Report

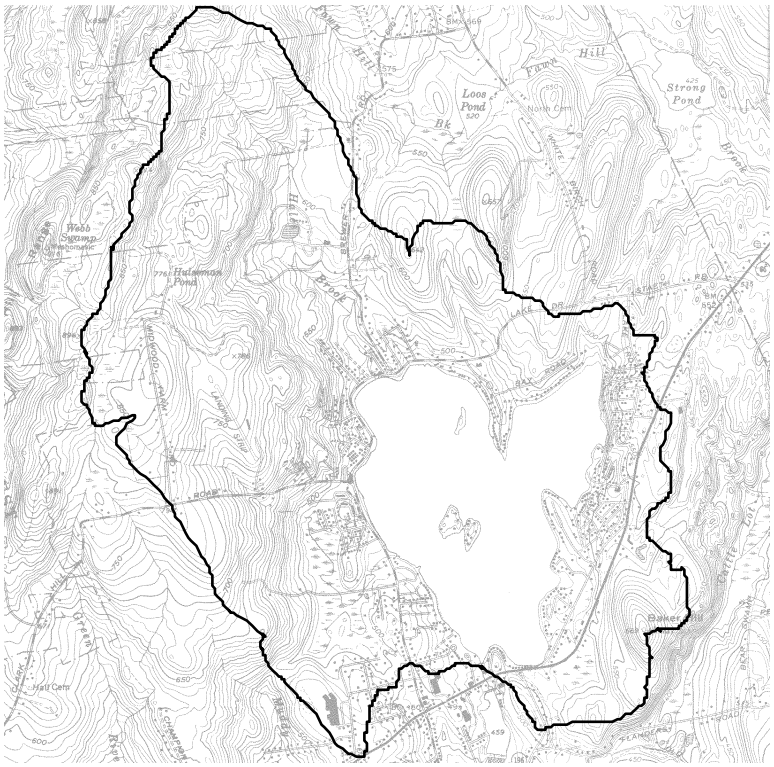
Lake Pocotopaug
Management Recommendations

East Hampton Ad Hoc Lake Advisory Committee

March 28, 1995

"As for me, give me the companionship of
a small lake with sweet crystal water..."

Carl F. Price, "Yankee Township", 1941



Peter Aarrestad, Barton Blau, Kathy Ferner, Julie Pearce, George Pfaffenbach,
Mark Philhower, Maria Foss-Rand, Thomas Wells and Raymond Zatorski

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Copies of the Appendix are available at the East Hampton Public Library and East Hampton Town Hall

Section 1
EXECUTIVE SUMMARY

Subsequent to a severe algae bloom that plagued Lake Pocotopaug in the summer of 1992, the Town Council established the Ad Hoc Lake Advisory Committee (LAC). Part of the charge of the committee was to develop recommendations toward the furtherance of a Watershed and Lake Management Plan. This report is in response to that charge. It is the culmination of two and one half years of research and discussion by the LAC. The report is based on the literature available on lakes, the various seminars LAC members have attended, the reports, letters and discussions with various experts in the field of lake science, land use, and lake management, including David Worden formally with Fugro-McClelland East, Inc., the consultant hired by the Town of East Hampton to conduct an in-lake study in 1993. Though some of the recommendations may be unpopular, we feel they are worthy of further discussion and incorporation into a Lake Management Plan. We have strived to base the recommendations on facts and expert advise. We have also strived to present practical recommendations that have been used elsewhere with success.

The report is presented in six sections:

Section 1.	An executive summary that briefly outlines the structure of the report, and the approach the LAC recommends to address algae blooms in Lake Pocotopaug.
Section 2.	A summary of the recommendations organized under three major objectives. The first objective describes ways to establish mechanisms to achieve lake goals. The second objective describes ways to reduce the input of sediment and nutrients to the lake through the adoption of conservation practices, or non-regulatory methods. The third objective covers regulatory measures to reduce sediment and nutrient inflow to the lake. A more detailed discussion of the recommendations is presented in section 4.
Section 3.	A narrative that describes Lake Pocotopaug's problem, the LAC's goals, and the technical rationale that forms the basis of the recommendations that follow.
Section 4.	The recommendations. Each is presented with a statement of its purpose and a short discussion to provide additional information and the rationale behind it.
Section 5.	A list of the technical resources used in the preparation of the recommendations.
Section 6.	This section is an Appendix that contains additional information referred to in this report. It is provided under a separate cover.

The LAC emphasizes the importance of watershed management of nutrient export as the basis for a successful and long lasting solution to Lake Pocotopaug's algae problem. This approach is recommended by most expert sources of information, including David Worden, the town's consulting limnologist. It is an important cornerstone of a Lake Management Plan, with in-lake techniques to be considered after watershed sources of nutrients have been reduced. The Fugro-McClelland report advised that in-lake techniques are not a substitute to watershed management and should only be considered as one component of an overall management strategy.

The LAC regrets that information from the Stormwater Renovation and Management Plan currently being prepared by WMC Consulting Engineers was not available to be considered in the preparation of this report. The LAC made the recommendation to the town council in January of 1994 to hire a consultant to perform the study, intending that it would be part of the pool of information from which our recommendations would be developed. Though the basic principles of watershed management are widely recognized, the specifics that will be provided in the WMC report will need to be evaluated and prioritized in the same manner as those in the Fugro-McClelland report. Effective stormwater management is the cornerstone of successful watershed management.

The basic approach recommended by the LAC is to 1), reduce current inputs of eutrophication causing material to the lake, and 2), minimize future increases from future land use changes in the lake basin. Reduction of current sources will rely heavily on the recommendations from the WMC report which will describe specific projects to accomplish these reductions. Methods to minimize future sources should also be detailed in the report. These methods include conservation practices and land use controls designed to reduce sources, and improve the quality of stormwater eventually reaching the lake.

Another important cornerstone to a successful lake program is a group that will oversee the the development and implementation of the Lake Management Plan. In many lake communities this function is served by a private lake association that works with various groups and governmental agencies to provide the inertia needed to see the lake restoration through to completion. Other lake communities have lake committees as part of their town governments. Whatever form this group takes, it should be knowledgeable and represent all interests in the community. It is essential that

the primary focus of this group be the long term health of the lake. Lake restoration is a long term endeavor that requires a great deal of effort and coordination of various groups and agencies to implement cost effective solutions. To this end the LAC recommends establishing a permanent Lake Advisory Committee.

To reduce the potential of future development degrading lake water quality, the LAC recommends the adoption of a phosphorus based performance standard as described in recommendation III-2. This approach is used in the state of Maine to specifically address nutrient export from new development in a fair and equitable manner without unnecessarily restricting development. It provides flexibility to applicants, while addressing the cumulative impacts of development on the lake. We stress that if this recommendation is adopted, most of the suggestions in recommendations III-4 through 9, and 12, would be accounted for, and need not be adopted elsewhere in wetland and zoning regulations.

With the completion of these recommendations and the acceptance of the WMC report, East Hampton's next step should be to draft and adopt an effective Lake Management Plan. This document should be the culmination of previous work and describe the actual steps East Hampton will take to restore the lake. It is important that the plan be developed with input from all interests in the community. Acceptance by the entire community is essential for a successful Lake Management Plan.

The road to successful lake restoration is often long, and the decisions necessary to strike a balance between the things we do in and near the lake, and the health of the lake, are sometimes difficult to make. The LAC thanks the Town Council for the opportunity to participate in this endeavor. We trust that the Town of East Hampton will maintain its proud and unwavering support for the lake, and that we collectively remain dedicated stewards by cooperatively developing and implementing an effective Lake and Watershed Management Plan. Failure to do so will deprive future generations of the immeasurable aesthetic, recreational, and economic benefits that Lake Pocotopaug, our most valuable natural resource, has blessed us with.

Respectfully submitted,

Peter Aarrestad
Barton Blau
Kathy Ferner
Julie Pearce
George Pfaffenbach
Mark Philhower
Maria Foss-Rand
Thomas Wells
Raymond Zatorski

Section 2
SUMMARY OF RECOMMENDATIONS

The following is a summary of the recommendations that are presented in greater detail in Section 4. They are grouped under three major objectives.

OBJECTIVE I

To establish a coordinated system to develop and implement programs to improve the water quality of Lake Pocotopaug.

1. Create a permanent Lake Advisory Committee rather than a Lake Pocotopaug Watershed Authority.
2. Adopt a schedule and budget to accomplish lake goals.
3. Continue with a lake and inlet monitoring program.
4. Develop and implement a strategy for funding lake projects.
5. Continue with a vigorous public education program.
6. Provide adequate funding to hire a professional town planner, and secure the services of an environmental engineering firm and land use legal specialists.
7. Encourage continued professional development of town staff and provide training opportunities for land use commissioners.

OBJECTIVE II

To implement effective conservation practices to reduce nutrient and sediment inflow into, and nutrient recycling within Lake Pocotopaug.

1. Implement and complete watershed projects designed to reduce present inputs of phosphorus and other eutrophication causing materials to the lake before evaluating the need for in-lake restoration measures.
2. Do not use algicides such as copper sulfate to control algae blooms.
3. Develop and implement a coordinated and cooperative plan for managing the water level of Lake Pocotopaug.

4 Limit the operation of motor boats and jet-skis in shallow areas of the lake to five miles per hour.

5. Continue to encourage beach owners to properly maintain their beaches.
6. Periodically conduct surveys to identify areas where there are obvious erosion problems in the watershed for immediate attention.
7. Continue to develop and implement a strategy to periodically remove sediment that accumulates at various inlets to the lake.
8. Develop a system of positive incentives to encourage the maintenance of naturally vegetated land in the lake basin.

9. Develop voluntary guidelines for homeowner projects, such as landscaping or retaining walls, that may not be covered by the regulatory process.

10. Reassess the desirability of expanding the sanitary sewer system in residential areas of the watershed by establishing an effective sewer avoidance program.

11. Institute a program to insure that all gray water discharges are properly hooked up to the sewer system in the serviced area, or to properly operating septic systems.

12. Establish a water conservation program in the watershed.

13. When considering installation of the proposed public water supply system, review the ramifications of increased growth and density on the lake ecosystem.

14. Insure the maintenance of wetland functions in the watershed.

15. Continue to improve road stormwater drainage systems and road maintenance practices.

16. Continue to investigate methods to reduce waterfowl populations on the lake.

OBJECTIVE III

To develop and implement a coordinated and comprehensive system of land use controls to reduce nutrient and sediment inflow into Lake Pocotopaug.

1. Develop and implement land use policies in the lake watershed to insure that cumulative impacts from allowed uses do not exceed the capacity of the lake ecosystem to absorb them.

2. Develop and implement a Phosphorus Management Method (PMM) for development projects in the watershed.

3. Amend the Plan of Development to insure the goals and intent of lake restoration and preservation are represented.

4. Develop and implement an Open Space Development (cluster) subdivision regulation that would reduce the export of eutrophication causing materials to the lake from that of regular subdivisions.

5. Require an environmental impact assessment on all significant watershed land use proposals that can affect lake water quality.

6. Require the use of stormwater best management practices (BMP's) designed to improve water quality for all development applications in the watershed.

7. Amend zoning requirements to minimize impervious surfaces in the watershed.

8. Review the current system of land use controls for maintaining buffer areas between development or clearing activities and wetlands, watercourses, stormwater drainage systems, and the lake.

9. Develop criteria and standards for land use applications for lake shoreline construction and landscaping activities.

10. Review and amend the current open space exaction policy under the planning and zoning regulations.

11. Develop a formal, written town policy for conservation easements.

12. Amend the planning and zoning buildable rectangle regulation to consider sensitive areas, such as buffer areas, areas with steep slopes, and areas with and highly and potentially highly erodible soils.

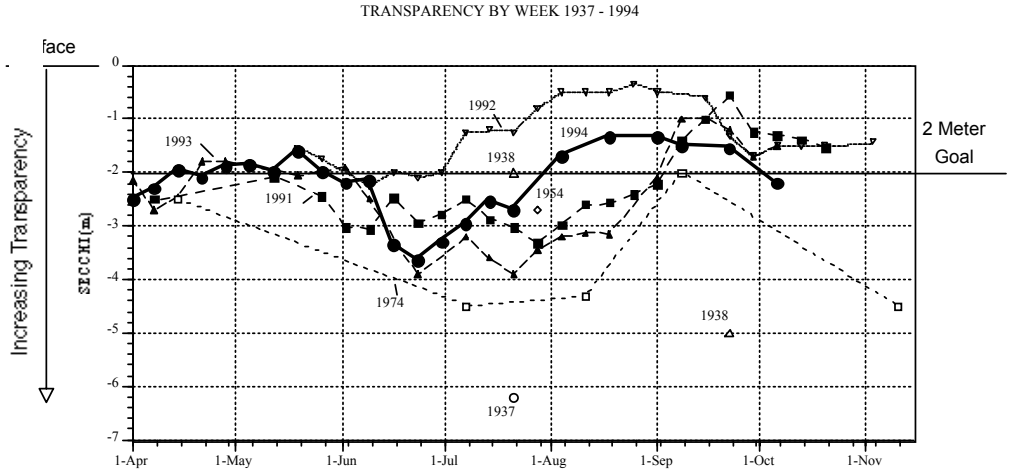
13. Minimize the potential for soil erosion from presently developed areas, and from future development.

14. Avoid granting zoning variances that increase lot coverage and decrease buffer areas.

Section 3
NARRATIVE

Introduction

Repeated algae blooms have been affecting the recreational use of Lake Pocotopaug since 1990. These blooms have been described as the worst in memory by long time lake residents. The Fugro-McClelland, Inc. (FM) report of December, 1993 (Worden 1993b) emphasized the role of increasing phosphorus concentrations as the cause of algae blooms. Phosphorus entering the lake both from the watershed and other external sources, and from recycling from bottom sediments, have increased phosphorus concentrations in the lake, resulting in excessive algae growth.



Lake Pocotopaug transparency

Two separate blooms have been evident in the lake on an annual basis. A spring bloom, dominated by Diatoms (a yellow-green algae) occurs between early April and the beginning of June. This bloom is associated with the average annual input of phosphorus to the lake that causes spring transparencies to be about 2 meters. In late summer, average phosphorus concentrations are augmented by a release of phosphorus stored in bottom sediments. This occurs when oxygen in the deeper water is depleted during summer stratification. During the severe bloom of 1992, the contribution of phosphorus from the bottom to surface waters was estimated to be almost equal to the average annual input from external sources (Worden 1993b and 1994a). This late summer bloom of *Anabaena*, (a blue-green algae,) has caused transparencies as low as 0.5 meters. Although the lake is currently predisposed to these late summer blooms, their length and severity is dependent on climactic conditions which affects the stratification of the lake during the spring and early summer (Worden 1993b).

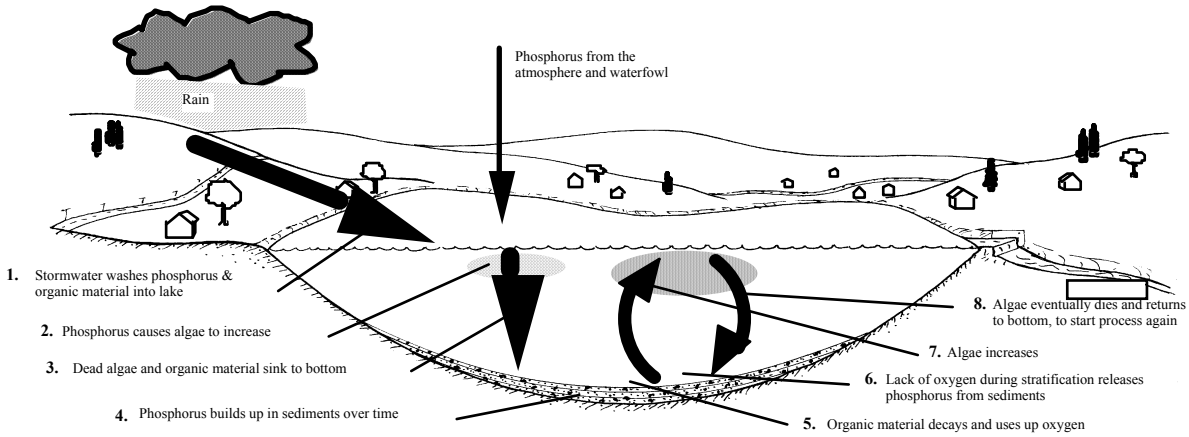
Goals

Lake management is the process of managing a lake ecosystem to improve and maintain lake water quality to an acceptable standard. Whenever a restoration program is undertaken, it is important to establish a measurable goal. The Lake Advisory Committee set a goal of improving the water quality of the lake so that the transparency of the water does not decrease below two meters at any time during the year. To accomplish this goal, lake phosphorus concentrations must be reduced and maintained at lower levels for a long lasting solution to algae problems in the lake (Worden 1993b).

