

EXECUTIVE SUMMARY
And IMPLEMENTATION Of The
WATERSHED MANAGEMENT PLAN

For
LAKE QUINSIGAMOND

And
FLINT POND

COMMONWEALTH OF MASSACHUSETTS
DEPARTMENT OF
ENVIRONMENTAL QUALITY ENGINEERING

Office of Planning and Program Management

Division of Water Pollution Control

EXECUTIVE SUMMARY AND IMPLEMENTATION OF THE WATERSHED MANAGEMENT PLAN
FOR LAKE QUINSIGAMOND AND FLINT POND

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I. SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

A. Introduction

Lake Quinsigamond is located in the heart of Worcester County, Massachusetts and lies between the city of Worcester and the town of Shrewsbury. It is a unique natural resource providing recreational opportunities and a major source of water supply for a region inhabited by over 1-1/2 million people. However, rapid urbanization, industrial development and increasing population have affected the lake and its tributaries. Due to the effects of such rapid urbanization, many of the desirable uses of the lake have been impaired by the gradual degradation of water quality in the lake. Effects have included declining fisheries population; prohibition of swimming due to bacterial contamination; occasional growth of nuisance aquatic vegetation; regular occurrences of algae "blooms"; and limitations on the use of the lake as a source of water supply for the surrounding communities.

In an effort to more clearly understand the response of the lake system to changes brought about by man's activities within the watershed, the Commonwealth of Massachusetts, with the assistance of the U.S. Environmental Protection Agency (EPA), undertook two major environmental programs. The Division of Water Pollution Control (DWPC) conducted a Diagnostic/Feasibility Study of the lake under the EPA, Section 314 Clean Lakes Program (Section 314, Public Law 92-500 and 95-217). The objectives of this program were to define the water quality conditions encountered in the lake, to determine the cause/effect relationships between the lake's water quality and sources of water pollution and to recommend actions required to control or alleviate sources of pollution.

The Department of Environmental Quality Engineering, under the Nationwide Urban Runoff Program (NURP), evaluated the impact of the specific water pollution problem of urban runoff as it affected Lake Quinsigamond and its tributaries.

This report will serve to summarize the recommendations and conclusions presented in the Watershed Management Plan for Lake Quinsigamond and Flint Pond. It will also describe the institutional framework that exists to deal with water quality and will recommend an implementation plan to achieve water quality goals.

B. Water Quality Conditions

A multi-component sampling program was designed to address the program data objectives of both the 314 diagnostic and NURP programs. The major components of the sampling program included monitoring of in-lake and natural tributaries, upper watershed tributary monitoring, sediment sampling of lake stations and tributaries, and stormwater sampling. Flow gaging was conducted on major tributaries and stage/discharge rating curves were developed for each. Supplemental data collection programs included a fisheries survey conducted jointly by the NURP staff and the Massachusetts Division of Fisheries & Wildlife and algal assay studies conducted cooperatively between the NURP staff, and the DWPC Research and Demonstration project with the University of Massachusetts Department of Civil Engineering.

A modeling framework for predicting the effects of nutrient and suspended solids loadings on Flint Pond and Lake Quinsigamond water quality was developed by William W. Walker Jr., Ph.D., a NURP project sub-consultant. The framework focused on eutrophication and related water quality aspects including algae, transparency and hypolimnetic dissolved oxygen. The framework consisted of a series of linked empirical and theoretical models designed to predict average growing season responses of the above variables to annual loadings of nutrients and suspended solids.

Based on the water quality data and lake modeling analysis, the following conclusions were drawn with regard to water quality conditions in Lake Quinsigamond and Flint Pond:

1. Water quality in Lake Quinsigamond and Flint Pond during 1980 was generally similar to that measured in 1971 and 1979.
2. Chlorophyll, transparency, and hypolimnetic oxygen depletion rates indicate that Quinsigamond is in a late mesotrophic stage. Despite its similar water quality, the relatively shallow Flint Pond should probably be classified as eutrophic owing to its aquatic plant densities.
3. The three hypolimnetic basins of Lake Quinsigamond have spring oxygen supplies ranging from 72 to 140 days, compared with a 200-day stratified period. Based upon oxygen and temperature profiles, the potential cold-water fish habitat is limited to the thermocline (20-30 feet) in late summer.

