VERMONT BUSINESS ROUNDTABLE

Cleaner Water for the 21st Century: Environmental and Economic Wastewater Imperatives

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Established in 1987, the Vermont Business Roundtable is a non-partisan organization dedicated to helping Vermont achieve long-term public policy objectives worthy of its citizens. Composed of the principal officers of 136 Vermont companies representing geographic diversity and all major sectors of the economy, the Roundtable is committed to achieving a healthy economy and preserving Vermont's unique quality of life.

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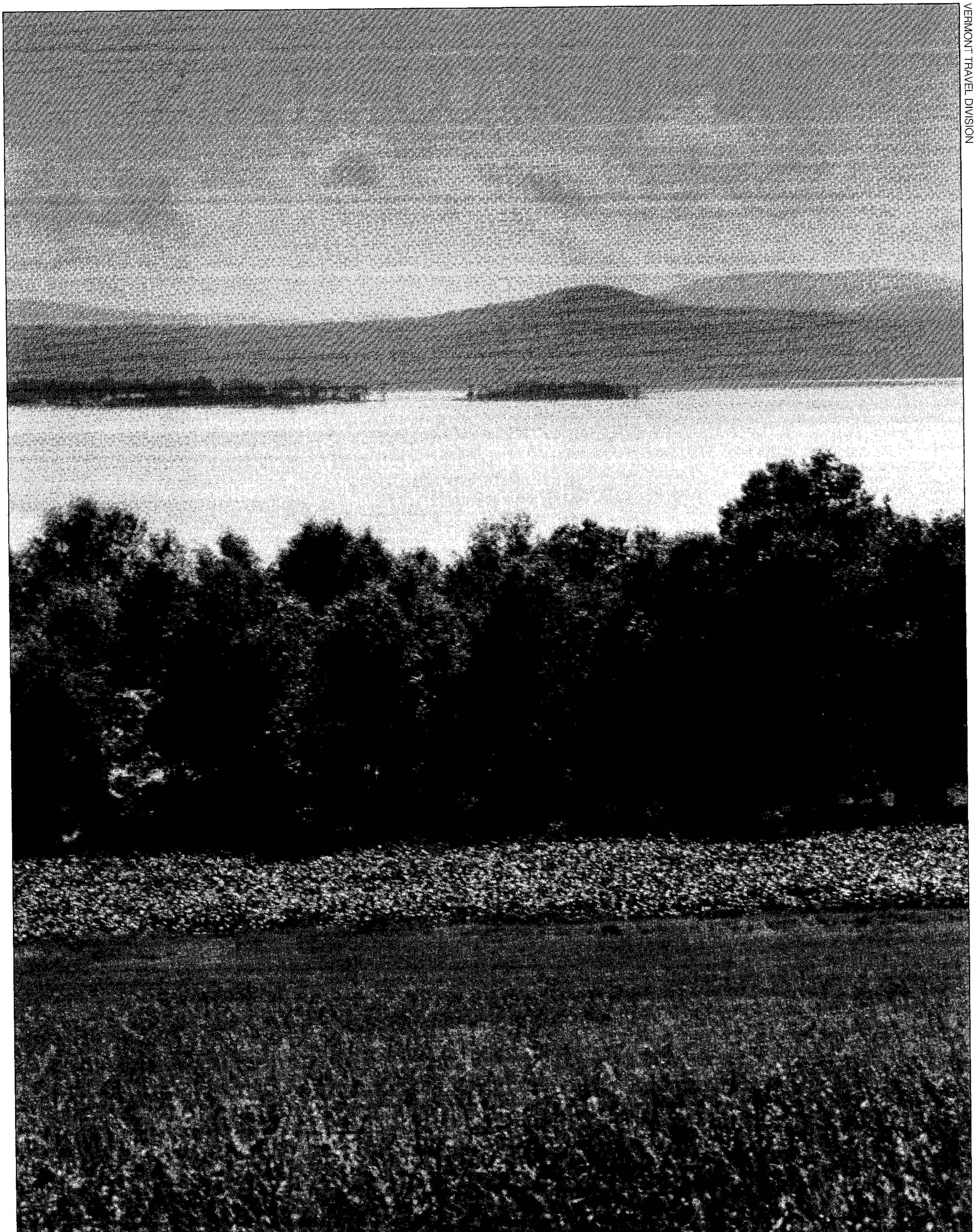


VERMONT TRAVEL DIVISION

EXECUTIVE SUMMARY

Wastewater management has been called one of the "largest looming problems" facing Vermont today. As the population of the state continues to grow, our capacity to guarantee clean water and an adequate system of wastewater management is threatened. Vermonters, who passionately value the natural resources of their state, demand that responsible decisions be made about how those resources are used and protected.

In 1989 the Roundtable undertook this study of the state's wastewater management infrastructure. Responsible management of the state's waters and wastewater requires policies and actions that are both environmentally and economically sound. Careful and conscientious wastewater policies can make an important difference for future job creation, affordable housing, and economic development, as well as for the preservation of the state's unique environmental qualities.

The study committee set out to examine current wastewater capacity, rules and regulations affecting wastewater management, and new technologies that might enhance wastewater treatment. We considered the interrelationships of wastewater treatment capacity and economic growth and quality of life. The results and conclusions of the study yield a clear message: to meet the wastewater treatment needs of our state and to ensure cleaner water for the 21st century, it is essential that the capacity to provide clean water for consumption and recreation be maintained and enhanced.

Vermont's Current Situation

The wastewater study began with a calculation and evaluation of current and projected wastewater treatment capacity in Vermont. Using growth projections from the Roundtable's 1988 population forecast, and figures on estimated housing unit growth from the Vermont Department of Health, an assessment was performed of the state's current and future inventory and capacity.

In 1988 the state was estimated to have 258,031 total housing units generating 116,113,950 gallons of sewage daily: 51 percent was disposed of in small on-site septic systems; 37 percent through municipal treatment and disposal systems; and 12 percent through large on-site indirect discharge systems.

Using the health department's growth rate figures, additional housing units and the commercial complex they support, will generate an estimated statewide total of 47,265,750 gallons of new wastewater flows each day in the year 2010, for a total of 163,379,700 gallons of wastewater generated statewide daily.

Evaluation of the capacity and inventory of municipal and private treatment and disposal systems clearly demonstrates the capacity deficit the state faces. New municipal capacity will be urgently needed within the next 10 years to meet *existing* municipal needs *and* to help with the rural deficit created by the stringent rules, environmental laws, and soil conditions that limit the expansion and development of large and small on-site disposal systems.

The need to address the state's future wastewater requirements comes at a time when federal and state funding have been eliminated or significantly reduced. An examination of the future wastewater treatment objectives for the state must be made in the context of this reduced funding. It is imperative that the regulators and technical experts explore efficient, environmentally sound treatment strategies that are cost effective, while lawmakers and local leaders explore options for providing financial support for the needed changes.

The Regulatory Climate

Citizens and businesses who hope to gain access to Vermont's wastewater services to meet current and future treatment and disposal needs, must follow a complex and sometimes conflicting regulatory process that can take months and even years to complete. No matter how safe and reliable the capacity and technology, access to sewage disposal resources will not be granted unless the applicant has demonstrated compliance with certain technical rules, regulations, and policies.

To meet the wastewater treatment needs of our state and to ensure cleaner water for the 21st century, it is essential that the capacity to provide clean water for consumption and recreation be maintained and enhanced.

At the same time, non-technical requirements and values expressed in a variety of land-use planning, growth management, and growth limiting programs at the state, regional, and local levels must be considered.

All land development in Vermont is affected by statutes, rules, regulations, policies, and procedures relating to collection, treatment, and direct or indirect discharge or disposal of wastewater. Different categories of discharges are governed by different regulatory agencies and programs. Municipal, state, and regional waste disposal regulations may complement, duplicate, or even contradict one another.

Individuals and businesses dependent on access to sewage disposal infrastructure and capacity must operate within this network of rules, regulations, policies, procedures, and subjective interpretations. Reviews by regulatory agencies are appropriate to ensure compliance with rules and regulations and to provide quality control. There is evidence, however, that the inflexibility of regulations and the lack of consistency in implementation do not always encourage, and in some cases inhibit, the implementation of the most efficient, cost-effective, environmentally sound wastewater treatment strategies.

Enhancing our ability to manage the state's wastewater will require new approaches, including the pursuit of water conservation measures, changes in the regulatory process, and operational modifications and construction activity.

Exploring New Solutions

Enhancing our ability to manage the state's wastewater will require new approaches, including the pursuit of water conservation measures, changes in the regulatory process, and operational modifications and construction activity.

Water conservation is one of the most cost-effective and environmentally sound means of increasing the availability of wastewater treatment capacity because it reduces the amount of wastewater requiring treatment and the quantity of clean water needed.

Revisions in the regulatory process will be required to encourage effective solutions to wastewater needs and to allow new and innovative approaches to be tested and implemented. Current regulations often limit and restrict the use of the most positive, reliable, and cost-effective approaches to environmental protection.

Many alternatives exist for increasing industrial and municipal treatment plant capacity, some of which require modification of operating systems or construction activity. Many of these options are costly when done retroactively, but can offer significant opportunities and cost savings when communities or industries face the need for new wastewater management facilities. Some natural treatment concepts, such as wetlands and greenhouse designs, are being piloted nationally as well as in Vermont. These methods can increase the capacity of existing systems or they may constitute the major component of new systems.

A Look to the Future

While the state has, over the past 20 years, made great progress in achieving better water quality through improved wastewater treatment and disposal, more needs to be done to eliminate existing water pollution and to meet the increasing demands for additional wastewater treatment and disposal capacity. At the same time, however, traditional federal and state funding sources, which were relied on heavily during the past 20 years, will probably not be available in the future. This conflict between the demand for cleaner water and the diminishing financial resources points up the critical need to explore alternative means of dealing with wastewater management. New regulatory strategies, alternative funding solutions, conservation techniques, and innovative technologies must be explored.

Following almost two years of studying Vermont's wastewater management situation and evaluating future challenges, the Vermont Business Roundtable has developed a set of recommendations. These policy recommendations are made in the interest of preserving the highest quality and volume of clean water while at the same time addressing the needs of a constantly growing population.

They are premised on the belief that the continued responsible and controlled use of public waters for the general benefit, including the processing of properly treated wastewater, is consistent with public health, safety, and welfare. A unified commitment to clean, plentiful water is required to adequately achieve these goals. It is the responsibility of all involved—lawmakers, agency personnel, technical experts, municipal leaders, concerned citizens—to guarantee that the most effective and least expensive wastewater collection, treatment, and disposal strategies are available in Vermont.

It is our hope that these recommendations will provide the basis for ongoing dialogue between the private and public sectors seeking solutions to the compelling problems and issues—environmental, social, political, and economic—of wastewater management in the state of Vermont.

Policy Recommendations

1. Review all wastewater management rules and regulations and develop a unified mission statement and policy objectives for all agencies and personnel responsible for the administration of wastewater management.

- Require that appropriate agencies periodically review rules and regulations and evaluate their effectiveness and timely administration by agency personnel.
- Streamline the regulatory review process by creating a new state licensing category of Environmental Engineers for all private and public engineers who review wastewater treatment systems; authorize these Environmental Engineers to develop plans for small to medium (under 6,500 GPD) wastewater treatment facilities and affirm the substantial compliance of the plans with applicable rules with minimum state review.
- Review the economic and public finance implications of all management rules and regulations.
- Ensure conformance with Act 200 planning goals and with municipal, regional, and state agency plans.
- Require annual agency reporting of the number of filings, number of permits processed and granted, and average time for processing permits by category.

2. Implement strategies and programs to make wastewater treatment affordable to individuals and municipalities, acknowledging that federal funds are no longer available for the development and improvement of public wastewater treatment facilities.

- Develop a comprehensive wastewater fee structure based on estimates and calculations of the full cost of collection, treatment, and disposal.
- Encourage industrial pretreatment where necessary.
- Require state and local governments to undertake and implement capital planning and programming, including capital funding, to ensure that needed wastewater treatment and disposal facilities are anticipated and provided and that towns in particular evaluate their existing facilities on an annual basis.
- Appropriate public funds for operation, expansion, upgrade, and replacement to those facilities with capital plans and budgets in place.

3. Identify and implement conservation strategies to ensure clean water and adequate capacity to treat wastewater.

- Educate the public about the environmental and economic impacts of water use and conservation.
- Establish state and local incentives—for individuals, business and industry, and developers—for installation and use of water conservation devices and technologies to reduce the volume of water that must be treated.
- Require that state grant and loan recipients identify and implement water conservation measures as a condition for receiving funds.

4. Support research and development of alternative and innovative technologies to increase wastewater capacity and provide cleaner water.

- Establish public-private partnerships to explore and implement new strategies.
- Provide incentives for the exploration of innovative solutions and remove obstacles to their testing and implementation.

INTRODUCTION

An Agenda for Vermont's Future

The Vermont Business Roundtable, through its research and policy studies, is working to guarantee that a healthy economic climate is maintained for the state and that the cherished quality of life is preserved. All of the Roundtable's study projects have been related to this objective.

