Lake Singletary Watershed Association

Wastewater Facilities Plan for the Lake Singletary Watershed

Final Report

July 2000

Submitted by:

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Executive Summary

ES.1 General

Lake Singletary, located in Millbury and Sutton, Massachusetts, has exhibited symptoms of eutrophication including algal blooms, reduced transparency and infestations of nuisance exotic aquatic vegetation. Excessive nutrient loadings resulting from poor wastewater and stormwater practices, seasonal over-use, and the use of nitrogen-rich lawn fertilizers have contributed significantly to the degradation of water quality over the last 50 years. In recent years the lake has experienced significant Eurasian Watermilfoil infestations that have been treated with herbicides for growth control.

Under Title 5 regulations, many old, on-site disposal systems cannot be repaired and an alternative wastewater collection and management plan must be developed for residents living near the lake. Presently, 100 percent of all homes located in the Lake Singletary watershed area use some type of on-site wastewater disposal system.

ES.2 Purpose

The purpose of this study is to develop a 20-year, wastewater collection and management plan for residents of Lake Singletary in both Sutton and Millbury, Massachusetts. The plan considers both present and future wastewater needs, with regards to the available resources. The goal of the new system is to help reduce contaminant loadings to Lake Singletary, while complying with Massachusetts Title 5 regulations.

ES.3 Scope

The project scope includes the following tasks:

- Collection and review of all existing reports and data
- Define existing conditions within the planning area
- Conduct a needs analysis to identify areas having subsurface disposal problems

- Review current watershed protection plan and recommend changes or additions
- Determine existing and future population and wastewater flows and loads
- Delineate areas considered for alternative wastewater management and develop overall plan for the future
- Develop a strategy for integrating the new collection plan into the existing system in Millbury and the Upper Blackstone Water Pollution Abatement District.
- Present project phasing, estimated costs, and funding on a yearly basis
- Prepare conclusions and recommendations

ES.4 Results and Conclusions

A gravity sewer system in combination with low-pressure grinder pumps is the most cost effective method of nutrient load reduction on Lake Singletary. The system will convey wastewater to the Upper Blackstone Waste Water Treatment Facility via the Millbury collection system. The most cost effective method is Alternative 2 (Figure 5-2) in terms of the number of homes served per unit cost of construction. The most practical, in terms of expansion, is Alternative 1 (Figure 5-1).

In both alternatives, Phase 1 and 2 (Chapter 5), are identical, these phases are the most important areas for surface water nutrient load reduction while Phase 3 differs in each alternative. Design and Construction costs for both phases are estimated at $3.4 million. Funding limitations and construction across the town line may dictate the project progression. Phase 1 must be completed before Phase 2 and it also services the lakefront homes located on small lots. The majority of Phase 1 construction will have to be financed by Millbury. Phase 2 resides entirely within Sutton and can be constructed as soon as financing is available after the completion of Phase 1. A tabulation of the project costs are listed on Table ES-1 and ES-2.

Table ES-1
Sutton Loans and Debt Service

Alt. 1	Design/Construction	Buy-in	Annual Debt Service (1)	Treatment (2)	O & M (3)	Total Yearly Expenses	Pop. Served (4)	ERU Cost (5)
Phase 1	$500,000	$0	$25,000	$1,100	$4,000	$30,100	160	$600
Phase 2	$970,000	$0	$48,500	$1,500	$5,800	$55,800	232	$700
Phase 3	$1,150,000	$0	$57,500	$1,600	$6,100	$65,200	244	$800
Totals	**$2,620,000**	**$0**	**$131,000**	**$4,200**	**$15,900**	**$151,100**	**636**	**$700**
Alt. 2	**Design/Construction**	**Buy-in**	**Annual Debt Service (1)**	**Treatment (2)**	**O & M (3)**	**Total Yearly Expenses**	**Pop. Served (4)**	**ERU Cost (5)**
Phase 1	$500,000	$0	$25,000	$1,100	$4,000	$30,100	160	$600
Phase 2	$970,000	$0	$48,500	$1,500	$5,800	$55,800	232	$700
Phase 3	$460,000	$0	$23,000	$1,200	$4,400	$28,500	175	$500
Totals	**$1,930,000**	**$0**	**$96,500**	**$3,800**	**$14,200**	**$114,400**	**567**	**$600**

1) SRF w/ 20-year payback @ 0% financing
2) Based on UBWPAD charge of $0.25/1000 gal with 10% I/I
3) % of O&M cost at Millbury WWTP attributed to Lake Singletary (worst case)
4) Year 2000 population (worst case)
5) Equivalent Residential Unit Cost (ERU) is based on 2.9 people/home (worst case). As development occurs, prices will be spread out over more homes.

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Table ES-2
Millbury Loans and Debt Service

Alt. 1	Design/Construction	Buy-in	Annual Debt Service (1)	Treatment (2)	O & M (3)	Total Yearly Expenses	Pop. Served (4)	ERU Cost (5)
Phase 1	$1,930,000	$0	$96,500	$3,500	$12,500	$112,500	498	$700
Phase 2	$0	$0	$0	$0	$0	$0	0	$0
Phase 3	$473,000	$0	$23,650	$800	$2,100	$26,500	81	$1,000
Totals	**$2,403,000**	**$0**	**$120,150**	**$4,300**	**$14,600**	**$139,000**	**579**	**$700**

Alt. 2	Design/Construction	Buy-in	Annual Debt Service (1)	Treatment (2)	O & M (3)	Total Yearly Expenses	Pop. Served (4)	ERU Cost (5)
Phase 1	$1,930,000	$0	$96,500	$3,500	$12,500	$112,400	498	$700
Phase 2	$0	$0	$0	$0	$0	$0	0	$0
Phase 3	$0	$0	$0	$0	$0	$0	0	$0
Totals	**$1,930,000**	**$0**	**$96,500**	**$3,500**	**$12,500**	**$112,400**	**498**	**$700**

1) SRF w/ 20-year payback @ 0% financing
2) Based on UBWPAD charge of $0.25/1000 gal with 10% I/I
3) % of O&M cost at Millbury WWTP attributed to Lake Singletary (worst case)
4) Year 2000 population (worst case)
5) Equivalent Residential Unit Cost (ERU) is based on 2.9 people/home (worst case). As development occurs, prices will be spread out over more homes.

Section One
Introduction

1.1 Overview

Individual on-lot, wastewater disposal systems have been used for years in unsewered areas throughout the State of Massachusetts. Periodic failures of these systems have resulted in the degradation of groundwater and surface water quality as well as ecological instability. In an attempt to protect public health, safety, welfare, and the environment, on-site disposal systems have been regulated and managed under Department of Environmental Protection (DEP) 310 CMR 15.000: Title 5 Regulations. These new regulations strictly limit repair and construction of cesspools and septic tanks, forcing municipalities to seek alternative solutions to their wastewater disposal needs.

Lake Singletary, located in Millbury and Sutton, Massachusetts, has experienced increased contaminant loadings due to failed wastewater disposal systems, poor stormwater management, and recreational use. Under Title 5 regulations, many old, on-site disposal systems cannot be repaired and an alternative wastewater collection and management plan must be developed for residents living near the lake. Recent reports sponsored by the Lake Singletary Watershed Association (LSWA), an association concerned with the Lake Singletary watershed, have quantified contaminant loadings and developed preliminary management plans for the area surrounding Lake Singletary. The most recent lake management plan, published in May 1995, presented a framework for future developments in water quality improvements for the lake.

1.2 Purpose and Scope of Study

One purpose of this study is to develop a 20-year, wastewater collection and management plan for residents of Lake Singletary in both Sutton and Millbury, Massachusetts. The other purpose is to facilitate the coordination of the project between the towns of Sutton and Millbury. The plan considers both present and future wastewater needs, with regards to the available resources.

The goal of the new system should be to help reduce contaminant loadings to Lake Singletary, while complying with Massachusetts Title 5 regulations.

The project scope includes the following tasks:

- Collect and review existing reports and data
- Define existing conditions within the planning area
- Conduct a needs analysis to identify areas having subsurface disposal problems
- Review current watershed protection plan and recommend changes or additions
- Determine existing and future population and wastewater flows and loads
- Delineate areas considered for alternative wastewater management and develop overall plan for the future
- Develop a strategy for integrating the new collection plan into the existing system in Millbury and the Upper Blackstone Water Pollution Abatement District.
- Present project phasing, estimated costs, and funding on a yearly basis
- Summarize conclusions and recommendations in a facilities plan report

1.3 Previous Investigations

Investigations, reports, and plans reviewed in this study include:

- Lake Singletary Watershed Association, *Water Quality Data, Management Plan and Feasibility Study for Lake Singletary, Sutton, Massachusetts*, January, 1998.
- BETA Engineering, Inc., *Town of Sutton, Massachusetts, Facilities Plan Update Draft Report,* August, 1998.

1.4 Study Area

The Study Area for this report is the Lake Singletary watershed, the homes surrounding the lake, and the proposed collection system between the lake and the existing Millbury collection system. Included within the study area are the towns of Millbury and Sutton, Massachusetts. Both of these municipalities are located in the Blackstone River Valley region of south-central

Massachusetts. Figure 1-1 is an aerial photograph of the study area. Figure 1-2 shows the watershed limits of the lake.

Lake Singletary is a 330-acre, moderately deep, mesotrophic (deep with a steeply sloping basin) lake. Water flows into the lake via 3 unnamed tributaries and a number of storm drains. Water leaving the lake discharges to several smaller ponds and finally into the Blackstone River. The majority of the lake watershed is located in Sutton.

1.5 Area Usage

Currently 66 percent of the 2,645-acre watershed is undeveloped. Undeveloped areas are primarily wooded and open land, including wetlands and the Merrill Lake State Reservation. The shoreline of the lake, however, is densely developed with 157 dwellings located within 300 feet of the lake. This number could grow significantly in the next 20 years if adequate watershed protection management practices are not implemented in the near future. Figure 1-3 is a photograph of the development along the Sutton shoreline.

Lake Singletary is used extensively during all four seasons for swimming, boating, fishing, and ice-skating. Public access is provided by a State boat ramp located in Millbury and at a town beach in Sutton. The boat ramp is used extensively during the summer months. The lake also hosts a number of bass tournaments during the year.

1.6 Geophysical Conditions

Development of an effective wastewater management program requires adequate knowledge of geophysical conditions including soil conditions, hydrology, topography, and geology of the area. The Lake Singletary watershed is situated above the Nashoba bedrock formation that consists of metamorphosed sedimentary rocks (Zen, 1983). The Nashoba formation consists of sillimantic schists and gneiss, amphibolite, biotite gneiss, calc-silicate gneiss, marble, and partly sulfidic (LSWA, 1991). These rocks originated in marine environments during the Ordovician Period, approximately 500-435 million years ago (LSWA, 1991).

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LAKE SINGLETARY AERIAL PHOTOGRAPH

FIGURE 1-1

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LAKE SINGLETARY
EXISTING LAKEFRONT DEVELOPMENT

FIGURE 1-3

Soils in the Lake Singletary watershed were identified using information provided by the Soil Conservation Service (SCS). The most common soils found in the area are type B, fine sandy loam, typically with slopes between 3 and 8 percent. Paxton and Canton are the most predominant soils within the watershed. These soils are typically well drained and have high potential for severe erosion. They also have moderate to severe limitations for septic tank absorption fields.