4. A typical seasonal succession of dominant algal types from diatoms in spring, to greens in early and mid-summer, to blue-greens in late summer, and a return to diatoms in the fall was observed in both lakes. This succession was regulated by temperature, light, and nutrient supplies.

5. Periods of algal growth limitation by phosphorus, silica, and nitrogen are indicated and reflected in the algal type shifts. Of these nutrients, phosphorus is considered to be the most important from a control point of view since it is limiting for most of the period of oxygen deficit development and because of the potential for nitrogen fixation by blue-green algae. Since water transparency averaged over 2 meters, light is not likely to be unusually important as a regulating factor.

6. Analysis of lake data in relation to antecedent rainfall periods indicated significantly higher concentrations of total phosphorus, dissolved phosphorus, and coliform bacteria on wet days, as compared with dry days. This reflected urban runoff loading impacts. In late summer, the system tended to shift from nitrogen to phosphorus limitation during extended dry periods (about one week).

7. The level of primary production in the lakes (as gauged by chlorophyll-a, transparency, and hypolimnetic oxygen deficit) was best correlated with dry-weather and/or spring total phosphorus measurements.

8. Lake data indicated that an average of 49% of the light attenuation in Lake Quinsigamond surface waters can be attributed to algae and algae-related materials (detritus, zooplankton), 21% to suspended solids, 25% to color and 5% to background (water). Corresponding percentages for Flint Pond are 34%, 29%, 33% and 4%.

9. Fecal coliform counts in the lakes averaged more than an order of magnitude below the standard for body-contact recreation. Fecal coliform counts exceeded 200/100 ml in 2 samples out of 104 in Lake Quinsigamond and in 0 samples out of 96 in Flint Pond. In the main lake, counts tended to be higher on sample days which followed within two days of significant rainstorms and at stations which were closest to the most concentrated source (Belmont Street Storm Drain). A more intensive lake monitoring program would be needed to properly assess the extent and significance of short-term violations in the coliform standard in certain areas of the lake immediately following storm events.

10. Total coliform counts averaged 62/100 ml in Quinsigamond and 46/100 ml in Flint Pond, compared with a state Class A (drinking water) standard of 50/100 ml. As in the case of fecal coliforms, spatial and temporal variabilities were large and certain areas of each lake may be more suitable than others as a reserve water supply from a microbiological standpoint.

11. Nutrient balance calculations indicated that surface runoff accounted for 87% of the total phosphorus, 67% of the dissolved phosphorus, 96% of the suspended solids and 49% of the total nitrogen discharged to these lakes during 1980. The remaining loadings are attributed to tributary baseflows and atmospheric inputs.

12. Morphometric characteristics and hypolimnetic iron, manganese, and phosphorus measurements suggested that the potential for internal recycling of dissolved phosphorus from the anaerobic hypolimnion to the mixed layer is limited. Release of bottom sediment phosphorus from shallow, littoral areas via diffusion, wind-induced re-suspension, and uptake by rooted aquatic plants may be significant in certain areas of the lake.

13. Lake mass balances and literature studies suggested that between 0 and 20% of the particulate phosphorus loadings entering the lake are eventually available to support algal growth through the mechanisms discussed in conclusion 12 above. Assumptions concerning the bio-availability of particulate phosphorus are critical to the assessment of potential control strategies and direct measurements should be undertaken as part of a control strategy design.

14. Dissolved phosphorus inputs to Flint Pond from unsewered residences nominally estimated at 18% of other sources. A refined analysis of the watershed, soils, and on-site disposal systems could improve the accuracy of this estimate.

C. Problem Assessment

An identification of the sources of pollution to Lake Quinsigamond and Flint Pond and the degree of pollution associated with them was undertaken. Pollution categories which were assessed include point sources (municipal sewerage systems and industrial discharges) and non-point sources (sub-surface disposal systems, sanitary landfills, erosion-sedimentation and land disturbing activities, and stormwater runoff).

To assess the magnitude and severity of the stormwater problem, a sampling program was designed to monitor six sampling sites and to provide coverage of 23 water quality indicators. Discrete water quality samples were taken over the course of rain events to enable precise tracking of loading variations with flows. Settling column samples were taken at selected sites to better assess the settling potential of water quality constituents.

In addition, a runoff model utilizing the model STORM concept of pollution accumulation was used to predict an annual pollution loading for the entire watershed.