The 1988 *Population and Employment Forecast*, which projected the growth of population and jobs over a 20-year period, reinforced the fact that the population in Vermont will continue to grow, regardless of economic slowdown or growth. In 1989, the Roundtable's *Vermont's Unspoken Danger: Educating Our Children for the 21st Century* asserted that building a superior education system for the next decade is essential if Vermont wants to ensure economic vitality, good jobs for Vermonters, and the continuation of our quality of life.

In the summer of 1990, the Roundtable published *Pulse of Vermont*, the report on a survey conducted to identify how Vermonters define and value their "quality of life." The statewide poll reaffirmed that maintaining and protecting the environment, while encouraging economic growth, is a top priority for the majority of Vermonters.

Measuring Vermont's Fiscal Condition, the first part of the Roundtable's public finance study, raises serious questions about the state's capacity to ensure continued economic vitality under the pressure of current spending practices. Without a strong economy, good jobs may not be available for Vermonters, and the state's quality of life could be compromised.

Quality of Life: Wastewater Management

The *Pulse of Vermont* survey report provided one very clear picture: Vermonters are more concerned with "preserving clean air and water" than any other general aspect of life in Vermont. Vermonters have always been enormously proud of—and concerned about—the beauty and natural resources of their state.

How wastewater is managed—collected, treated, and disposed of—is a critical element in the pursuit of clean, healthy water in our state; wastewater management has been called one of the "largest looming problems" facing Vermont. As the population of the state grows, wastewater management practices must be evaluated and actions must be taken to ensure that the capacity to provide safe water for consumption and recreation is maintained. At the same time, it must be acknowledged that the use of public waters for the disposal of treated wastewater is an appropriate and necessary public purpose.

The Infrastructure Study Committee of the Roundtable was established to examine areas such as transportation, telecommunications, energy, and wastewater management. While these elements are all important to the maintenance and improvement of Vermont's economic and environmental quality of life, the committee concluded that wastewater management was the most critical in terms of future job creation, affordable housing, economic development, and preserving the state's unique environmental quality.

In early 1989, the committee began a study of the wastewater management in the state. The subcommittee set out to examine current wastewater capacity, rules and regulations affecting wastewater management, and new technologies that might enhance wastewater management strategies. Input was sought from a broad group of experts from both the private and public sectors, including engineers, hydrogeologists, lawyers, consultants, agency personnel, and state and municipal leaders.

Based on the research, the study group established policy recommendations regarding wastewater capacity, regulations, and technology, which are contained in this report. It is the Vermont Business Roundtable's intention that these findings provide the basis for ongoing dialogue between the private and public sectors seeking solutions to the compelling problems and issues—environmental, social, political, and economic—raised by the study.

How wastewater is managed is a critical element in the pursuit of clean, healthy water in our state.

As the population of the state grows, wastewater management practices must be evaluated and actions must be taken to ensure that the capacity to provide safe water for consumption and recreation is maintained.

WASTEWATER TREATMENT:

To understand the myriad issues surrounding wastewater management, it is important first to be familiar with some basic definitions and concepts.

Wastewater and capacity: Residential wastewater refers to discharge from homes, including toilets, sinks, tubs, showers, dishwashers, and washing machines. Industrial discharge is any wastewater that is disposed of by industrial and manufacturing facilities. Both residential and industrial wastewater are measured and evaluated based on volume as well as strength, which varies greatly depending on the quantity of organic material, nutrients, or metals and toxic compounds the wastewater contains. The entire discussion of wastewater management centers around assimilative capacity, which refers to the ability of a body of water—river, lake, or stream—or the soils into which sewage is discharged or deposited to assimilate, or clean and recycle, the waste without posing undue health or environmental risks.

Water classification: The waters of the state are a public resource; they are, theoretically, available for public use for a variety of recreational, commercial, and municipal purposes. By statute, the Vermont legislature has established three classes of public waters: Class A waters, which are suitable for public drinking water supply; Class B waters, which are suitable for swimming and, with treatment, public water supply; and Class C waters, which are suitable for boating, fishing and "such industrial uses as are consistent with other Class C uses."

Levels of treatment: Primary treatment is the first and sometimes only treatment provided in a wastewater treatment facility. Primary treatment removes a substantial amount of the suspended matter in wastewater but little or none of the colloidal and dissolved matter.

Secondary treatment processes remove or reduce the suspended solids, dissolved solids, and the fine and colloidal solids from wastewater and reduce the amount of organic material it contains.

Tertiary level treatment involves those processes that treat effluent that has received secondary treatment. Tertiary treatment removes or reduces nutrients, including phosphorus, residual organics, and residual solids.

Advanced wastewater treatment is a final polishing of wastewater discharge, sometimes following primary or secondary treatment.

Private vs. public treatment systems: Public treatment facilities are those operated by municipalities—towns, cities, fire districts, or intermunicipal compacts—and regulated by the state. Treatment plants that are privately operated are also subject to municipal, state, and federal requirements.

Direct vs. indirect discharge: All wastewater—commercial, industrial, and residential—is discharged into the waters of the state either directly or indirectly. Direct discharge refers to sewage that is treated then released directly into any river, stream, lake, or other open body of water classified as "waters of the state." Under existing state regulations, it is virtually impossible for private systems to obtain permission to discharge sewage into Class C waters, and a municipality can only obtain a permit for direct discharge if it is first shown that there is no other feasible way to indirectly dispose of effluent. Direct discharge restrictions depend on the volume of sewage that is discharged, the level of treatment the sewage receives before it is discharged, and the quality and quantity of the receiving waters.

Any method of private or public sewage disposal that does not result in a direct discharge of sewage to public waters is called an indirect discharge. Indirect discharge is a land-based system of wastewater management in which often untreated or partially treated effluent is deposited or injected onto or into the ground. The effluent percolates through the receiving soils and is treated through natural biological and chemical processes occurring in the receiving soil, much the same way sewage is treated in a municipal plant. The liquid portion of the treated sewage ultimately, though indirectly, flows into public waters. This affects natural reservoirs of underground water known as aquifers, which provide much of our drinking water, and streams, rivers, or lakes, which are fed by springs or other sources of surfacing groundwater.

The migration of this treated sewage into the public waters occurs with every surface or subsurface indirect disposal system, from home septic systems to large, community sewage disposal facilities. By statute and regulation, the state has created two principal categories of land-based indirect discharges, each with its own regulations. The first category includes land uses that either individually or collectively generate and require disposal of effluent through small land-based systems with a disposal capacity of 6,500 gallons or less of sewage per day; the second includes those that generate and require disposal of effluent through large land-based systems with a disposal capacity of more than 6,500 gallons of effluent per day.

Design flows: The Vermont Agency of Natural Resources' Environmental Protection Rules establish specific flow quantities for particular categories of land use, commonly referred to as design flows, that must be used in determining the amount of sewage the state assumes will be generated by various types of land uses. Design flows are set forth in detail in the rules and dictate the capacity requirements of municipal and private wastewater disposal facilities.

These design flow standards are

somewhat arbitrary and in many instances far exceed the actual daily flows generated by the identified categories of uses. When compared to actual usage, there is a significant built-in safety factor.

For residential usage, the rules assume that 150 gallons of sewage effluent will be generated each day for each bedroom in a single-family housing unit. The assumed design flow includes all hypothetical residential uses and considers peak usages, such as dinner parties and guests, to be the norm.

Based on the 150-gallon-per-day design flow standard, to construct a single-family unit with three bedrooms, it must be demonstrated that there is sewage treatment and disposal capacity of at least 450 gallons per day available to the dwelling. A ten-lot subdivision of three-bedroom units would require 4,500 gallons per day; a 15-lot subdivision of three-bedroom units would exceed the 6,500 gallons per day threshold, thus requiring compliance with specific Indirect Discharge Rules (described below).

In calculating the design flows for a typical commercial project, the Environmental Protection Rules require 15 gallons per day for each employee. For example, to construct a small manufacturing facility employing 20 full-time employees on a single eight-hour, five-day schedule, the owner of the facility must demonstrate available direct or indirect discharge capacity of 300 gallons per day (exclusive of process wastes).

Total design flows for any given project involving more than 500 feet of sewer line must also account for the amount of water that infiltrates or "leaks into" sewer pipes. Total project design flows will always be about five to ten percent higher than user assumptions or actual measured usage.

Byproducts of Wastewater Treatment

While this report focuses on issues related to the management of sewage, the liquid component of wastewater, it is widely recognized that the treatment and disposal of sludge and septage, residual components of sewage, also have major economic and environmental consequences around the state. The Agency of Natural Resources has adopted Solid Waste Management Guidelines to address sludge and septage management and disposal.

Sludge

Sludge, which is a byproduct of wastewater treatment plants, varies greatly depending on the characteristics of the wastewater being treated. It ranges from about 2 to 30 percent solid material. Various residual components in sludge, such as heavy metals, create problems when the sludge is disposed of or reused. Pretreatment may be required in some communities where excessive amounts of these materials are found. This results in additional costs for industrial wastewater contributors.

It is believed that the adoption of wastewater treatment concepts and technologies that minimize sludge disposal requirements will result in significant environmental benefits. Several natural methods for sludge management have been tested in Vermont. If approved and successfully implemented, these systems could provide considerable labor and cost savings for existing and future municipal treatment plants.

Septage

Septage is the concentrated waste pumped from the septic tanks of Vermont homes and businesses that are not linked to a municipal treatment facility. It poses a significant threat to the health and safety of Vermont's waters, though it is a problem that goes largely unnoticed.

Septage can be 10 to 100 times more concentrated than ordinary sewage, and may contain high levels of toxins, plastics, and inert wastes flushed into the system. Because of the very high concentrations, most wastewater treatment facilities must limit their daily loading of septage or risk process complications that could produce effluent below discharge permit standards.

It is generally recommended that a family of four have its septic tank pumped once every two years, though no regulated requirements exist in Vermont. Many systems are not pumped until the failure of the system results in clogged pipes and overflow.

Much of Vermont's septage is currently "stabilized" with lime, which alters the pH and kills pathogens. It is then spread on specially permitted agricultural sites. This practice is regulated under the state Solid Waste Guidelines and requires site certification.

At present, Vermont has no treatment facilities designed solely to treat septage, and existing wastewater treatment facilities cannot begin to handle the volume generated annually. Few technologies exist for chemical treatment of septage, and those few are costly to implement. Innovative biological processes, including "solar aquatic" treatment, are rapidly evolving and offer more cost-effective treatment to advanced standards.

This report focuses on the safe and effective treatment and disposal of sewage, but it is important to note that issues related to sludge and septage management merit attention as well.

THE CURRENT SCENARIO

Bond issues for wastewater upgrades are reluctantly considered by most communities because other major items such as schools, solid waste facilities, highways, and water systems need major bond capital for construction.

Wastewater Treatment Process: A Primer

The primary function of wastewater treatment is to reduce or remove sources of potential contamination or prevent degradation of surface and groundwater. Methods of treatment are constantly changing and evolving as new contaminants emerge and characteristics of wastewater change. Technologies continue to be refined and developed that offer new approaches to wastewater treatment.

The two major constituents of wastewater are biochemical oxygen demand (BOD) and total suspended solids (TSS). BOD is a measure of the oxygen used in the biochemical oxidation of organic matter in a specified time, at a specified temperature, under specific conditions; TSS refers to wastewater matter that will stay suspended for an extended period of time. The National Pollution Discharge System (NPDS), which governs all wastewater treatment facilities, requires that secondary treatment reduce organic loadings of wastewater discharge by 85 percent; that is, treated wastewater may not exceed 30 milligrams per liter (mg/L) of BOD and 30 mg/L of TSS when discharged into receiving waters.

A wide variety of treatment processes are employed to achieve these standards. In Vermont, there are 79 municipal wastewater treatment facilities that are designed to treat from 12,000 gallons per day (in Whitingham) to 6,800,000 gallons per day (in the City of Rutland). These plants include activated sludge, aerated lagoon, rotating biological contact, and extended aeration facilities, as well as various hybrids of each.