Topographical information is of particular concern when designing a wastewater collection system. Topography affects the necessity for and location of wastewater pumping stations as well as the possible locations, slopes, and sizes of the pipes. The area within the Lake Singletary watershed is upgradient to the Blackstone River, therefore, it tends to slope from the South to North.

1.7 Lake History

1.7.1 Aquatic Ecology

A wide variety of aquatic vegetation and fish coexist in Lake Singletary. The most recent plant and fish assessments were conducted in 1989 and 1978, respectively. Dominant plant species in the lake include Vallisneria (water celery), Nitella and Chara (macroscopic alga), Elodea (waterweed), and scarce traces of Myriophyllum (Milfoil). In recent years, the lake has experienced significant Eurasian Watermilfoil infestations that have been treated with herbicides for growth control.

The Massachusetts Division of Fish and Wildlife conducted a fish inventory of Lake Singletary during August of 1978. During the survey, 470 fish of 11 different species were collected. Yellow perch and white perch made up 65 percent of the fish population of the lake at the time of the study. Other abundant species included largemouth bass, small mouth bass, bluegill, pumpkinseed and chain pickerel. Historical Fish and Wildlife data indicates that species abundance has fluctuated greatly over time. In 1945, the lake was dominated by pumpkinseed while, in 1911, largemouth bass was the predominant species.

Every year, during the spring season, the lake is stocked with 2,000 9-inch or greater rainbow trout. The pond has, in the past, also been stocked with brown trout, small mouth black bass, pickerel, white and yellow perch, crappie, and blue gills. The popularity of game fishing during the spring and summer months emphasizes the importance of maintaining water quality and dissolved oxygen (DO) levels throughout the lake. Unfortunately, the presence of boats on the lake has an adverse effect on water quality during each fishing season.

1.7.2 Water Quality

Singletary Lake is an important multiple use resource. The LSWA has actively worked towards the management, restoration, and protection of the lake since 1982. Since that time, the water quality of Singletary Lake has been studied in an attempt to identify pollutant sources and develop better watershed management plans for the future.

Historically, the lake has exhibited symptoms of eutrophication including algal blooms, reduced transparency and infestations of nuisance exotic aquatic vegetation. Excessive nutrient loadings resulting from poor wastewater and stormwater practices, seasonal over-use, and the use of nitrogen-rich lawn fertilizers have contributed significantly to the degradation of water quality over the last 50 years.

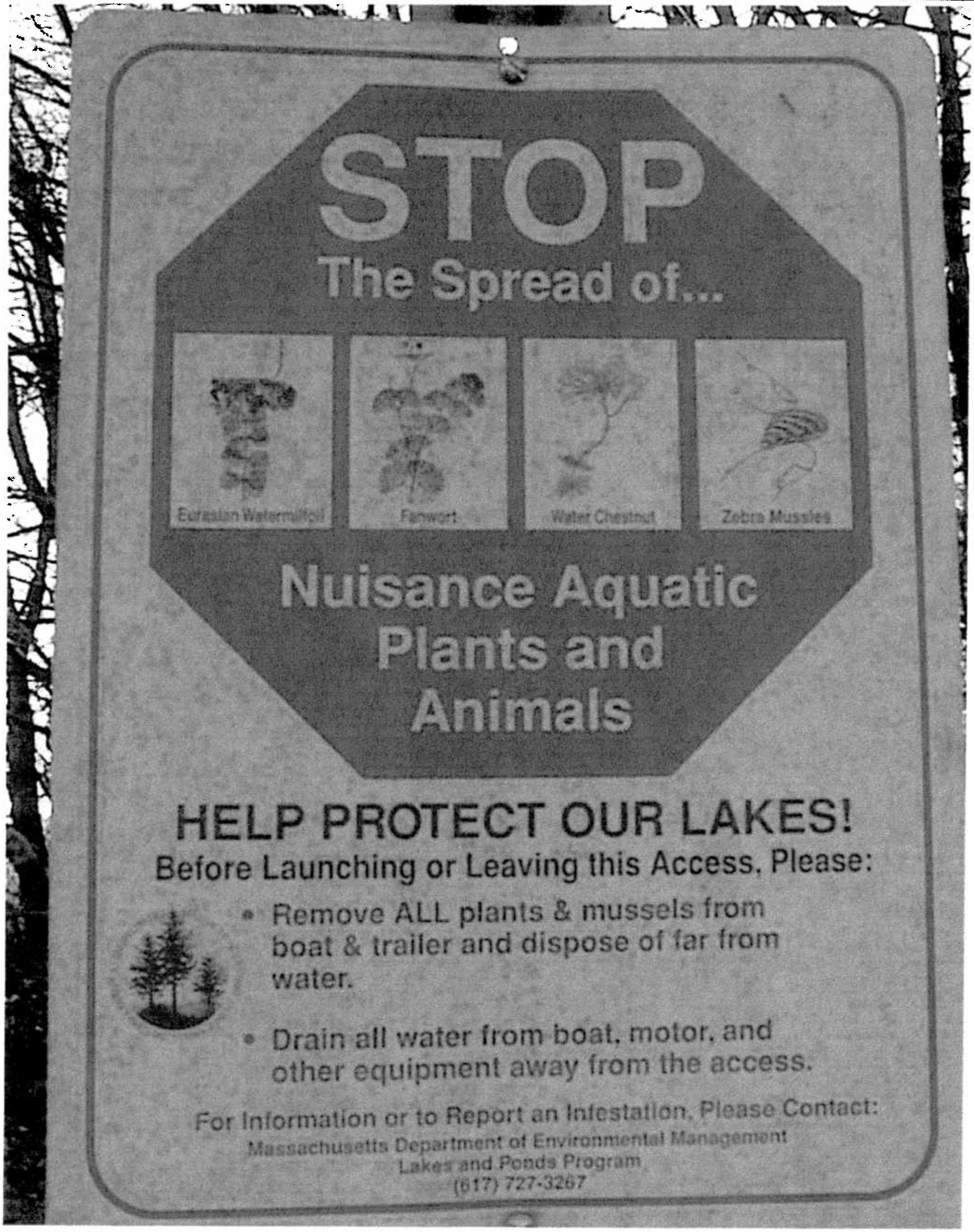
An intensive monitoring program was undertaken in 1984 by the Division of Water Pollution Control (DWPC) to assess the extent and sources of pollution throughout the watershed. The Lake Singletary Watershed Association, between the years of 1994 and 1997, conducted subsequent water quality investigations. These investigations examined clarity, pH, alkalinity, dissolved oxygen, temperature, and phosphorous loadings at eleven (11) sampling stations within the lake. Most samples taken indicate water quality from moderate to poor, with the summer months exhibiting the most unstable chemistry each year.

Considerable drops in dissolved oxygen levels are exhibited each year and present the most drastic, water quality problems for the watershed. In 1997 dissolved oxygen levels for the month of August approached 0 mg/L. This is a significant drop from measurements made just four months earlier of 11 mg/L. Dissolved oxygen data for June, July and August of all three years of the study period show levels to be below 5 mg/L, the minimum amount of oxygen needed to support trout habitat in the lake. The water quality data for these studies have been presented under separate cover, "*Current Water Quality Data for Lake Singletary, Sutton, Massachusetts*" by the Lake Singletary Watershed Association.

Data compiled from the 1984 study reveal phosphorus concentrations ranging from <0.01 to 0.17 mg/L at the surface. This data translates into an average load of 844 lbs / year of phosphorus to the lake. This average is well above both the lake's permissible phosphorus load of 318 lbs / year and its critical load of 635 lbs / year.[1] Under pristine conditions, the average in-lake phosphorus concentrations would have been about one quarter of those observed today. Phosphorus concentrations are expected to grow as more land in the Lake Singletary Watershed area is developed and could increase by as much as 85 percent of the current average.

The Lake Singletary Watershed Association is currently developing sources reduction procedures, where phosphorus inputs are eliminated or minimized at their source. New wastewater, stormwater and watershed management plans should help to lessen the impact of nutrient loadings to the watershed. Figure 1-4 is a photograph of a sign that is part of the recent watershed management plan. Appendix C includes some DEP watershed management plan strategies.

(1) Lake Singletary Watershed Association, *Water Quality Data, Management Plan and Feasibility Study for Lake Singetary, Sutton, Massachusetts, January 1998.*



BETA Group, Inc. Engineers • Scientists • Planners 1420 Providence Highway, Suite 117 Norwood, MA 02062 781 255 1982 fax 781 255 1974 6 Blackstone Valley Place, Lincoln, RI 02865 401 333 2382 fax 401 333 9225 88D Howard Street, New London, CT 06320 860 437 0239 email BETA@BETA-eng.com	**LAKE SINGLETARY** **WATERSHED MANAGEMENT PLAN**	FIGURE 1-4

Section Two
Existing Conditions

2.1 General

The purpose of this chapter is to describe existing conditions within the Lake Singletary watershed that will influence development and bear a direct impact on wastewater management planning. The physical environment including topographic conditions, presence of natural systems (wetlands, etc.), soil conditions, groundwater, and surface water quality significantly influence the rate and location of development, as well as impact the efficiency of on-site wastewater management practices. Finally, the location of the watershed in relation to major economic forces, regional job centers, transportation networks and the availability of public water and sewer services can also greatly influence growth. Factors that were considered in assessing the problems in unsewered areas were:

- Soil suitability for on-lot disposal systems
- Density of housing
- Surface and groundwater quality
- On-site failure rates
- Age of on-site systems
- Depth of groundwater

2.2 On-site Sewerage Disposal

Presently, 100 percent of all homes located in the Lake Singletary watershed area use some type of on-site wastewater disposal system. In 1990, a questionnaire was distributed to 151 homes located within 300 meters of the Lake Singletary shoreline. Sixty-five (47 percent) of the questionnaires were returned completed. Of the respondents, 67 percent used septic tank/leachfield systems, 27 percent used cesspools, and 1 percent used outhouses.

A septic system is comprised of a collection/settling tank and a leaching field. A cesspool consists of an underground collection tank with either single or multiple discharge ports that allow delivery of the liquid portion of the wastewater to surrounding soil. Cesspools were the standard system used prior to 1964. Under current regulations they are no longer allowed, but are still found serving some older homes. Since 1964, most on-site disposal systems have consisted of septic systems. The leaching field allows the liquid portion of the wastewater to discharge to a larger area than the cesspool system, while the septic tank holds most of the solids.

The main purpose of the cesspool and septic tank is to separate the solids from the liquid. These systems reduce the volume of solids through biodegradation. Remaining solids must be pumped out on a regular basis (every 3 to 5 years) to ensure proper operation. Like most communities Sutton and Millbury rely on the individual property owner to maintain and repair their on-site sewage disposal systems. A more detailed description of wastewater management systems can be found in Chapter 4.

2.3 Sutton Zoning

Current zoning regulations for the Town of Sutton include six districts: residential rural (R-1), residential suburban (R-2), business village (B-1), business highway (B-2), industrial (I), and office/light industrial (OLI). All of the area adjacent to Singletary Lake is zoned R-1. Currently R-1 zoning allows for a minimum lot size of 80,000 square feet, which can be reduced to 40,000 square feet with the availability of municipal water and sewer. Many of the homes along the Singletary Lake shoreline were constructed prior to current zoning regulations and therefore exempt from minimum lot sizing requirements.