Based upon the assessment of pollution sources, water quality impacts, and receiving water response to projected pollutant loadings, the following conclusions were drawn:

1. Stormwater runoff in the Lake Quinsigamond watershed is a major source of pollution. The pollution is most extensive for particulates and for parameters associated with particulate solids. The generation of sand bars and filling-in of shallow water areas is extensive. Pollutants such as phosphorus are associated with non-dissolved solids in high proportions. Dissolved constituents are heavily present in stormwater flows although dry weather flows also contribute significant amounts. Pollutants such as nitrogen in various forms and dissolved phosphorus are significant. Heavy metals are present in runoff in relatively small quantities. Bacteria related pollution is widespread in stormwater runoff.

2. Although there is a strong negative response in the lake to stormwater loadings, Lake Quinsigamond possesses a substantial buffering capacity against stormwater pollutants. The abundance of iron to precipitate phosphorus and deep lake depths have maintained the recreational uses in the face of urbanization in the watershed. Still, dissolved oxygen problems arise in the hypolimnion as a result of nutrient loads. These problems limit the fish habitat and encourage recycling of bottom sediment metals. Bacterial pollution is evident following a storm event. Solids deposition in the areas of storm drains cause boating hazards and aesthetic concerns. Although transparency is generally good, there is a significant decrease in transparency following a rain event. Aquatic plant growth and deposition in the shallow parts of the lake and in Flint Pond are limiting recreational activities. Water

transparency is reasonable, algae in the surface layers are reasonably limited, and eutrophication does not appear to be increasing except in the shallow areas where aquatic plants dominate.

3. Dissolved phosphorus was identified as a key to the rate of eutrophication and the hypolimnetic dissolved oxygen depletion rate. Dissolved phosphorus concentrations were determined to be uniform over the watershed. Particulate phosphorus control will have only a minimal immediate impact on the dissolved oxygen problem although such control may help more in the long run by reducing sediment phosphorus and subsequent aquatic plant growth and decay. Significant improvement in hypolimnetic dissolved oxygen levels would require a 50% reduction in dissolved phosphorus which is beyond the reduction attainable through stormwater control.

4. Suspended solids and associated pollutant loadings are heaviest on the Worcester side of Lake Quinsigamond where the steeper ground slopes provide greater scouring capacity. The wetland areas and small ponds intercepting tributary flows in other parts of the watershed may be important in reducing particulate loadings.

5. Bacterial related pollution is widespread. Fecal coliform levels indicate that sewage contamination is still occurring throughout the watershed.

6. Anticipated future land uses are estimated to result in a 12-14% degradation in average water quality conditions, as measured by suspended solids, available phosphorus, and other eutrophication-related variables. Therefore, control of 12-14% of future available phosphorus and suspended solids loadings would be needed to maintain existing water quality.

7. Reduction of phosphorus loadings to insure 200 days of hypolimnetic dissolved oxygen supply at spring turnover is suggested as a potential water quality management objective, which would reduce the potential for internal metals and nutrient cycling, improve fish habitat, provide proportionate reductions in chlorophyll and increase water transparency.

8. Under projected future land uses, the above objective would require about a 50% reduction in loadings of available phosphorus in surface runoff during an average hydrologic year. Control requirements during wet hydrologic year would be more stringent (78%).

9. Because of the importance of dissolved phosphorus loadings, watershed management strategies for reducing runoff volumes by encouraging water infiltration should be examined along with runoff treatment schemes as a means of achieving water quality objectives.

D. Management Objective for Water Quality and Use

Water quality management objectives for the Lake Quinsigamond/Flint Pond drainage area can be defined as follows:

- Maintain highest level of water quality required to support current uses, (i.e., all recreational uses).
- Maintain or upgrade all surface water in the drainage basin at a minimum acceptable level of Class B water quality.
- Protect all primary and secondary water supply groundwater aquifers from contamination/degradation.
- Preserve remaining wetlands for flood storage/release and pollutant attenuation.

Based on the water quality assessment and pollutant source inventory, specific water quality goals can be identified for Lake Quinsigamond/Flint Pond as follows:

- Protect beach areas from bacterial pollution.
- Provide 200-day hypolimnetic oxygen supply during stratification to increase cold-water fisheries habitat, reduce internal cycling of nutrients and heavy metals, and reduce occurrences of blue-green algae populations.
- Control/limit growth of nuisance aquatic plants (Flint Pond and Lake Quinsigamond above Main Street, Shrewsbury).
- Limit/reduce sedimentation and sandbar formation in near-shore areas.
- Maintain a minimum 4 foot secchi depth, in accordance with State Regulations.