Lake Basics

Phosphorus is one of many nutrients that algae need to grow. Since phosphorus is usually in the least supply with respect to the growth needs of algae in lakes, it is usually called the *limiting nutrient*. More phosphorus causes more algae to grow. Less phosphorus means less algae. For this reason lake restoration efforts typically involve reducing phosphorus concentrations in lake water (US EPA 1988).

The watershed of the lake is the land area surrounding a lake that contributes water to it. Since the area of the watershed is five times the area of the lake itself, most of the water in the lake comes from the watershed. Rain falling in the watershed picks up and transports many pollutants as it travels over land to the lake (NY DEP 1992). These materials affect water quality greatly. For this reason, the watershed is considered to be part of the lake's ecosystem.



Lake Pocotopaug and the phosphorus cycle.

Internal loading is a process that recycles phosphorus already in the lake. Since the lake was created about 12,000 years ago, phosphorus has been entering the lake from external sources, sinking to the bottom and accumulating in bottom sediments (US EPA 1988). Normally, the phosphorus stays in the sediments. However, when oxygen levels approach zero, a chemical change on the surface of the sediments causes a release of stored phosphorus into the overlaying water. In the deeper areas of the lake, bacteria use up oxygen as they consume *organic material* that continually settles to bottom from the surface (Kortmann and Rich 1994). This material includes dead algae, bird droppings, and material that enters the lake from the watershed, such as soil and leaves. Oxygen is replenished from the surface when the water mixes. However, in the winter and summer, mixing is prevented by thermal stratification. Released phosphorous eventually mixes upward to the surface to increase algae growth, and is returned to the sediments when the algae dies and sinks to the bottom. Although internal loading can occur under the ice in winter to a limited extent, the process is most pronounced during summer stratification, and results in a late summer bloom (Worden 1993b). *Turbidity* in the lake water causes reduced light penetration into the water column. If light penetrates deep enough, it can limit internal loading by encouraging algae growth beneath the thermocline, which replenishes oxygen and decreases the extent of internal loading (Kortmann and Rich 1994).

Algae blooms, oxygen depletion and internal loading are symptoms of *eutrophication*, or the lake's response to increased nutrients. It is the end result of increased input of phosphorus, organic material, and turbidity to the lake from external sources (Kortmann and Rich 1994).

Management Strategies

Strategies to improve lakes can use a number of different approaches. Education of citizens is important to both make people aware that everyday things they do in the lake and watershed affect the lake, and to foster acceptance of policy changes that may be necessary during restoration. It also helps to gain support for town expenditures for consultants and restoration projects that may be needed. Town governmental policies concerning activities such as road maintenance and drainage improvements can improve the lake. Local ordinances can be amended and adopted. Because watershed land use profoundly affects lake water quality, inland wetland and planning and zoning policies are another important mechanism to accomplish lake goals. (US EPA 1988)

Strategies need to focus on *source reduction* of eutrophication causing materials wherever possible. Source reduction reduces the need for the costly installation and maintenance of stormwater control structures. Efforts should be made to reduce stormwater generation to *lessen the quantity* of overland flow due to development, and *improve the quality* of stormwater that eventually reaches the lake. A primary goal of stormwater management is to assure that the quantity and quality of stormwater runoff from any specific development is not substantially altered from predevelopment conditions. (NY DEC 1992)

Once watershed sources of nutrients are effectively managed, then the need for in-lake strategies can be evaluated. Watershed nutrient reduction will enhance the effectiveness of in-lake techniques and increase their longevity (Worden 1993b). It is possible that in-lake efforts may not be needed if watershed efforts are successful.

Few people would argue that a clean lake is beneficial to our community in an aesthetic and recreational sense. It is also a beneficial in an economic sense. Tax revenues from the high assessments of near-lake properties are a significant source of revenue to the town. Seasonal cottages increase tax revenues without adding to the burden of our school system. The lake fosters tourism that helps our businesses during the summer season. Many people who move to East Hampton are drawn by the lake, aiding our construction and real estate industries. All of these benefits are diminished when the attractiveness of the lake is degraded by algae blooms. In essence, Lake Pocotopaug, being the focus of our community and most valuable natural resource, affects everyone in the community.

Land use and lake water quality are intimately related. Whenever one talks about lake restoration, the discussion must focus on changing the way we use our land. Though some of these changes can be accomplished through education and voluntary actions, regulatory changes must also be considered. This, of course, can be a sensitive subject in a land where property rights are held in high regard. The U.S. Constitution guarantees a citizen's right to use one's property in a reasonable manner. The questions arise: Are changes in land use polices justified? Are peoples land rights being restricted? Are these restrictions excessive? The easy part of lake restoration is the science and technology. We know *how* to fix the lake. The difficult part has to do with community acceptance, which is a social and economic issue. As with most things in life, there are tradeoffs that must be weighed. Though largely unforeseen, our current problems with the lake are the result of uninformed choices of the past, for which we are now paying for in terms of water quality.

The technical basis for the amendment of land use policies lies in the wealth of technical information on lakes generated over past decades, which links lake water quality with human activities in the watershed. Much of that information is presented here and in other reports. Care has been taken to

base all recommendations on facts presented in the literature available on lakes, and by experts in the fields of lake science, lake management, and land use.

The intent of our state legislature and the importance of water resources like our lake is clearly expressed in the legislative finding preceding the inland wetland statutes (CGS 22a-36);

> "to protect the citizens of the state by making provisions for the protection, preservation, maintenance and use" of water resources by "minimizing their disturbance and pollution; maintaining and improving water quality in accordance with the highest standards set by federal, state and local authority... by providing an orderly process to balance the need for the economic growth of the state and the use of its land with the need to protect its environment and ecology in order to forever guarantee to the people of the state, the safety of such natural resources for their benefit and enjoyment and for the benefit and enjoyment of generations yet unborn."

The delicate balance between personal property rights and the public right was considered by Justice Holmes over 100 years ago;

> "Long ago it was recognized that all property in this country is held under the implied obligation that the owners use of it shall not be injurious to the community."

Citizens have a right to enjoy a clean lake. The need for water based recreation will grow as our population grows. A single person's use of their property is unlikely to cause a problem in the lake. However, as years have gone by, the population in the lake basin has increased to the point that the combined effect of everyone's actions has exceeded the lake's capacity to absorb their cumulative impact. It is hard to justify that any citizen has a right to harm the lake through the use of their property. In essence, reasonable policies to avoid pollution of the lake are unlikely to restrict anyone's legitimate "right" to use their property. Avoiding prudent land use amendments today to foster short term economic gains, will eventually lead to long term losses for the business community, individual citizens, and result in erosion of our tax base. Delaying will also increase the eventual cost to taxpayers of restoring the lake.

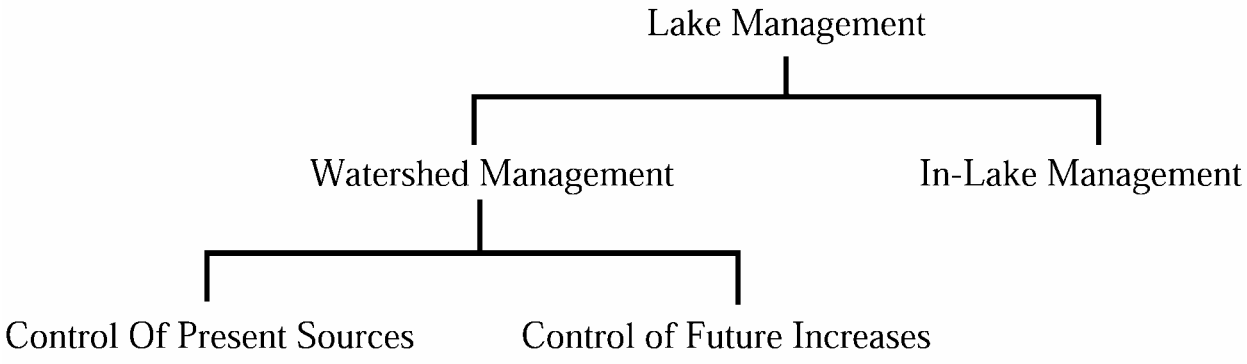
Since the Lake Area Task Force (LATF) report of 1988, citizens have been informed of the link between land use and the lake. Support for the restoration of the lake has remained strong. The recent Open Space Survey, conducted by East Hampton's Open Space Working Group, demonstrates this support. 87 percent of those responding support preservation of open space to protect water quality. 71 percent support town funding to improve Lake Pocotopaug water quality. When asked if improving and protecting lake water quality was important, 75 percent answered that it was "very important." (EH OSWG 1994)

Lake Management

Lake management can be divided into two categories; *in-lake* restoration and maintenance, and *watershed* management (US EPA 1988).

In-lake measures can be expensive, and by themselves offer only short term solutions to lake problems because they usually address the symptoms of eutrophication, not the source. In-lake approaches generally use techniques to kill the algae, remove phosphorus from the water column, or reduce the release of phosphorus from the bottom sediments. In the long run, watershed management is generally

more cost effective and longer lasting, since it addresses the *source* of the problem, rather than its *symptoms*. Even without algae blooms or data such as that gathered about Lake Pocotopaug, watershed management is advisable if the long term water quality is important to the citizens of East Hampton. All lakes will benefit from reducing the input of nutrients from their watershed. Waiting for problems to become acute before acting makes it more difficult and expensive to successfully deal with them.



Watershed management can be divided into two parts; the control of *present sources* of eutrophication causing materials, and measures that avoid *future increases* of nutrient export from land use changes in presently undeveloped areas of the watershed.

Many studies have shown that phosphorus loads to surface waters increase greatly with the intensity of land use in a watershed (NY DEC 1992, Norvell et al. 1979, Reckhow et al. 1980). Successful efforts to reduce export from already developed areas can eventually be negated by increases from new development unless diligent efforts are made to reduce the impacts of the conversion of forest into more intense uses. In-lake management is often expensive, and the results are not always predictable. If in-lake measures are undertaken, they should be done as part of an overall management strategy that ultimately addresses the source of nutrients in the watershed for a lasting solution to the problem of eutrophication in Lake Pocotopaug (Worden 1993b).

Watershed Management

Current Sources of Phosphorus

Using data collected for Lake Pocotopaug, present contributions of phosphorus to the lake from external sources have been estimated as follows:

SOURCE	PHOSPHORUS INPUT (lb/year)	PERCENT OF TOTAL
Atmosphere (lake surface)	455	35%
Waterfowl	43	4%
Watershed Land	791	61%
Total	1,289	100%

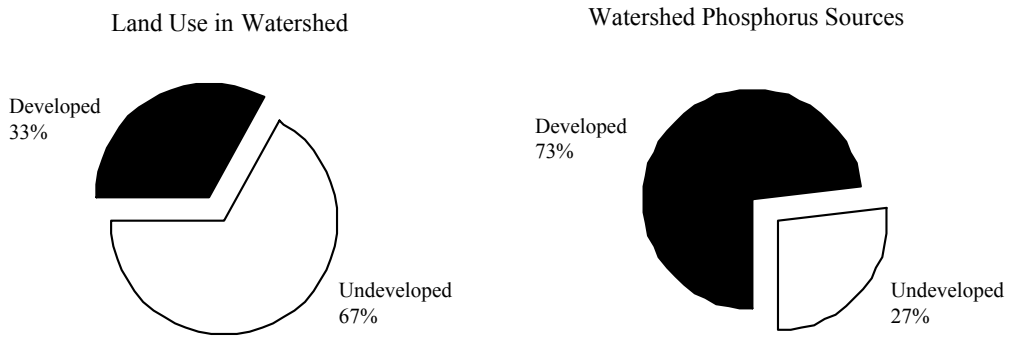
Estimated external contributions of phosphorus for Lake Pocotopaug (EH LAC 1995)

To reduce phosphorus concentrations in the lake, each source must be examined to determine what options are available for control, and the feasibility of these options with respect to cost and social acceptance.

1. Direct atmospheric loading of phosphorus to the lake surface from rain, airborne dust, pollutants, and pollen is significant, comprising 35 percent of the total loading of the lake. However, there are no options available to reduce this source.

2. Phosphorus input from seagulls roosting on the lake during the colder months was estimated to be about four percent of the total loading of Lake Pocotopaug. Various options have been researched and discussed to discourage seagulls from using the lake. However, because of their habits, the size of the lake and their federal status as a species of concern, no practical method of control has been identified. Although their contribution of phosphorus is small, their contribution of oxidizable organic material and its effect on the internal loading process could be more significant, but has not been assessed. Methods of control should still be pursued.

3. The land area of the watershed is the most significant external source of phosphorus to Lake Pocotopaug, comprising 61 percent of the total external loading of the lake. Storm water runoff coming directly from impervious surfaces such as roads tends to be very high in phosphorus. Higher export rates correspond with a higher percentage of development in sampled areas. Drainage from forested areas is consistently low in phosphorus. On average, phosphorus export from developed areas in the lake basin is over 5 times that from forests. Consequently, presently developed areas, which comprise 33 percent of the land area of the watershed, were estimated to account for about 73 percent of the current phosphorus export from land areas. (EH LAC 1995)



Land use and phosphorus export for Lake Pocotopaug's watershed (EH LAC 1995).

Many studies have shown that phosphorus export from a lake's watershed is dependent on the intensity of land use in the watershed. Data collected in Lake Pocotopaug's watershed are consistent with these studies (Worden 1994b):

Source of Information	Forest (lb/acre-year)	Developed Areas (lb/acre-year)	Increase (times)
Norvell et al. 1979	.09	1.51	16.8
NY DEC 1992	.1	.8 - 1.1	8 - 11
Reckow 1980	.24	1.9	8.1
Dennis 1986	.17	1.4	7.5
Lake Pocotopaug (EH LAC 1995)	.18	1.0	5.6

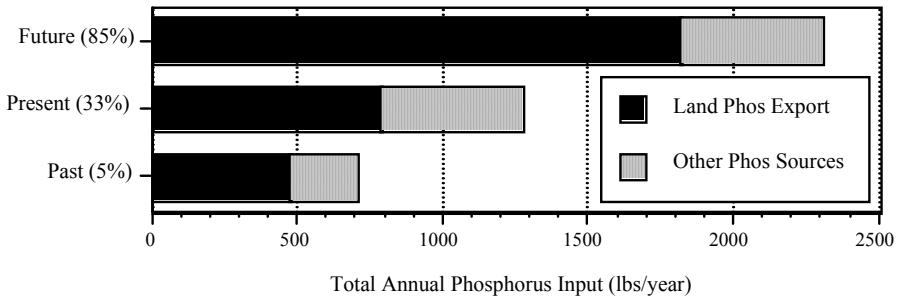
Phosphorus export rates for forest and developed areas from various studies and a model developed for Lake Pocotopaug.

Of all external sources of phosphorus, inputs from the land area of the watershed show the greatest promise for control to reduce present inputs of phosphorus to Lake Pocotopaug. These efforts must address both the *sources* of eutrophication causing materials, and their *pathways to the lake*.

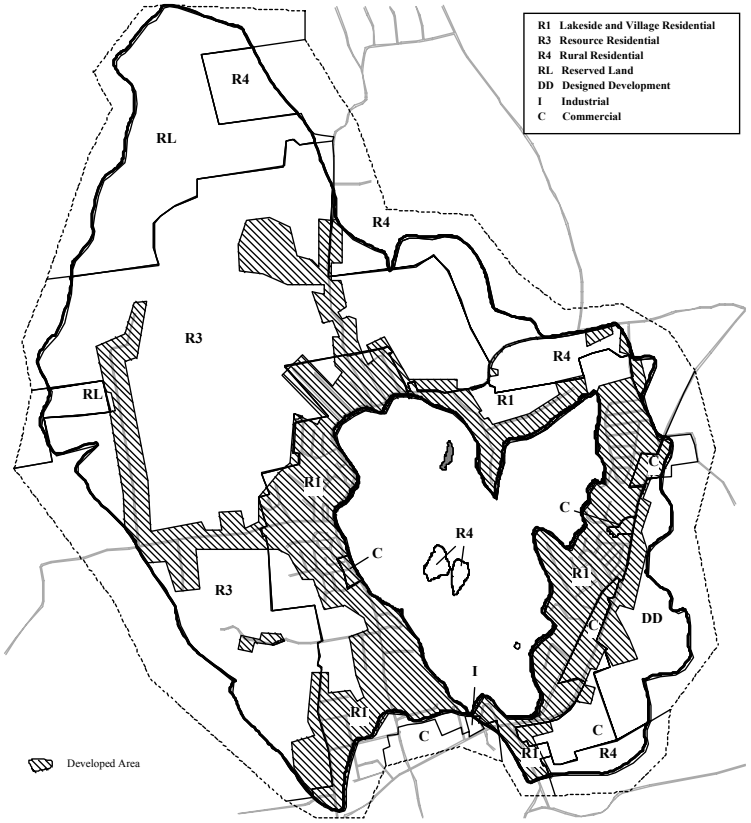
The single most important watershed consideration is stormwater runoff because it is the vehicle that transports these materials to the lake. Efforts should be made to r*educe the quantity of overland stormwater flows* due to development, and to *improve the quality* of stormwater that eventually reaches the lake (NYDEC 1992, Worden 1993b). Since efforts to reduce exports from presently developed areas often depend heavily on treatment of stormwater runoff rather than source reduction, solutions usually require the expenditure of public funds to retrofit existing natural and manmade drainage systems with control structures.