2.4 Millbury Zoning

Current zoning regulations for the Town of Millbury include twelve districts: suburban 1, 2, 3, and 4 (S-1, S-2, S-3, S-4), residential 1, 2, and 3 (R-1, R-2, R-3), residential office (R-O), business 1 and 2 (B-1, B-2), industrial 1 and 2 (I-1, I-2). The majority of the area adjacent to Singletary Lake is zoned S-1. The Hemlock Drive and Laurel Lane developments are zoned as S-2 and a small section near Brierly Pond is I-1. Currently S-1 zoning allows for a minimum lot size of 60,000 square feet. S-2 zoning minimum lot sizes are 40,000 square feet which can be reduced to 15,000 square feet with the availability of municipal water and sewer. I-1 minimum lot sizes are 80,000 square feet. Many of the homes along the Singletary Lake shoreline were constructed prior to current zoning regulations and therefore exempt from minimum lot sizing requirements.

2.5 Soil Conditions

Determination of the types of soils and their suitability for subsurface disposal systems was based on the United States Department of Agriculture Natural Resource Conservation Service report entitled "*Interim Soil Report for Southern Worcester County*" dated March 1995.

The soil type of a subsurface wastewater disposal system is critical to its ability to function properly. The most important soil characteristic in this regard is permeability. Soils that have a low permeability do not allow sufficient volumes of effluent to infiltrate. This low permeability can cause ponding or back-ups into building plumbing. Conversely, soils with a high permeability generally do not provide adequate treatment of effluent allowing excessive nutrients and bacteria to pass directly into the groundwater.

Soils near Lake Singletary consist largely of rough, stony soils and fine sandy loam combinations. The four most common soil types are Canton, Paxton and Charlton. Table 2-1 summarizes the soil types and amounts around the lake.

The majority of the lake's soils are characterized by their severe restrictions toward the use of subsurface wastewater disposal systems because of inadequate permeability, depth to seasonal high water table, depth to bedrock, or susceptibility to flooding. In most cases, these limitations are too difficult to overcome. This can severely limit the overall development potential. Soils classified with slight and moderate restrictions can generally be developed because the limitations can be addressed with proper site engineering.

2.6 Surface Water Pollution

The small lot sizes, steep slopes and poor soil types found in the developed areas along the northwest and eastern shoreline have created a concern regarding pollution of Lake Singletary by septic system failures. In 1991, a diagnostic study of the lake was prepared for the Lake Singletary Watershed Association. This study showed that water quality was deteriorating due in part to excessive nutrient loading. Fugro East, Incorporated prepared a management plan

Table 2-1

Soil Types in Singletary Lake Area

Town	Class	Type	Approx. Percentage
Millbury	420B	Canton Fine Sandy Loam, 8-15% slopes, extremely stony	75%
	71A	Ridgebury Fine Sandy Loam, 0-3% slopes, extremely stony	10%
	73	Whitman Sandy Loam, extremely stony	10%
	305B	Paxton Fine Sandy Loam, 3-8% slopes	5%
Sutton	407B	Charlton Fine Sandy Loam, 3-8% slopes, extremely stony	25%
	305B	Paxton Fine Sandy Loam, 3-8% slopes	22%
	422B	Canton Fine Sandy Loam, 3-8% slopes, extremely stony	10%
	307D	Paxton Fine Sandy Loam, 15-35% slopes, extremely stony	10%
	307C	Paxton Fine Sandy Loam, 8-15% slopes, extremely stony	8%
	307B	Paxton Fine Sandy Loam, 3-8% slopes, extremely stony	5%
	420B	Canton Fine Sandy Loam, 8-15% slopes, extremely stony	5%
	51	Swansea Muck	5%
	71A	Ridgebury Fine Sandy Loam, 0-3% slopes, extremely stony	5%
	310B	Woodbridge Fine Sandy Loam, 3-8% slopes	3%
	71B	Ridgebury Fine Sandy Loam, 3-8% slopes, extremely stony	2%

feasibility study for the Association in May, 1995 that recommended action for reducing nutrient and sediment loads as well as controlling nuisance aquatic plants. Although no significant bacteriological contamination was identified, it was inferred that the high nutrient concentrations found in the pond are partially derived from failing or inadequate septic systems. Excessive nutrient loading and related plant growth could eventually degrade water quality to a level that affects the recreational value of this resource.

Historically, areas that rely on on-site sewage disposal systems can contribute fecal coliform and excessive nutrient contamination to surface water bodies. The two primary mechanisms by which contaminants are transported to water bodies are surface runoff in areas with a high degree of failing sewage disposal systems and groundwater migration where inadequately treated wastewater passes quickly through the soil.

2.7 On-site Sewage Disposal Concerns

There are two types of failures associated with on-site sewage disposal systems: failure of the system to dispose of wastes, and failure of the system to properly treat the waste prior to entering the groundwater. There are several types of problems that result from these failures. Some problems, such as overflowing septic tanks, are readily detected while others, such as a contamination of a surface water body, are not. Examples of typical on-lot system failures and their related problems are given in Table 2-2.

Disposal failures occur when a leaching field is unable to absorb effluent. This can lead to soil surface breakouts, backup into household plumbing fixtures, and severe odor problems. One of the more common reasons for this is an improper design. Most of the systems constructed prior to 1960 were cesspools or other systems designed using criteria that have since been upgraded to reflect more stringent requirements now believed needed to properly dispose of waste. A minimum leaching area is now required for proper disposal of wastewater, with the size of the area dependent on the type of soil and expected flow. If this minimum area is not provided, the leaching field will eventually become overloaded and the system will fail.

Treatment failure occurs when the wastewater passes through the soil underlying the leaching area so quickly that some contaminants (i.e., pathogens, bacteria, nitrates, etc.) pass directly into the groundwater. Such problems typically occur when soils are coarse sand or loamy sand, or the distance between the bottom of the leaching area and the groundwater table is less than four feet. Coarse soils have rapid permeability, which equates to high percolation rates. This type of failure degrades the quality of the underlying groundwater system, and may jeopardize the public's health by polluting ground or surface water.

The principal wastewater constituents that pass through a properly functioning leaching field are nitrates and phosphates. More than 90 percent of the nitrogen in human waste is not removed in either septic tank or cesspool systems. Nitrogen exists as ammonia, which remains dissolved in wastewater as it percolates through the soil. Phosphates will similarly pass through the leaching

Table 2-2
Types of On-site Failures

Type of Failure	Associated Problem
Disposal Failure	
Blocked pipe	Inability to use bathroom and kitchen facilities
Undersized septic tank/broken baffle in septic tank	Clogged leaching area, overflowing tank and/or odors, surface ponding
Tilted distribution box	A portion of the leaching area clogged, overflowing tank and/or odors, surface ponding
Undersized leaching area	Inability to fully use water facilities in house and overflowing of tank
Treatment Failures	
Coarse/sandy soil	Limited treatment is available and groundwater contamination may occur
Less than 4 feet to groundwater	Partial treatment by the soil in the leaching area and groundwater contamination may occur

field. Through an ion exchange process, phosphates are absorbed onto soils but eventually the ability of the soil to accomplish such removal may become exhausted. Thus, most of the nitrates and some of the phosphates will pass through the soil, enter the groundwater, and eventually reach the surface. Nutrients that reach surface waters can stimulate algae growth and promote eutrophication. In areas where groundwater is used for drinking purposes, nitrates represent a potential health hazard. The drinking water standard for nitrates is 10 mg/L.

2.8 Massachusetts Title 5 Regulations

On-site disposal system design, construction, and maintenance in Massachusetts are managed under Department of Environmental Protection (DEP) 310 CMR 15.000: Title 5 Regulations, which are intended as a means to protect public health, safety, welfare and the environment. Massachusetts Title 5 was initially enacted in 1978. Prior to 1978, many on-site disposal systems consisted of cesspools or septic systems with less than a 1,000-gallon capacity. As of March 31, 1995, Title 5 requires septic tanks with a minimum capacity of 1,500 gallons and prohibits construction or repair of cesspools. Table 2-3 compares the Title 5 regulation as revised in November 1995 with the 1978 Massachusetts code for subsurface wastewater disposal.

In addition to the requirements shown in Table 2.4 for conventional septic systems, new Title 5 regulations require facilities with design flow rates greater than 10,000 gallons per day (gpd), or 2,000 gpd for facilities located in DEP Zone II wellhead protection areas, to adhere to additional requirements. The additional requirements also apply to any land designated by the state as an Area of Critical Environmental Concern. Facilities that generate a design flow rate in excess of 10,000 gpd are required to obtain a groundwater discharge permit and install a wastewater treatment system which treats wastewater effluent to Class I (tertiary) groundwater standards. Facilities located within a DEP approved Zone II area that exceed a flow rate of 2,000 gpd require a recirculating sand filter or some other approved method to reduce nitrogen loading to the groundwater supply. Title 5 also allows for the use of innovative and alternative technologies that provide the same or higher degree of treatment as the conventional Title 5 system.

2.9 Municipal Systems

2.9.1 Millbury

Millbury possesses a municipal sewer system that services 60 percent of the total population. Forty-three miles of gravity sewers are used to transport wastewater to a treatment plant that is owned and operated by Millbury. The treatment plant is designed to treat a maximum of 1.2

mgd and currently receives an average of 0.9 mgd. Flow entering the plant in 1998-1999 had peaks of up to 2.6 mgd. In recent years, Millbury has accepted a proposal to abandon its wastewater treatment facility in favor of pumping wastewater to the Upper Blackstone Regional Treatment Facility. Construction of the pumping station is estimated to be complete by 2003.

This project eliminates the need for Millbury to expand its treatment facility and greatly reduces responsibility for operation and maintenance. Sewer system expansion in both Millbury and Sutton is suspended until the transfer to the UBWPAD is completed. Additional flows from Lake Singletary or any other area cannot be handled at this time.

2.9.2 Sutton

The Wilkinsonville area of Sutton is the only area in Town that presently receives municipal sewer service. This service consists of separate sanitary sewers, which means they are designed to transport only sanitary and industrial/commercial wastewater and not stormwater or surface runoff. The system includes approximately 5,200 linear feet of force mains, 52,000 linear feet of gravity sewer and three pump stations. Flow from the Wilkinsonville service area is collected at the Blackstone Street pump station and is pumped via a force main to the Town of Millbury's wastewater treatment plant. The contractual agreement between Sutton and Millbury allows for flow up to 100,000 gallons per day of domestic sewage and 26,000 gallons per day of industrial sewage. The current average daily flow is approximately 97,000 gallons per day.

Impacts to Sutton appear minimal in that their contract for wastewater disposal would continue to be with the Town of Millbury. However, Millbury has negotiated capacity allotment with Upper Blackstone Water Pollution Abatement District (UBWPAD) in which Sutton is included. It is therefore important for Sutton to identify their future flow requirement so pumping facilities in Millbury can be properly sized and an accurate capacity agreement can be obtained.