Any proposed control/management program designed to achieve these goals must therefore include the following elements:

- Control of bacterial pollution sources
- Control of nutrients (particularly dissolved phosphorus)
- Control of internal cycling of nutrients and heavy metals
- Control of aquatic weeds
- Control of erosion and sedimentation
- Control of heavy metals

The following sections will discuss these elements.

1. Control of Bacterial Pollution Sources

Bacterial pollution is widespread throughout the basin. In terms of control strategies, either disinfection of stormwater discharges and major tributaries (including Route 9 drain, Poor Farm, Coal Mine, Fitzgerald, O'Hara and Tilly Brooks) or a program of source identification and correction are required. Source identification and correction has several advantages over disinfection including cost, impacts on aquatic life and secondary benefits in terms of solids and nutrient reductions. A third option is regulatory control to protect public health. Under this option, the beach areas would automatically be closed following rain storms of specified magnitude and duration.

2. Control of Nutrients - External Sources

Control of dissolved phosphorus and biologically-available particulate phosphorus have been identified as key nutrients controlling eutrophication, algal growth and depletion rate of hypolimnetic oxygen.

Major control alternatives include particulate control (either source control or treatment of runoff), runoff volume reduction (storage or groundwater recharge), runoff diversion (collection and pumping to the Quinsigamond or Blackstone River) and in-lake measures such as chemical treatment or in-lake aeration. In terms of effectiveness, particulate control will not likely result in significant reductions of either particulate or dissolved phosphorus. It is important, however, to recognize that particulate controls may have a significant impact in reducing the solids and heavy metals loads to the lake which are also major control elements (control of erosion and sedimentation and control of heavy metals). Runoff volume reduction may have a significant impact on reducing dissolved phosphorus levels in addition to particulates and other dissolved constituents. However, due to both the limited availability of land in the vicinity of the most heavily developed areas and physical characteristics, this approach may be of somewhat limited applicability. Runoff diversion by collection and pumping is both costly and difficult and not particularly practical from either an engineering or environmental point of view. In-lake measures such as chemical treatment may alleviate some of the symptoms of lake eutrophication on a short term basis, but unless pollution sources are addressed, additional treatment will undoubtedly be required.

In-lake aeration may enable the lake to meet the 200-day hypolimnetic dissolved oxygen goal in addition to limiting internal cycling of nutrients and metals. Cost, operational responsibility, and monitoring requirements to prevent upsetting the temperature stratification are vital considerations with regard to this option.

3. Control of Internal Cycling of Nutrients and Heavy Metals

In Flint Pond and the small shallow northern basin of Lake Quinsigamond (above Main Street, Shrewsbury), internal nutrient cycling is a major factor affecting the growth of aquatic weeds. Available control alternatives include chemical treatment, dredging, and artificial liners. Due to the relationship between internal cycling and growth of aquatic weeds, these control alternatives must be considered concomitant with weed control alternatives.

4. Control of Aquatic Plants

Aquatic plants are a major problem in Flint Pond and in the shallow northern basin of the lake. In addition to the control alternatives listed above, which apply to both aquatic weeds and nutrient cycling, alternatives applicable to the control of aquatic weeds include harvesting and lake drawdown. Generally, chemical treatment, weed harvesting and lake drawdown provide only temporary relief of rooted aquatic vegetation. Given the available sediment nutrient reservoir, these techniques offer little toward the improvement of Flint Pond. Dredging and use of artificial liners both warrant serious consideration. Also, serious consideration should be given to modifications of the hydraulics of Flint Pond towards improving flushing characteristics and limiting settleability in open water areas of the pond's three major basins.

5. Control of Erosion and Sedimentation

Control of erosion and sedimentation can yield significant improvements in terms of both solids and nutrients. Control alternatives include land treatment measures, stream and pond bank stabilization, in-line and off-line storage of base and/or storm runoff flows, land use control and regulatory measures as well as land-based particulate controls (i.e., street sweeping, catch basin cleaning, and leaf and litter pick-up). Much of the success of these controls is dependent on the ability and commitment of responsible authorities to enforce regulations and maintain adequate operation and maintenance programs.