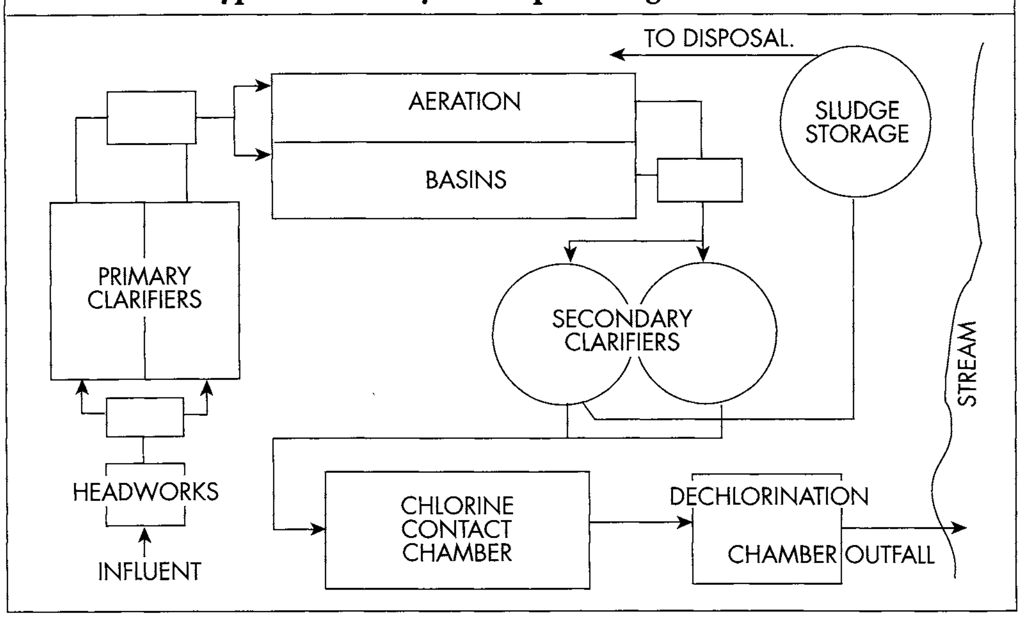
Once treated, the wastewater is disinfected by chlorination, ultraviolet exposure, or other chemical means and discharged into a receiving surface water. The solid portion, called sludge, is treated to reduce pathogens, reduced in volume, and disposed of by land application, incineration, composting or landfilling, or other suitable methods.

Legislation and Funding Picture

Vermont has achieved complete secondary-level treatment at all of its direct discharge locations. The Clean Water Act (PL92-500) of 1972 and subsequent amendments ensure that improvements in the treatment of wastewater continue. (See "Federal Water Pollution Law" on page 5 for an overview of federal laws related to wastewater.)

Many of the state's municipal wastewater treatment facilities have been retrofitted and upgraded at least once over the

Typical Secondary Municipal Sewage Treatment



past 20 years. The performance and capacity of these facilities are affected by a number of different external factors: changing requirements of state and federal laws, development, weather, the devaluation of equipment, and construction or upgrading of structures.

These facilities all represent very expensive capital investments with complicated technical equipment. In Vermont, most wastewater facilities were funded by major state and federal capital investment; often as much as 90 to 95 percent of a facility's original construction costs were grant funded.

Each community that operates a municipal facility initially set up a revenue system to fund the operations and maintenance costs. Where capital costs were associated with the local share of the construction costs of the facilities (usually 10 percent or less), these costs were included in revenue intended to pay for wastewater treatment and collection costs. Rates did not reflect the total capital costs of facilities. The large grants-in-aid allowed towns and cities to set rates that did not include the capitalization of many millions of dollars worth of construction and equipment, even though the U.S. Environmental Protection Agency (EPA) conditioned grants on replacement of the facility.

Under Vermont's Municipal and Regional Planning and Development Act, municipalities are permitted to undertake and implement capital planning and programming. While municipalities have been granted authority to impose impact fees to fund infrastructure improvements, they may do so only if they adopt capital plans and programs. There is, however, nothing in the law that *requires* municipalities to undertake capital planning and programming. Typically, municipalities do not include depreciation of facilities as an expense to recover in rates. As a consequence, there has been no meaningful effort on the part of the state or its municipalities to generate funding sources to replace or upgrade wastewater infrastructure.

Until recent years, very few communities charged new connectors to tie into their systems. Some charged small fees for actual connection costs, but those that charged for replacement or use of capacity were in the minority. The town of Ludlow was possibly one of Vermont's pioneers in assessing "buy-in" type fees. (That town subsequently had two upgrades that were primarily funded by local reserve funds.) More systems are recognizing the need for funding capacity upgrades by using impact fees, connection fees, and system development charges. For most, it is "too little too late," however. There is not enough reserve capacity available to begin to fund major system expansions.

Currently, there are no construction grant programs at the federal level. The EPA has converted its grant program to a loan program. The state has severely reduced its grant program and also converted to a loan basis. It appears that future costs of upgrades and expansions will fall on the towns and cities—and on the users. Bond issues for wastewater upgrades are reluctantly considered by most communities because other major items such as schools, solid waste facilities, highways, and water systems need major bond capital for construction. The public's reception to bond issues is less than favorable, as taxpayers face ever-increasing pressures from seemingly endless needs.

The Critical Equation: Inventory and Capacity

An understanding of Vermont's wastewater management picture must include a comprehensive assessment of the present

Federal Water Pollution Law

1972 WATER POLLUTION CONTROL ACT (PL 92-500)
- Established grant funds for wastewater facilities.
- Set goals for reaching abatement.
- Established waste maximums for receiving waters.
- Set secondary treatment minimums.
- Established a national permitting system (National Pollution Discharge Elimination System).

1977 CLEAN WATER ACT (PL 94-217)
- Further defined effluent standards for receiving waters.
- Established state roles in water quality programs.
- Set schedules for conformance.
- Broadened authority of EPA in wastewater management.
- Encouraged innovation through the Innovative Alternatives Program.

1987 WATER QUALITY ACT (PL 100-4)
- Phased out construction grants.
- Increased regulation on storm water runoff.
- Modified deadlines.
- Emphasized enforcement and penalties.
- Promulgated industry-specific effluent limitations.

inventory and capacity of the state's wastewater treatment facilities. To calculate and evaluate current and projected wastewater treatment capacity in Vermont, the Roundtable's 1988 *Population and Employment Forecast* was used as a trend indicator. The assumption was made that the rate of population growth in Vermont through the year 2010 would be the same as that reported by the Roundtable for the 1980 to 1987 period.

Using a 1988 Vermont Department of Health report on growth of housing units by county, current and future total housing units in Vermont (year-round and seasonal) were calculated. Since the state mandates that housing units, not population, be the basis of sewer allocation, this analysis is based on housing unit growth.

Flow and capacity data are based on a 1989 Vermont Agency of Natural Resources report of reserve capacity; data on plant revisions were provided by a private Vermont engineering firm. Using the state's standard of 450 gallons per day per unit for a three-bedroom dwelling, the projected future sewage flows were established. That figure accounts for all sewage, including residential, commercial, and light industrial.

The Roundtable study reported state population growing 1.1 percent a year between 1980 and 1987. During the same period, the Department of Health reported that housing units grew at an annual rate of 1.85 percent. In 1988 the state was estimated to have 258,031 total housing units generating 116,113,950 gallons of sewage daily: 51 percent was disposed of in small, on-site septic systems; 37 percent through municipal treatment and disposal systems; and 12 percent through large on-site indirect discharge systems.

Using the health department's growth rate figures, total housing units projected for the state in 2010 are 363,066, an increase of 105,035 units. Additional housing units, and the commercial complex they support, will generate an estimated statewide total of 47,265,750 gallons of new wastewater flows each day in the year 2010, for a total of 163,379,700 gallons of wastewater generated statewide daily.

Additional housing units, and the commercial complex they support, will generate an estimated statewide total of 47,513,700 gallons of new wastewater flows each day in the year 2010, for a total of 163,627,200 gallons of wastewater generated statewide daily.

Municipal Systems

Municipal sewage plants currently treat approximately 42,962,000 gallons of wastewater per day, or 37 percent of the state's wastewater. In 1988, municipal reserve capacity was estimated at 28,580,000 gallons per day. With population and job growth in the ranges forecasted by the Roundtable, the state's municipal reserve capacity in the year 2010 will fall to 5,820,000 gallons per day, if no new municipal capacity is added and the percent of total housing units connected to municipalities remains the same as in 1988.

The table below provides an overview of the current and projected capacity of municipal wastewater treatment systems in Vermont. Although there appears to be "excess" municipal capacity in the state of

Current and Projected Municipal Capacity

	HOUSING UNITS			MUNICIPAL SEWAGE			COSTS	
	1988 Total	Per Year Growth	2010 Total	Reserve Capacity 1988	Reserve Capacity 2010	Reserve Capacity Zero Year	Reserve Capacity Cost to Build	Reserve Capacity Cost to Conserve
Addison	13,362	1.4%	17,477	0.91 mgd	0.23 mgd	2016	$ 6,802,871	$ 3,401,435
Bennington	18,126	1.9	25,703	0.665	(1.92)	1995	25,851,718	12,925,859
Caledonia	13,196	1.6	17,841	5.41	4.83	2087	5,832,292	2,916,146
Chittenden	49,551	2.3	74,624	5.85	(0.64)	2008	64,871,756	32,435,878
Essex	4,006	1.0	4,887	n/a	n/a	n/a	n/a	n/a
Franklin	16,203	1.5	21,550	2.244	0.81	2020	14,295,232	7,147,616
Grand Isle	3,731	0.6	4,223	0.087	0.07	2092	130,546	65,273
Lamoille	8,958	2.2	13,294	0.395	(0.010)	2010	4,067,595	2,033,797
Orange	11,280	0.9	13,513	0.267	0.17	2039	956,792	478,396
Orleans	11,889	0.8	13,981	0.09	0.07	1998	193,727	96,864
Rutland	30,295	2.0	43,625	2.446	(1.48)	2003	39,232,382	19,616,191
Washington	25,277	1.7	34,731	4.17	1.47	2019	26,993,208	13,496,604
Windham	24,270	2.7	38,686	3.09	1.07	2018	20,193,227	10,096,614
Windsor	27,887	1.8	38,930	2.96	1.15	2020	18,031,885	9,015,943
Total State	**258,031**	**1.85%**	**363,066**	**28.58 mgd**	**5.82 mgd**		**$227,453,231**	**$113,726,616**

Vermont as a whole, there will be little if any reserve in the major municipal growth areas of the state—Bennington, Chittenden, and Rutland counties—by the year 2000.

Pressures to use existing municipal capacity have increased in the last two years as the result of Act 200 and, more recently, the state's new Indirect Discharge Rules. One of the dominant principles of Act 200 is the concentration of future development into designated village center growth areas rather than scattered development in more rural areas of the state. This statement of social policy is supported by new technical rules that make it difficult and expensive to develop a large indirect land-based system serving more than 14 units.

The result of these changes will be more growth of existing municipal systems than has been seen in the past. It is believed that given current policies the municipal portion of wastewater treatment and disposal will increase from the current 37 percent to almost 50 percent of the state's total wastewater by the year 2010. The capacity table includes a summary of housing unit and capacity statistics by county. The first column in the housing units section shows the total number of housing units in each county in 1988, based on the health department's 1.85 percent rate of annual increase. The column total represents all housing units, both year-round (primary) and seasonal (secondary), in the state.

The second column in this section shows the individual growth rate per county and the third column is the projected number of total housing units by county for the year 2010 (1988 figures x percent of growth = 2010 figures).

Assuming a usage of 450 gallons per day per unit, the next section of the analysis summarizes municipal sewage reserve capacities by county. The reserve capacities for 1988 are followed by the reserve projections for 2010, based on no new capacity being added to municipal systems. The "zero year" column is the projected date when reserve capacity will be exhausted at current rates of growth in each county.

The final columns project costs per county to maintain the current (1988) reserve capacity assuming an estimated new plant construction cost of $10 per gallon per day of capacity. (See "Estimated Cost of Capacity Replacement" on page 8.)

The municipal sewage capacity figures in the table do not include rural homes built using small on-site septic systems. They do not include the overall capacity of those systems nor the projected "reserve capacity" of state soils to handle additional small on-site septic systems from now until the year 2010.

Our forecast shows that five counties—Bennington, Chittenden, Lamoille, Orleans, and Rutland—will exhaust their municipal reserve capacities by the year 2010. Bennington County has the most pressing problem, with its "zero year" projected to be 1995; Orleans County is close behind with a zero year of 1998. Grand Isle would appear to be an exception, artificially understated by the low amount of municipal capacity (6 percent).

In addition to the above counties, the following individual municipalities around the state are projected to reach their maximum design capacities (zero year) before the year 2010:

Bennington	2002
Bradford	2004
Burlington Main	1994
Burlington North	1988*
Castleton	2008
Essex Junction	2010
Hinesburg	2010
Jeffersonville	2010
Milton	1999
Pittsford	1996
Poultney	1988**
Proctor	2002
Randolph	2007
Rutland	1998
Shelburne FD#1	1990*
Shelburne FD#2	1994
S. Burlington Airport	2000
S. Burlington Bartlett	1992*
Swanton	2010
Vergennes	2005
Wallingford	1984**
W. Rutland	1995
Whitingham	2009
Wilmington	1994

** New "zero year" dates for these municipalities have not yet been calculated because of capacity upgrades now in progress.*

*** Moratorium conditions—no capacity upgrades in progress; these communities are exceeding their design capacity on a regular basis.*

Source: Dufresne-Henry

Although there appears to be "excess" municipal capacity in the state of Vermont as a whole, there will be little if any reserve in the major municipal growth areas of the state—Bennington, Chittenden, and Rutland counties—by the year 2000.

Small On-Site Systems

Small on-site systems and individual septic systems, those designed and approved for disposal of less than 6,500 gallons of effluent per day, currently contribute 51 percent (59,217,885 gallons per day) of the state's daily sewage flows.