Table 2-3

Comparison of 1995 Title 5 and 1978 Regulations for Subsurface Disposal Systems

Provision	*1978 Code*	*New Title 5*
	Setback Requirements for Leaching Area	
Water Supply Reservoirs	100 feet	400 feet
Tributaries to Reservoirs	100 feet	200 feet
Certified Vernal Pools	Not Addressed	100 feet (50 feet if vernal pool is upgradient)
Bordering Vegetated Wetlands, Salt Marshes, Inland and Coastal Banks	50 feet	50 feet (100 feet if wetlands bordering surface water supply or tributary thereto)
Other Surface Waters	50 feet	50 feet
Property Line	10 feet	10 feet
Cellar Wall	20 feet	20 feet
In-Ground Pool	20 feet	20 feet
Slab Foundation	Not Addressed	10 feet (25 feet for septic tank)
Water Supply Line (Pressure)	10 feet	10 feet
Private Water Supply Well or Suction Line	100 feet	150 feet
Public Water Supply Well	100 feet	
--Gravel Packed		400 feet
--Tubular		250 feet
Surface or Subsurface Drains that Discharge to Water Supplies or Tributaries Thereto	100 feet	100 feet
Road Catch Basins, Surface or Subsurface Drains, and Drainage Easements (Subsurface)	25 feet	10 feet excluding foundation drains (50 feet if installed upgradient); 25 feet for leaching catch basins and dry wells
	Design Criteria	
Reserve Area	Area between leaching pits, galleries, or trenches may be used	Area between trenches may be used if greater than or equal to 6 feet apart: new systems shall include a reserve area sufficient to replace the primary soil absorption system
Edge of Fill	Varies with formula	15 feet; maximum slope 3:1
Minimum Design Flow	None	330 gpd (220 allowed if 2-bedroom deed restriction) 3-bedroom home
Minimum Leaching Area	Dependent on percolation rate	Dependent on percolation rate and soil type; for some soils, allows smaller leaching areas than 1978 code; for others, requires larger leaching areas
Leaching Trenches	Minimum width: 1 foot Maximum length: 100 feet	Minimum width: 2 feet Maximum width: 4 feet Maximum length: 100 feet

Table 2-3 (cont.)
Comparison of Revised Title 5 with 1978 Regulations for Subsurface Disposal Systems

Provision	*1978 Code*	*New Title 5*
		Design Criteria
Minimum Septic Tank Capacity	1,000 Gallons	1,500 Gallons
Distance from Maximum Groundwater	4 feet to bottom of leaching area; 1 foot from invert of septic tank outlet	4 feet to bottom of stone underlying soil absorption system if percolation rate >2 min/in, 5 feet if percolation rate <2 min/in
Definition of Failed System	System suffering breakout or backup or deemed to pose public health threat	System exhibiting breakout or backup; cesspools and privies located within Zone I of public water supply wells, within 100 feet of reservoirs or their tributaries, or within 50 feet of a private well, (septic tanks/soil absorption systems in these areas do not fail automatically if the local Board of Health determines the system is protective); cesspools without at least a half-day capacity: system found to be specific health or environmental threat; systems with excessive pumping (greater than 4 times/year); cesspool or leaching system is in groundwater table; septic tank is metal or is structurally unsound; cesspool within 50 feet of surface water bodies or a wetland is found to be unprotected by Board of Health
Large Systems	Defined as systems greater than 15,000 gpd	Defined as systems greater than 10,000 gpd (treatment plant required) or systems greater than 2,000 gpd in well recharge areas or within setbacks for water supplies (recirculating sand filter or equivalent alternative system required). Existing systems over 10,000 gpd must be inspected by December 1, 1996, and reinspected at least once every three years thereafter; those located within Zone II of public wells, within 400 feet of reservoirs, or 200 feet of their tributaries must upgrade to treatment plant within 5-7 years unless the owner demonstrates that drinking water standards are being met
Pumping	Recommended annually	Suggested at least every three years

Table 2-3 (cont.)
Comparison of Revised Title 5 with 1978 Regulations for Subsurface Disposal Systems

Provision	*1978 Code*	*New Title 5*
	Design Criteria	
Upgrade Standard	Required substandard systems be upgraded to meet requirements of code, or get a variance from the Board of Health and DEP	Where no expansion or change of use proposed, standard is "maximum feasible upgrade," with Board of Health approval: considering physical site conditions and economic feasibility; DEP approval needed if system cannot meet groundwater separation or drinking water supply setback requirements, or construction of a basic three-part system
Shared Use	Prohibited	Allowed for upgrade of existing systems, new construction or for increased flow to an existing system; shared systems shall be inspected annually; definition of shared system does not include a condo-minimum unit or units located on the same facility
Nitrogen Loading	Not Addressed	One acre of land required to build 4-bedroom house in: recharge areas of public wells, designated (through Surface Water Quality Standards) nitrogen-sensitive areas and coastal embayments, and new developments served by well and septic system on same lot; no new system in these areas shall receive greater than 440 gpd per acre
Alternative Systems	Case-by-case approval	Proposes systematic approach; approves use of recirculating sand filters, composting toilets, and several aerobic treatment processes to reduce leaching area requirements, or the separation distance to groundwater or an impervious layer
Grandfathering Existing Lots	Not Addressed	If an individual lot was buildable under the 1978 code, but cannot fully comply with the new rules, the same flow, up to a 3-bedroom home, will be allowed if the disposal system application is filed on or before January 1, 2000 and the system is built within three years of the receipt of the permit; a larger house may be built with a higher level of treatment

Sutton will be charged for the transporting of sewage flow from Millbury to UBWPAD for treatment. The fees will include capital costs, operation charges, and maintenance. These costs are discussed with greater detail in Chapter 6.

2.9.3 Upper Blackstone Water Pollution Abatement District (UBWPAD)

The UBWPAD is a group of several communities that are treated by the Upper Blackstone wastewater treatment plant in Millbury. The towns of Auburn, Holden, Rutland, West Boylston, and Worcester currently transport wastewater flows to the treatment facility. Several additional towns are in the district but are not members. There are also a number of towns that have septage agreements with the district for sludge disposal. The treatment facility currently receives an average of 36.9 mgd of untreated wastewater.

Section Three
Population, Flows, and Loads

3.1 General

To properly plan a wastewater system past, present, and future conditions must be considered. Generally a 20-year planning period is used as a parameter in the selection of a wastewater management plan. Wastewater flows due to future conditions account for: potential residential development (build-out), population increases, industrial and commercial development, and extraneous flows not arising from usage (infiltration and inflow).

Future wastewater flows and loadings must be estimated and evaluated to plan for the future needs of the lake. Projected flows are used to design the hydraulic capacity of a proposed collection system. Projected loads are used to properly design or upgrade a treatment system.

The U.S. Environmental Protections Agency (EPA) Cost-Effectiveness Analysis Guidelines and the Department of Environmental Management (DEM) Facility Planning Guidelines require that a planning period for a cost effectiveness analysis to span a 20-year time frame. The planning period for this plan will begin in 2000 and extend to the design year 2020.

3.2 Existing Development

Existing development for the study area is necessary to achieve a good estimation of homes that are generating wastewater. An aerial photograph was used in determining the number of homes in the area, as well as a site visit to assess the number of homes that were built after the photograph was taken. An exact count was not possible due to the limited access on the southwestern side of the lake, so a few estimations had to be made. Table 3-1 and 3-2 show the estimated existing number of homes that are located in the study area. Alternatives and phasing plans are located in Figure 5-1 and Figure 5-2.

Table 3-1

Alternative 1 Estimated Homes Served

	Sutton	Millbury	Total
Phase 1			
Res.	55	120	175
Com.	0	3	3
Phase 2			
Res.	80	0	80
Com.	0	0	0
Phase 3			
Res.	67	28	95
Com.	1	0	1
Total			
Res.	202	148	350
Com.	1	3	4

Table 3-2

Alternative 2 Estimated Homes Served

	Sutton	Millbury	Total
Phase 1			
Res.	55	120	175
Com.	0	3	3
Phase 2			
Res.	80	0	80
Com.	0	0	0
Phase 3			
Res.	43	0	46
Com.	1	0	0
Total			
Res.	178	120	298
Com.	1	3	4

3.2.1 Buildout

Future wastewater needs of the area are directly related to development that will occur during and following the planning period. Buildout is a projection of the maximum number of homes that can be built in the study area if all remaining unoccupied land parcels are developed to the maximum density allowed by current zoning laws. The buildout is used as a worst-case scenario in the design considerations to allow for all possible future expansion. Use of complete buildout assures a useful life of a collection system design beyond the 20-year planning period. Water supply restrictions have not been considered.

The study area encompasses 900 acres of which 330 acres are water surface, leaving a maximum of 570 acres of land available for development. All of the land in Sutton is zoned as rural residential (R-1) with a minimum lot size is 40,000 square feet if public sewer systems are available. The majority of the land in Millbury is zoned as suburban 1 (S-1), which has a minimum lot size of 60,000 square feet. The Laurel Lane and Hemlock Drive subdivisions of Millbury are zoned as suburban 2 (S-2) and allow a minimum lot size of 15,000 square feet with public sewer and water. A small area near Mayo Pond is zoned as industrial 1 (I-1), which allows for a minimum lot size of 80,000 square feet. The minimum lot sizes for Millbury average approximately 40,000 square feet so this was used as an average.

The 570 acres of land allows for the division of 620 buildable lots. Currently, 352 lots are developed and a 20- percent reduction was used to account for roads, leaving 268 lots available for development. The majority of these developable lots are located in Sutton. Due to zoning in Millbury, most of the commercially zoned areas are built out; therefore no additional commercial flow should be added to the system.

3.3 Population

3.3.1 Present Population

Present populations were estimated to predict wastewater flows that will be generated from the study area. An approximate house count was taken using both aerial photographs and a visual count. There are approximately 157 homes that lie within 300-feet of the Lake Singletary shoreline. In addition, there are 191 homes in the immediate vicinity that are likely to impact water quality. Service population will depend on the extent of the future collection system. Two different wastewater management alternatives are shown in Figures 5-1 and 5-2. Additional areas beyond the limits of this study were considered only for design purposes. None of the population projections reflect these areas.

Population estimates are based on the number of current homes presently in the Lake Singletary area. Based on the 1990 U.S. Census, both Sutton and Millbury have an average population density of 2.9 people per house. All of the residential homes in the vicinity are single family and majority of these are small, two bedroom cottages. Commercial establishments were estimated to have an average of 50 employees each. Population estimates for the proposed area are represented in tables 3-3 and 3-4.

Table 3-3

Alternative 1 Estimated Existing Population Served

	Sutton	Millbury	Total
Phase 1	160	498	658
Phase 2	232	0	232
Phase 3	244	81	326
Total	636	579	**1,215**

Table 3-4

Alternative 2 Estimated Existing Population Served

	Sutton	Millbury	Total
Phase 1	160	498	658
Phase 2	232	0	232
Phase 3	175	0	175
Total	566	498	**1,064**

3.3.2 Future Population

Future populations are necessary to predict future demand on wastewater management methods. Populations were based upon the current 2.9 percent annual growth that Sutton is currently experiencing. The population growth in Millbury is lower in that region, so therefore 2.9 percent is used as a conservative number. Tables 3-5 and 3-6 present the population estimates of the study area over the next 20 years.