Future Sources of Phosphorus

At this time approximately 33 percent of the land in the watershed has been developed. 52 percent of the remaining land in the watershed is developable. Eventually, most of it will be developed. It is hard to say how long this will take, however, Midstate Regional Planning Agency forecasts that East Hampton will be the fastest growing town in the midstate region between 1990 and 2000, and the second fastest between 1990 and 2010. The implication of continued development is clear; unless steps are taken to reduce future sources of phosphorus, phosphorus input to the lake from presently forested areas will increase as these areas are converted to more intense land uses.



Estimated past, present and future external phosphorus input to Lake Pocotopaug (EH LAC 1995).



Developed area in Lake Pocotopaug's watershed.

Zoning and inland wetland requirements have improved since most of the present development has occurred in the watershed. However, changes have not been made to specifically address long term phosphorus export. Typical stormwater drainage practices, though well designed to safely remove water from developed areas and reduce peak flows downstream, do not address the fact that they are also well designed (unintentionally) to deliver phosphorus and other eutrophication causing materials directly into lakes. Though some of East Hampton's current practices do decrease phosphorus export from developed areas, they are not applied in a consistent manner. There are many other accepted best management practices (BMP's) not currently utilized that are designed specifically for controlling the export of pollutants that affect lake water quality (NYDEC 1992, Schueler 1987).

Lake Pocotopaug has reached its phosphorus tolerance limit. This is demonstrated by transparency readings in the eutrophic range every year since 1990. Even if efforts to reduce present inputs of excessive amounts of nutrients, turbidity and organic material are successful to restore water quality to acceptable limits, these efforts could eventually be offset by increases from new development. In the long run, how future development is done will in a large part determine the future of the Lake Pocotopaug.

In-Lake Techniques

The FM report of December 1993 (Worden 1993b) discussed potential lake management strategies. It outlined five in-lake techniques that could be considered for Lake Pocotopaug and discussed their advantages and disadvantages. The report stressed that in-lake techniques are not a substitute for watershed management. They should be considered as only one component of an overall management strategy, and that "the only strategy that offers long term protection is one focused on the reduction and/or elimination of nutrient inputs from the watershed." A brief description of the five in-lake techniques follows. (Refer to the FM report for more information.)

Chemical Treatments

Algicides control algae blooms by killing algae cells. The most common, copper sulfate, kills algae cells by rupturing them. One application is relatively inexpensive, but more than one application may be needed in a single season if a bloom occurs early in the year. Typically, the water begins to clear within 48 to 72 hours but dead algae may continue to float and impair water clarity to some degree. The timing of application is important. If applied during the peak of a bloom, there is a greater risk of oxygen depletion as the algae cells decay. As treatments do not address the cause of blooms, they must be repeated each time there is a bloom. Algicides are not discriminate and can kill beneficial lake organisms, such as zooplankton which graze on algae. Repeated applications may give rise to copper resistant algae species, and can cause a buildup of copper in the ecosystem that can become injurious to desirable lake organisms.

Hypolimnetic Withdrawal

This technique entails siphoning or pumping nutrient enriched water from the two deep basins of the lake and discharging it to waters downstream of the lake outlet. Withdrawals occur continuously during summer stratification. Installation expenses can be high because of the location of the deep basins, the amount of pipe required, and the lack of elevation drop at the outlet of the lake. Pumping may be necessary. Annual operation costs can also be high. Results may be marginal. The nutrient laden anoxic water from the lake bottom must be treated before discharge. A DEP permit would be required.

Phosphorus Inactivation (Alum)

Alum is used to inactivate phosphorus by binding with it to form a precipitate that sinks to the bottom, making it unavailable to algae. The results are often impressive increases in water clarity. The resulting layer of precipitate on the bottom eliminates or retards phosphorus release from sediments for a period of years. Applications are expensive. Disadvantages are that aluminum is toxic to lake organisms, and may be released if the pH of the lake is outside the range of about 6.0 to 8.5. The report advised that alum not be used until watershed phosphorus loadings have been reduced as much as possible. Otherwise, the precipitate layer over the sediments can soon be overlaid by new deposits of organic material from the watershed, causing oxygen depletion and internal loading to start again.

Aeration

Aeration systems increase oxygen levels in deeper waters to replace oxygen used up by the decay of organic material. This would reduce the release of phosphorus from bottom sediments. An advantage is that the introductions of foreign chemicals is avoided and that a discharge permit is not needed. The technique that is most appropriate for Lake Pocotopaug is layer aeration, which pumps water up from a

specific level, oxygenates it, and returns it to near the same level, thus avoiding mixing nutrient laden bottom water to the surface. Disadvantages are that it is expensive to install and the operation costs are high. Design of systems are critical and results are difficult to predict.

Biomanipulation

Biomanipulation is a technique that increases grazing on algae by algae predators in the lake. This is usually done by enhancing zooplankton populations by manipulating the food web to favor these organisms. Currently this is an experimental method. Consequently, it was not recommended as a primary control method, but could be used as a supplement to other methods.

Section 4
RECOMMENDATIONS

OBJECTIVE I

To establish a coordinated system to develop and implement programs to improve the water quality of Lake Pocotopaug.

1. RECOMMENDATION: Create a permanent Lake Advisory Committee rather than a Lake Pocotopaug Watershed Authority.

PURPOSE: To establish a committee of citizens and officials that would promote the wise use of our most valuable resource.

DISCUSSION: The LAC was charged to consider establishing a Lake Pocotopaug Watershed Authority. After researching the advantages and disadvantages of an authority and the capabilities of existing town agencies, the LAC concluded that lake goals can be accomplished with a permanent Lake Advisory Committee in conjunction with existing town agencies. (For more information refer to the LAC position paper dated March 21, 1995, in the Appendix.)

In 1988, the Lake Area Task Force emphasized the importance of establishing a permanent Lake Committee. Lake restoration is a long term endeavor. Essentially, there is a need to look after a lake as long as it exists. A permanent committee would best represent our town's commitment to the lake by providing an organization that would bring together governmental boards and commissions, lake groups, and the general citizenry to address lake issues in a coordinated manner. Without a group that focuses on the lake, a successful, coordinated, cost effective restoration program is unlikely. Town employees and other boards and commissions have many other responsibilities and may be unable to to spend the time and effort that is required. A clear sense of purpose is necessary. A committee need not be limited to environmental issues. Many lake entities also get involved with recreational issues.

Functions a permanent lake committee would perform include:

a. In coordination with the town council and other town agencies, and the public, draft and implement a coordinated lake and watershed management plan.
b. Continue to develop educational programs about the lake for citizens and public officials.
c. Continue to work with the library to create a library of information on lakes for use by citizens and public officials.
d. Continue to develop and distribute newsletters about the lake on a yearly basis.
e. Be cognizant of all issues involving the lake and serve as a source of information concerning lake and watershed issues. A permanent committee would continue to research lake issues as the need arises.
f. Research and pursue alternate funding strategies, such as state and federal grants, and other fund raising activities.
g. Provide an organization that will continue with the cost effective volunteer monitoring program.
h. Provides a sounding board for citizen input to the decisions that must be made concerning the use and preservation of the lake.
i. Monitor and assess lake use and review the effectiveness of lake policies to make reports for various town boards and commissions.
j. Identify and propose solutions to new problems as they arise and anticipate our future needs for conservation and recreation.
k. On an ongoing basis, work with town officials to assist in the implementation of management strategies.
l. On an annual basis, hold a workshop to discuss strategies and progress with implementing lake programs. This workshop would include the lake committee, the planning and zoning commission, inland wetland and watercourse agency, conservation commission, economic development commission, town council, and town staff.
m. Assist in the organization of an annual Lake Appreciation Day.

The following suggestions are made concerning the structure of the proposed commission:

a. The members should be appointed by the Town Council.
b. The members should elect a chairman, vice chairman and secretary.
c. The commission should be made up of 9 members who are not serving on any other boards or commissions. This would provide sufficient resources to establish subcommittees without overtaxing citizens already serving on other boards.
d. Liaisons should be appointed to the PZC, IWWCA, CC and Town Council to promote inter-commission communications.
e. The initial committee should include some members who participated in the ad hoc LAC to promote continuity.
f. Members should include citizens with technical abilities to help in understanding the technical aspects of lake restoration.
g. Members should serve staggered three year terms.
h. Meetings should be held on a monthly basis.
i. The committee should submit an annual report to the Town Council reviewing the progress that has been made as well as periodic reports on special projects and lake conditions.
j. The committee should have a line item operating budget to cover incidental costs.

2. **RECOMMENDATION: Adopt a schedule and budget to accomplish lake goals.**

PURPOSE: To establish a coordinated program and funding to accomplish lake goals.

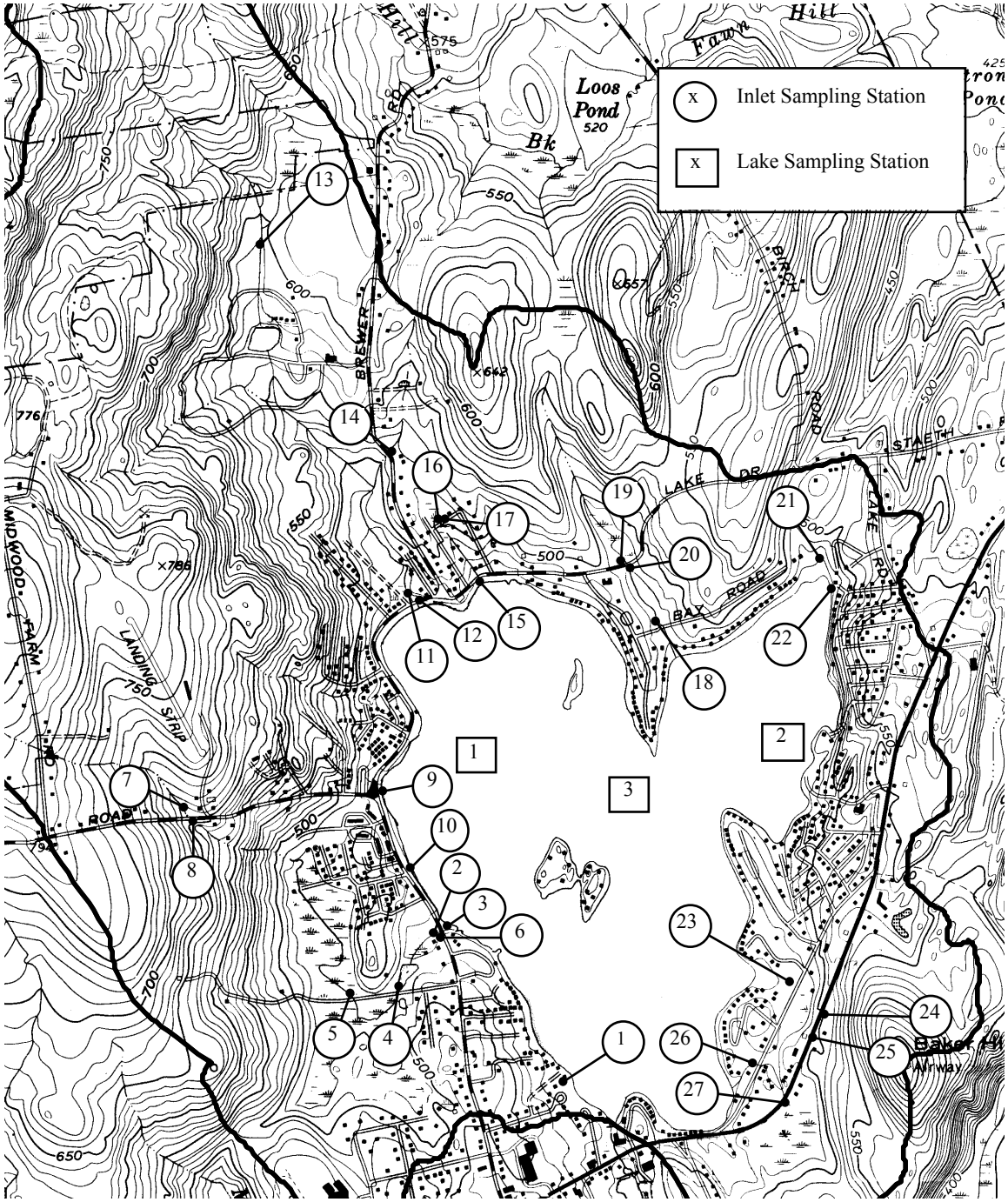
DISCUSSION: Lake restoration and maintaining lake water quality is a long term endeavor that requires effort in a number of areas. To accomplish goals, a coordinated schedule outlining the specific tasks to be completed is essential. From this schedule a budget can be developed. A draft budget has been developed from the research that has been done by the LAC and the various consultants hired by the town. It addresses education, specific watershed projects to reduce current inputs of eutrophication causing materials to the lake, impacts from future development in the watershed, in-lake measures, lake and watershed monitoring, and the development and implementation of future land use policies. It also considers funding limitations.

3. RECOMMENDATION: Continue with a lake and inlet monitoring program.

PURPOSE: To add to baseline data and to detect future trends of the lake ecosystem.

DISCUSSION: The first three years of sampling on Lake Pocotopaug was designed to establish its trophic status. In 1994 a scaled back program was implemented to continue monitoring at reduced cost. An ongoing monitoring program is necessary to assess water quality trends or changes over time. Inlet monitoring is important for the same reasons. Continued monitoring is important to assess the lake's response to the implementation of management strategies. To have information that is comparable with past data, it is essential to collect data in the same manner as it has been collected in past years. As in the past, most of the work can be done by the citizen volunteer group. In addition to minimizing costs, citizens involvement fosters lake stewardship and public acceptance of ongoing lake programs.

The services of a limnologist should be retained on a yearly basis to provide consistent professional oversight of the monitoring program and to interpret the results. It is anticipated that these services will cost a reasonable nominal fee



Lake Pocotopaug sampling stations.

IN-LAKE SAMPLING: Continue to fund the monitoring program. As a minimum, the following parameters should be monitored from spring turnover to fall overturn, (approximately April 1 to October 15), at station 1 and 2:

a. Transparency measurements on a weekly basis.
b. Dissolved oxygen and temperature profiles 2 times a month.
c. Measure pH and take samples at the surface, upper hypolimnion, and bottom to be analyzed for turbidity and total phosphorus on a monthly basis.
d. Water level measurements.

When oxygen depletion rises to seven meters or less as measured from the surface, dissolved oxygen and temperature profiles should be taken at station 3.

Additional lab analysis on collected samples can be useful to provide more information if funds are available.

INLET SAMPLING: This should continue to be done in the same manner as in past years. Stations 2, 4, 5, 7, 9, 11, 13, 14, 15, 16, 18, 19, 21, 22, 23, 24, 25, 26, and 27 should be done at four times during the year at a minimum. This allows future data to be compared to data from previous years. Samples should be taken at the beginning of rainstorms and analyzed for total phosphorus and turbidity.

4. RECOMMENDATION: Develop and implement a strategy for funding lake projects.

PURPOSE: To fund lake restoration programs including studies, watershed restoration projects, and in-lake actions.

DISCUSSION: Managing lake water quality will require expending funds to accomplish goals. Potential funding sources include local property taxes, state and federal grants, appropriations from the state legislature, grants from private institutions, donations from individuals, and fund raising projects. A strategy to secure adequate funding must be developed and implemented. This funding strategy *need not* and *should not* heavily rely on local property taxes.

a. Implement a procedure for receiving, holding and disbursing funds for lake restoration.
b. Establish a committee to develop and implement a funding strategy. Members should be familiar with the process of applying for grants and lake management. This would be addressed best by a permanent lake committee.
c. Sponsor fund raising events to help fund lake projects. In addition to providing funds, fund raising fosters public involvement and positive publicity.
d. Applications to the DEP for state funding, or federal funding administered by the state for lake and watershed projects are judged on a number of attributes. Since the DEP is interested in promoting water recreation for all citizens of the state, public access is an important consideration. With the competition for these funds, lakes without public access are at a considerable disadvantage. Public access need not be in the form of a major boat launch. This concept has not been well received by lake users in the past because of the crowded conditions on the lake during peak use, and attendant safety concerns. Creation of a no-trailer "car topping" launch area may satisfy minimum eligibility criteria in a manner having minimal impact on present lake uses. This area would have a limited parking area to minimize crowding of the lake during peak use times. A "car topping" area would be expected to cater to boaters who would most likely use the lake during non peak times, such as fishermen and canoeists. East Hampton's Open Space Survey (EH OSWG 1994) indicated that while 71 percent of those responding favor town funding to improve lake water quality, only 20 percent favored not having public access and no state or federal funding. 49 percent felt a car topping area was acceptable for funding. Only 19 percent were in favor of having a launch area that allowed all types of boats to qualify for state and federal funding.