Under the current sewage disposal rules, small on-site systems can accommodate 14 three-bedroom units. The potential capacity for small on-site systems is based on the number of new systems approved under current state regulations.

Information about potential small on-site system approval and development, given current regulatory requirements, was derived from interviews with professional civil engineers and on-site specialists who are involved with the review, design, and permitting of small on-site septic systems in their respective geographic areas. The information gained through these interviews covered 62 towns representing over 25 percent of the total land area and 35 percent of the major growth areas in the state, as indicated on the map.

High rejection rates were reported on parcels tested: rejection rates from 70 to 92 percent were reported in five statistically significant towns (Cavendish, Vernon, Halifax, Mount Holly, and Ludlow). An additional 22 towns had rejection rates of 50 percent or greater; in all, 46 percent of the towns had rejection rates of 50 percent or more. High rejection rates were attributed to stringent on-site Environmental Protection Rules and rigid enforcement by state application reviewers.

In addition to high rejection rates, the local engineers and on-site specialists estimate very low potential acreage still available for most of the towns surveyed. Twenty-nine of the towns covered were judged to have no more than 10 percent of total town acreage available for on-site sewer systems. An additional 14 towns were reported to have only 10 to 20 percent of their total land area still available for on-site sewage systems under the current regulations. The overwhelming majority (90 percent—or 56 towns) had potential acreage estimated at 30 percent or less.

Low estimated potential acreage combined with high rejection rates result in 28 towns (45 percent) having less than 1,000 acres available for new on-site sewage systems and 23 more towns having less than 3,000 acres available. Eighty-three percent of the towns have less than 3,000 acres available for on-site systems under current state regulations.

According to the information collected, total statewide acreage available for on-site systems for the next 20 years is estimated to be 454,760 acres. Taking the 1988 Rutland County density of 16 acres per unit as a standard and projecting over the entire state for the year 2010, the available area for small on-site systems will ac-

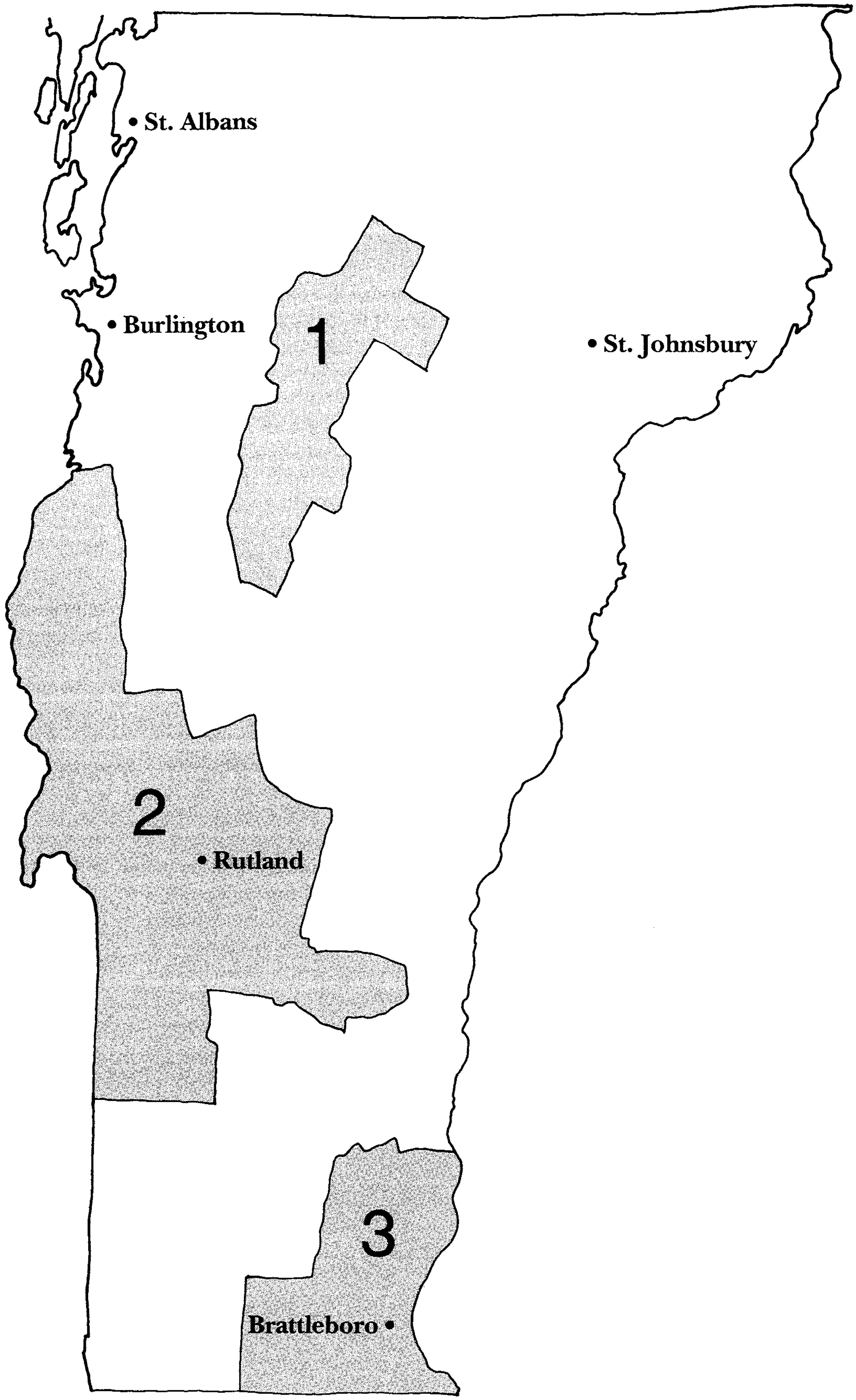
Estimated Cost of Capacity Replacement

MUNICIPALITY	YEAR	CAPACITY INCREASE	APPROX. COST	COST/GAL.	PRESENT VALUE	TOTAL COST PER GAL.
Rutland	1986	2,200,000	$16,000,000	$ 7.27	$ 8.08	$10.83
Bennington	1986	1,100,000	8,300,000	7.55	8.38	11.13
Fair Haven	1988	430,000	2,400,000	5.58	5.89	8.64
Bethel*	1988	115,000	3,000,000	26.09	27.54	30.29
Bellows Falls	1989	900,000	7,000,000	7.78	8.06	10.81
Jeffersonville*	1989	76,600	1,000,000	13.05	13.52	16.27
Windsor	1989	1,000,000	6,900,000	6.90	7.15	9.90
Cavendish	1990	50,000	400,000	8.00	8.07	10.82
Ludlow (pending)	1991	350,000	1,800,000	5.14	5.14	7.89
*New facilities — not in average				**AVERAGE**	**$7.25**	**$10.00**

Costs have been brought to 1991 values by using the construction cost index of the Engineering News Record. *Because collection systems are affected by facility expansions and upgrades, $2.75 per gallon has been added to account for the cost of upgrading the collection system. This figure represents the cost of capital improvements required to handle additional flow within the system, including upgrading pump stations, controls, manholes, etc.*

Source: Dufresne-Henry

Towns Covered by On-Site Interviews



Area 1

Duxbury
Elmore
Fayston
Hyde Park
Moretown
Morristown
Stowe
Waitsfield
Waterbury
Warren

Area 2

Addison
Benson
Brandon
Bridport
Castleton
Cavendish
Chittenden
Clarendon
Cornwall
Danby
Dorset
Fair Haven
Ferrisberg
Hubbardton
Ira
Leicester
Ludlow
Mendon
Mt. Holly
Orwell
Panton
Pawlet
Poultney
Pittsford
Proctor
Redburne
Rupert
Rutland Town
Sherburne
Shoreham
Shrewsbury
Sudbury
Tinmouth
Wallingford
Waltham
Wells
West Haven
West Rutland
Weybridge
Whiting

Area 3

Brattleboro
Dummerston
Guilford
Halifax
Marlboro
Newfane
Putney
Townshend
Vernon
Westminster
Whitingham
Wilmington

commodate 28,423 homes statewide. At 450 gallons per day per unit, the small on-site system reserve is 12,790,350 gallons.

Given current state rules and local zoning regulations, a 20 to 30 percent reduction in the development of small on-site systems is anticipated. These small indirect discharge systems, which currently account for 51 percent of Vermont's sewage flows, will only fulfill about 22 percent of the state's wastewater treatment expansion needs in the year 2010.

New municipal capacity will be urgently needed within the next 10 years to meet existing municipal needs and to help with the rural deficit created by the environmental rules and soil conditions that limit the expansion and development of on-site disposal systems.

Large On-Site Systems

A review of major large on-site disposal systems (those designed and approved to dispose of more than 6,500 gallons of effluent per day) around the state shows that total flows to most of these systems are much smaller than municipal flows, generally less than 1,000,000 gallons per day. Large on-site systems currently contribute 12 percent of the state's daily sewage flows (13,933,620 gallons per day). Private, large on-site reserve capacity is currently estimated at 4,000,000 gallons per day, which translates to 8,888 housing units or almost seven percent of the projected total needed for the next 20 years. Very few of these systems have "uncommitted" capacity.

Between 1987 and 1990, the Agency of Environmental Conservation approved 30 of 44 applications for large on-site system development for a total of 1,236,846 gallons per day of new sewage disposal capacity. The agency believes a similar number will be approved during the next three years; however, the private technical and engineering community in Vermont generally believes that newly adopted Indirect Discharge Rules and pending revisions to the state's Water Quality Rules will greatly reduce the number of large on-site systems designed and approved over the next few years.

Large on-site systems will continue to be developed over the next 20 years, though at a much slower pace. It is projected that these systems will contribute no more than 8 to 10 percent of the state's additional needed capacity by the year 2010.

Those interviewed agreed that the new Indirect Discharge Rules for on-site systems treating more than 6,500 gallons per day would result in even fewer moderate to large on-site systems being approved. It was generally estimated that lower potential acreage would be available in all towns for these larger systems. This is a particularly important fact considering that many of the proposed "affordable housing" complexes depend on moderate-size (6,500 to 15,000 gallons per day) on-site sewage disposal systems.

Use and Capacity: An Overview

The following overview and comparison points to the critical capacity deficit that the state faces. New municipal capacity will be urgently needed within the next 10 years to meet *existing* municipal needs *and* to help with the rural deficit created by the environmental rules and soil conditions that limit the expansion and development of small and large on-site disposal systems. The rural sewage deficit (which refers to capacity needs in areas not served by municipal plants) is projected to be 25 to 30 percent over the next 20 years if regulations remain the same and alternative systems are not explored and approved.

Statewide Wastewater Overview

	1988	2010	Difference
Housing*	258,031	363,066	105,035
Wastewater (mgd)**	116.1	163.3	47.2

**Based on the 1988 Vermont Department of Health estimate of 1.85 percent increase per year in housing units.*

***Based on the state's standard of 450 gallons per day per unit for a three-bedroom dwelling.*

Current Use/ Reserve Capacity Comparison

	1988 use (mgd/%)	1988 reserve (mgd)	2010 needs (%)
Municipal	43.0/37	28.6	68
Small on-site	59.2/51	12.8	22
Large on-site	13.9/12	4.0	10

Estimated 1988 total reserve = 45.4 mgd
Projected 2010 new needs = 47.2 mgd
Difference = 1.8 mgd
Projected sewage capacity deficit if all existing reserves are used = 4%

WASTEWATER MANAGEMENT & THE NETWORK OF REGULATIONS

While managing wastewater might appear to be a matter of identification of available treatment and disposal capacity coupled with the application of proven and reliable engineering technology, it is not that simple. In Vermont, demonstrated capacity and proven technology must first be subjected to regulatory and political processes. No matter how safe and reliable, approval of a system will not be granted unless the applicant has demonstrated compliance with environmental rules and subjective values expressed in a variety of regulatory programs at the state, regional, and local levels.

Virtually all land development in Vermont—from single-family dwellings to large manufacturing facilities—is affected by statutes, rules, regulations, policies, and procedures relating to collection, treatment, and direct or indirect discharge or disposal of wastewater. Different categories of effluent discharges are governed by different regulatory programs. Municipal stream-based discharges are governed by rules and regulations that are based in part on technical criteria and in part on political criteria, and are significantly different from the regulations that govern land-based discharges. Land-based discharges under 6,500 gallons per day are reviewed under different rules and procedures from those that govern land-based systems discharging more than 6,500 gallons per day.

Public buildings are reviewed under one set of rules, while subdivisions and single-family dwellings are subject to a different set of regulations. For example, the same septic system which, for a single-family home can be approved by a Class B site technician (who need not be a licensed professional engineer), must, if it is to serve a public building, be designed and approved by a licensed professional engineer, even though the quantities and components of the effluent and the design of the disposal systems are identical.