Table 3-5

Estimated Future Population Alternative 1

	2000	2005	2010	2015	2020
Sutton					
Phase 1	160	184*	184*	184*	184*
Phase 2	232	268	309	356	411
Phase 3	244	282	325*	325*	325*
Total	**636**	**733**	**818**	**865**	**920**
Millbury					
Phase 1	498	575*	575*	575*	575*
Phase 2	0	0	0	0	0
Phase 3	81	94	108	115*	115*
Total	**579**	**668**	**683**	**690***	**690***
Total	**1,215**	**1,402**	**1,501**	**1,555**	**1,610**

* Full buildout occurs

Table 3-6

Estimated Future Population Alternative 2

	2000	2005	2010	2015	2020
Sutton					
Phase 1	160	184*	184*	184*	184*
Phase 2	232	268	309	356	411
Phase 3	175	202	233	243*	243*
Total	**566**	**653**	**725**	**783**	**838**
Millbury					
Phase 1	498	575*	575*	575*	575*
Phase 2	0	0	0	0	0
Phase 3	0	0	0	0	0
Total	**498**	**575***	**575***	**575***	**575***
Total	**1,064**	**1,228**	**1,300**	**1,358**	**1,413**

* Full buildout occurs

3.4 Flows

3.4.1 Present Flows

Present wastewater flows need to be established as a basis to establish existing conditions and predict treatment options. Three basic methods for determining present flows are generally used. The first and most accurate is actual metering of flow in an existing collection system. There is not an existing municipal conveyance system in the Lake Singletary area so this method was not an option. The second method is a review of the municipal water use records for all of the homes that are part of the project. As an estimate, 85 percent of all water that is used in a household is returned as wastewater. Since all of the homes in the area are serviced by private wells, this method was not feasible. The third method is to use historical data from similar communities to estimate wastewater flow (70 gallons/capita/day).

3.4.2 Projected Flows

Existing wastewater flows were estimated using an average of 70 gallons/capita/day based on 2.9 people per household and 50 people per commercial building. Future flows were calculated based upon the population projections in Table 3-5. Future flows are based on 70 gallons/capita/day with an annual growth rate of 2.9 percent. Tables 3-7 and 3-8 contain the estimated present flows that would be discharged to a central collection system.

3.5 Loads

The most commonly used indicators of wastewater strength are five-day biochemical oxygen demand (BOD_5) and suspended solids (SS). BOD_5 involves the measurement of the dissolved oxygen used by microorganisms in the biochemical oxidation of organics over a 5-day period. Suspended solids measurements are used to determine the quantity of sludge that will be removed in the sedimentation phase of wastewater treatment.

Table 3-7

Alternative 1 Projected Flows

	2000	2005	2010	2015	2020
Sutton					
Phase 1 (gpd)	11,200	12,900*	12,900*	12,900*	12,900*
Phase 2 (gpd)	16,300	18,800	21,700	25,000	28,800
Phase 3 (gpd)	17,200	19,800	22,800*	22,800*	22,800*
Total	**44,700**	**51,500**	**57,400**	**60,700**	**64,500**
Millbury					
Phase 1 (gpd)	34,900	40,300*	40,300*	40,300*	40,300*
Phase 2 (gpd)	0	0	0	0	0
Phase 3 (gpd)	5,700	6,600	7,600	8,100*	8,100*
Total	**40,600**	**46,900**	**47,900**	**48,400***	**48,400***
Total (gpd)	**85,300**	**98,400**	**105,300**	**109,100**	**112,900**

* Full buildout occurs

Table 3-8

Alternative 2 Projected Flows

	2000	2005	2010	2015	2020
Sutton					
Phase 1 (gpd)	11,200	12,900*	12,900*	12,900*	12,900*
Phase 2 (gpd)	16,300	18,800	21,700	25,000	28,800
Phase 3 (gpd)	12,300	14,200	16,300	17,100*	17,100*
Total	**39,800**	**45,900**	**50,900**	**55,000**	**58,800**
Millbury					
Phase 1 (gpd)	34,900	40,300*	40,300*	40,300*	40,300*
Phase 2 (gpd)	0	0	0	0	0
Phase 3 (gpd)	0	0	0	0	0
Total	**34,900**	**40,300**	**40,300**	**40,300**	**40,300**
Total (gpd)	**74,700**	**86,200**	**91,200**	**95,300**	**99,100**

* Full buildout occurs

Loading estimations are based on facility records and experience in other Massachusetts communities. Almost all of the present development of the Lake Singletary area is residential and zoning requirements strictly limit institutional, commercial, and industrial development.

None of the existing commercial operations are water intensive. All present and future loadings are based on domestic loads. Five-day Biochemical Oxygen Demand (BOD_5), Suspended Solids (SS), Ammonia (NH_3), Total Kjeldahl Nitrogen (TKN), and Total Phosphorus (TP) are contaminants that are a major concern in wastewater quality. Values listed below are expected to remain relatively constant during the entire duration of the planning period. Total estimated loads are listed in table 3-9. Typical values of medium strength wastewater are as follows:

- BOD_5 = 0.15 lbs/cap/day
- SS = 0.13 lbs/cap/day
- NH_3 = 0.017 lbs/cap/day
- TKN = 0.03 lbs/cap/day
- TP = 0.007 lbs/cap/day

Table 3-9

Estimated Future Loadings

	2000	2005	2010	2015	2020
Sutton					
BOD (lbs/day)	95	110	123	130	138
SS (lbs/day)	83	95	106	112	120
NH_3 (lbs/day)	11	12	14	15	16
TKN (lbs/day)	19	22	25	26	28
TP (lbs/day)	4	5	6	6	6
Millbury					
BOD (lbs/day)	87	100	102	104	104
SS (lbs/day)	75	87	89	90	90
NH_3 (lbs/day)	10	11	12	12	12
TKN (lbs/day)	17	20	20	21	21
TP (lbs/day)	4	5	5	5	5
Total					
BOD (lbs/day)	182	210	225	233	241
SS (lbs/day)	158	182	195	202	209
NH_3 (lbs/day)	21	24	26	26	27
TKN (lbs/day)	36	42	45	47	48
TP (lbs/day)	9	10	11	11	11

SECTION 4
AVAILABLE WASTEWATER MANAGEMENT METHODS

4.1 General

Viable wastewater management alternatives will differ from area to area based on the type of problem, physical conditions, environmental constraints, and cost impacts. Alternatives may include on-lot system construction, central collection, and cluster or package treatment facilities designed to handle wastewater generated from specific neighborhoods. An evaluation of each area must include consideration of the ability of any alternative to reliably achieve the goals of protection of public health and maintenance of water quality. On-site disposal systems must be held to the same standards of treatment and disposal that public sewerage systems achieve.

4.2 On-Site Sewage Disposal Systems

All of the residents in the Lake Singletary Watershed area are currently dependent on on-site disposal systems. Unfortunately, neglect or improper operation on the part of the property owner, along with unsatisfactory site conditions, can lead to early failure of a system, potentially threatening the health of residents and increasing contaminant loadings on the lake.

Failure of an on-site system can be attributed to any or all of the following factors:

- Improper location
- Inadequate sizing
- Hydraulic overloading
- Introduction of large quantities of non-biodegradable solids
- Failure to pump the system regularly
- Improper installation or substandard construction materials
- Adverse activities around the leaching field (i.e. planting trees)

Failed systems must be rehabilitated or replaced to comply with Title 5 regulations. Existing cesspools that fail must be replaced with an approved disposal system since they do not comply with the current Title 5 requirements. On-site system improvements may be achieved by upgrading or replacing existing individual systems or by implementing a shared system serving several homes and/or businesses.

4.2.1 Typical On-site Systems

A typical Title 5 septic system consists of three components: a septic tank, distribution box and a soil absorption system (leaching field). Pretreatment of the wastewater occurs in the septic tank. The distribution box directs the septic tank effluent evenly to the absorption system, which typically consists of trenches containing perforated polyvinyl chloride (PVC) pipe backfilled with gravel.

4.2.2 Innovative/Alternative Systems

The State of Massachusetts allows for the use of approved innovative and alternative treatment and disposal systems as replacements for conventional systems. These systems are becoming more widely used for cost effective upgrades of old failing systems on difficult sites with high water tables, poorly drained soils and restricted area that cannot support a conventional system. They are also used for new construction particularly in environmentally sensitive areas where enhanced treatment is beneficial. The DEP maintains and publishes a list of approved alternative systems. Some of these systems are described below. A listing of approved innovative/alternative technologies and answers to common questions can be found in Appendix A.

4.2.3 Treatment

4.2.3.1 Recirculating Sand Filters

The overall system consists of a septic tank, a recirculation tank, and an underdrained open sand filter. Effluent from the septic tank is collected in the recirculation tank, where it is mixed with effluent from the sand filter. The mixture is periodically pumped onto the sand filter. Overflow from the recirculation tank is directed to a leaching field. Benefits of this system are possible leaching field reduction of 50 percent, a 2-foot reduction in groundwater separation, and nitrogen removal.

4.2.3.2 Ruck System

A proprietary system designed to treat domestic sewage by means of parallel septic tanks, receiving gray water and black water, respectively, a nitrifying sand filter and a leaching field. Effluent from the black water septic tank is nitrified on the sand filter. Effluent from the sand filter is then mixed with gray water promoting denitrification in the leaching field. This system reduces nitrogen concentrations, which will provide benefit to groundwater recharge areas and to regions adjacent to sensitive surface water bodies.

4.2.3.3 AWT Bioclere System

A proprietary system that uses a modified trickling filter concept for wastewater treatment. The filter consists of a bed of highly permeable plastic media where microorganisms are attached and septic tank effluent passes through. The base of the unit serves as a final settling tank that discharges to a leaching field. Nitrified effluent from the settling tank can be returned to the septic tank for passive denitrification. A 50 percent reduction in leaching field area or a 2-foot reduction in groundwater separation is allowed with the use of this system.

4.2.3.4 Smith and Loveless FAST System

A proprietary Fixed Activated Sludge Treatment process that consists of a primary settling zone and an aerobic biological zone. Solids are trapped in the primary. In the aerobic zone, activated sludge attaches to the surface of a submerged media bed, feeding on the sewage as it circulates. Both single home and modular units are available. Use of this system allows for a 50 percent reduction in leaching area or a 2-foot reduction of the groundwater separation. Nitrogen reduction can also be accomplished by adding an effluent recirculation loop to the system.

4.2.3.5 Saneco Intermittent Sand Filter

Intermittent sand filters are beds of medium to coarse sand, 24 to 36 inches deep, to which effluent from the septic tank is intermittently applied. Underdrains collect the filtrate and convey it to the leaching field. Use of this system allows for a 50 percent reduction in leaching area or a 2-foot reduction of the groundwater separation.

4.2.4 Soil Absorption Systems

4.2.4.1 Mound Systems

Mounds are a type of fill system designed to elevate the infiltration surface above wet, slowly permeable natural soil. Natural topsoil is plowed or furrowed to facilitate infiltration. Permeable fill material distributes effluent from a septic tank over a large area preventing excessive clogging and reducing the loading rate on natural soils.

4.2.4.2 Eljen In-Drain System

A proprietary system that consists of panels, each with a cuspated plastic core having channels on both sides, which are completely enveloped by a geotechnical fabric. The fabric is folded around and sewn closed on two edges. Openings at the bottom of each vertical edge of the fabric permit the insertion of a perforated pipe. The system does not require the use of stone.

4.2.4.3 Infiltrator

A proprietary leaching field that is designed for use without stone. The system consists of an open bottom-leaching chamber molded from high-density polyethylene.