5. RECOMMENDATION: Continue with a vigorous public education program.

PURPOSE: To cultivate public interest and awareness about the environmental aspects of the lake and its watershed and to foster lake stewardship.

DISCUSSION: An essential ingredient for a successful lake management plan is the support of citizens. It is important that individuals adopt an attitude of lake stewardship. Stewardship reflects an understanding that what we do on land and in the water affects our lake. Lake stewardship takes into account the need to better balance our daily lives and lifestyles with the needs of our lake. It is recognition that our lake is vulnerable, and in order to insure its future viability as a recreational resource, we must both individually and collectively assume responsibility for its care. The reasoning behind sound lake management practices is not always obvious, but an understanding of the reasons behind these practices is essential for their adoption and eventual success. Education topics include:

1. Informing citizens how healthy lakes function

2. Providing information to watershed residents and lake users about how their actions can degrade lake water quality and what practical steps they can take to prevent this, such as:
   a. Avoiding the use of phosphorus containing detergents and soaps in non sewered watershed areas to reduce septic tank loading
   b. Taking care when washing outdoors, such as when washing a car, to avoid letting wash water reach drainage systems that eventually lead to the the lake. Wash on the grass or other pervious surfaces where water will soak into the ground, rather than on pavement.
   c. Using low or no phosphorus fertilizers when fertilizing lawns. A soil test kit can determine fertilizer needs.
   d. Discouraging the feeding of waterfowl in the lake.
   e. Properly disposing of pet droppings so they will not be washed into drainage systems to eventually reach the lake.
   f. Cleaning boats before putting them in the lake to reduce the possibility of introducing exotic species, such as Eurasian water milfoil or zebra mussels, into the lake.
   g. Following best management practices for gardens and agricultural areas.
   h. Properly disposing of lawn debris.
   i. Planning a new home that is "lake friendly".
   j. Maintaining or creating buffer areas.
   k. Practicing water conservation.
   l. Properly operating and maintaining septic systems.
   m. Minimizing shoreline alteration.
   n. Reclaiming sand from the lake rather than adding sand when maintaining beaches, and ways to reduce beach erosion.
   o. Being aware of alternatives available to landowners to developing their land.
   p. Being aware of the importance of estate planning for families who have significant land in the watershed.
   q. Accelerating boats slowly in shallow water to avoid mixing sediments up from the bottom.
   r. Reminding children and adults that the lake is not a bathroom.
   s. Make citizens aware that permits may be needed for some construction and landscaping activities that are conducted in or near the lake.

3. Keeping citizens abreast of current events regarding the lake, such as the results of professional studies, up-to-date sampling results, and dates and purposes of draw downs, dredging, application of chemicals, etc.

Methods to accomplish these objectives include distribution of newsletters and press releases, working with local businesses to produce and distribute flyers, presentations to civic groups, additions to the library lake collection, posting of a sign at Sear's Park, and working with the schools to find an appropriate way to include the town's children in understanding and taking care of the lake.

6. RECOMMENDATION: Provide adequate funding to hire a town planner, and secure the services of an environmental engineering firm and land use legal specialists.

PURPOSE: To insure that adequate technical and legal help is available to the town on a continuing basis to address lake goals.

DISCUSSION: During the 1980's, East Hampton was the second fastest growing town in the midstate region. In spite of the recession, it is expected to be the fastest growing in the midstate region in the 1990's. People like to live near the lake. Consequently, the pressure to develop the lake basin is great. During the building boom, many towns learned the value of specialized expert assistance to avoid the long term costs of inappropriate development. Adequate technical and legal expertise is essential to assist in the development of land use policies and to apply them, especially when sensitive lake watersheds are involved. Effective management of future development in the watershed is critical to the lake's long term health. All towns in our area currently employ full time planners, including Marlborough, Hebron, East Haddam, Glastonbury, Middletown, Haddam, Portland, and Colchester, to assist with the development of land use policies, provide commissions with expert opinion, and review land use applications for the various commissions. In addition, many towns engage the services of qualified environmental engineering firms to provide advice and expert review of applications.

These firms often have certified soil and erosion control specialists, environmental planners, and biologists on staff, as well as civil engineers to handle all aspects of municipal land use issues. Many towns also retain the services of attorneys who specialize in land use issues. Adequate funding is necessary to retain these services:

a. Provide funding for a town planner. In addition to serving various town land use commissions, a planner would be qualified to act as an economic development director.
b. Create a line item budget for IWWCA and P&Z to use for expert advise at their discretion. This would allow them to hire specialists to provide expert legal and technical assistance when it is otherwise not available.
c. Review fee structures for land use applications to insure there are adequate funds available to secure expert environmental and legal review.
d. Review funding for personnel to carry out the enforcement advised by the land use commissions. This must include funding for staff, legal advice and funding to follow through with court action as the need arises. Without firm and consistent enforcement, regulations are not taken seriously.

7. RECOMMENDATION: Encourage continued professional development of town staff and provide training opportunities for land use commissioners.

PURPOSE: To insure that land use commissioners and staff are familiar with best management practices and state and local regulations to make informed decisions on projects in the lake basin.

DISCUSSION: To achieve lake goals and objectives, adequate professional development of staff, training of board members, and procedure are vital. Land use policies and regulations will not achieve goals unless they are understood and are applied in a fair, firm and consistent manner. The following recommendations are provided to help accomplish this:

a. Hold periodic workshops between a permanent LAC and the various land use commission to discuss new information and lake protection strategies.
a. Require that land use commissioners attend at least one seminar each year pertaining to issues their commissions deal with. Review attendance of these seminars when considering renewal of terms.
b. Make the completion of the DEP wetland training course mandatory for an IWWCA alternate to become a regular member. Establish a similar policy for the P&Z.
c. Provide copies of the DEP's Wetland Commissioner's Handbook and An Inland Wetland Commissioner's Guide to Site Plan Review to each member of the IWWCA.
d. Hold periodic workshops with technical and legal specialists to keep commissioners and staff abreast of new developments and provide an informal atmosphere for question and answer sessions.
e. Encourage citizens with related specialized skills to join our commissions. Environmental engineers and legal specialists are valued commissioners in most towns, and they provide readily available expert knowledge while reducing cost to the town.

OBJECTIVE II

To implement effective conservation practices to reduce nutrient and sediment inflow into, and nutrient recycling within Lake Pocotopaug.

1. RECOMMENDATION: Implement and complete watershed projects designed to reduce present inputs of phosphorus and other eutrophication causing materials to the lake before evaluating the need for in-lake restoration measures.

PURPOSE: To address the cause of algae problems for a long lasting and cost effective solution for algae blooms in the lake.

DISCUSSION: In-lake techniques are not a substitute for watershed management and should only be considered as one component of an overall lake management strategy (Worden 1993b). The cause of algae blooms in Lake Pocotopaug is increased concentrations of phosphorus in the lake, from both internal loading and external sources (Worden 1994). Internal loading is ultimately a result of increased input of phosphorus and other eutrophication causing materials to the lake (Kortmann and Rich 1994). In-lake techniques address the symptoms of the problem rather than the cause, and are generally not long lasting. In-lake treatment may not be necessary if nutrient inputs are sufficiently reduced. In-lake efforts are expensive in the long term, but will be even costlier unless nutrient reduction is not implemented first. Some, such as nutrient inactivation (alum), are not advised unless watershed loadings are reduced, otherwise the longevity of the treatment is reduced, and the long term costs become unacceptably high. The only lake management strategy that offers long term protection is one focused on the reduction and/or elimination of nutrient inputs from the watershed (Worden 1993a).

2. RECOMMENDATION: Do not use algicides such as copper sulfate to control algae blooms.

PURPOSE: To avoid harm to beneficial lake organisms and avoid expenditures for temporary reductions of algae.

DISCUSSION: Copper sulfate is an algicide that can provide temporary clearing of lake water by killing algae cells. It can also harm other beneficial organisms in the lake. Because its affect in clearing the water is short, more than one application may be needed in a given season depending on when blooms occur. Repeated use can cause long term harm to the ecosystem, give rise to copper resistant species of algae, and build up in the ecosystem to cause long term problems. Results are not always satisfactory since dead algae may continue to float in the water for a period of time. Dead algae sinking to the bottom may also increase oxygen depletion and internal loading, causing more severe blooms to occur later on. Timing of the application of copper sulfate is critical. Application must take place before the bloom when algae densities are increasing at an exponential rate. The money dedicated to copper sulfate treatments would best be redirected to longer lasting efforts, such as watershed restoration. (Lee 1992, Worden 1993a)

3. RECOMMENDATION: Develop and implement a coordinated and cooperative plan for managing the water level of Lake Pocotopaug.

PURPOSE: To reduce lake impacts from high water levels, while minimizing conflicts with other lake uses.

DISCUSSION: The LAC sent a letter of recommendations to the town council on June 12, 1993, concerning a lake water level policy that would reduce water quality impacts resulting from maintaining high water levels in the lake. Briefly, the problems outlined were 1) shoreline damage and subsequent erosion of soil into the lake from boat and wind driven waves, 2) leaching of nutrients into the lake from high ground water levels near the lake, and 3) raising the one percent light level in the lake which could affect the internal loading process. Specific recommendations are as follows:

a. Continue to seek the cooperation of the Connecticut Water and Power company to implement a mutually agreeable plan for managing the water level in the lake.
b. Develop a schedule for changing and maintaining levels that consider environmental impacts, recreational needs and safety needs:

1. The lake level should be maintained no higher than 6 inches below the top of the dam spillway at any time during the year. This would decrease shoreline damage and reduce the continual erosion of soil into the lake from wind and motorboat driven waves.
2. On October 15, lower the lake level to 18 inches below the top of the dam and maintain this level until ice out, or about March 1. This would minimize shoreline damage from ice, and wind driven waves from late season hurricanes and fall and winter gales. It also allows shoreline residents to do shoreline maintenance and repair work more conveniently and with less impact to the lake.
3. After ice out, the level should be brought to the maximum height of 6 inches below the top of the dam spillway, and maintained there until October 15.

c. Publicize the draw down schedule well in advance to make lake users and shoreline owners aware of when it will occur so they can prepare for level changes. The town manager's office should coordinate this with the Connecticut Water and Power Company. Schedules could be handed out when boaters apply for Sears Park stickers.

d. A maximum draw down should be scheduled every three to five years, or as needed, to allow shoreline residents to do major repairs to shoreline property, such as seawalls, and to allow for reclaiming beach sand and removal of debris such as leaves from shoreline areas.

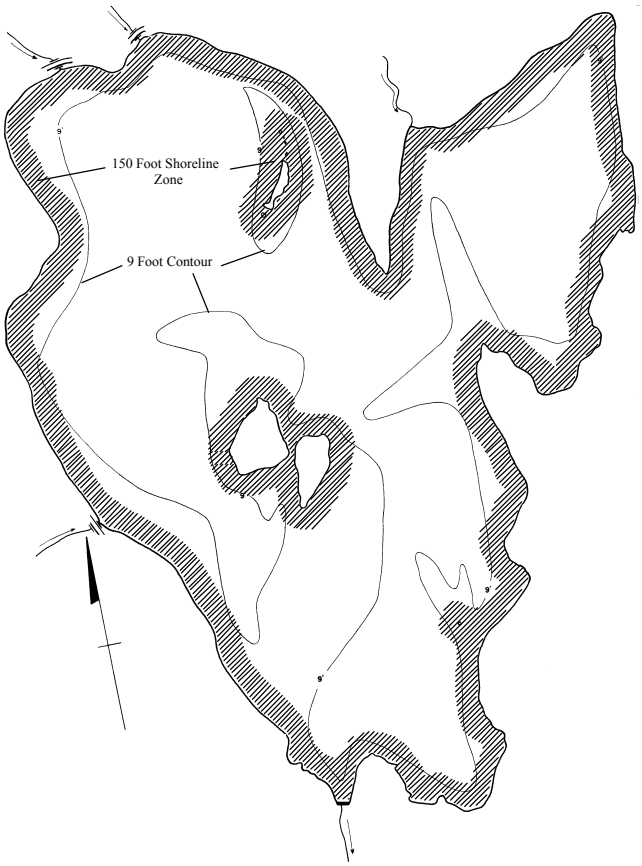
4. RECOMMENDATION: Limit the operation of motor boats and jet-skis in shallow areas of the lake to five miles per hour.

PURPOSE: To minimize the resuspension of bottom sediments from prop wash.

DISCUSSION: Several studies have shown that prop wash from motor boats operating in shallow water can resuspend sediments. One study showed that a 10 hp engine can stir up sediments 6 feet down, a 28 hp engine 10 feet down, and a 50 hp engine 15 feet down (Wright and Wagner 1991). These sediments contain phosphorus which becomes available to increase algae growth. Sediments also contain organic material which can disperse to the deeper areas of the lake and sink to the bottom to increase oxygen depletion rates. Added turbidity decreases water column light penetration. Resuspension of sediments is of particular concern when a motor boat is throttled up in shallow water, such as when pulling up skiers or the typical operation of jet skis. When motorboat traffic is heavy, such as on weekends and holidays, increased turbidity is visible in near shore areas of Lake Pocotopaug.

a. Educate motorboat operators to avoid fast startups in shallow water.

b. Consider amending town ordinances to increase the low speed zone along the shore to 150 feet. This would include many of the areas shallower than 10 feet. A shoreline steerage speed zone also increases safety because it is consistent with the multiple uses associated with the near-shore areas of the lake, such as swimming and fishing, and obstructions such as rafts, moored boats, and underwater hazards such as rocks, which are not compatible with speeding boat traffic.



Areas of Lake Pocotopaug less than 9 feet deep and 150' zone

5. RECOMMENDATION: Continue to encourage beach owners to properly maintain their beaches.

PURPOSE: To minimize lake sedimentation.

DISCUSSION: In 1988 the Lake Area Task Force (LATF) report identified beach creation and maintenance as a significant source of sedimentation to the lake. Placing new sand to replace sand lost by wave and stormwater erosion was considered to be widespread. Since 1988, this practice has been substantially reduced by the actions of the East Hampton IWWCA. Currently, advice given to applicants is to reclaim sand from the lake to replenish their beaches, rather than place new sand.

a. Continue to discourage the creation of new beaches. Allow sandy areas near the lake only when applicants demonstrate that the sand is contained and that drainage and slope conditions have been adequately addressed to prevent sand loss into the lake. Sand should be of appropriate quality (no fines or organics.).
b. Continue to encourage beach owners to pull back sand that has been washed from beaches into the water. This can be encouraged by periodically lowering the lake level to provide easier access to the sand. Beach owners should be encouraged to adopt measures to correct problems causing washouts. As a condition of any permits to pull back sand, improved drainage to prevent washouts should be required.

The problems associated with beach erosion are detailed in the December 14, 1989 Conservation Commission report to the IWWCA, "Information Concerning the Environmental Consequences of Placing Sand on Near Shore Areas of Lake Pocotopaug" (EH CC 1989).

6. RECOMMENDATION: Periodically conduct surveys to identify areas where there are obvious erosion problems in the watershed for immediate attention.

PURPOSE: To reduce future lake impacts from new problem areas as they develop.

DISCUSSION: Soil erosion is a significant source of nutrients and sediment to the lake. Source reduction is often more successful than attempting to remove these pollutants from stormwater flows before they reach the lake. Examples include obvious erosion problems such as unpaved roads and stream bank erosion. Current problem areas should be identified in the WMC Stormwater Renovation and Management Plan. Future periodic inspection of natural and manmade drainage systems will help identify new problem areas so they can be remediated in a timely manner to avoid more frequent cleaning of control structures and/or unnecessarily prolonged inputs of soil to the lake. The Soil and Water Conservation District can provide technical assistance for these surveys at no additional cost to the town. In the case where problems are not on town property, work cooperatively with landowners to arrive at a mutually agreeable solution to fix problems in a timely manner.

7. RECOMMENDATION: Continue to develop and implement a strategy to periodically remove sediment that accumulates at various inlets to the lake.

PURPOSE: To reduce lake sedimentation by removing accumulated material before it disperses further out into the lake.

DISCUSSION: The LATF report of 1988 recommended periodic removal of accumulated sediments at certain inlets to the lake when water levels are low as a cost effective way of reducing the amount sediment reaching the lake. Possible locations for sediment removal included Christopher Brook, the foot of Clark Hill Road, the pond and the entry of Hales Brook, and the cove at the mouth of O'Neill's Brook (Sandy Cove). Heavier particles of sand entering the lake from both natural and manmade drainage ways tend to settle to the bottom immediately adjacent to these inlets as flow velocities slow. These accumulations are often close enough to shore so that they can be removed relatively easily with excavation equipment. Resulting "sumps" serve to collect additional material more efficiently. Regular removal reduces the process of dispersal to less accessible areas by wind and motorboat driven waves. Implementation of this strategy has already begun with the dredging of the lake at the mouth of Hales Brook and the small pond just north of Lake Drive.