The Agency of Natural Resources regulates the collection, transportation, treatment, and disposal of waste from a building's foundation out; the Department of Labor and Industry regulates the collection and transportation of waste from the foundation in. Municipalities often adopt waste disposal ordinances that complement, duplicate, or even contradict state regulations. If municipal regulations contradict state regulations, individuals seeking approval for sewage disposal systems must somehow satisfy both. And even if the Agency of Natural Resources, the Department of Environmental Conservation, the Department of Labor and Industry, and the municipality approve the proposed sewage disposal system, District Environmental Commissions often, under Act 250, reject an approved system because the commissions, which often have no technical expertise, disagree with the state agencies that are expressly empowered by statute to review and approve such systems.

Following is a review of the principal policies, procedures, rules, and regulations that must be followed for an individual or business to obtain direct and indirect discharge permits and be granted access to sewage disposal capacity. It is within this network of rules, regulations, policies, procedures, and subjective interpretations that individuals and businesses must operate if they depend on access to sewage disposal infrastructure and capacity.

Direct Discharges

To obtain approval for direct discharge of sewage effluent, a municipality must demonstrate either that its discharge will enter the receiving waters in an area that is classified as Class C waters or the municipality must petition the Water Resources Board for reclassification of the receiving waters from Class A or B to Class C.

To connect to a municipal system that directly discharges sewage into the waters of the state, a property owner must demonstrate that there is sufficient remaining capacity under the municipality's direct discharge permit to accommodate the antici-

No matter how safe and reliable, approval of a system will not be granted unless the applicant has demonstrated compliance with environmental rules and subjective values expressed in a variety of regulatory programs at the state, regional, and local levels.

Municipalities often adopt waste disposal ordinances that complement, duplicate, or even contradict state regulations.

pated sewage volume. Once it is demonstrated that the municipal facility has sufficient capacity and that the mechanical aspects of collection, delivery, and constituency of the sewage from the owner's property to the municipal sewer system have met state requirements, the property owner may receive a wastewater permit. Only then may property owners connect to the municipal system and "convert" their private sewage to public sewage. (It should be noted that, while ten-acre lots do not require a Subdivision Permit, a municipal system must have permitted, available capacity to accept effluent from any dwelling, even on a lot larger than ten acres.)

The lack of information about the actual assimilative capacity of many of the state's receiving waters limits the ability of both the public and the private sector to ascertain the availability and potential of disposal capacity.

Assimilative Capacity

As part of its permitting mission, the Water Resources Board is required to establish the assimilative capacity of receiving waters. Each river, stream, or lake has a theoretical finite capacity, based on volume and chemical and biological components, for assimilating sewage discharges at a given level of treatment without adversely affecting the public health and welfare. Municipal sewage treatment facilities must be designed and operated to not exceed the assimilative capacity established by the board for various levels of treatment.

Some rivers in Vermont have been evaluated by the Department of Environmental Conservation to determine their assimilative capacity. The lack of information about the actual assimilative capacity of many of the state's receiving waters limits the ability of both the public and the private sectors to ascertain the availability and potential of disposal capacity.

Assimilative capacity also varies with seasonal changes in water temperature and volume, so the capacity of a given stream may be greater in the spring than in the summer. In such cases the proposed discharge will either have to be limited to the minimum assimilative capacity, or the facility will have to be designed to hold the sewage off-stream until greater levels of assimilative capacity are reached.

The total assimilative capacity of receiving waters is critical to the allocation of the resource between competing users. Municipalities seeking direct discharges into the receiving waters and private developers seeking indirect discharge permits into the same receiving waters must be able to demonstrate that their proposed discharges, when combined with existing or planned discharges from other users of the resource, will not exceed the total assimilative capacity.

Accessing Treatment Facilities

Individuals and businesses requiring access to municipal direct discharge facilities must apply for and obtain from the municipality approval to connect to the municipal sewage collection system. Typically, there are two types of approvals required. First, the municipality must approve the physical connection to the system; often the applicant is required to pay an impact fee, sometimes referred to as a "hookup charge."

Second, the municipality must review and approve the volume and quality of the sewage the applicant intends to discharge into the municipal system. As described above, the municipal direct discharge is limited by the state's determination of the assimilative capacity of the receiving waters, and each individual and business that is connected to the municipal system uses a portion of that finite capacity. Before granting approval for connection to the system, the municipality must determine that the design discharge from that particular applicant does not cause the cumulative discharge from all individuals and businesses connected to the system to exceed the design volume of the facility, as approved by the Department of Environmental Conservation.

Before a permit will be issued, the Agency of Natural Resources must determine, to its satisfaction, that there is sufficient design capacity remaining in the municipal treatment plant and that the remaining assimilative capacity of the receiving waters is adequate to accept the proposed discharge. The agency has established criteria that must be met before the municipality can allow a proposed development to be connected to the municipal treatment facility. The agency's review program is administered by the Permits Compliance and Protection Division of the Agency of Natural Resources.

Even though the agency now oversees the municipality's allocation of capacity in its municipal treatment facilities, local governments have recently been given greater authority from the legislature to determine the allocation of their remaining capacity. By July 1, 1990, all municipalities were to adopt an ordinance or bylaw establishing standards and procedures for allocation of municipal wastewater treatment and disposal capacity to different classes of users. Municipalities are also allowed to reserve capacity for different classes of users; they will have significantly greater latitude to promote or inhibit particular types of development depending on planning and growth philosophies rather than on availability of the resource alone.

Conflicts in compliance

The Agency of Natural Resource's Environmental Protection Rules mandate that, whether wastewater is to be discharged into a land-based indirect discharge system or a municipal direct discharge system, applicants for disposal permits must design their proposed systems according to the appropriate design flows specified in the rules. Under another set of rules, the agency permits disposal into direct discharge systems based on the assimilative capacity of the receiving waters. Technically, there is no correlation between the design flows mandated by the Environmental Protection Rules and the assimilative capacity of the stream.

And while the rules and policies of the Agency of Natural Resources make it appear that treatment plant capacity—based on the assimilative capacity of the receiving waters—is the determining factor in allowing private discharges into direct discharge systems, no effective monitoring system exists to evaluate either the components or the volume of private sewage entering direct discharge systems through individual connections.

If it is determined that either available plant capacity or the assimilative capacity of the receiving waters is insufficient to allow connection of the next user to the system, or to provide for anticipated future requirements for sewage disposal for other developments, a municipality may, but is not obligated to, increase its approved discharge capacity. This may be accomplished either by obtaining reclassification of additional state waters to allow the enlargement of the mixing zone, by increasing the degree of treatment the sewage effluent receives and ensuring the removal of inflows and infiltration, or by making major modifications to process operations to allow more flow. The first alternative may, under existing law, be practically impossible; the other alternatives may be prohibitively expensive.

While the irregularities that result from conflicting policies may be resolved by individual review by the agency, the lack of coordination between one set of rules and another creates confusion and results in unnecessary expenditures by both the public and private sectors to resolve the inconsistencies.

The absence of consistent regulatory standards and the lack of a comprehensive commitment to a direct discharge standard contribute to the perception in the private sector that the Agency of Natural Resources has not clearly articulated or effectively implemented its mission to provide cost-effective, environmentally sound wastewater disposal regulations.

Indirect Discharges

Land-based indirect discharges fall into two categories, those over 6,500 gallons a day, which require indirect discharge permits, and those under 6,500 gallons a day, which are governed by the Environmental Protection Rules.

In 1986, the Vermont legislature established that individual systems, or single projects, which require disposal capacity for more than 6,500 gallons per day were to be regulated as indirect discharges to the state waters under conditions and procedures that were to be developed and adopted by the Agency of Natural Resources. New procedures, standards, and technical criteria were adopted by the agency on January 15, 1990. The new Indirect Discharge Rules (IDRs) provide an approval system by which an indirect discharge permit can be obtained, insuring that indirect discharges from systems with the capacity of 6,500 gallons per day or more "will not significantly alter the aquatic biota in the receiving waters."

The IDRs attempt to define and quantify the statutory mandate not to "significantly alter the aquatic biota in the receiving waters." The rules give the agency the authority to determine whether an indirect discharge is in compliance with the aquatic biota criteria through visual (observed stream conditions) and biological (water sampling and testing) evidence.

While the biological evidence is some-

Municipalities are also allowed to reserve capacity for different classes of users; they will have significantly greater latitude to promote or inhibit particular types of development depending on planning and growth philosophies rather than on availability of the resource alone.

what objective, the visual evidence can be very subjective, placing the permittee in the dangerous position of having a permit revoked due to a visual change that may or may not be attributable to his or her discharge.

A Complex Process of Review and Application

To obtain an indirect discharge permit, numerous procedures must be followed. Some of these procedures are relatively simple, in so far as they are established by the rules themselves; others may be considered rules of practice that are not defined by the rules but are well established in the field.

Indirect discharge permit applications must prove by clear and convincing evidence that the project: (1) will not cause a significant alteration of aquatic biota; (2) will be consistent with existing and potential beneficial uses; (3) will create no more than negligible health hazards; and (4) will not violate the water quality standards of the state of Vermont.

Before an application is submitted, the applicant must demonstrate to the Department of Environmental Conservation that it meets certain "reliability criteria," public health protection criteria, and the Vermont Water Quality Standards. The reliability criteria are "those engineering standards necessary for the design, construction, and operation of an indirect discharge collection, treatment, and disposal system necessary to comply with the criterion of posing not more than a negligible risk to public health." The public health protection criteria are essential administrative, design, and operation standards.

To show compliance with the aquatic permitting requirements, an applicant must first submit to the Department of Environmental Conservation a quality assurance/quality control plan (QA/QC) and sampling and testing must be done for site specific compliance. The site check for the QA/QC plan can be expected to take two weeks to one month, though collecting samples will take a significantly longer period. Depending on when the pretesting plan is approved, the applicant should be prepared to conduct pretesting for approximately one year.

The Department of Environmental Conservation has broad discretion to require the applicant to perform more tests and submit new data, and it is not unheard of for the preapplication procedure to exceed two and a half years. Until the applicant has received a "capacity letter" from the Department of Environmental Conservation supporting the hydrogeological work performed and the applicant's conclusion that a certain number of gallons can be discharged per day, it would be imprudent to spend a significant amount of money on engineering. Only after the capacity letter is issued may the permit application begin.

The Department of Environmental Conservation has broad discretion to require the applicant to perform more tests and submit new data, and it is not unheard of for the preapplication procedure to exceed two and a half years.

The procedure for application for an indirect discharge permit is made to the Permits and Compliance Division of the Agency of Natural Resources. Review by the Secretary of the agency, submission to the appropriate town clerk as well as selectmen and town and regional planning commissions, public notice to adjacent landowners and any other "interested parties," and the opportunity for public hearings are included in the process. This procedure may require up to 60 days to complete.

The Course for Adverse Rulings

An applicant denied an indirect discharge permit is entitled to appeal to the Vermont Water Resources Board. The board is empowered to issue an order affirming, reversing, or modifying the Water Resource Department's decision. Such a decision must be issued within 10 days of the conclusion of the hearing. If the board affirms the department's denial of the permit, the applicant must resort to the courts, and has 30 days from the date of the board's order to appeal to the Superior Court in the county where the receiving waters are located. The court is empowered only to review the record of the proceedings before the board and determine whether the board acted arbitrarily, unreasonably, or contrary to law. The court must then issue its findings and order accordingly.

Contradictions in Wastewater Management Policy and Regulations

Act 250 and Indirect Discharges

It should be recognized that compliance with municipal, federal, or other state agency regulations does not automatically result in a finding of compliance with applicable criteria under Act 250. Because the Act 250 Environmental Board provides concurrent jurisdiction with various state environmental agencies (and acts as supervisory body), it is not bound by the approvals or permits given to applicants by other agencies. Thus, such a permit or Certificate of Compliance may conflict with applicable health and Department of Environmental Conservation regulations pertaining to the disposal of wastes. The Environmental Commissions and the Environmental Board are allowed to conduct an independent review of the proposed wastewater facilities of the project. An Act 250 permit may be denied if it is decided that permits were improperly or negligently granted.

Act 200: The Impact on how Wastewater is Managed

In 1988, Act 200 was adopted by the Vermont legislature to provide specific planning standards and incentives for municipal, regional, and statewide growth, land use, and development. Although Act 200 does not mandate a statewide land-use plan, it does strongly encourage the adoption of specific, mandatory planning "goals." Municipalities, regional planning commissions, and state agencies are required to include these goals in their plans.

Among the planning goals included in Act 200 is the requirement that future commercial and residential development occur in, or in close proximity to, "growth centers," including existing villages, towns, and cities. The rationale for this is the belief that services, such as wastewater treatment and disposal, are most cost effective and least environmentally and socially intrusive if they are limited to serving commercial and residential developments, concentrated in growth centers.

As part of the Act 200 process, state agencies are required to adopt plans that are compatible with municipal and regional plans and with the planning goals of Act 200. In view of the legislation's bias toward urban development and against rural growth, one would expect that legislative initiatives and future wastewater management policies and plans would be structured to encourage the development of more sophisticated and effective municipal wastewater treatment plants or the upgrading and expansion of existing plants. Certain state industries that are vital to the state's economic well-being, including recreation, are not located in areas served by municipal sewage treatment facilities. State agency rules and regulations dealing with land-based disposal systems might be designed to encourage larger, more concentrated private land-based systems so that future resort and recreation development would be targeted to areas served by such systems.

