1		PO BOX 414	CHOCOWINITY	E	013	NC27817
156403	WOOLARD, JOSEPH L	1831	8401	CE50	1		RT 4 BOX 678	WASHINGTON	E	013	NC27889
792709	WOOLARD, TOBY WAYNE	2746	8401	5558	3		RT 4 BOX 170	WASHINGTON	E	013	NC27889

TOTAL -- 35

19-JAN-83

December 6, 1977

Commercial Laboratories with North Carolina Certification

Name and Address	Cert. No.	Name and Address
Beacham Laboratory 640 Wilmington Highway Jacksonville, N. C. 28540	14	Guilford Laboratories, Inc. P. O. Box 9735 Greensboro, N. C. 27408
Biomedical Laboratories, Inc. 1308 Rainey St. Burlington, N. C. 27215	16	Law & Co. of Wilmington, Inc. P. O. Box 629 Wilmington, N. C. 28401
Burlington Industries, Inc. Chemical Division Analytical Testing Services P. O. Box 523 Jamestown, N. C. 27282	17	Dr. Fred Holtkamp, Head Dept. of Chemistry Mars Hill College Mars Hill, N. C. 28754
Carolina Laboratories, Inc. 201 Pine Street Greensboro, N. C. 27405	18	Moore, Gardner & Associates, Inc. Environmental Laboratory P. O. Box 728 Asheboro, N. C. 27203
Charles T. Main, Inc. Environmental Laboratory P. O. Box 15236 Charlotte, N. C. 28210	19	Town of Morehead Wastewater Treatment Laboratory Drawer M Morehead City, N. C. 28557
Cross Creek Wastewater Plant P. O. Box 1089 Fayetteville, N. C. 28302	20	Par Laboratories, Inc. Box 15722 Charlotte, N. C. 28210
Environmental Engineering Laboratory P. O. Box 8678 Durham, N. C. 27707	21	Southern Testing & Research Labs, Inc. P. O. Box 350 Wilson, N. C. 27893
Entropy Environmentalist, Inc. P. O. Box 12291 Research Triangle Park, N. C. 27709	22	Vann Laboratories P. O. Box 668 Wallace, N. C. 28466
Environment I, Inc. Box 7085 Greenville, N. C. 27834	24	Commonwealth Laboratory, Inc. Nardin Division 112 Greenacre Rd. Greenville, S. C. 29607
Environmental Laboratories of Fayetteville, N. C., Inc. 4634 Yadkin Road Fayetteville, N. C. 28303	25	Davis & Floyd Engineers, Inc. P. O. Drawer 428 Greenwood, S. C. 29646
Environmental Testing, Inc. P. O. Box 17454 Charlotte, N. C. 28209	26	R. S. Noonan, Inc. of S. C. P. O. Box 1388 Greenville, S. C. 29602
Grainger Laboratories, Inc. 709 W. Johnson St. Raleigh, N. C. 27605	27	J. L. Rogers & Callcott Engrs., Inc. 718 Lowndes Hills Rd. Greenville, S. C. 29607

Commercial Laboratories with North Carolina Certification

Cert. No.	Name and Address
28	J. E. Sirrine Co., Engrs.,Architects P. O. Box 5456, Station B Greenville, S. C. 29606
29	Stevens-Environmental Services Lab P. O. Box 6545 Greenville, S. C. 29606
30	Texidyne, Incorporated P. O. Box 932 Clemson, S. C. 29631
31	Commonwealth Laboratory, Inc. P. O. Box 8025 Richmond, Virginia 23225
32	Sharpley Laboratories, Inc. P. O. Box 846 Fredericksburg, Virginia 19380
33	Hayes, Seay, Mattern & Mattern Laboratory & Testing Services P. O. Box 1490 Roanoke, Virginia 24007
34	Research & Analytical Laboratories, Inc. 106 Short St., P. O. Box 473 Kernersville, N. C. 27284
35	Chem-Bac Laboratories, Inc. P. O. Box 3114 Charlotte, N. C. 28203
36	The Mogul Corporation P. O. Box 1267 Charlotte, N. C. 28231
37	Professional Environmental Lab of Lumberton 2401 West 5th Street Lumberton, N. C. 28358
39	AquAir Laboratories, Inc. 431 Foster Avenue Charlotte, N. C. 28203
40	Environmental Testing, Inc. 766½ Biltmore Asheville, N. C. 28803
41	En-Cas Analytical Laboratories 807 Brookstown Ave. Winston-Salem, N. C. 27101
42	Jesse Jones, Div. GoodMark, Inc Rt. 1, Box 187 Garner, N. C. 27529
43	City of Lexington Industrial Waste Laboratory Rt. 12, Box 46 Lexington, N. C. 27292
47	Wastewater Services, Inc. 122 Stewart St. Asheville, N. C. 28806

APPENDIX D

BATH SMALL AREA WASTEWATER SYSTEMS BIBLIOGRAPHY

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