8. RECOMMENDATION: Develop a system of positive incentives to encourage the maintenance of naturally vegetated land in the lake basin.

PURPOSE: To minimize increases in phosphorus export to the lake.

DISCUSSION: The LATF report of 1988 emphasized the importance of naturally vegetated land when planning for water quality. Maintaining natural cover is a fundamental concept in managing for optimal water quality. Forested land contributed the least amount of nutrients and sediments to lake per unit area as compared to all other land uses (WRPA 1982).

> "Woodlands are important protectors and conservers of watersheds and soils in certain critical areas. Forest vegetation stabilizes the soil, reduces the impact of precipitation and slows runoff. In doing so, a healthy forest functions to reduce erosion, sediment and nutrient runoff." (LWTF 1978).

Once forest cover is removed, such as during construction, the rate of soil erosion can increase dramatically. After construction is completed and a site all stabilized, erosion continues at a lesser, but still elevated rate. Replacing natural vegetation with impervious surfaces such as roads and rooftops, and lawns increase nutrient export rates significantly. Trees that had absorbed the impact of falling raindrops are felled. The thick humus layer of the forest floor that had absorbed rainfall is scraped off or erodes away. Consequently, the land loses much of its natural capacity to absorb water and rainfall is rapidly converted into overland runoff. (Schueler 1987). Impervious surfaces collect atmospheric fallout and other materials that are subsequently washed into drainage systems by rainfall.

Lawn runoff has been shown to have high phosphorus concentrations (Bannermann et al. 1993). The removal of natural vegetation and creation of lawns often increases long term runoff rates by compacting soil and eliminating natural depressions during landscaping and subsequent use. Larger lawns increase the amount of fertilizer used for lawn care.

Lawns on the uphill side of roads are particularly important because runoff drains into directly into stormwater drainage systems. Reducing the size of lawns effectively reduces future phosphorus sources, and reduces the potential for soil erosion during lawn construction.

It has been shown in numerous studies that undeveloped forest land exports the least amount of eutrophication causing material to lakes. Maintaining naturally vegetated land is important to the lake's future, since conversion to more intense uses increases phosphorus export to the lake. 67 Percent or 1,581 acres of Lake Pocotopaug's watershed is presently forested. 83 percent of the forested land is privately owned and can be developed in the future. Not all landowners may be interested in developing their land. Creating positive incentives to encourage these landowners to keep their land as forest represents a cost effective way for a community to reduce lake impacts from changes in land use. With todays land values, and local, state and federal taxation policies, the incentive for landowners to sell their land into development is high.

a. Tax incentives:
    1. Consider the adoption of the open space provision of Public Act (PA) 490 to extend this option to lower property taxes to owners of parcels under 25 acres. The intent of PA 490 is to preserve forest, farm and open space for the benefits they provide to citizens, and to reduce the forced sale of land into residential development, which usually costs a town more in town services than the revenue it brings in (Gibbons 1984). Statewide, smaller parcels comprise over 58 percent of all privately held woodlands that do not qualify for the forestry provision (Gibbons and Ricard undated). Enactment requires the planning commission to designate the open space desired in the Plan of Development, and approval of adoption of the open space provision at a town meeting. Many options are available as to what open space is allowable. (See LAC March 7, 1995 report, Taxes and Lake Pocotopaug)
    2. Current federal and state estate taxes and land values are so high that many families are forced to sell their family lands to pay death taxes unless they carefully plan their estate. Most of the time these lands go into development even though owners may not wish them to. Establish a program to make watershed landowners aware of the difficulty of passing land onto their heirs, and encourage them to prepare estate plans to help avoid the forced sale of woodland into development because of taxes.
    3. Current local tax policy offers little reduction in property tax when landowners choose to give up their development rights by placing a permanent conservation easement on their property. Develop a policy to reduce taxes on these eased lands to encourage the dedication of permanent conservation easements.
b. Review town policies regarding private donations of land to the town, land trusts or the state. It may be imprudent to discourage such donations based solely on reductions in the Grand List. In addition to providing important recreational and ecological benefits, these dedications may also have a beneficial long term effect on the overall fiscal strategy of the town by avoiding the increased need for town services from residential development.
c. Acquisition of key watershed properties by the town or state can preserve natural land that is important for water quality. This method is preferred by water companies to protect public water supplies from development impacts. The Meshomasic State Forest comprises 263 acres or 11 percent of the watershed. The DEP gives land next to state forest land higher priority when considering purchase through the Recreation and Natural Heritage Trust Fund program. Acquisition of lake shore property can expand recreational access to the lake by citizens while providing an opportunity to preserve some natural vegetation along the shore. Encourage land owners of key watershed parcels to work with the state or town if they are considering selling their land.
d. Assist local land trusts in preserving watershed lands. These organizations are established to preserve donated or eased lands in perpetuity in accordance with the donor's wishes. Donations of land and easements to land trusts can provide the donor with significant tax benefits that offset loss of income from not selling their property into development.
e. To aid local land trusts in providing an organization to which landowners can donate property for preservation purposes, enact CGS 12-81b. This statute allows assessors to prorate property tax bills to the date of sale when property is transferred to charitable organizations. Land trusts are exempt from property tax, but can receive bills unless tax payments are prorated at the time the donation is made. Enactment of this option can avoid a situation where a land trust may be forced to turn down sizable donations because of their inability to pay these taxes.

Maintaining natural vegetation effectively reduces nutrient export by reducing nutrient sources and by filtering out pollutants from developed areas. Many of the following recommendations are based on this fundamental concept.

9. RECOMMENDATION: Develop voluntary guidelines for homeowner projects, such as landscaping or retaining walls, that may not be covered by the regulatory process.

PURPOSE: To provide guidance to landowners on how to accomplish these projects while minimizing lake impacts.

DISCUSSION: There are many projects landowners undertake that are exempt from regulatory review, that can affect the lake both positively and negatively. These projects include clearing of vegetation, minor remodeling of homes, landscaping, modifying driveways, installing sidewalks, and modifying drainage patterns. A set of written guidelines for these types of projects should be developed and made available to citizens to aid in planning for these projects. Distribution should be through the building department and advertised in the lake newsletter.

10. RECOMMENDATION: Reassess the desirability of expanding the sanitary sewer system in residential areas of the watershed by establishing an effective sewer avoidance program.

PURPOSE: To reduce lake impacts due to increased non-point source pollution resulting from more intense development encouraged by the sanitary sewer system.

DISCUSSION: The installation of the sanitary sewer system in the early 1980's was in response to a Pollution Abatement Order issued by the DEP. Coliform counts in the lake had risen to the point where beaches were closed by the health department. The sewer system greatly reduced the probability of septic effluent, which is high in phosphorus, from entering the lake from failing or nonexistent septic systems in the heavily developed areas near the lake. Subsequently, the frequency and duration of algae blooms decreased for a number of years, perhaps because of reduced phosphorus concentrations.

Like many things, sanitary sewer systems have advantages and disadvantages. They can be a solution to problem areas such as the lake area before 1980, where buildings were too close together, or soils inadequate to install effective septic systems. Sewer systems affect development patterns greatly, allowing a greater use of land for housing and commercial and industrial development where it is appropriate. However, they can have negative side effects that affect surface waters. Sewer lines typically gravity feed to pumping stations located at low points near streams and the lake. Failure of pumps can cause substantial amounts of effluent to enter the lake before problems can be detected and repaired. The installation of sewers disrupt wetlands and streams during construction. Unlike septic systems, they do not return water to the ground to replenish groundwater reserves. They divert it out of the watershed away from the lake. It is estimated that the sewer system currently diverts five percent of the lake's supply of water away from the basin before it reaches the lake (EH LAC 1995). Ground water that enters the lake directly, and via streams, generally have much lower concentrations of phosphorus than overland runoff . Groundwater tends to dilute higher concentrations found in overland runoff (Rich 1992). The most significant affect of the sewer system, however, is increased nonpoint source pollution to surface waters from higher density land use, which may cause more problems than the septic systems they replace.

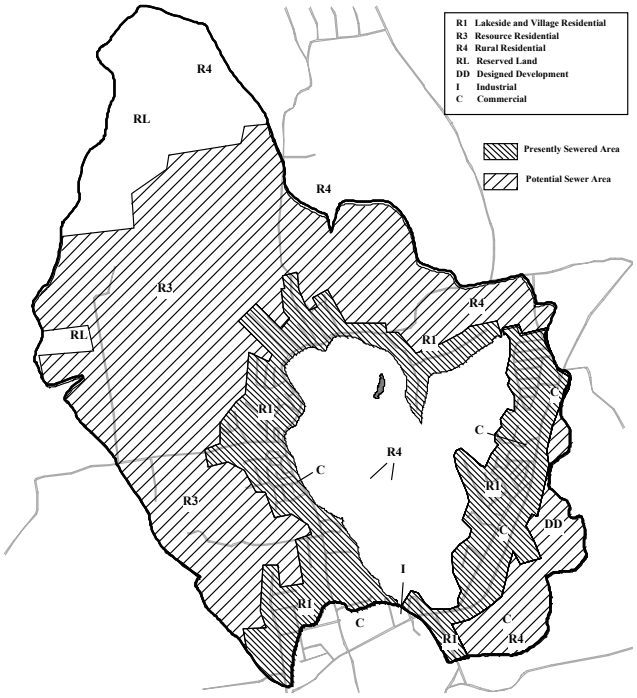
> "The construction of sewers in Connecticut has led to many secondary impacts including higher density land use patterns in areas where it is neither appropriate nor desired. Higher density development generally leads to increases in nonpoint pollution. Many towns have adopted sewer avoidance plans, not to eliminate high density development, but to channel such development to areas where it is most suitable. Sewers are intended to solve problems, not to encourage intense development in environmentally sensitive areas." (Doenges 1993).

In 1980, the Midstate Regional Planning Agency drafted a Sewer Avoidance Program for East Hampton. The purpose of the Program is to avoid the costly extension of the sewer system unless abatement of problems by other means is ineffective or too costly, by the use of alternative methods, such as establishing a comprehensive program to insure that septic systems are properly sited, installed, operated and maintained. (MRPA 1980). Similarly, the *State Policies Plan for the Conservation and Development of Connecticut* also recommends avoiding extending sewers into rural areas and areas of environmental concern unless it can be demonstrated sewers are the most "cost effective alternative to correct an identified public health hazard" (CT OPM 1991). The purpose of the recommendation is to avoid secondary impacts due to increased density resulting from sewers in areas where it may not be appropriate. The Plan states that this is of particular concern in sensitive watersheds such as public water supply watersheds, because of increased nonpoint pollution and the resulting eutrophication of receiving water bodies by stormwater runoff associated with development. The plan recommends that intensive development be guided away from these sensitive areas and that sewers not be used unless they are the *only* feasible solution to *existing* pollution problems.

East Hampton's Sewer Avoidance Plan states that the most reasonable plan option for water pollution control in outlying areas of town are septic systems because they meet health and pollution abatement needs of the community, they are economical, and they entail low risk and high reliability, providing they are properly sited, installed, operated and

maintained. It includes recommendations to reduce the occurrence of septic system failures, to avoid the need and expense to extend sewers to address failing systems. (MRPA 1980) Several of these recommendations have been acted on, however no program to insure proper maintenance of septic systems has been implemented.

In contrast to the State Plan and the Sewer Avoidance Plan, however, East Hampton's Plan of Development recommends that "The *first* option for solving existing sewage disposal problems should be to *expand* the public sewer system," and that "The planning and zoning commission should encourage higher density development in areas served by sewers or areas where sewer service i*s likely to be expanded*." The watershed of the lake is an area of environmental concern because of the lake's sensitivity to nonpoint pollution and eutrophication. East Hampton currently maps 96 percent of the developable area of the watershed as "potential sewer area". (E.H. Plan of Development 1989). If this area is sewered, it will increase the serviced area of the watershed from 637 acres to 2,015 acres, or 216 percent (EH LAC 1995).



MAP 7

Presently sewered area and potential sewered area for the lake basin.

In keeping with the goals set forth in the Plan of Development, East Hampton's policies encourage the extension of the sewer system in a number of ways:

1. Current zoning allows substantial increases in density and impervious surface when sewers are used. Density increases allowed in residential zones amount to 66 percent in R1, and 31 percent in R3. Impervious surface may increase 168 percent in the R1 zone and 48 percent in the R3, or more with these density increases. In practice, the resulting density is increased more than the regulations would imply because it eliminates the difficulty of finding suitable soils for siting septic systems, which usually determines the number of lots allowed on a parcel when sewers are not available.
2. Commercial and Designed Development and its 60 and 50 percent maximum impervious surfaces are allowed only on sewers, as is congregate housing, which allows up to five units per acre and 25 percent impervious surface.
3. Local ordinances can reduce costs to developers who extend sewers to new development through a reimbursement program. The reimbursement covers lines laid from existing lines along road frontage not owned by the developer, to the developer's property line. These funds can then be assessed to the landowners abutting the new lines on a per foot of frontage basis. In addition, landowners abutting the new lines would then be required to abandon their existing functioning septic systems and hook up to the sewers, and pay a hookup fee.

East Hampton's sewer policy in the watershed of Lake Pocotopaug needs to be reassessed as it is inconsistent with the state's policy and recommended practice for sensitive watersheds. The Sewer Avoidance Plan offers a sound alternative to sewer extensions where the are no existing problems. New septic systems installed in accordance with state health codes

minimizes the potential for failure. Watershed areas using properly sited, installed, operated and maintained, septic systems will likely have less impact on the lake than sewered areas.

RECOMMENDATIONS:

a. Pursuant to CGS Section 7-246, the WPCA is empowered to prepare a water pollution control plan that designates where sewers are planned and where they are to be avoided. This plan should be amended to designate the unsewered residential portions of the watershed as a sewer avoidance area.
b. Amend the Plan of Development to adopt the WPCA plan that designates the unsewered residential portion of the lake watershed as a sewer avoidance area. The stated reasons should include avoiding increases in nonpoint pollution to the lake due to increased land use intensity, and reducing the diversion of groundwater out of the lake basin.
c. Amend zoning regulations to discontinue minimum lot size reductions in the R3 zone as part of a watershed overlay zone. This need not be done in the R1 zone since it is currently densely developed, and entirely sewered.
d. Amend the town ordinance "Providing for Connection Charges in Lieu of Assessments for Sanitary Sewers in Certain Cases," paragraph 2, concerning reimbursement of sewer extension costs to eliminate this option in the lake watershed.
e. Continue to insure that septic systems are properly sited, installed, operated and maintained in the watershed to minimize the possibility of failing systems, and subsequent impacts to lake water quality.
f. Develop and implement a program to insure that septic systems are inspected and pumped at appropriate intervals. One reference recommends that they be inspected at intervals not less than two years, and pumped out every three to five years (Doenges 1990). The cost to homeowners is approximately $150 for pump out and inspection. Currently, there is no formal system to encourage proper system maintenance, except on a voluntary basis. Most septic system owners ignore maintenance until a problem becomes obvious with backups or breakouts. In addition to reducing lake impacts, prevention of problems before they happen is more cost effective than dealing with them after they occur. Proper septic system maintenance is essential to avoid the "problem areas" of the future that can only be addressed by extending the sewer system. A model Septic System Maintenance ordinance developed by the DEP is provided in the Appendix (Doenges 1993). This ordinance is similar to the recommendation in Section 4.2 (3)a of the East Hampton Sewer Avoidance Plan.
g. Establish a water conservation program in the watershed to extend the life of septic systems. (See recommendation II-13.)

11. RECOMMENDATION: Institute a program to insure that all gray water discharges are properly hooked up to the sewer system in the serviced area, or to properly operating septic systems.

PURPOSE: To reduce nutrient input to the lake.

DISCUSSION: A "gray" water discharge is wastewater from washing machines, dish washers, sinks, and showers, as opposed to discharges from toilets. Gray water typically contains high levels of nutrients from soap, and food scraps, particularly when garbage disposal units are used in kitchen sinks. One study showed that clothes washing and dish washing can account for over 70 percent of the phosphorus in residential wastewater (Doenges 1990). Though local ordinances, and building and state health codes require that gray water is disposed of either in the sewer system, where they are available, or in approved septic systems, they are sometimes drained onto the ground or abandoned septic systems. It has been alleged that many gray water sources were never properly hooked up after the sewer system was installed in the early 1980's . Once on the ground, gray water effluent can then be washed into drainage systems and into the lake.

12. RECOMMENDATION: Establish a water conservation program in the watershed.

PURPOSE: To reduce septic system problems, and reduce the quantity of water diverted from the lake by the sewer system.