4.2.5 Miscellaneous

4.2.5.1 Composting Toilets

Waterless toilets utilize biological oxidation to stabilize and reduce the volume of waste material. A separate septic system must be installed to treat gray water waste streams. Installation of composting toilets is most economically done in new houses. The size of the unit and radical plumbing changes make retrofitting very difficult.

4.2.6 Costs

Typical costs associated with the installation and operation of various on-site components and systems are presented in Table 4-1. For a conventional leaching field, a minimum area of 750 square feet for a 3-bedroom home with soils having a percolation rate of 25 minutes per inch has been used to estimate the cost. Costs will vary with the individual installation and could be considerably higher than those shown in some cases. According to the DEP, engineering and construction costs of an innovative/alternative upgrade to meet Title 5 may range from $6,000 to $40,000 depending on site conditions.

Table 4.1
Costs for On-site Disposal Systems

Description	Capital Cost $ (1)	Annual O&M Cost (2)	Amortized Cost (3)
Systems (4)			
Conventional	6,000	50	650
Recirculation Sand Filter	14,100	75	1,485
Ruck System	13,000	75	1,375
Bioclere-Trickling Filter	11,900	500	1,690
FAST System-Activated Sludge	10,000	150	1,150
Saneco ISF	10,700	170	1,240
Leaching Fields (5)			
Mound System	5,100	---	510
Elgin In-drain	3,800	---	380
Infiltrator	3,800	---	380
Miscellaneous			
Compost Toilets	7,600	200	960

(1) Cost based on ENR index of 5,895 (1998)
(2) Septic tank assumed to be pumped once per 3 years. Power and labor costs included.
(3) Interest = 7-7/8%, system life = 20 years
(4) Includes treatment system and leaching field
(5) Includes replacement cost for field only.

4.3 Tight Tanks

A tight tank system can be considered an option when an existing system cannot be upgraded or repaired to meet Title 5 regulations. A tight tank system consists of a storage or holding tank installed before or after a septic tank to collect the wastewater which eliminates the need to discharge wastewater to the ground. The holding tanks must be sized at a minimum of 500% of the system sewage design but shall have a minimum storage capacity of 2,000-gallons. This creates a necessity for pumping out the stored sewage on a regular basis. Although this alternative is environmentally acceptable and meets Title 5 requirements, the operation and maintenance costs are high due to the frequent pumping. This option should only be considered feasible as a last resort where other options have been examined and eliminated.

4.4 Shared Local Wastewater Treatment and Disposal

Locally shared systems may be a viable option for areas where conventional systems and individual systems are not feasible or cost prohibitive. This type of system requires a parcel of land with suitable environmental conditions such as; soil type, geologic conditions and groundwater conditions, for on-site wastewater disposal located relatively close to the cluster of homes to be served.

4.4.1 Shared Leaching Systems

A shared leaching system is designed to utilize a vacant parcel of land near a group of problematic existing systems that is suitable for wastewater disposal. This alternative is used for existing systems that can accommodate a septic tank, but can no longer effectively use a soil absorption system. Effluent from the existing septic tanks is conveyed to the shared leaching system via gravity sewers or low-pressure septic tank effluent pumping (STEP) systems. Shared leaching systems involve proper facility siting, modifications to existing systems and the creation of a community organization that will be responsible for operation and maintenance of the system.

4.4.2 Shared Treatment and Disposal Systems

Shared treatment and disposal systems can be used where lo t size constraints and environmental conditions make upgrades of both septic tank and leaching fields unfeasible. This alternative includes all of the components of a conventional septic system (i.e., septic tank, distribution box and absorption field). Existing on-site disposal systems are abandoned and the sewage from the existing systems is conveyed to the shared system location via gravity or low-pressure individual grinder pump systems.

4.5 Central Wastewater Collection

Central collection is a structural alternative, which provides the most positive means of removing wastewater from densely developed areas. The types of collection systems available are gravity (conventional), small diameter gravity sewers, and pressure sewers. Each of these systems is explained below.

4.5.1 Gravity Systems

This alternative has been universally employed for collection of wastewater. The system is the simplest concept, in that natural topography is used to allow the wastewater to flow by gravity through a network of pipes to a desired point. There is little maintenance with these systems except for yearly inspection and occasional cleaning and flushing. The systems can be limited by topography, and pumping is required in some gravity systems as an alternative to unreasonably deep sewer construction.

4.5.2 Low-Pressure Sewers

There are two major types of pressure sewer systems: the septic tank effluent pump (STEP) system and the grinder pump system. The major difference between these alternate systems is in the on-site equipment and layout. Neither system requires any modification of household plumbing. In both designs, wastewater is collected via the building sewer and conveyed by gravity to the pumping facility. The on-site piping arrangement includes at least one check valve and one gate valve to permit isolation of each pump from the main pressure sewer. Both systems have the advantage of relatively low capital cost for pipeline construction, as pressure sewers are smaller and shallower than gravity sewers. Because of their shallow depth, pressure sewers may also be constructed more easily in densely developed areas than gravity sewers.

In the STEP systems, wastewater receives intermediate treatment in a septic tank, and the effluent flows to a holding tank. The tank houses the pump, control sensors, and valves required. A small pump, pumps the effluent from the tank to the pressurized system. The primary disadvantage with this system is that the septic tank must still be pumped out periodically, just as with a conventional on-site disposal system.

In the grinder pump system, wastewater from the building sewer flows by gravity to a grinder pump. The pump can be located either inside or outside the building. The grinder pump macerates all solids and the effluent is discharge into the pressurized pipe conveyance system. This system has been used in numerous locations throughout the United States and is considered very reliable. Thus, the grinder pump system is considered a viable alternative under appropriate conditions. These conditions include inadequate space to construct a conventional gravity wastewater collection system and where topography requires isolated areas to be pumped.

4.5.3 Small Diameter Gravity Sewers

Small diameter gravity sewers are used with a septic tank at each individual lot to be served. The septic tank retains solids, which allows the use of smaller diameter pipe. The minimum diameter is usually 6-inches and piping is generally PVC. One disadvantage of this system is the maintenance and pumping of the septic tank at each lot. These systems are most applicable when the effluent needs to be clarified because conveyance is to a common leaching system and where a new treatment plant is to be constructed without facilities for primary treatment.

4.5.4 Pump Station and Force Mains

Pumping stations are typically used in gravity sewer alternatives. Gravity sewer systems collect and transport wastewater from service connections to the treatment facility. Areas within the wastewater collection system that have topographical constraints utilize pump stations and force mains with gravity sewers to transport wastewater to the desired location.

Pump stations must be designed to handle the peak wastewater flow. The costs for pump stations can be a considerable portion of a gravity sewer construction project. Each pump station requires a backup pump, emergency power (generator) and in some cases odor control measures.

4.6 Satellite Treatment Facilities

Treatment facilities in Massachusetts, designed to handle flows in excess of 10,000 gpd and with a land disposal alternative, are required to obtain a groundwater discharge permit. At present, it is not considered feasible to obtain a new surface water discharge permit in Massachusetts, particularly if other discharge alternatives are available. Should design flows exceed 40,000 gpd the DEP requires that redundant treatment units be provided. Treatment facilities exceeding 40,000 gpd become more complex, require more operator attention, and are more expensive.

4.7 Municipal Treatment Plants

Commercially available wastewater treatment plants or "package plants" are sold as prefabricated units or in easily assembled components. They are available with capacities up to 1 mgd, but are not commonly used for flows of greater than 200,000 gpd. These units have higher manpower requirements associated with their use than other community systems. Daily attention is required, and anything less will result in an inefficient operation. Although these systems are capable of providing nitrified/denitrified effluents, it is assumed that some level of nitrification and phosphorus removal will be required, but denitrification will not be required.

With consideration to the large number of treatment alternatives available, a screening level evaluation was conducted to include those alternative technologies that have a history of use in similar applications, have gained regulatory approval, have reliably met discharge limits, and are comparatively cost effective. Alternative treatment technologies considered in this study include fixed activated sludge treatment (FAST), rotating biological contactors (RBC), and sequencing batch reactors (SBR).

4.7.1 Municipal Treatment Methods

4.7.1.1 Fixed Activated Sludge Treatment (FAST)

The FAST system is a submerged aerobic fixed film process using corrugated PVC media as the site for microbial growth. Airlifts are used to circulate and transfer oxygen into the tank contents. The completely mixed process provides high-rate circulation and oxygen to the microbes. Sludge settles and is stored in a zone below the media. Separate clarifiers are not required. The complete treatment system will include anoxic tanks, FAST units for biological treatment, ultraviolet disinfection, and effluent disposal to a ground discharge site. Liquid sludge is treated off-site at an incinerating facility.

4.7.1.2 Rotating Biological Contactors (RBC)

A RBC is a fixed film biological reactor consisting of plastic media mounted on a horizontal shaft placed in a rectangular tank. Common media forms are disc-type made of Styrofoam and a lattice-type made of polyethylene. While wastewater flows through the tank, the media, which is 40% submerged, is slowly rotated to provide contact of the biofilm that develops in the media with the wastewater. Rotation results in exposure of the film to the atmosphere and serves as a means of aeration. Excess biomass sloughs off by rotational shear forces.

The overall treatment process may consist of primary settling tanks, a flow equalization basin, RBC's, secondary clarifiers, and ultraviolet disinfection. Sludge produced would be stored in an aerated holding tank. Liquid sludge would then be trucked off-site.

4.7.1.3 Sequencing Batch Reactors (SBR)

A SBR is a form of the activated sludge process, which is the most widely accepted biological treatment method. It consists of a concrete tank, approximately 15 to 18 feet in depth, where mixing, aeration, and sedimentation occur in various stages for a specific volume of wastewater.

Wastewater flows into a basin during a fill stage. This stage overlaps a mixing stage and a mixing/aeration stage which both occur while the filling of the basin continues. Once the basin is filled, mixing and aeration continue such as in an aeration tank. Organic material contained in the wastewater is used by microorganisms, as a source of food and energy, to support their metabolic functions. Growth of the desired microbial populations is encouraged by maintaining aerobic conditions. Waste material is converted to new cells, which settles out during sedimentation as in a secondary clarifier. This is followed by a decant stage where treated wastewater can be recycled for additional treatment or continues for disinfection and discharge. Excess sludge is collected in a sludge holding tank and disposed.

Section Five
Alternatives Analysis

5.1 General

Two general alternatives are feasible for the improvement of wastewater treatment in the Lake Singletary watershed. The first is upgrading on-site systems and the second is shared community wastewater collection, treatment, and disposal. Satellite treatment was considered, however, it was cost prohibitive and therefore was dropped from consideration. Chapter four contains a detailed list of the individual systems.

5.1.1 On-Site Systems

Only a few of the available on-site systems are applicable to this project. High groundwater, small lots, and close lake proximity make meeting Massachusetts Title 5 regulations nearly impossible for homes located on the lake shoreline. For many of these small lots, a tight tank or an excessively high mounding system would have to be installed. Mounding of up to seven feet may be required to meet regulations. A tight tank system is effective but it must be pumped out frequently, making it inconvenient and expensive to maintain.

Prices for new on-site treatment systems range from $10,000 to $20,000 for each septic system upgrade (if possible). If all 157 homes within 300 feet of the lakefront were to upgrade their system to meet current Title 5 regulations, costs would be approximately $2.3 million. Upgrades to the septic systems would not eliminate nutrient loadings to the lake.