However, the statutory and regulatory complexities facing municipalities and private developers create some ambiguity regarding the commitment of the legislature, the administration, or the regulatory agencies to the principles of Act 200.

The problem is compounded by the absence of a well-defined mission statement and an apparent lack of consistent direction for the Agency of Natural Resources. The agency has been allowed to establish its own priorities and objectives, which at times appear to be more concerned with growth management to achieve social and political ends than with the efficient delivery of governmental services to ensure that Vermonters have clean air and water.

The wastewater disposal regulatory system, along with Act 200 and Act 250, must be viewed as a continuum, with each component influencing and being influenced by the other. Expressed or implied policy decisions relating to one component will directly and indirectly affect the achievement of the objectives of the others.

To ensure that reasonable environmental standards are adopted and that Vermonters enjoy a clean, safe, and economically viable environment will require the comprehensive, coordinated, and meaningful planning contemplated by Act 200. Specifically it calls for clearly articulated legislative objectives that are mindful of the Act 200 planning goals, management and leadership from the administration to guarantee that those planning goals are understood and adhered to, and an agency administration that recognizes that social and political issues were addressed by the legislature with the passage of Act 200.

Water Classification and Reclassification

By statute, all waters of the state that have not previously been designated Class

The agency has been allowed to establish its own priorities and objectives, which at times appear to be more concerned with growth management to achieve social and political ends than with the efficient delivery of governmental services to ensure that Vermonters have clean air and water.

C waters are rated as either Class A or Class B and may not be used for direct wastewater disposal. Indirect discharges of 6,500 gallons or more may flow only into Class B and C waters.

At the present time, most of the waters of the state are listed as either Class A or B, and only limited sections of streams or lakes are labeled Class C. When identifying waters available for sewage disposal, those limited sections are known as "mixing zones." Not only must the waters into which sewage is directly discharged be rated as Class C waters, the receiving waters must be shown to have the capacity to receive the anticipated volume of sewage from the treatment facility.

If a municipality wishes to develop a new sewage disposal facility to serve either residential or commercial users, or if a municipality wants to expand an existing direct discharge system, it must first petition the Water Resources Board to have the necessary body of water—the mixing zone—reclassified to Class C. Before the Board can reclassify the section of the body of water, however, it must find that the existing designation of the stream as either Class A or B is *contrary to the public interest,* whether or not the use of the stream for disposal of treated effluent would pose any health or environmental risk.

Meanwhile, any group of 30 or more people may petition the Water Resources Board to upgrade a stream classification from B or C to Class A. In that instance, the Board need only find that the change to Class A is in the public interest; it is not required that it be established that the existing lower classification is *not* in the public interest. In a contested reclassifica-

Public Trust Doctrine

Vermont's Public Trust Doctrine is currently the subject of considerable debate. As generally interpreted in Vermont, the Public Trust Doctrine provides that all navigable waters are held for the benefit of the public by the state in its sovereign capacity, and the legislature must act as the trustee.

The impact of this doctrine on environmental issues such as wastewater management practices will depend on whether the Vermont legislature decides to change the traditional scope of the doctrine. Historically, the Public Trust Doctrine was intended to protect the public's right to use navigable waters for fishing, navigation, and commerce. It did not deal with "environmental" issues.

It has only been within the past ten or 15 years that environmental groups, legislators, and legal writers have suggested that the Public Trust Doctrine be used as a primary tool of the environmentalists. The doctrine has accordingly been broadened in some instances to include issues related to groundwater, wetlands, and discharges of pollutants; in some cases it has been expanded to govern all waters of a state, not just "navigable" waters.

Although in Vermont there is currently considerable regulation affecting public water resources through existing environmental legislation (i.e., subdivision regulations, wetland rules, water quality standards, groundwater rules, Act 250, Act 248), certain individuals and groups are actively lobbying the Vermont legislature to expand the Public Trust Doctrine to become the driving force behind all present and future environmental regulation.

A special legislative study committee, composed of four senators and four representatives, has been given the charge to recommend how the Public Trust Doctrine should be interpreted in Vermont. The discussion of "public trust" issues in the committee has been abstract, legalistic, and rapidly changing in focus. The committee has received drafts from the state, environmental groups, and attorneys representing specific segments of the private sector.

It is unclear at this time whether the legislature will limit the Public Trust Doctrine to issues of public access, navigation, commerce, recreation, and fishing rights, or make it an environmental regulation as well. If public trust legislation goes beyond navigable waters and concerns itself with water quality, the impact on wastewater management in the state could be significant. For example, any present or future wastewater treatment system, whether it serves a single-family residence or a private development, would be evaluated to determine whether it served the "public purpose" and was for a "public benefit or good" before it could be approved. Since all wastewater treatment systems eventually directly or indirectly affect groundwater, streams, or rivers, almost any form of development requiring wastewater systems could be subject to an additional new layer of rules and regulations under the "public trust" canopy. Since the public trust issues tend to be interpreted more subjectively, the process could become *more* costly and time consuming.

tion proceeding, it would be extremely difficult for a municipality to demonstrate that the designation of state waters for drinking or swimming—that is, Class A or B—would *not* be in the public interest. So the legal reclassification requirement reflects a strong bias against the use of state waters for the disposal of treated effluent, regardless of the environmental or health impact.

The difficulty in obtaining the reclassifications necessary for mixing zones may severely limit the ability of municipalities to develop new wastewater disposal facilities or to upgrade existing ones. As a consequence, the mandate in Act 200 to favor development concentrated around village centers over rural development in the municipal, regional, and state agency planning processes may be frustrated by the inability of municipalities to provide cost-effective municipal direct discharge sewage disposal facilities for village centers.

Future Demand for Municipal Systems

The "Current Scenario" section of this report demonstrates that only 37 percent of the state's wastewater treatment demand is met by municipal sewage treatment plants. Of a total of 251 Vermont towns, 84 are served by municipal sewage treatment plants, while the remaining 167 rely almost entirely on individual on-site systems. Sixty-three percent of the state's wastewater treatment and disposal needs are met by on-site indirect discharge disposal methods, of which 51 percent are small on-site systems with capacities of less than 6,500 gallons per day. Many of these small on-site systems pre-date the Environmental Protection Rules and, in a number of cases, those systems may not be providing adequate sewage treatment and disposal.

As a result of ever more stringent regulation of small on-site systems, the lack of acceptable site and soil conditions for on-site systems, and the increasing time and cost of compliance with on-site regulations, approval of new on-site sewage disposal systems will become increasingly problematic.

Meanwhile, Act 250 criteria discouraging scattered rural development and Act 200 planning standards will mean that treatment systems will have to be constructed in, or in close proximity to, existing village centers. This heightens the need for towns to be able to develop new municipal wastewater treatment and disposal facilities.

If Vermont's cities, towns, and intermunicipal districts are to respond to the wastewater management demands created by inadequate or failed subsurface sewage disposal systems and the inevitable growth of their communities, the only economically and technically feasible means for wastewater disposal may be direct discharge to the streams, rivers, and lakes of the state.

To meet current and future demands for improved water quality and to accommodate future growth, municipalities with existing direct discharge systems will need additional disposal capacity. As discussed earlier, such capacity can only be gained through access to additional assimilative capacity in the lakes, rivers, and streams of the state.

It is critical that the public, the administration, and the legislature recognize that, to achieve the level of water quality that Vermonters will continue to demand, the development of direct discharge municipal wastewater treatment and disposal systems may be required.

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Conflicting Permitting Requirements

A recurring problem is the difficulty in complying with both state and municipal regulations. Frequently a municipality will not issue necessary permits until the applicant has received an indirect discharge permit from the state, so applicants are unable to proceed with related planning. The IDRs provide a possible solution to this problem: an applicant may apply for preliminary capacity approval through the Department of Environmental Conservation. The application will require soil, water quality, biological, and hydrogeologic testing information; data on the disposal site; calculations and analyses to determine effluent discharge; and preliminary plans for the layout of the wastewater treatment and disposal system showing compliance with all isolation requirements. A full application must then be submitted within 365 days of the written capacity approval.

The applicant can then provide the capacity approval to the municipality in place of an actual permit, and may then receive the municipal permits before investing substantial sums on engineering designs.

The Consequence of Ambiguity

A consequence of the ambivalence of competing state policies will be that the people of the state will bear the burden of less environmentally sound and more expensive wastewater treatment and disposal alternatives. For example, the current examination of the state's Public Trust Doctrine illustrates the consequence of policy ambivalence. (See "Public Trust Doctrine" on page 16.) If the legislature and the administration are committed to improving water quality, facilitating reasonable rates of growth, and achieving the policy and planning goals of Act 200, they must recognize that all policy decisions are interconnected and that there are public and environmental costs associated with each policy decision. Significant direct, indirect, and cumulative economic, environmental, and social costs arise from decisions to restrict access to and use of public waters.

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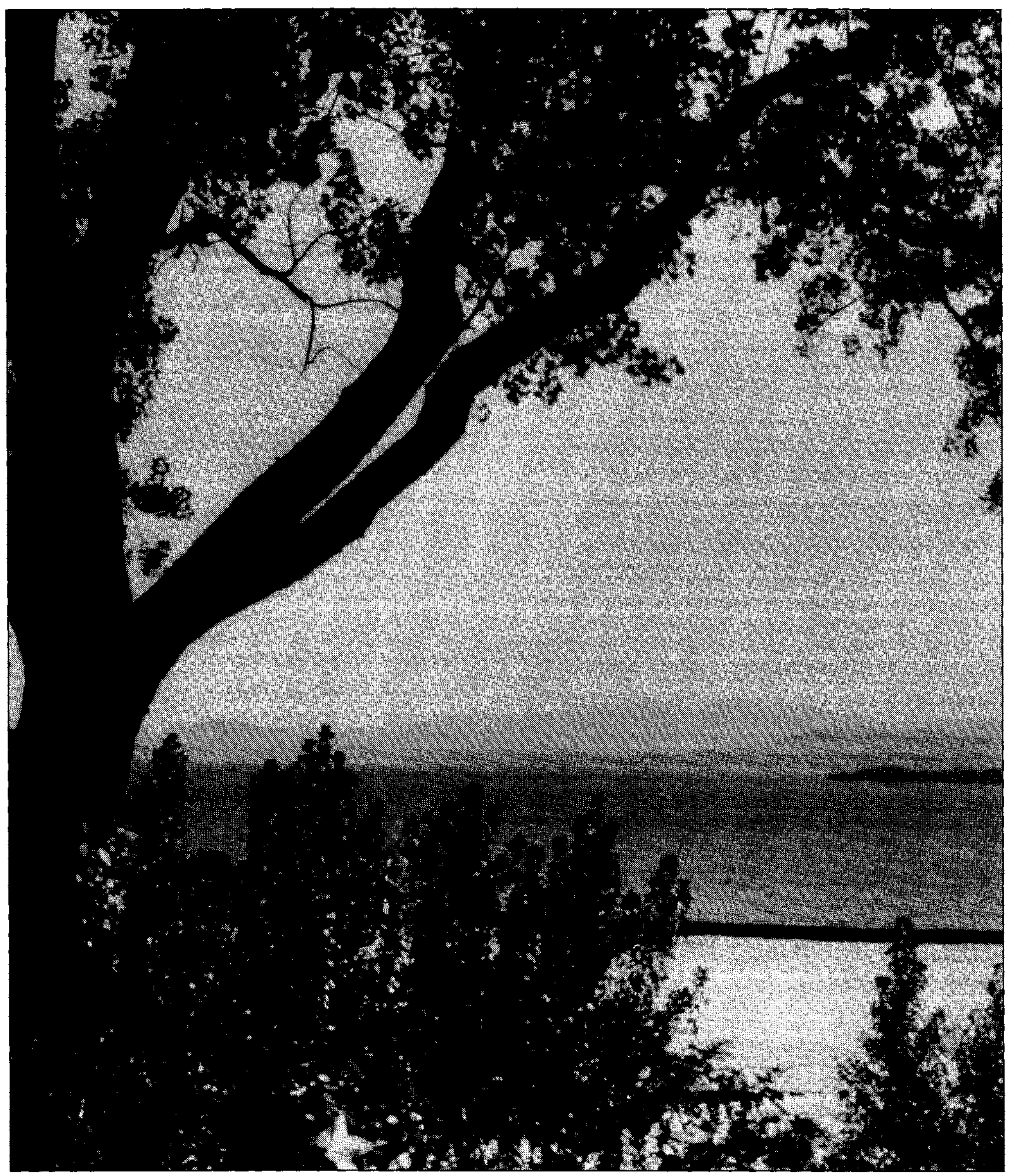

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FACING VERMONT'S FUTURE

Faced with the current picture—the present and projected wastewater treatment and disposal capacity and the prevailing regulatory conditions—it seems clear that we must explore new conservation, treatment, and disposal strategies if we wish to provide suitable capacity for wastewater management while ensuring full protection of Vermont's environment in the future.