DISCUSSION: Most of the residences in the lake basin are located near the lake and use the public sewer. However, 73 percent of the watershed is outside of the sewered area where subsurface septic systems must be used. Water conservation helps to reduce the potential of septic system failure by reducing the amount of water that needs to be renovated by the system (Doenges 1990). In the sewered area, water conservation reduces the amount of groundwater that is diverted away

from the lake by the sewers. Ground water typically contains less phosphorus which tends to dilute phosphorus laden overland flows that reach the lake (Rich 1992). It is estimated that 5 percent of the potential input of water to the lake is currently diverted by the sewer system (EH LAC 1995). Methods to reduce wastewater flows are outlined in the Appendix. (Doenges 1990)

13. RECOMMENDATION: When considering installation of the proposed public water supply system, review the ramifications of increased growth and density on the lake ecosystem.

PURPOSE: To reduce the consequences of increased land use intensity and non-point pollution of the lake.

DISCUSSION: The installation of a public water supply system can reduce the amount of water diverted away from the lake by the existing sewer system. However, like the sewers, a water system affects development patterns by increasing growth rates and density. This results in greater loss of natural vegetation and increased non-point pollution from increased soil erosion and impervious surfaces. These impacts may affect the lake more than the present water diversion. Currently, the Plan of Development maps most of the lake basin as short term and long term service area for the proposed water system. In 1986 the Water Pollution Control Authority surveyed citizens for opinions on the installation of a town wide water system. 60 percent of those responding indicated they would be in favor of the system. However, wells that currently serve citizens provide adequate supplies of water that do not pose health problems. It may be difficult to justify the expense of a town wide system except in a small area on the west side of the lake near Route 66 where salt contamination has been identified. An exception is a desire to provide public water to foster economic growth in the commercial and design development zones. Like the sewer system, the installation of the distribution lines for a water system will cause widespread construction activity and resulting soil erosion, as well as the disruption of wetland areas.

RECOMMENDATIONS:

a. Safeguard ground water supplies by continuing to carry out policies that reduce potential pollution.
b. If a watershed wide system is contemplated, adopt policies that reduce the likelihood of increased residential density and impervious surface in the serviced area.

14. RECOMMENDATION: Insure the maintenance of wetland functions in the watershed.

PURPOSE: To protect wetland functions that are important to lake water quality.

DISCUSSION: The LATF report of 1988 emphasized the importance of wetlands when planning for water quality. Wetlands provide many benefits. State inland wetland statutes describe 13 or more functional values that towns are charged to protect (Ammann et al. 1986). In addition to providing essential wildlife habitat areas, riparian wetlands, (or those near or adjacent to flowing waters), are especially important in controlling pollution from non-point sources because of their nutrient and sediment trapping function (CT DEP 1992). Wetlands provide important low cost benefits for reducing inputs of eutrophication causing materials to the lake, providing they are not damaged by filling, overloaded with sediment, or overwhelmed with excessive increases in storm water flows from developed areas. They can be used for "polishing" stormwater discharges to further reduce pollutant loads after stormwater pretreatment, but the practice of directly discharging stormwater directly into them without prior treatment should be avoided. (ACOE 1991). Construction of detention structures in wetlands and watercourses should also be avoided.

15. RECOMMENDATION: Continue to improve road stormwater drainage systems and road maintenance practices.

PURPOSE: To minimize nutrient and sediment input to the lake from roads.

DISCUSSION: Roads can be a substantial source of sediment to the lake. The LATF report of 1988 emphasized the importance of reducing the amount of sand and sediment entering the lake from roads. Sand from winter sanding operations is an important source of sedimentation to the lake, since most of the near lake area is steep and heavily

developed. It is also an easily controlled source of sedimentation through street sweeping and catch basin cleaning. Steep roads require more sanding and are quickly flushed clean by rain and snow melt.

Phosphorus, however, is less easily controlled through typical road maintenance practices. Phosphorus adheres to soil particles, particularly the smallest ones such as fine silt and clay, which are easily transported by water. 92 percent of phosphorus in suspended solids is associated with particle sizes less than 246 microns, which do not readily settle out. Clay particles are so small they become colloidally suspended and will not settle out. Organic material such as leaves and wood debris are light, and also easily transported by water. Because of this, typical catch basins retain only 5 to 10 percent of phosphorus when properly maintained. Catch basin effectiveness ceases when about 60 percent of the sump volume is filled. Street sweeping preferentially removes larger particles, whereas rain events remove finer particles. Because of this, regular sweeping is not expected to reduce phosphorus in road runoff by more than 10 percent. (Doenges 1990).

a. Continue to sweep lake area roads promptly before sand washes into drainage systems. Sweeping should be done in the winter between thaws as well as in the early spring.
b. Continue a vigorous program to clean catch basins in the watershed. Basins should be inspected a minimum of four times a year, and cleaned if necessary.
c. Consider other methods to clean catch basins. The current method of cleaning sumps is inefficient and time consuming. Vacuum cleaning, either by contracting the work out, or by purchasing a vacuum unit should be considered.
d. Continue the program to replace old catch basins with basins that have deep sumps. In addition to catching smaller particles of sand, large sumps do not need to be cleaned as often as standard sumps.
e. Consider using water quality inlets at key locations in the watershed. Water quality inlets (or coarse particle separators) are similar to large catch basins. Although their ability to attenuate phosphorus is limited, water quality inlets are more efficient at retaining sediments because they are larger than standard catch basins. They may be the only practical control measure in some areas near the lake.
f. Unstabilized roadsides can be a significant source of sediment and nutrients. Road banks should be periodically inspected and seeded if erosion is evident. Roadsides should be promptly stabilized after being disturbed during road improvement projects. Drainage ditches should be stabilized after being cleaned out. Otherwise, it takes several years for vegetation to reestablish itself and stabilize disturbed soil.
g. Funding should be provided to purchase equipment to adequately maintain roadways and drainage systems to reduce sediment and eutrophication causing materials from reaching the lake. This would include access to a catch basin vacuum capable of servicing existing and future basin designs.
h. Capital improvement proposals for improvements in the lake basin should include adequate funding to conduct an environmental design review to insure that project impacts to the lake are minimized, and that BMP's designed for improving water quality are employed. Adequate funding must also be provided to insure that adequate erosion controls are specified, installed, inspected and maintained to insure that these projects are in accordance with best management practices that curtail the export of eutrophication causing materials to the lake. The IWWCA should be included in this review.

16. RECOMMENDATION: Continue to investigate methods to reduce waterfowl populations on the lake.

PURPOSE: To reduce external nutrient inputs to the lake.

DISCUSSION: Waterfowl populations can be a significant source of phosphorus and organic material to lakes. The LATF report of 1988 noted that large numbers of seagulls were roosting on the lake at night during the winter season. In the winter of 1992 - 1993, the land use subcommittee counted as many as 3200 gulls leaving the lake in the early morning. Based on these counts, it was estimated that they contribute approximately 4 percent of the total annual external input of phosphorus to the lake (EH LAC 1995). Ducks and geese populations have not been estimated. Their numbers are small, but may be increasing. The contribution of phosphorus to the lake from seagulls and other waterfowl likely varies from year to year, depending on weather patterns, ice cover, and other factors. Methods to control seagull populations have been investigated, but because of their habits, the size of the lake, and their federal status as a protected species, no practical control method for Lake Pocotopaug has been identified. Residents should be discouraged from feeding all waterfowl, including ducks and geese, as this practice increases the resident populations on the lake and interferes with normal seasonal migration patterns. An increasing problem has been identified near the mouth of Hales Brook where feeding is establishing a "resident" population. With the possibility of increased numbers of all species, control methods for seagulls and other waterfowl should still be pursued.

OBJECTIVE III

To develop and implement a coordinated and comprehensive system of land use controls to reduce nutrient and sediment inflow into Lake Pocotopaug.

1. RECOMMENDATION: Develop and implement land use policies in the lake watershed to insure that cumulative impacts from allowed uses do not exceed the capacity of the lake ecosystem to absorb them.

PURPOSE: To reduce environmental impacts due to land use that is inappropriate in the areas for which it is proposed.

DISCUSSION: Land varies in its capacity to support development without unacceptable harm to natural resources. Some areas are better suited to support more intense uses, such as commercial and industrial use. Other areas may be suitable for less intense uses, such as light residential. Lakes are particularly sensitive to increases in nutrient export that invariably accompanies the conversion of forest to more intense uses. Algae blooms in lakes are often an indication that past land use policies exceed the capacity of the lake ecosystem to absorb resulting impacts. Land use policies should have a goal of *sustainable development*, or an intensity of development that can be sustained by an ecosystem without unacceptable degradation. The following characteristics should be considered when planning for land use in a community, particularly in sensitive lake watersheds:

a. Steep slopes.
c. The sensitivity of downstream resources, such as the lake.
b. The presence of wetlands and watercourses.
c. Buffer areas.
d. Soil types.
e. The potential for future development.
f. The character of the proposed use of land, including the proportion of impervious surface, the removal of natural vegetation, etc.

2. RECOMMENDATION: Develop and implement a Phosphorus Management Method (PMM) for development projects in the watershed.

PURPOSE: To minimize future phosphorus inputs to the lake to an acceptable standard.

DISCUSSION: Many studies have shown that development of forested areas can substantially increase phosphorus export to lakes unless steps are taken to avoid increases. The use of best management practices (BMP's) in the design and construction phases of development can reduce phosphorus export, but their use alone does not assure that export rates will be reduced sufficiently. Currently, in most cases BMP's effective at reducing phosphorus are neither required nor implemented voluntarily. A PMM is presently used in the state of Maine for lake protection. It offers a method that insures that lake goals are met without creating unnecessary restrictions on development by establishing a performance based phosphorus standard (Maine DEP 1990a). A similar method, called a Nutrient Allocation Plan and Policy (NAPP), has been proposed for Columbia and Coventry Lakes in Connecticut, by Ecosystem Consulting Service, Inc. (ECS undated). This method is not unlike the method currently used in East Hampton to reduce downstream flooding due to new development by calculating before and after peak flows, and requiring control technology to mitigate increases. This method has many advantages for protecting water bodies like Lake Pocotopaug:

a. The method accounts for the specific characteristics of the lake ecosystem and its tolerance to phosphorus input.
b. It is site and project specific. It identifies the necessary level of BMP's needed to reduce impacts to an acceptable standard for a particular site and the proposed intensity of use. It accounts for the differences between residential, design development, and commercial uses.
c. It provides a method to reach informed land use decisions. Land use officials are provided a measurable basis to make decisions when regulating activities that can impact the lake. Decision making is more consistent and less arbitrary. It also gives applicants a clear understanding of what is expected of them, and guidance to arrive at an acceptable plan.

d. It focuses on the impacts of development without prohibiting use. The method sets a standard, and allows the applicant to decide how he wants to meet the standard in the context of his project goals. Every land use that is allowable under zoning and inland wetland regulations can be permitted by the method. This approach allows an applicant a great deal of flexibility while addressing phosphorus export without placing unnecessary restrictions on the applicant.
e. The method is applied equitably to all areas of the watershed and to all landowners.
f. It accounts for cumulative impacts. A single project seldom increases phosphorus in a lake to an extent to cause a noticeable change by itself. However, the sum total of all the individual projects that can occur in a watershed likely will.
g The method requires that each individual project address the problems it creates. This avoids spending the taxpayers money on public projects for restoration or retrofitting to correct problems created by the cumulative impacts of previous projects.
h. Because the method has a scientific basis, is equitable to all, directly addresses impacts caused by land use proposals, and does not prohibit any land use, it is legally sound and will stand up to appeals better than many other regulatory programs.

Recommended steps for setting up a phosphorus performance standard are as follows. The town should work with a qualified environmental engineering consultant to perform the first three:

a. Determine the lake's phosphorus loading tolerance level for an acceptable level of lake water quality.
b. Calculate the permissible per acre phosphorus export rate based on the area of the watershed that is likely to be developed in the future. This is the phosphorus goal for new development.
c. Develop a method to evaluate phosphorus export rates for land use in the watershed. The method used in Maine can be adopted or modified for use in Lake Pocotopaug's watershed. (Refer to Maine DEP publications, Comprehensive Planning for Lake Watersheds, Implementation Strategies for Lake Water Quality Protection, and Phosphorus Control in Lake Watersheds for more information). The method should address all uses allowed in the watershed by current zoning and inland wetland regulations, and specify techniques and BMP's that are appropriate to meet phosphorus reduction goals.
d. Formally adopt the method and set up a watershed overlay zone. Both the PZC and the IWWCA could use the method to judge applications. Local ordinances can also be used to implement the plan.

By specifying how much is enough, a PMM can avoid unnecessary burden on applicants. Without a measurable goal for a given project, an applicant could employ costly measures that exceed those necessary to meet lake objectives. The use of this method in the watershed of Lake Pocotopaug simplifies the regulatory structure needed to insure that lake goals are met. If a PMM program is adopted, most of the factors and concerns represented in recommendations III-4 through 9, and 12, are automatically accounted for, and need not be adopted elsewhere in wetland and zoning regulations.

3. RECOMMENDATION: Amend the Plan of Development to insure the goals and intent of lake restoration and preservation are represented.

PURPOSE: To include lake goals in the town's future plans.

DISCUSSION: East Hampton's Plan of Development is the town's guide for future conservation and development. Including lake goals in the plan provides a basis for subsequent amendment of land use regulations to meet these goals. It also provides an important legal basis for land use policy changes. The following items should be addressed.

a. Lake restoration goals and importance to the community
b. Goal to limit phosphorus input to the lake
c. Sewer system, septic system, and water system policies
d. Designate open space that is important to water quality.

4. RECOMMENDATION: Develop an Open Space Development (cluster) subdivision regulation that would reduce the export of eutrophication causing materials to the lake from that of regular subdivisions.

PURPOSE: To give landowners an option to conventional subdivisions that can reduce impacts on the lake due to the export of eutrophication causing materials.

DISCUSSION: Open Space Development (OSD) is an alternative to typical subdivisions that allows "clustering" buildings into a particular portion of a parcel so that at least one third of the parcel remains as open space to be used exclusively for recreational, conservation, and agricultural purposes, as long as such development is consistent with soil types, terrain, infrastructure capacity, and the Plan of Development (Zizka 1993). OSD can reduce disturbances to sensitive areas on a parcel by permitting more flexibility with the layout of buildings and roads by clustering units into areas that may be better suited for development, and away from buffer areas, wetlands and watercourses, steep slopes, and water bodies. In addition to potentially reducing environmental impacts, the OSD option can reduce development costs and town maintenance costs. Although OSD can be a benefit in most any area in town to achieve a number of objectives, a regulation that includes provisions for reducing the export of eutrophication causing materials off site could be used to reduce development impacts on the lake. Most OSD regulations allow the same number of lots as a standard subdivision would support on a given parcel. Additional open space area is then created by reducing the minimum lot size for those lots. Typically, a formula is used to determine what a realistic number of units would be for a standard subdivision on a parcel. These formulas calculate a "buildable" area by subtracting from the total area of the parcel, all or a portion of wetland and watercourse area, steep slope area, the amount of open space required by the standard subdivision, road area, soils unsuitable for septic systems, and easements that would limit the use of the parcel. The buildable area is then divided by the minimum lot size for the zone to arrive at the total number of units allowed. An OSD regulation could reduce impacts to the lake from that of standard subdivisions, if it is carefully designed to minimize the export of eutrophication causing materials.

a. OSD can be offered as an option in the lake watershed as part of an overlay zone by special permit.
b. A special permit must have standards that provide the applicant a clear understanding of what is required, and provide local commissions a clear basis on which to judge applications. The standards of the regulation should include 1) reducing the volume and velocity of overland stormwater runoff, 2) reducing the removal of natural vegetation, the creation of lawns and impervious surfaces, 3) reducing the export of eutrophication causing materials, and 4) the permanent protection of land important to lake water quality, such as buffer areas.
c. A phosphorus based performance standard should be used to determine if proposed plan actually reduces the export of eutrophication causing materials, particularly phosphorus, from that of a standard subdivision. (See recommendation III 2 concerning a phosphorus based performance standard.) Without a performance standard, a poorly designed OSD could actually increase phosphorus export.
d. Open space must be permanently preserved. Otherwise the open space may eventually be developed and the benefits critical open space areas provide will disappear.
e. The OSD regulation should allow no more units than a standard subdivision would realistically support. Most OSD's do not allow increased overall density. The incentive to the developer to consider OSD is reduced costs for roads, driveways, utilities, and to have an alternative that can help him meet lake protection goals in a more cost effective manner, while allowing flexibility to better address site constraints.
f. The calculation for the number of units a parcel could realistically support using a standard subdivision should account for steep slopes, buffer areas, wetland and watercourses, open space required by the standard subdivision regulations, soils unsuitable for septic systems, and easements that would limit the developable area.
h. OSD need not be limited to sewered areas. The Sewer Avoidance Plan of 1980 encourages the WPCA to establish a policy on community septic systems to allow development like OSD's. Large systems must be installed to DEP standards. Suitable provisions for acceptable operation and maintenance of these systems can limit town liabilities for these systems if problems arise (Doenges 1990, MRPA 1980).
i. Some communities require open space development in some areas, rather than allowing it as an option. Typical subdivisions area then allowed by special permit. This could be appropriate in watershed areas that have marginal development capabilities, where maximum flexibility is typically needed to deal with difficult site conditions.