5.1.2 Community Collection

Another method of wastewater management is a community collection system that transfers wastewater to a central location for treatment. Topography of the study area and the location of the homes make a gravity/low-pressure system a viable alternative. Low-pressure grinder pumps can be used, at all of the homes that lie at a low elevation, to pump through a low-pressure main up to the nearest gravity main.

Grinder pumps are capable of pumping against many feet of head and are relatively inexpensive. Two types of units are currently available. The outdoor unit is installed underground near the existing septic tank or cesspool. A small control panel is installed inside the home. The indoor unit can also be installed in a basement and it is self-contained. Each unit is approximately one horsepower and uses little energy. Installation of the pump and the 1-¼-inch service will be on private property and may have to be paid for by the homeowner.

Collected wastewater would be transferred to the existing Millbury collection system. From there it would be pumped to the Upper Blackstone Wastewater Treatment Plant for proper treatment.

5.2 Alternative Analysis

5.2.1 Alternative 1

Alternative 1 represents a wastewater management plan that uses a combination of gravity sewer mains with a grinder pump/low-pressure sewer system. Due to favorable land contours, a gravity main can be installed starting from the existing manhole on West Main Street in the Bramanville section of Millbury up to McGrath Road. The gravity main could be run along Singletary Road, but because most of the homes along the lake will require grinder pumps, the additional expense of excavation involved in a gravity system would not be justified. Another gravity main can be installed from Tuttle Road to the same existing manhole in Bramanville. Houses along the lake and at low elevations will receive a grinder pump that will discharge to the gravity main. Figure 5-1 shows the pipe layout and sizes for this alternative. All of the flow will be transferred to Millbury's present wastewater collection system.

Phasing of each alternative has been shown to break up the total project cost up into smaller sections. Phase numbers represent priorities of the construction sequence with Phase 1 being the most important. One, two, or all three phases can be placed under the same contract if funding is available.

Alternative 1 offers the possibility for elimination of most septic tanks in the immediate Lake Singletary area. Phase 1 will allow the densely populated northwest section of the lake shoreline to be serviced as well as West Main Street. Many of the low lying homes along the lake shore will need grinder pumps to pump their wastewater up to the gravity main. Grinder pumps cost approximately $2,700 each. Installation and tie in costs are extra, and are usually provided by the homeowner. The low-pressure system on Winwood Road will provide service for the remaining northern section of the lake. An additional development is presently being considered in the area to the southwest of West Main Street. This development will be able to tie into the gravity sewer at the intersection of West Main Street and McGrath Road. Phase 1 will offer elimination of on-site treatment for approximately 70 lakefront homes with on-site systems.

The Ramshorn Pond area is also considering a wastewater management plan. Sewage that is generated from this area can be pumped up West Main Street to the end of the proposed gravity main in Phase 1. The proposed pipe size will have enough capacity to handle the entire area.

Phase 2 consists of a low-pressure system around the southern tip of the lake. Approximately 90 homes will be served by this phase. Every home will be provided with a grinder pump that can either be installed underground or in a basement. Final discharge of the low-pressure system will be at the end of the gravity main from the Phase 1 construction on West Main Street. This phase will eliminate approximately 75 lakefront homes from septic system discharge.

Phase 3 is not critical to the nutrient loading on the lake. Only a small portion of Singletary Avenue and all of Tuttle Road are located in the watershed. The cost of this phase is very high for the number of homes served. The advantage of this phase is the large number of people that will have the potential to be served in the developed areas in Millbury and the availability of sewer service to all of the homes on Singletary Avenue. This phase also allows for expansion of sewer service to Sutton Center, which contains Sutton's municipal buildings. Future expansion of the system can also include the middle and high schools and the rest of Boston Road.

5.2.2 Alternative 2

A gravity sewer system in combination with low-pressure grinder pumps is the most cost effective method of nutrient load reduction on Lake Singletary. The system will convey wastewater to the Upper Blackstone Waste Water Treatment Facility via the Millbury collection system. The most cost effective method is Alternative 2 (Figure 5-2) in terms of the number of homes served per unit cost of construction. The most practical, in terms of expansion, is Alternative 1 (Figure 5-1).

Phase 3 in Alternative 2 represents the lowest cost alternative for providing sewer service to all of the lakefront property. A low-pressure system would convey all of the Tuttle Road flow to Winwood Road. The advantage of this phase is the minimal amount of effort that is required as compared to alternative 1. The disadvantage is the limited expandability of the system.

If this alternative is selected, a parallel low-pressure main must be placed along side of the Phase 1 Winwood Road low-pressure main. Additional construction costs would only be minimal. Two different mains are necessary, because if the Phase 1 low-pressure main is sized to handle flows from Phase 3, delay or absence of Phase 3 will cause odor problems in the discharge manhole due to excessive retention times.

5.3 Construction Timeframes

Exact dates for the construction of the proposed wastewater facilities are impossible to predict. Completion dates of the pump station from Millbury to the UBWPAD and the availability and quantity of funding are not known. Table 5-1 lists estimated timeframes for construction.

Table 5-1

Estimated Construction Timeframes

Alternative 1			Alternative 2		
Phase 1	Phase 2	Phase 3	Phase 1	Phase 2	Phase 3
6 months	4 months	5 months	6 months	4 months	2 months

5.4 Remaining Homes

The homes that are not serviceable by either of these alternatives (i.e., homes at the opposite end of the watershed) do not have a large impact on the water quality of the lake. Most of these homes have adequate lot sizes to maintain an effective on-site disposal system. The cost per home would be too high to justify construction.

The homes on Hutchinson Road are recently constructed and lie on more than adequate lot sizes to accommodate Title 5 compliant systems. Homes in the Merrill Pond Wildlife Management Area are not cost effective to service and also have adequate land for on-site treatment. If future consideration for wastewater management is seriously considered for these homes, an additional, empty low-pressure pipe should be run next to the proposed pipe on Sutton Road. Costs for this extra pipe are extremely minimal and allow for expansion of a grinder pump system to that area. The empty pipe can be tied into when expansion of that area is complete.

5.5 Responsibility and Ownership

Responsibility and Ownership of the new collection system must be considered. Sutton and Millbury must come to an agreement concerning the maintenance of the proposed collection system. Maintenance can either be provided by Sutton or Sutton can pay Millbury to maintain the collection system that lies in its boundaries. An agreement should be made before plans for construction begin.

Responsibility for purchasing and installation of grinder pumps should also be determined. Generally the Town(s) purchase and deliver the pumps but installation and maintenance costs are left up to the homeowner. If ownership of the grinder pumps is transferred to the homeowners there will be no need for town personnel to continuously monitor or maintain the pumps in the future.

5.6 Applicable Permits

Alternatives 1 and 2 will require permits to be obtained prior to construction. The following is a list of the necessary permits:

- Sewer Extension Permit
- Road Opening Permit
- Notice of Intent (NOI)
- Expanded Environmental Notification Form (ENF) or Environmental Impact Report (EIR)

Sewer Connection/Extension permits are issued by the Massachusetts Department of Environmental Protection (DEP), Division of Water Pollution Control. It is required for sewer extensions and new connections to an existing sewer system. The permit must be obtained from the DEP and endorsed by the towns.

For work in the towns' roads, a road opening permit may be necessary from each Towns' Department of Public Works. In addition, Massachusetts law requires that Dig Safe be notified 72 hours before construction begins (excluding Saturdays, Sundays, and holidays).

A NOI may be required from each town's Conservation Commission due to the close proximity of construction to the lake.

Appendix B is a listing of the Department of Environmental Protection (DEP) 310 CMR 11.03 regulations. Section 5, Part 4 states that "New sewer service to a municipality or sewer district across a municipal boundary through New or existing pipelines, unless an emergency is declared in accordance with acceptable statutes and regulations". This is "categorically included" because it is crossing a municipal boundary, so an EIR officially required. However, an expanded ENF or an EIR waver may be obtainable with approval from MEPA.

Section Six
Financing

6.1 General

This chapter discusses the estimated costs and financing alternatives for the recommended wastewater management plan. Costs that must be considered include construction (capital) expenses, treatment costs, UBWPAD buy-in charges, operation, maintenance, and future upgrades. All costs must be considered before estimated charges and loan repayment strategies can be estimated.

6.2 Funding Options

In Massachusetts, funds for financing construction of wastewater treatment and collection facilities have been commonly raised from a combination of sources:

- Federal and State grants and loans
- General obligation bonds
- Betterment assessments and service charges

SRF - The Massachusetts State Revolving Fund (SRF) program provides subsidized loans to Massachusetts communities for the design, construction, and/or upgrade of wastewater treatment and collection facilities. The SRF program is administered by the Massachusetts Department of Environmental Protection. The current loan interest rate through the SRF is zero percent.

The SRF program receives funds from three sources:

- Capitalization grants from the US Environmental Protection Agency
- Capitalization grants from the State of Massachusetts
- The sale of tax-exempt revenue bonds

The program structures subsidized loans to fund construction and long-term financing for projects. To obtain SRF funding, a Town must receive approval of the Facility Plan from MADEP, complete an SRF Loan application, and have the necessary bonding authority to ensure repayment of the loan.

Probability of award for SRF loans depend on the number and size of loans that are needed from other Massachusetts communities in the tier of application. Award probability is increased because the project would benefit two towns and because of the active investigation and presentation of need such as the Water Quality Data, Management Plan, and Feasibility Study (January 1998), the Sutton Facilities Plan Update, and this report.

USDA Rural Development – The United States Department of Agriculture (USDA) offers loans and/or grants to communities with populations under 10,000 for water and waste disposal systems in rural areas and towns. Sutton may qualify for this program because of its small population. Information in regards to this program is located in Appendix E.

General Obligation Bonds - are certificates of debt, issued by a Town, guaranteeing payment of the money borrowed plus interest, according to a pre-defined payment schedule. General obligation bonds are repaid with proceeds from real estate taxes. All or a portion of the construction cost could be funded through general obligation bonds, depending on the benefits that the project has to all the Town's residences.

Betterment Assessments - are assessments placed on the property that abuts the sewers or directly benefits from the construction.

Recommended Funding Options - Given available sources of funding, it is recommended that the Town pursue funding for treatment plant improvements using the SRF program. The Town can borrow money from the SRF program at a zero percent interest rate. Repayment of the loan would be guaranteed by user fees.

The USDA Rural Development Loan/Grant program should be investigated further. Grants or loans may be able to be secured under this program.

6.3 Construction Costs

Construction costs include installation of gravity pipe, manholes, service to the property line, and low-pressure sewer main. Costs also include rock removal based on 20 percent of the total excavation on the southern and eastern sides of the lake and 10 percent of the total excavation on the western and northern sides of the lake. Prices may vary due to the actual amount of rock present in these areas. Costs also include the purchase and delivery of grinder pumps to all homes that will require them. Construction costs do not include installation of grinder pumps, low-pressure connections, or gravity services on private property.

Tables 6-1 and 6-2 list construction, engineering, and contingency costs for implementing the proposed wastewater management plan. Twenty five percent of the construction cost was used as an estimate for design and 10 percent of the construction costs were used for contingiencies.