Numerous wastewater treatment facilities were built in the 1970s and '80s to provide treatment capacity to last into the late 1990s. As the next decade—and a new century—approach, we must look at ways to meet future needs for small private on-site systems and the larger-scale private and municipal systems. To address these demands, Vermonters can begin to make a difference by practicing careful conservation measures. Changes will need to take place in the regulatory processes, and operational modifications and new construction activity will be required. Many of these new directions will require the examination and pursuit of new and innovative technologies.

Conservation: A Vital First Step

Increasing and improving the capacity for wastewater treatment in Vermont can be accomplished using strategies that involve neither great capital investment nor significant construction. Some of these methods will require public education and participation, including the employment of basic water conservation measures, the installation of water-flow regulating devices, and the implementation of water metering systems and adjusted rate structures.

Water conservation—the use of less water for domestic, commercial, and industrial purposes—is one of the most cost-effective and environmentally sound means of increasing the availability of wastewater treatment capacity because it reduces the amount of wastewater requiring treatment and the quantity of clean water needed.

Water conservation has been shown to reduce the cost of process electricity and chemicals needed in municipal plants. Studies also show that reduced flows contribute to better septic system operation through longer retention times in the tanks and lower hydraulic loading (less water) to leach fields.

Conservation techniques available for most homeowners include repairing leaks in water-using fixtures, replacing fixtures with water-saving devices, operating washing machines and dishwashers only when they are full, and limiting water use in food preparation and hygiene. Industrial conservation techniques include reusing process waters and modifying washing and rinsing techniques. Municipalities can repair leaking mains, initiate and enforce metering, and institute water conservation ordinances and building codes.

Low-Flow Fixtures

Low-flow water fixtures include toilets that use small amounts of water to flush the waste, flow-restricting faucet and shower heads, and dishwashers and clothes washers designed for water-use efficiency.

The use of these fixtures can reduce the amount of wastewater generated in new developments by an average of 20 to 30 percent, allowing for continued community development with a decrease in per capita water use. For example, at least one major Vermont development has incorporated low-consumption toilets in its new construction, reducing water use by more than 30 percent. Many public water systems, as well as electric and gas utilities, have provided incentive programs designed for water conservation using flow-control devices.

The use of low-flow water fixtures is required in all building development and renovation in Connecticut, Massachusetts, Rhode Island, New York, New Jersey, Delaware, Colorado, California, and Washington. Similar requirements could be implemented in Vermont for all new treatment plant and housing construction as well as for replacement fixtures.

We must explore new conservation, treatment, and disposal strategies if we wish to provide suitable capacity for wastewater management while ensuring full protection of Vermont's environment in the future.

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Metering and Rate Structures

The installation of water meters has been shown to decrease water use and wastewater generation. Before New York City implemented a metered water system, water use was excessive and a significant amount of water was wasted. After meters were installed and customers were billed based on actual use, homeowners and businesses became aware of exactly how much water they used—and wasted—and they made changes to reduce the waste and conserve use.

Rate structures that discourage excessive water use, by increasing the cost per gallon as consumption increases, can also help in water conservation efforts. Communities such as Denver, Colorado, and Tucson, Arizona, have found that these progressive water rate structures have led to decreases in water use by 3 to 25 percent.

It is important to note that water conservation measures like those mentioned here do reduce the *liquid volume* of wastewater to be treated, but the mass of pollutants remains the same. New or upgraded equipment might be needed for the higher concentrations in the entering wastes.

The major limitation on the future use of land-based technologies for large on-site systems is believed to be the newly adopted rules on indirect discharges and pending state water quality rules.

Addressing Needed Regulatory Changes

As reviewed earlier, many regulatory processes affect wastewater treatment and disposal. It is likely that changes in some of the procedures would allow more efficient and effective management of the state's wastewater.

Innovation in land-based sewage treatment systems is currently limited by regulations that require that alternative systems only be approved and tested where it can be guaranteed that an acceptable disposal system—one that conforms to current regulations and requirements—can be designed and, if necessary, constructed.

Indirect Discharge Systems

Small on-site systems

The projected future capacity for small on-site systems in Vermont is limited largely because of the soil and site conditions required for approval of system location and design. A critical tool in evaluating potential sites is the percolation test, which determines the rate at which septic tank effluent can be applied to the soil. The results of percolation tests identify the capacity of the location to accommodate the effluent.

Current percolation test procedures, however, give no indication of the actual capacity of the native soils to move water nor do they consider treatment levels beyond septic tanks, which would enhance the performance of the treatment system. The future capacity for small on-site systems in Vermont could be increased significantly if site selection and design procedures considered these two factors. Higher levels of treatment could be provided prior to the final disposal stage, for example, by using a septic tank and recirculating sand filter or constructing a small subsurface-flow wetland. A demonstration project might show that higher quality effluents can be reliably disposed of on smaller land areas and on soils of higher permeabilities than currently permitted.

The costs for field investigation, construction, and operation of these systems would be higher than for the conventional septic tank option, but this approach might significantly expand the limited capacity now available in the state. Other states, such as Oregon and Wisconsin, have tested and approved innovative on-site systems and now have several years of field reliability experience.

Large on-site systems

The major limitation on the future use of land-based technologies for large on-site systems is believed to be the newly adopted rules on indirect discharges and pending state water quality rules. This is unfortunate since these new methods can offer the most positive, reliable, and cost-effective approach to both wastewater management *and* environmental protection.

Land-based treatment concepts are well defined and well understood and are in common use in other parts of the country. Their application in Vermont is essentially limited to the slow-rate process, which often takes the form of sprinkler irrigation on fields or in forests. Overland flow and rapid infiltration land treatment concepts are widely used elsewhere in the U.S., and their combined use in Vermont (as discussed later in this section) could achieve the necessary water quality requirements on a smaller land area than typically used for the slow rate process.

Currently in Vermont, preliminary treatment steps often remove constituents that could be more easily and more reliably removed in the soil ecosystem. Consideration of land-based treatment techniques, and appropriate state permitting, could increase the potential for large-scale indirect discharges in Vermont.

Direct Discharge Systems

Both the volume and the quality of a municipal system's effluent are controlled by permit, which is based on the assimilative capacity of the receiving waters. These factors together determine the design capacity of the wastewater treatment plant, though it is sometimes possible to increase that original capacity.

In most cases, the mass and concentration of pollutants entering the receiving water is more critical than the volume of water discharged. It is therefore often possible to increase the capacity of a system by improving treatment efficiency so a greater volume of wastewater can be treated properly. Treatment efficiency can be improved, to some degree, by modifications to the existing operation or the addition of some new treatment component.

If the municipality hosts industries or large commercial establishments it may be possible to increase plant capacity by adopting pretreatment programs at these operations, thereby reducing the load on the municipal system. Though these steps are typically taken when the treatment plant is originally designed, if the industry can be encouraged to improve performance with a lower-cost procedure, both sides benefit and it may then be possible to expand the capacity of the municipal system.

Other techniques for expansion of municipal capacity might include reduction of infiltration/inflow to the community sewers, separation of storm-water and sewage, construction of additional similar facilities, and replacement of a portion or all of the existing facility with a more efficient process. Recycling "gray water" (dish water, wash water, shower water) in communities and process water in industry can also increase capacity at the municipal plant. Most of these options tend to be costly when done retroactively, but offer significant opportunities when communities or industry face the need for construction of new wastewater management facilities.

Alternative Operation and Construction Strategies

While it is not possible in this report to list and discuss all of the possible alternatives for increasing treatment plant capacity, a few specific examples can illustrate the range of possibilities. All of these strategies involve systems operation or construction, and can apply to either municipal or industrial systems. The use of a particular technology may also fit under one or more of these categories.

Operational modifications for increasing capacity include:

- Replacement of rock media in trickling filters with high-surface-area plastic.
- Modifications to the operation of the oxidation ditch process.
- Enhancement of conventional activated sludge units.

In recent years, trickling filter systems have been upgraded by replacing the rocks used in the filtering process with plastic media, which have as much as ten times more surface area than the rock media being used. In some cases such an upgrade can nearly double the performance of the filters.

In oxidation ditch systems, oxygen is dissolved into the wastewater; complete mixing is accomplished and a relatively high dissolved oxygen level is maintained in the liquid. This produces the expected removal of BOD and typically converts most of the ammonia in the wastewater to nitrate. It has been demonstrated that by manipulating the mixing/aeration devices of the oxidation ditch, it is possible to then remove a large portion of that nitrate by converting it to nitrogen gas, which escapes the system. Since BOD is consumed during this process, the system can achieve higher organic loading than can systems operated in the normal manner. Two advantages accrue: the plant capacity for organic loading is increased and the system effluent contains significantly lower nitrogen concentrations.

Activated sludge systems also use a

Most of these options tend to be costly when done retroactively, but can offer significant opportunities when communities or industry face the need for new wastewater management facilities.

completely mixed aeration tank, with the biological organisms suspended in the liquid rather than attached to the filter media, as in trickling filters. The conventional activated sludge process will remove BOD to the expected level, but the cycle is usually too short, compared to oxidation ditches, for significant conversion of ammonia to nitrate.

A new concept, developed in Europe and Japan and called "high biomass" systems, combines the suspended and attached growth processes in the same tank. In all cases, the media that support the attached growth are inserted directly into an existing activated sludge aeration tank.

One of the most promising approaches is the "Ring Lace" system, which consists of many thousands of feet of polyvinyl chloridene looped string attached to racks that are in the aeration tank. This approach, which was developed in Japan and patented in the U.S., can increase the capacity of the treatment plant and avoid the need for additional aeration tanks or clarifiers. The modified system will typically produce lower effluent BOD and/or higher levels of conversion of ammonia to nitrate. Pilot plant studies are recommended to determine the capacity increase potentially available at a specific location.

Constructed wetlands and "solar aquatics" concepts can also be used as add-on treatments to increase the capacity of existing systems.

Add-On Components

When any treatment system exceeds its design capacity the effluent characteristics will deteriorate and discharge standards will no longer be satisfied. In the past the most common solution to this problem has been to add facilities of the same type to increase the overall capacity of the plant.

An often overlooked possibility is to add a new and different component to the system. This may allow the original system to operate, unchanged, in an overloaded mode with the new component treating or polishing the liquid to the desired level prior to discharge. Add-on devices include a number of filtration systems as well as some of the natural systems discussed in the next section.

One of the most promising filtration type concepts is the biological aerated filter (also know as the biocarbone process in Europe). This single unit provides for both biological stabilization and removal of suspended solids, thereby increasing overall plant capacity.

Rapid infiltration is one natural treatment method that can be used to increase system capacity. Infiltration through natural deposits of granular type soils, which are commonly found in Vermont, will remove BOD and solids to very low levels, remove phosphorus to low levels (depending on the soil type and travel distance), convert essentially all of the ammonia to nitrate, and also remove a significant part of that nitrate.

Constructed wetlands and the "solar aquatics" concept described in the next section can also be used as add-on treatments to increase the capacity of existing systems.

Natural Treatment Solutions

Constructed wetland systems can increase the capacity of existing systems or they may serve as the major component in new systems. A recent national survey has documented over 150 of these systems in use in the United States, and a much larger number being used in Europe.

The term "constructed wetland" means that the system was built specifically for the purpose of wastewater treatment and is not part of a naturally occurring wetland or marsh. These constructed wetlands take two forms. The first is known as the free water surface type, where plants are rooted in suitable soils above an impermeable liner and the wastewater flows through the bed for treatment. The water surface is exposed to the atmosphere. The second type of constructed wetland, the subsurface flow wetland, has a lined bed constructed and then filled with permeable media (usually gravel or rock). The vegetation is planted in the media and the water surface in the bed is maintained below the media surface. Advantages of the subsurface flow wetland include no exposed wastewater, no odors, no mosquitoes, and potentially a greater surface area (on the media) for development of treatment organisms. These systems could be employed for secondary treatment and also installed after a secondary treatment system to further improve effluent quality and increase system capacity.

These wetlands are usually exposed to the environment and subject to the seasonal influences at the site. In Vermont, that would mean continued year-round removal of BOD and solids but only seasonal conversion of ammonia and nitrogen removal. In addition, such wetlands have limited capacity for phosphorus removal. The subsurface flow type has particular advantages for on-site and cluster type developments; since the wastewater is not exposed, the unit could be located almost anywhere on the site. Combined with a septic tank, such a system could provide a high level of treatment prior to disposal to the ground or discharge to the community sewer.

"Solar aquatics" systems treat wastewater using aerated translucent plastic tanks and marsh beds enclosed in a greenhouse with low-cost plastic glazing. This method can be planned to treat almost any type of wastewater, but should be most cost effective for treatment of high-strength wastes (dairy products, food processing, septage, etc.) and where year-round nitrogen removal is required for more dilute domestic wastes.