5. RECOMMENDATION: Require an environmental impact assessment on all significant watershed land use proposals that can affect lake water quality.

PURPOSE: To assess lake impacts due to land use applications, aid the applicant in developing plans to avoid or minimize them, and to assist public officials in their review of applications and decision making.

DISCUSSION: Any land use proposal in the watershed has the potential to cause impacts to water quality. Though a single project is unlikely to cause problems by itself, the cumulative impact of many small projects can. Environmental

impact assessment facilitates the development of plans that avoid unnecessary impacts to lake water quality. This is particularly critical whenever overland stormwater flows will be leaving a site. Environmental impact assessment is an integral part of inland wetland regulation. PZC regulations allow for assessments to be submitted when the commission deems necessary. The assessment must specifically address the export of eutrophication causing materials to the lake, and plans must provide for remediation of stormwater before leaving the site. Otherwise, remediation then becomes the responsibility of the public. These reports should be reviewed be qualified experts for the town to insure that watershed goals and objectives are adequately addressed.

6. RECOMMENDATION: Require the use of stormwater best management practices (BMP's) designed to improve water quality for all development applications in the watershed.

PURPOSE: To control the export of eutrophication causing materials from each site, and to insure that the quantity and quality of stormwater runoff from any specific development is not substantially altered from predevelopment conditions.

DISCUSSION: Development substantially increases the export of non-point source pollutants that cause lake water quality problems. To reduce these impacts best management practices (BMP's) have been developed to reduce the quantity and improve the quality of stormwater from development projects before it leaves the site. Zoning regulations should be amended to require their use in the watershed when appropriate in combination with source reduction, such as the reduction of impervious surface and lawns, and the maintenance of natural vegetation, to minimize the export of phosphorus, organic material, and turbidity from the site after the project is completed. (Refer to Schueler 1987, 1992, Galli 1992, NY DEC 1992 for descriptions and specifications of BMPs). It is anticipated that the WMC report will also outline water quality BMPs. The following is a listing BMP's that are often used to address water quality:

a. Infiltration:
   - -Infiltration basins
   - -Infiltration trenches
   - -Porous pavement systems
   - -Dry wells
   - -Surface depressions and roughness
   - -Off-line basins

b. Retention:
   - -Wet ponds
   - -Artificial (created) wetlands

c. Detention:
   - -Extended detention ponds

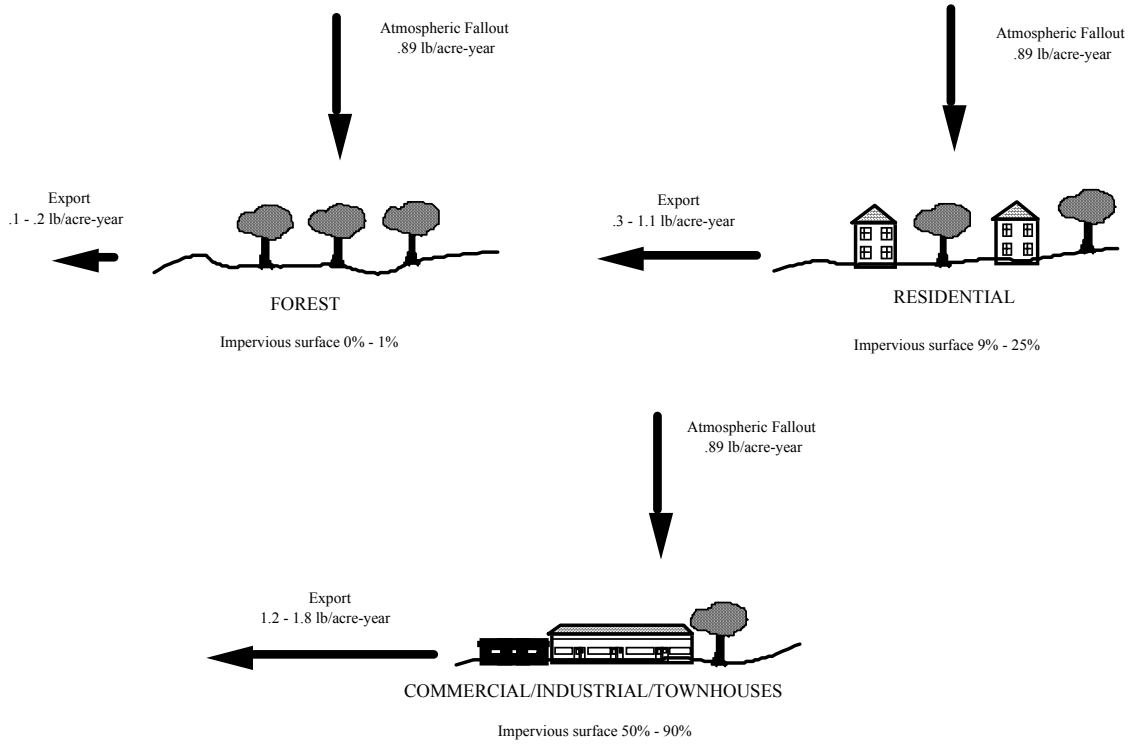
d. Supplemental stormwater management practices:
   - -Sand filters
   - -Grassed swales
   - -Filter strips
   - -Water quality inlet structures (gross particle separators)

7. RECOMMENDATION: Amend zoning requirements to minimize impervious surfaces in the watershed.

PURPOSE: To reduce the quantity of overland runoff and to reduce the amounts of pollutants washing off these surfaces that affect lake water quality.

DISCUSSION: Impervious surfaces such as roads, paved driveways, and rooftops, increase the quantity of overland flow into storm drainage systems and decrease infiltration of water into the ground. Runoff from impervious surfaces contain significant amounts of pollutants, including eutrophication causing materials such as phosphorus, nitrogen, turbidity, and oxidizable organic material. Water that soaks into the ground is filtered as it travels through soil and eventually exfiltrates into wetlands and watercourses that lead to the lake. Impervious surfaces collect atmospheric fallout, eroded soil, deposits from vehicles, and animal droppings, which are then washed into storm drainage systems when it rains. (NY DEC 1992). Pollutant loading of surface waters is a direct function of watershed imperviousness (Schueler 1987). Decreasing impervious surfaces effectively reduces the amount of material exported by reducing it at its source. Decreased overland

flows enhance the effectiveness of stormwater control measures installed to improve the quality of runoff reaching streams and the lake. Reduced runoff volumes also reduce installation and maintenance costs for stormwater control structures. When impervious surface begins to exceed 12 percent, streams start to show degradation (Klein 1979). Even sewered low density residential development with 15 percent impervious surface has been shown to increase phosphorus export 5 to 10 times over that of forested areas with no impervious surface (Dennis 1986).



Impervious surface and phosphorus export rates (from NYDEC 1992)

Current zoning regulations limit lot coverage (defined as impervious surface) for various types of development. The following table summarizes zoning requirements in the watershed of Lake Pocotopaug. Note that actual overall resulting impervious surface limits are higher than the zoning regulations would imply because lot coverage requirements do not include roads and sidewalks.

Zone Designation	Principle Use	Minimum Lot Area (Without / with sewer)	Max Impervious Area (Without / with sewer)
R1	Lakeside and Village Residential	60,000 sf / 20,000 sf	10% / 20%
R3	Resource Residential	60,000 sf / 40,000 sf	10% / 10%
R4	Rural Residential	60,000 sf / 60,000 sf	10% / 10%
RL	Reserved Land	not applicable	not applicable
DD	Designed Development	Not allowed / 5 acres	Not allowed / 50%
I	Industrial	Not allowed / 40,000 sf	Not allowed / 50%
C	Commercial	Not allowed / 40,000 sf	Not allowed / 60%
(R1, C)	Congregate Housing (special permit)	Not allowed / 8,712 sf/unit	Not allowed / 25%
Undesignated	Scraggy Island	not applicable	not applicable

Watershed zoning requirements (EH Zoning Regulations 1992).

RECOMMENDATIONS:

a. Review lot coverage requirements in the watershed to reduce impervious surfaces. Review the required widths for roads, and develop a hierarchy of road widths based on usage to minimize impervious surface.

b. Review the consequences of having commercial, industrial and design development zones in the watershed with respect to the intensity of development and high amount of impervious surface these zones allow. The congregate housing provision should also be reviewed for the same reason. The high density and the impervious surface these zones allow make it difficult for a project to adequately address the quality and quantity of storm water drainage before it leaves the site because of the high volume of runoff collected and limited area to install sufficiently sized control structures. In light of this, a phosphorus based performance standard as described in Recommendation III-2 should be strongly considered for all commercial, design development, and congregate housing projects in the watershed to balance desired uses and acceptable impacts from intense land uses such as these and still allow a great deal of flexibility while achieving lake goals without placing a specific limit on allowed percentage of impervious surface.

8. RECOMMENDATION: Review the current system of land use controls for maintaining buffer areas between development or clearing activities and wetlands, watercourses, stormwater drainage systems, and the lake.

PURPOSE: To improve buffer preservation policies to reduce the amount of eutrophication causing materials from reaching the lake.

DISCUSSION: Buffers, or naturally vegetated areas located between cleared or developed areas and surface waters, have been shown to be a cost effective low maintenance method to reduce the amount of pollutants reaching surface waters in stormwater runoff. Buffers trap nutrients and sediments by filtering out particulates, and by infiltration into the ground, as stormwater flows over the ground. The effectiveness of buffers depend on the amount of pollutants entering the buffer, slope, soils, the width of the buffer, and the type of vegetation present. Channelization, or the concentration of flows (intentional or unintentional), substantially reduces the effectiveness of buffers. Typical stormwater drainage systems effectively "short circuit" buffers by channeling water around or through these areas via pipes and swales directly to streams, water bodies, and wetlands (ACOE 1991). See report by the East Hampton Conservation Commission, "Buffer widths and the Protection of Surface Waters", (EH CC 1992) for a summary of information on buffers.

RECOMMENDATIONS:

a. Develop and implement an IWWCA regulated buffer area around wetlands and watercourses. Many activities occur in the watershed that could impact the lake and therefore are regulated activities, but are not reviewed by the IWWCA because they are unaware of them. A regulated buffer area would help insure that the intent of the IWWCA regulations are carried out. Which activities are regulated and those that are allowed as of right should be specified in the regulation. Projects that take place in areas where overland or piped stormwater drainage may eventually reach wetlands and streams that lead to the lake should also be included in the regulated area since experience has shown that stormwater drainage systems often extend the critical area well beyond natural drainage ways. Several court cases have established the legal and scientific precedent for regulating areas outside of wetlands and watercourses. As of December 1993, 129 or 76 percent of the towns in Connecticut had adopted regulated buffer areas in their wetland regulations. 63 specified distances under 100 feet, and 66 had 100 feet or more. The largest was 200 meters (656 feet), which has been upheld in court. Some used a model incorporating slope to determine the width of the regulated area. Another had a no disturbance zone prohibiting certain uses, with provisions for an exemption. This has also been upheld in court.

b. The P&Z wetbelt regulation (Section 7.11 of the East Hampton Zoning Regulations) was created to help protect sensitive areas adjacent to wetland and watercourses. To better serve its purpose, it should be reviewed with respect to the export of eutrophication causing materials to the lake, and state statutes. The uses allowed by special permit, and the standards which must be met should be clearly stated in the regulations. As well as being legally advisable, this would give applicants a better idea what is expected, and would provide the commission a basis on which to judge an application. Performance standards that specifically address lake water quality could be added. Currently there is much confusion concerning what uses are regulated, what standards apply, and when the regulation is to be applied. The present regulation should be reviewed by independent land use legal experts to achieve stated goals in a legally defensible manner.

c. Areas adjacent to manmade drainage systems must be considered in order to reduce pollutant export. For instance, house sites on the uphill side of roadways that have drainage systems leading to the lake can impact

the lake just as easily as a house on the lake, even though the nearest wetland or watercourse is thousands of feet away. Buffer areas between developed areas and man made drainage ways should be considered.

9. RECOMMENDATION: Develop criteria and standards for land use applications for lake shoreline construction and landscaping activities.

PURPOSE: To provide applicants with a standard by which to design and evaluate projects in this critical area, and staff and commissions a basis to judge them by.

DISCUSSION: The shoreline area of the lake is presently mostly developed. Consequently, opportunities to reduce impacts to the lake from new shoreline development are limited. However there are still some undeveloped lots and naturally vegetated frontage left. Standards are needed to guide development applications in this critical area to reduce further lake impacts in a fair and consistent manner. These standards must also address applications for previously developed lots to minimize new nutrient export, and if possible, reduce existing sources. These standards should allow for the high degree of variability of these sights but be specific enough to provide measurable standards. Standards should address:

a. Erosion control requirements for before and after development.
b. Natural or planted buffers.
c. Stormwater disposal and renovation considerations.
d. Natural shoreline conservation and methods for stabilizing shorelines.
e. When applications for landscaping or construction or modification of existing structures are made, these permits should be conditioned to require making improvements to address existing sources of eutrophication causing materials to the lake, as well as those caused by the proposed project. This could include installation of drywells and porous pavement systems to address roof and driveway runoff, and landscaping to divert lawn runoff into existing or created vegetative buffer areas or depressions to encourage infiltration, rather than directly into the lake.

10. RECOMMENDATION: Review and amend the current open space exaction policy under the planning and zoning regulations.

PURPOSE: To provide adequate protection for land areas critical to water quality in a straightforward and consistent manner.

DISCUSSION: The state legislature allows that towns may exact certain amenities as part of subdivision applications to provide for the public's health, safety and welfare. These amenities include providing for roads, drainage systems, and open space areas. Open space dedications can be set aside to protect areas important for the protection of lake water quality, as well as recreation and other uses. This process can be an important part of a watershed management plan. Open space areas can provide for buffer areas, and infiltration of sheet runoff, and space for water quality improvement structures such as detention ponds.

a. Most towns use a percentage basis for determining the exacted area. East Hampton's current zoning regulation exacts one acre per 5 building lots, regardless of zone. This allows applicants to avoid dedicating any open space by developing four lots or less at a time, which may result in protection of the less important areas of a parcel. An up front percentage would allow commissions to specify the exaction in a straightforward and rational manner, that could better address lake protection. The current regulation can result in zero to as much as 30 percent of a parcel being exacted in the R1 zone, zero to 18 percent in the R3 zone, and zero to 13 percent in the R4 zone. No open space is required for commercial use unless there are five or more lots created, where zero to 18 percent would be required.
b. The *type* of open space desired and the *reasons for its importance* should be specified in the regulations and the Plan of Development.
c. In the majority of cases, wetlands are eased to fulfill subdivision requirements for open space in East Hampton. Since wetlands and watercourses cover about 15 percent of the state, an open space exaction of say 15 percent would not on average be adequate to protect wetlands *and* buffer areas. Since wetlands and watercourses already have a certain degree of protection through the IWWCA regulations, open space exactions could include only non-wetland areas, such as essential buffer areas. Simsbury's open space

regulation requires that 20 percent of a parcel be dedicated as open space to allow for active and passive recreation areas, and buffer areas. The regulation specifies that the ratio of wetland/ non-wetland area of the open space dedication cannot be less than the wetland/ non-wetland ratio for the entire site. An approach such as this would effectively allow for adequate protection of critical buffer areas with a limited open space requirement.

d. Section VI 8 of the subdivision regulations allows waivers based on lot size and proximity to active public recreation areas. Though this may be appropriate for active recreational reasons, it may encourage waivers when there is a need for preservation of sensitive areas important to water quality. To give applicants and commissions guidance and establish a reasonable basis, subsection 8A language should include, "except in the case where open space is required to preserve sensitive areas important to water quality." The Plan of Development should designate what type of areas are important to water quality as part of the definition of open space to provide a basis for setting aside these areas as open space.

e. A model open space regulation developed by Attorney Mark Branse is included in the Appendix. This regulation has been reviewed by a number of top land use attorneys in the state and, as such, provides a sound base for East Hampton's open space policy. This model can be adopted in its entirety, or in part.

11. RECOMMENDATION: Develop a formal, written town policy for conservation easements.

PURPOSE: To provide a sound basis for protecting sensitive areas through the use of conservation easements in a long lasting and defensible manner that will provide maximum benefits to the donor and the town.