6.4 Operation and Maintenance Costs

Operation and maintenance costs include sewer main cleaning, repairs, pump station maintenance, electrical consumption, treatment, and sludge removal. The majority of the additional budgeted money will be allocated to Millbury, because the flow generated will eventually end up in their system. A small amount of money must be set aside for Sutton to maintain the new system.

Currently an agreement exists between Millbury and Sutton to handle the wastewater flows generated in the Wilkinsonville area of Sutton. The agreement states that Sutton will pay for a percentage of Millbury's operation and maintenance costs equal to the percentage of the total flow received at the treatment plant that is generated by Sutton. Operation and maintenance costs for Millbury are now approximately $450,000 and additional flow from Lake Singletary will increase it. Flow generated from Lake Singletary will be approximately 85,000 gpd and total flow to the Millbury treatment plant averages 900,000 gpd.

Table 6-1

Alternative 1 Estimated Project Costs

	Sutton	Millbury	Total
Phase 1			
Construction	$370,000	$1,430,000	**$1,800,000**
Eng/Cont	$130,000	$500,000	**$630,000**
Total	**$500,000**	**$1,930,000**	**$2,430,000**
Phase 2			
Construction	$720,000	$0	**$720,000**
Eng/Cont	$250,000	$0	**$250,000**
Total	**$970,000**	**$0**	**$970,000**
Phase 3			
Construction	$850,000	$350,000	**$1,200,000**
Eng/Cont	$300,000	$123,000	**$420,000**
Total	**$1,150,000**	**$473,000**	**$1,620,000**
Total	**$2,620,000**	**$2,403,000**	**$5,020,000**

Table 6-2

Alternative 2 Estimated Project Costs

	Sutton	Millbury	Total
Phase 1			
Construction	$370,000	$1,430,000	**$1,800,000**
Eng/Cont	$130,000	$500,000	**$630,000**
Total	**$500,000**	**$1,930,000**	**$2,430,000**
Phase 2			
Construction	$720,000	$0	**$720,000**
Eng/Cont	$250,000	$0	**$250,000**
Total	**$970,000**	**$0**	**$970,000**
Phase 3			
Construction	$340,000	$0	**$340,000**
Eng/Cont	$120,000	$0	**$120,000**
Total	**$460,000**	**$0**	**$460,000**
Total	**$1,930,000**	**$1,930,000**	**$3,860,000**

6.5 Upper Blackstone Water Pollution Abatement District

Negotiations are currently in progress for Millbury to abandon its wastewater treatment facility in favor of pumping its wastewater to the Upper Blackstone Regional Treatment Facility. Once the sewer system in the Lake Singletary area is expanded, this future flow will be included in Millbury's capacity allotment from the Upper Blackstone Facility.

Millbury has recently bought into the UBWPAD for the entire town. Future population increases and sewer expansions will no longer be required to buy-in to the UBWPAD. Sutton has also recently bought-in to the UBWPAD for several areas of the town. The Lake Singletary area was included in this buy-in. Sutton is being considered as a sub-division of Millbury. Additional expansion in Sutton will only necessitate a buy-in in areas that are not currently members.

Additional buy-in opportunities will not occur for at least 3 years or until the UBWPAD pump station is completed in Millbury. At that time buy-in costs are envisioned to be $300 per person.

6.6 Total Charges

Table 6-3 and 6-4 summarize the total costs and estimated charges for each town. An ERU is an equivalent residential unit that it is used as a base for charges. An ERU is a unit of measurement based on average usage from one single-family house. The user charges can be collected as a yearly fee or distributed as monthly payments.

Table 6-3
Sutton Loans and Debt Service

Alt. 1	Design/Construction	Buy-in	Annual Debt Service (1)	Treatment (2)	O & M (3)	Total Yearly Expenses	Pop. Served (4)	ERU Cost (5)
Phase 1	$500,000	$0	$25,000	$1,100	$4,000	$30,100	160	$600
Phase 2	$970,000	$0	$48,500	$1,500	$5,800	$55,800	232	$700
Phase 3	$1,150,000	$0	$57,500	$1,600	$6,100	$65,200	244	$800
Totals	**$2,620,000**	**$0**	**$131,000**	**$4,200**	**$15,900**	**$151,100**	**636**	**$700**
Alt. 2	**Design/Construction**	**Buy-in**	**Annual Debt Service (1)**	**Treatment (2)**	**O & M (3)**	**Total Yearly Expenses**	**Pop. Served (4)**	**ERU Cost (5)**
Phase 1	$500,000	$0	$25,000	$1,100	$4,000	$30,100	160	$600
Phase 2	$970,000	$0	$48,500	$1,500	$5,800	$55,800	232	$700
Phase 3	$460,000	$0	$23,000	$1,200	$4,375	$28,600	175	$500
Totals	**$1,930,000**	**$0**	**$96,500**	**$3,800**	**$14,175**	**$114,500**	**567**	**$600**

1) SRF w/ 20-year payback @ 0% financing
2) Based on UBWPAD charge of $0.25/1000 gal with 10% I/I
3) % of O&M cost at Millbury WWTP attributed to Lake Singletary (worst case)
4) Year 2000 population (worst case)
5) Equivalent Residential Unit Cost (ERU) is based on 2.9 people/home (worst case). As development occurs, prices will be spread out over more homes.

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Table 6-4
Millbury Loans and Debt Service

Alt. 1	Design/Construction	Buy-in	Annual Debt Service (1)	Treatment (2)	O & M (3)	Total Yearly Expenses	Pop. Served (4)	ERU Cost (5)
Phase 1	$1,930,000	$0	$96,500	$3,500	$12,500	$112,500	498	$700
Phase 2	$0	$0	$0	$0	$0	$0	0	$0
Phase 3	$473,000	$0	$23,650	$800	$2,100	$26,500	81	$1,000
Totals	**$2,403,000**	**$0**	**$120,150**	**$4,300**	**$14,600**	**$138,800**	**579**	**$700**
Alt. 2	**Design/Construction**	**Buy-in**	**Annual Debt Service (1)**	**Treatment (2)**	**O & M (3)**	**Total Yearly Expenses**	**Pop. Served (4)**	**ERU Cost (5)**
Phase 1	$1,930,000	$0	$96,500	$3,500	$12,500	$112,400	498	**$700**
Phase 2	$0	$0	$0	$0	$0	$0	0	$0
Phase 3	$0	$0	$0	$0	$0	$0	0	$0
Totals	**$1,930,000**	**$0**	**$96,500**	**$3,500**	**$12,500**	**$112,400**	**498**	**$700**

1) SRF w/ 20-year payback @ 0% financing
2) Based on UBWPAD charge of $0.25/1000 gal with 10% I/I
3) % of O&M cost at Millbury WWTP attributed to Lake Singletary (worst case)
4) Year 2000 population (worst case)
5) Equivalent Residential Unit Cost (ERU) is based on 2.9 people/home (worst case). As development occurs, prices will be spread out over more homes.

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Section Seven
Recommended Plan

7.1 General

Alternatives were considered for the wastewater management of Lake Singletary. The alternatives discussed in Chapter 5 represent the most feasible wastewater management plan for the watershed. Criteria included topographic and hydrologic characteristics, environmental impacts, water quality standards and public health concerns. Chapter 6 described estimated expenses of each of the alternatives. The purpose of this chapter is to recommend the most practical and cost effective plan available for servicing the needs of the environment and the residents living in close proximity to Lake Singletary.

7.2 Collection System

A gravity sewer system with a low-pressure grinder pump that discharges to a gravity main is the most cost effective method for nutrient load reduction on Lake Singletary. The most cost effective method is Alternative 2 (Figure 5-2) in terms of homes served per unit cost of construction. This alternative consists of low-pressure sewer around the lake with a smaller quantity of gravity main. The most practical, in terms of expansion, is Alternative 1 (Figure 5-1). This alternative consists of some low-pressure sewer with a larger amount of gravity main.

For both alternatives, Phase 1 and 2 are identical. Phases 1 and 2 are the most important areas for surface water nutrient load reduction. Design and construction costs for both phases are estimated at approximately $3.4 million. Funding limitations and construction across the town line may dictate the project progression. Phase 1 must be completed before Phase 2. The majority of Phase 1 construction will have to be financed by Millbury. Phase 2 resides entirely within Sutton and can be constructed as soon as financing is available after the completion of Phase 1.

Phase 3 in Alternative 1 is recommended because of the flexibility of expanding the sewer service area in the future. It is not as critical to the water quality of the lake as the other two phases but it is important to the overall groundwater quality of the area. If Sutton ever finds it necessary for collection systems in Sutton Center and the schools and homes on Boston Road the gravity main can be extended to meet these needs. If Millbury would like to offer service to the Laurel Drive and Hemlock Drive developments off Sutton Road, a gravity main could easily be extended for both areas. The sizing that is shown is adequate for these expansions.

Phase 1 and 2 construction cannot be completed until after the transfer of flow from the Millbury treatment plant to the UBWPAD is implemented. Transfer is predicted to be complete in the year 2003.

Phase 1 and 2 boundaries may have to be slightly altered pending availability of funding. Phase 1 may have to end at the Millbury line on Sutton Road and Winwood Road if Millbury is able to secure funding, but Sutton is not able to finance. It is recommended that an application be sent to both towns jointly.

7.3 Financing

Given available sources of funding, it is recommended that the Town pursue funding for treatment plant improvements using the SRF program. The Town can borrow money from the SRF program at a zero percent interest rate. Repayment of the loan would be guaranteed by user fees. The USDA Rural Development Loan/Grant program should be investigated further. Grants or loans may be able to be secured under this program.

7.3.1 User Fees

User fees are charged based on system use. Typically, they are used to recover operations and maintenance costs, however, they can also be used to pay off the debt service. User fees are typically calculated based on the customer's water use.

Since most customers in Sutton are not connected to a municipal water system, water meter records will not be available for use in determining user fees. Therefore, it is recommended that Sutton's user fees will be based on an equivalent single-family unit basis (ERU). An ERU is a method of charging every single family home 1 ERU and every 2-8 family home 2-8 ERU's. Commercial businesses, that do not use water for manufacturing processes, should be converted to ERU based on the number of people employed in the building. The number of employees divided by 2.9 people per ERU could constitute the number of ERU's charged.

7.3.3 Homeowner Payments

In addition to the charges presented in Tables 6-5 and 6-6, customers will be responsible to make the connections between their homes and the collection system. The cost will vary depending on the length of the service connection and the route taken. Costs for gravity house connections generally run between $30 and $40 per linear foot. Homes requiring grinder pumps will need to have the pump installed as well as the connection to the low-pressure main or gravity sewer.

7.4 Watershed Management

In addition to wastewater management, additional watershed management procedures should also be considered. Watershed protection bylaws for the Town of Leominster, Massachusetts are included in Appendix D. These bylaws were selected as an example because Leominster is water supply district and their bylaws are very stringent in regards to surface water protection.

Simple steps that can be taken to reduce nutrient loadings include:

- Reduction/Elimination of lawn fertilizers.
- Seeding of bare areas prone to runoff.
- Enforcement of existing zoning requirements for future construction.
- Regular street sweeping

A more complicated procedure that has been proven effective in removing nutrient loading is a stormwater drainage system. Catch basins should be installed in low-lying areas and areas where significant runoff occurs. Catch basins should collectively discharge into a vegetated detention basin(s) to allow for nutrient absorption.