A "solar aquatics" system has been tested on a pilot scale at the Sugarbush resort. A recent independent evaluation of that effort indicated that the system, with modifications, could be expected to meet tertiary treatment levels for BOD, solids, and nitrogen; a supplemental step would be needed if phosphorus removal were required. Such a system, with necessary modifications, is in operation treating septage in Harwich, Massachusetts; in Vermont a demonstration unit has been constructed in cooperation with Ben & Jerry's at their Waterbury plant.

Flexibility and Solutions

Limitations on wastewater treatment and disposal capabilities in Vermont will commence within the next decade. A significant increase in this capacity is possible without massive capital investment. Solutions must be sought for large and small on-site systems as well as municipal wastewater treatment facilities. New approaches may require some flexibility on the part of regulatory officials, the engineering profession, and the system owners to recognize and accept the advantages of these innovative technologies.

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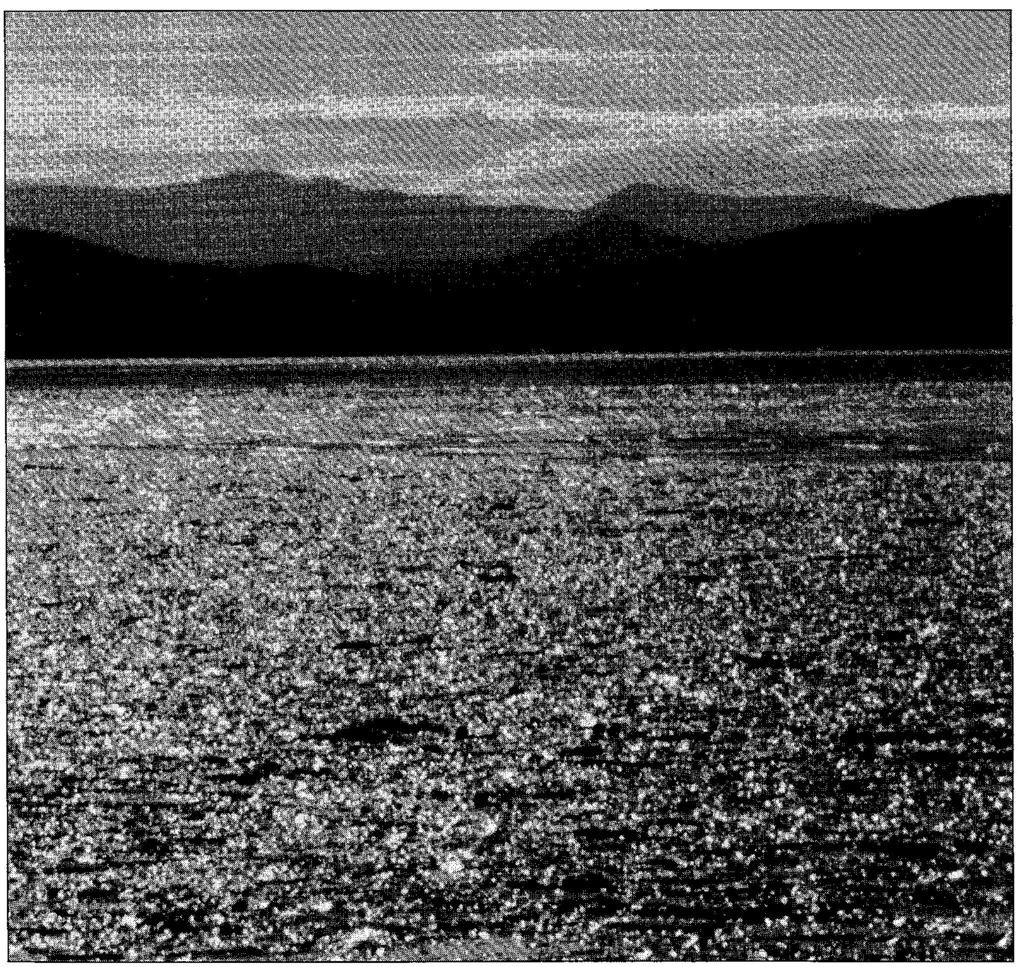


STEPHEN C. CROWLEY

POLICY RECOMMENDATIONS

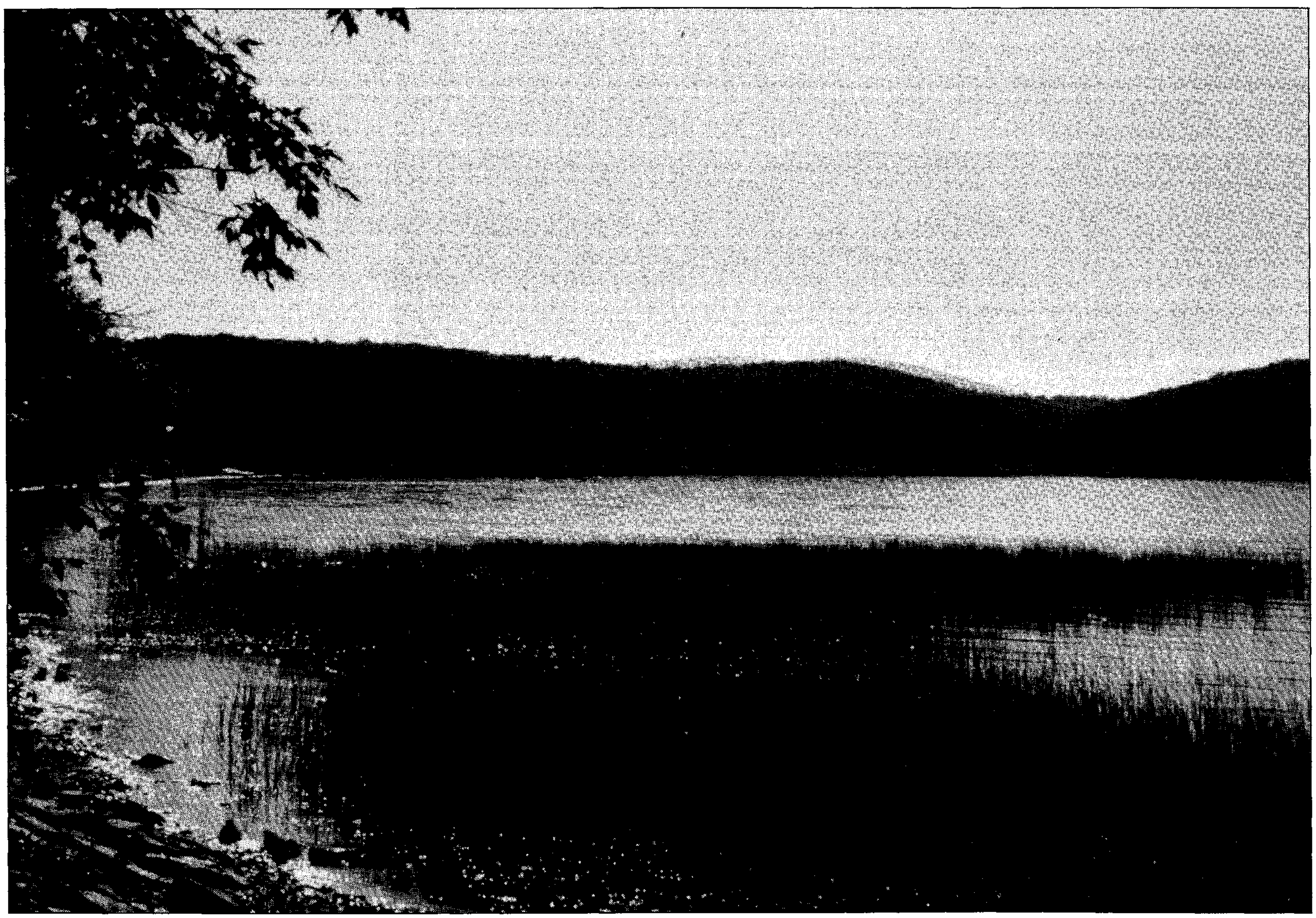
The following policy recommendations are made in the interest of preserving the highest quality and volume of clean water in Vermont while at the same time addressing the needs of a constantly growing population. They are premised on the belief that the continued responsible and controlled use of public waters for the general benefit of the public, including the processing of properly treated wastewater, is consistent with public health, safety, and welfare.

A unified commitment to clean, plentiful water is required to adequately achieve these goals. It is the responsibility of all involved—lawmakers, agency personnel, technical experts, municipal leaders, concerned citizens—to guarantee that the most effective and least expensive wastewater collection, treatment, and disposal strategies are available in Vermont.

It is our hope that these recommendations will provide the basis for ongoing dialogue between the private and public sectors seeking solutions to the compelling problems and issues—environmental, social, political, and economic—of wastewater management in the state of Vermont.

1. Review all wastewater management rules and regulations and develop a unified mission statement and policy objectives for all agencies and personnel responsible for the administration of wastewater management.

- Require that appropriate agencies periodically review rules and regulations and evaluate their effectiveness



VERMONT TRAVEL DIVISION

and timely administration by agency personnel.
- Streamline the regulatory review process by creating a new state licensing category of Environmental Engineers for all private and public engineers who review wastewater treatment systems; authorize these Environmental Engineers to develop plans for small to medium (under 6,500 gpd) wastewater treatment facilities and affirm the substantial compliance of the plans with applicable rules with minimum state review.
- Review the economic and public finance implications of all management rules and regulations.
- Ensure conformance with Act 200 planning goals and with municipal, regional, and state agency plans.
- Require annual agency reporting of the number of filings, number of permits processed and granted, and average time for processing permits by category.

2. Implement strategies and programs to make wastewater treatment affordable to individuals and municipalities, acknowledging that federal funds are no longer available for the development and improvement of public wastewater treatment facilities.
- Develop a comprehensive wastewater fee structure based on estimates and calculations of the full cost of collection, treatment, and disposal.
- Encourage industrial pretreatment where necessary.
- Require state and local governments to undertake and implement capital planning and programming, including capital funding, to ensure that needed wastewater treatment and disposal facilities are anticipated and provided and that towns in particular evaluate their existing facilities on an annual basis.
- Appropriate public funds for operation, expansion, upgrade, and replacement to those facilities with capital plans and budgets in place.

3. Identify and implement conservation strategies to ensure clean water and adequate capacity to treat wastewater.
- Educate the public about the environmental and economic impacts of water use and conservation.
- Establish state and local incentives—for individuals, business and industry, and developers—for installation and use of water conservation devices and technologies to reduce the volume of water that must be treated.
- Require that state grant and loan recipients identify and implement water conservation measures as a condition for receiving funds.

4. Support research and development of alternative and innovative technologies to increase wastewater capacity and provide cleaner water.
- Establish public-private partnerships to explore and implement new strategies.
- Provide incentives for the exploration of innovative solutions and remove obstacles to their testing and implementation.

They are premised on the belief that the continued responsible and controlled use of public waters for the general benefit of the public, including the processing of properly treated wastewater, is consistent with public health, safety, and welfare.

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Bread Loaf Construction Company, Inc.

Martin Miller
Miller, Eggleston & Rosenberg, Ltd.

Gordon P. Mills
Elcon Management Services

R. John Mitchell
The Times Argus

T. Kent Mitchell
House of Troy

Stephan Morse
Grafton Village Cheese Company, Inc.

Elbert G. Moulton
Verbanc Financial Corporation

Lyman Orton
The Vermont Country Store, Inc.

Rudy Pachl
C.J. Van Houten & Zoon, Inc.

Ray Pecor, Jr.
Lake Champlain Transportation Company

Paul A. Perrault
Chittenden Corporation

Edward C. Pike
Kinney Pike Bell & Conner, Inc.

Peter Pollak
Dynapower Corporation

Will Raap
Gardener's Supply Company

Stephen S. Rauh
Rauh & King Inc.

Lawrence H. Reilly
Union Mutual Fire Insurance Company

Paul J. Reiss
Saint Michael's College

Frederic A. Riehl
GW Plastics, Inc.

A. Wayne Roberts
Lake Champlain Regional Chamber of Commerce

Janice E. Ryan
Trinity College

Yoram Samets
Kelliher/Samets Marketing Communications

Barbara Sauer-Sandage
Sandage Advertising & Marketing, Inc.

William H. Schubart
Resolution, Inc.

Charles Shea
Gravel & Shea

Joseph Siliski, Jr.
Siliski & Buzzell, P.C.

Robert Skiff
Champlain College

Stephen R. Stinehour
The Stinehour Press

Kurt Swenson
Rock of Ages Corporation

James Taylor
Medical Center Hospital of Vermont

W. Russell Todd
Norwich University

Eugene Torvend
Champlain Cable Corporation

William H. Truex, Jr.
Truex deGroot Cullins, Architects

Henry M. Tufo
Given Health Care Center

John Varsames
Northshore Development, Inc.

Francis Voigt
New England Culinary Institute

J. Alvin Wakefield
Gilbert Tweed Associates, Inc.

Thomas Webb
Central Vermont Public Service Corporation

J. Gary Weigand
Vermont Yankee Nuclear Power Corporation

Jon Wettstein
Digital Equipment Corporation

William L. Wheeler
William L. Wheeler & Associates, Inc.

Peter Yankowski
Green Mountain Bank

VERMONT BUSINESS ROUNDTABLE

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