DISCUSSION: Conservation easements are regularly given in the name of the town, as well as other organizations established for the protection of natural lands. Acceptance of these easements incurs certain responsibilities. This policy should be reviewed to make sure the wishes of the donor are adequately provided for, and that the form of the easement accomplishes the objectives of the dedication:

RECOMMENDATIONS:

a. Ensure that all conservation easements are permanent. Sometimes easements are not "permanent", and can be discontinued by agreement of the property owner and the P&Z. This may not be consistent with preservation objectives of grantors or town officials. Easements that are not permanent in the eyes of the IRS do not receive the tax benefits that donors may be expecting.

b. Amend the zoning regulations to provide for the easement marking system adopted by the zoning commission in 1989. The regulations should require that the marking language be shown on the plans to insure that contractors are aware of the marking policy. This is to avoid needless cutting or clearing due to misunderstanding where the conservation area boundaries are.

c. Establish a formal procedure for inspecting and enforcing easements. Currently there is no formal procedure to insure that the wishes of the donor are being adhered to. Many towns use their conservation commissions as agents of their planning and zoning commission and inland wetlands and watercourses agency to regularly inspect easements and report problems to appropriate enforcement agents. Provisions for inspection and enforcement should be spelled out in the easement language.

12. RECOMMENDATION: Amend the planning and zoning buildable rectangle regulation to consider sensitive areas, such as buffer areas, areas with steep slopes, and areas with and highly and potentially highly erodible soils.

PURPOSE: To insure that all approved building lots have adequate area to support the normal activities most homeowners desire without encroaching on sensitive areas that are important to lake water quality.

DISCUSSION: Maintaining wetlands and watercourses is important for lake water quality. Maintaining natural vegetation adjacent to wetlands and watercourses, (or buffer areas), protects water quality by absorbing and filtering nutrients and pollutants before entering streams. Once in surface waters, most nutrients and pollutants will eventually reach the lake. Maintaining buffer areas in a naturally vegetated state during and after development is a cost effective way of reducing impacts on water resources, as well as providing visual diversity, wildlife habitat and recreation areas. The present buildable rectangle requirement in the subdivision regulations (Section IV 6) can insure that enough space is available on each building lot so that future homeowner's can conduct their activities and have all the normal amenities that property owner's often desire, such as houses, lawns, gardens, garages and other outbuildings, without encroaching in wetlands during development or at some time in the future. The current regulation could also allow for other factors that are important considerations for water quality, such as highly or potentially highly erodible soils, steep slope areas, buffer

areas, and easements. Though the regulation does not restrict uses to the rectangle area, it is a good indicator for planning purposes. The regulation does allow a waiver based on the availability of sewers, which may have little to do with the potential to pollute surface waters due to the development and occupation of a house lot. Suggested language for the buildable rectangle regulation is as follows:

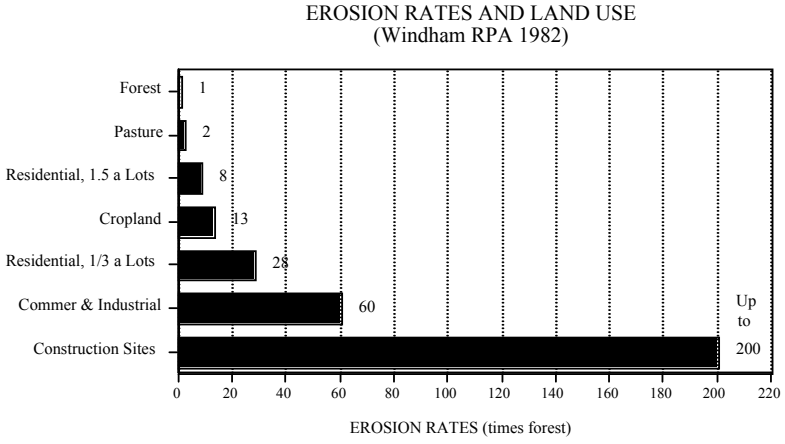
> "Each lot in a subdivision shall contain a rectangle containing the minimum width and depth in the applicable zone which contains:
> 1. No wetlands or watercourses as defined in section III.
> 2. No land within (x) feet of a wetland or watercourse. Land with slopes of 15 percent or more are not considered to count towards the required separating distance.
> 3. No land shown as floodway, Zone "A", or Zone "B" on a map entitled "Flood Insurance Rate Map - Town of East Hampton, Connecticut - Effective October 16, 1979", as amended.
> 4. No land with slopes over 20 percent.
> 5. No soils which are classified as highly erodible or potentially highly erodible by the Soil Conservation Service. (See Appendix for list.)
> 6. No land that is part of an easement that restricts the use of land.
>
> The commission may waive this requirement for the building rectangle if the applicant demonstrates that the building lot may be developed and occupied without the likelihood of encroachment of the above listed areas and that there is no other configuration or density for lots in the subdivision that will allow conformance with the requirements of this regulation."
>
> Add to Section III Definitions: "Wetlands and watercourses - As defined in Sections 22a-36 through 22a-45, inclusive of the Connecticut General Statutes, as amended, and including tidal wetlands and watercourses." This is to insure that wetlands and watercourses are defined in a consistent manner throughout all town regulations.

The suggested language for the waiver allows for cases where the regulation may result in a taking, and gives some guidance to applicants and the commission when a waiver might be appropriate.

13. RECOMMENDATION: Minimize the potential for soil erosion from presently developed areas, and from future development.

PURPOSE: To reduce the export of soil to the lake.

DISCUSSION: Eroded soil is considered to be the largest single non-point source water pollutant. It also accounts for a major proportion of phosphorus input to lakes. Soil also contains organic material and causes turbidity. Sediment export varies with land use. In forests, export rates are low, because the leaf canopy reduces the energy of falling rain drops. Forest litter and root masses effectively stabilize soils and provide high infiltration rates. The highest soil export rates are associated with intense land uses. Very high erosion rates from construction sites are of particular concern. However, erosion from developed areas after construction is completed must also be considered in lake watersheds. (WRPA 1977, CCSWC 1986)



Erosion rates for various types of land use (WRPA 1977)

Phosphorus adheres to soil particles, particularly the smallest ones such as fine silt and clay, which are easily transported by water. 92 percent of phosphorus in suspended solids is associated with particle sizes less than 246 microns, which do not readily settle out. Clay particles are so small they become colloidally suspended and will not settle out. Organic material such as leaves and wood debris are light, and also easily transported by water. Storm water drainage practices, though well designed to safely remove water from developed areas and reduce peak flows in downstream areas, do not address the fact that they are also well designed (unintentionally) to deliver phosphorus and other eutrophication causing materials directly into lakes. Because of the difficulty in controlling transport of fine soil particles, source control is of prime importance.

Construction site erosion is a serious source of nutrients, organic material, turbidity and sediment to surface waters. Erosion rates can be 10 to 100 times higher than agricultural land of the same soil and slope (Doenges 1990). The importance of the proper design, specification and installation of erosion and sedimentation controls cannot be over emphasized. Regular inspection and repair/replacement of controls is of paramount importance.

Erosion rates increase rapidly as slopes increase. Erosion rates, like rainfall, vary with the time of year. The highest risk period in Connecticut occurs during the months of June, July, August and September. During this time, intense rainfall associated with short duration thunderstorms creates a high erosion risk. In the spring, however, melting snow and spring storms adds to runoff and erosion hazards. Because the ground is still partially frozen, its absorptive capacity is reduced, and upon thawing soils may be very easily eroded. (CCSWC 1986)

Since 1985, Connecticut has required that state soil and erosion and sedimentation control guidelines be used as a minimum for development applications where disturbances are over one half acre. East Hampton zoning regulations address the guidelines in Section 27. Use of these guidelines reduce erosion. However, they do not address the quality of runoff with respect to any standard when they are applied. Depending on site conditions, such as soil type and slope, significant amounts of phosphorus, turbidity and organic material can be exported in spite of the proper use of these controls. Minimum standards set forth in the guidelines may not be adequate in sensitive watersheds like Lake Pocotopaug's.

RECOMMENDATIONS:

a. Insure that applications for development use BMP's designed to reduce the export of erosion products not only during construction, but after projects are completed.
b. Insist that projects be designed to avoid disturbances and maintain natural vegetation in areas where slopes are 15 percent and over. This is critical when these areas are adjacent to wetlands, watercourses and manmade drainage systems.
c. Critically review soil and erosion control plans for construction in the lake watershed. Require that erosion and sedimentation control plans for significant projects be prepared by certified soil and erosion control specialists. Insure that all plans provide for adequate inspection and maintenance of control measures.
d. Provide funding for all watershed erosion and sedimentation control plans to be reviewed by a certified erosion and sedimentation control specialist for the town.
e. Adopt a policy that assures that clearing of land for the purpose of development does not occur until just before construction is started, and that stabilization of areas not necessary for actual construction (say beyond 15' around building) occurs immediately. Building lots are often cleared long before they are sold and developed. Landscaped areas are often left unstabilized for the duration of a project, particularly with home site construction, which can be a year or more.
f. Avoid unnecessary clearing of natural vegetation. (See Recommendation II 8). Require that contract clearing limit lines be required on all land use applications. Any clearing beyond these lines would not be allowed unless reviewed and approved by the permitting agency. This would discourage indiscriminate clearing of natural vegetation beyond that represented to agencies at the time of application.
g. Review road maintenance practices. Inspect road banks for unstabilized areas and seed them. Restabilize areas disturbed during cleaning and maintenance projects. (See Recommendation II-15)

14. RECOMMENDATION: Avoid granting zoning variances that increase lot coverage and decrease buffer areas.

PURPOSE: To reduce cumulative lake impacts due to increased impervious surface, overland runoff, and removal of natural vegetation to the lake.

DISCUSSION: Zoning variances are granted by the Zoning Board of Appeals to modify certain requirements of the zoning regulations when the requirements cause a hardship that limits the reasonable use of a parcel because of its unique situation. The cumulative impact of some types of variances can impact the lake.

a. Currently, variances are often sought and are routinely granted to exceed the zoning limits for lot coverage. Because of the role impervious surface has in increasing overland runoff and the quality of that runoff, granting variances to exceed the zoning limits for impervious surface in the watershed should be avoided.
b. Variances that decrease the distance between any buildings, paved areas, or construction projects, and wetlands and watercourses in the watershed often reduce critical buffer areas. Vegetated buffer areas help filter overland runoff before it reaches drainage systems, streams, or the lake. Variances reducing these areas should be avoided if possible.
c. Any variances that are granted for the above situations should be conditioned to insure that stormwater runoff is renovated before leaving the property. (For example, the use of dry wells to remediate runoff from rooftops and driveways).

Section 5

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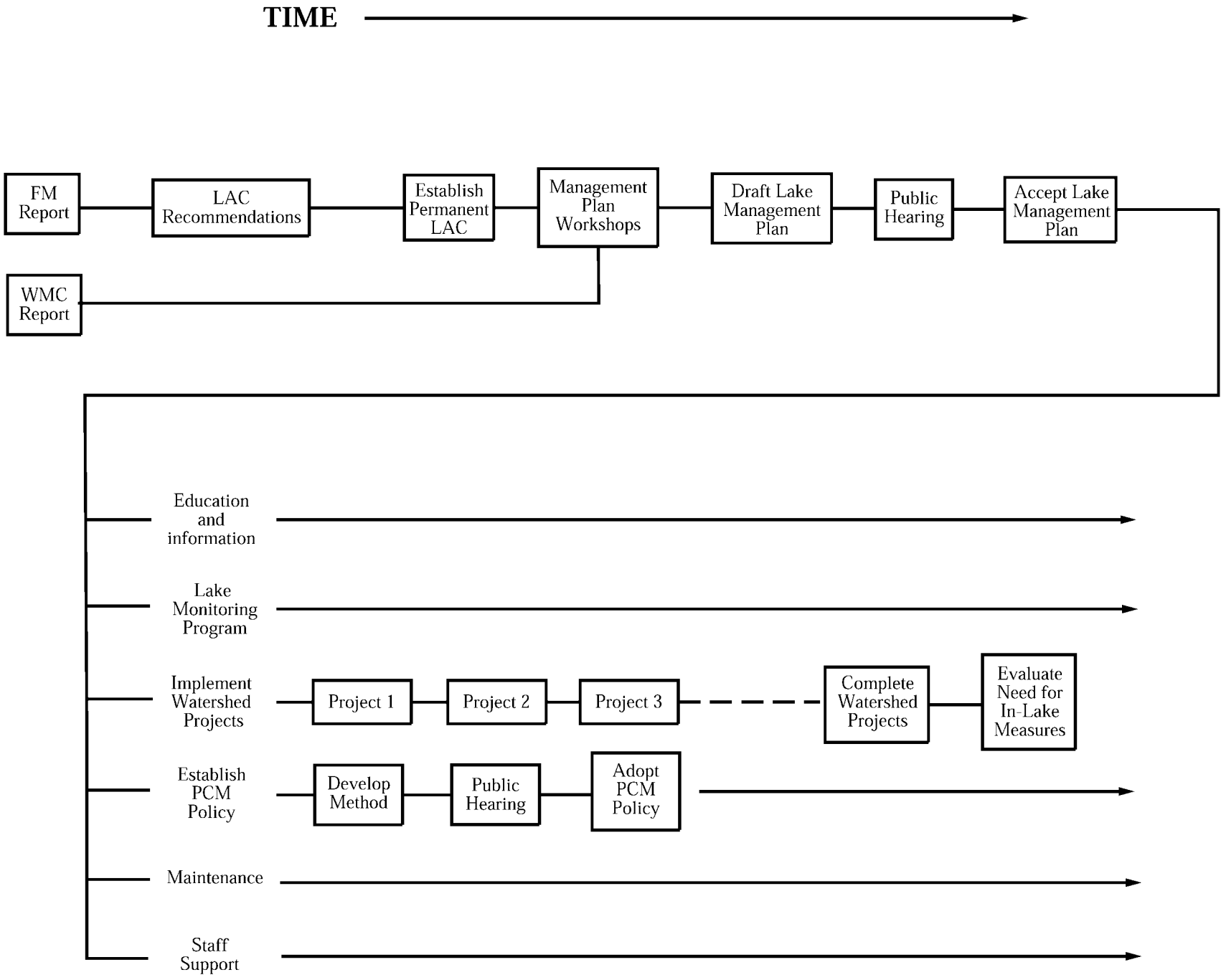
LAKE MANAGEMENT FLOW DIAGRAM



Draft

Lake Advisory Committee

10 Year Outlook for Town Expenditures on Lake

Item	Unit cost	Total	95-96	96-97	97-98	98-99	99-00	00-01	01-02	02-03	03-04	04-05	Comments
EDUCATION													
Library references		600	100	100	50	50	50	50	50	50	50	50	
News letter	1,500	15,000	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1 time/year
Misc. Education	500	5,000	500	500	500	500	500	500	500	500	500	500	
MONITORING													
In-lake monitoring (volunteer)	500	5,000	500	500	500	500	500	500	500	500	500	500	7 times/year, phosphorus lab analysis only
Inlet monitoring (volunteer)	800	8,000	800	800	800	800	800	800	800	800	800	800	4 times/year, phosphorus lab analysis only
Consultant	1,000	10,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	Quality control/interpretation/professional oversight
WATERSHED RESTORATION (1)													
Project 1		?	?	?									10 year program? Depends on specifics of WMC study
Project 2		?			?	?							
Project 3		?					?	?					
Project 4		?							?	?			
Project 5		?									?		
LAND USE CONTROL AMENDMENT													
Develop PCM Plan (2)			?										Legal & technical consultants to draft PCM policy
IN-LAKE MANAGEMENT													
Evaluation		5,000										5,000	Evaluate if in-lake treatment is needed
In-lake treatment (3)		200,000										200,000	In-lake treatment after watershed projects are complete
MAINTENANCE (5)													
Catch basin cleaning	?	(4)	?	?	?	?	?	?	?	?	?	?	Vacuum catch basin cleaner (buy, rent or contract)
Street cleaning	?	?	?	?	?	?	?	?	?	?	?	?	Sweeper maintenance/replacement
Periodic dredging of inlets	?	?	?	?	?	?	?	?	?	?	?	?	Yearly maintenance of dredged areas
Other Maintenance	?	?	?	?	?	?	?	?	?	?	?	?	WMC report not available, no specifics
STAFF SUPPORT (6)	?	?	?	?	?	?							
LAC SUPPORT	1000	12,000	2,000	2,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000	Pencils, paper, printing, etc.
Total		?	?	?	?	?	?	?	?	?	?	?	

(1) The results of the WMC study are not available. These costs can be offset by grants.

(2) Phosphorus Control Method Plan. Consultant to assist town.

(3) In-lake treatment (alum, aeration, etc.) if evaluation indicates it is needed.

(4) Vacuum type cleaner may be needed to clean coarse particle separators which may be installed during watershed restoration.

(5) WMC report not received. Specifics not available.

(6) Town Planner, Environmental Engineering services, and land use legal specialist services.