6. Control of Heavy Metals

The most significant sources of heavy metals to the lake are transportation-related. Although the impacts of heavy metals on the water quality of the lake are not fully understood at this time, some control over the sources of heavy metals may be realized through control measures discussed under erosion and sedimentation and particulate controls. Additional study of heavy metals in the lake ecosystem is presently being undertaken by the Division of Water Pollution Control.

The following sections will describe the recommended watershed management plan for Lake Quinsigamond, Flint Pond and their respective tributaries.

E. Lake Quinsigamond Management Plan

In order to be successful in meeting long-term water quality objectives, it is important to consider the adoption of appropriate development guidelines and regulatory controls throughout the watershed. It is therefore recommended that the towns of West Boylston, Boylston, Shrewsbury and Grafton and the City of Worcester develop and implement ordinances and by-laws as appropriate to control erosion and sedimentation from all earth disturbing activities within their jurisdiction. It is recommended that these municipalities require that all developments involving greater than 25,000 square feet provide infiltration capacity for a minimum of 0.50 inches of rainfall. Municipalities should also require that the development will not result in any net change in either the quantity of runoff or the rate of runoff from a site prior to the proposed development.

It is further recommended that any future studies conducted on Lake Quinsigamond include vertical chlorophyll-a and/or light absorbance profiles to determine the cause of high dissolved oxygen concentrations found in the metalimnion.

It is also recommended that a more intensive lake monitoring program be undertaken to properly assess the extent and significance of short-term violations in the coliform standard in certain areas of the lake immediately following storm events.

1. Belmont Street Drain

This system is a significant source of bacteria, solids, nutrients and heavy metals. Given the importance of bacterial control, a storm and sanitary sewer inspection program using TV equipment, visual inspection and dye tracer studies as appropriate should be conducted jointly by the City Departments of Public Works and Public Health. Corrective action on problems so identified should be initiated immediately.

Street sweeping and catch basin cleaning practices should be evaluated and targeted to major flood and pollution control areas within the system as may be identified in the sewer system inspection program.

The use of Hydro-brakes^R in conjunction with either oversize or perforated steel or aluminum pipe could be very effective in achieving stormwater volume control. The Hydro-brakes^R would be used to control flow into the system. The pipe would serve as either a detention basin (oversize pipe) or as a recharge/infiltration basin (perforated pipe). Candidate areas for this control alternative include the 60-inch stormwater line on Locust Avenue and the 48-inch line between Wells Street and Wigwam Avenue near the Providence and Worcester Railroad line. It is recommended that this alternative be further explored to develop preliminary design and cost information.

Optional corollary actions were identified to improve the condition of the receiving water channel in anticipation of improved stormwater quality characteristics. It is recommended that the gravel coffer dam remain in place to continue to direct runoff under the Route 9 bridge away from the beach areas. It is also recommended that the channel be dredged to a depth at least three feet below the invert elevation of the 60-inch submerged outfall from the outfall to the mouth of the channel. This will allow more complete and frequent flushing of the channel and eliminate the ponding characteristics which occur at the discharge on the north side of the bridge. Extending the outfall should not be considered any further at this time until a decision has been made with regard to treatment and/or control alternatives discussed above.

2. Lake Quinsigamond (North of Main Street, Shrewsbury)

The major problems identified in this area include sediment build-up and excessive aquatic plant growth.

Taking into account cost factors and expected nutrient and solids load reductions from Poor Brook Farm via implementation of its watershed management recommendations, it is recommended that weed harvesting should be conducted on a contractual basis with a qualified firm in this area.

It is also recommended that a minimum twenty-five foot vegetated buffer strip be developed between the pond and the Worcester Sand and Gravel Company. It is further recommended that surface runoff from the gravel company be diverted to groundwater recharge via perforated aluminum or steel pipe, infiltration basins or other percolation/filtration device. The objective of these recommendations is to reduce or eliminate wind erosion and stormwater sediment transport from the gravel company to the pond.

3. Interstate 290

Interstate 290 is a major east-west highway connecting Routes 495 and 52 through Worcester and Shrewsbury and several other Central Massachusetts communities. Three major pollution sources can be associated with the highway. They are the highway itself including maintenance and repair activities and the application of sand and chemicals for snow and ice control, and the vehicles which utilize the road.

It is recommended that the Massachusetts Department of Public Works (MDPW) increase the frequency of sweeping on the bridge deck, east and west bound lanes from the Lake to Burncoat Street and on and off-ramps on Plantation Street during the early spring as weather conditions permit.

It is recommended that the concrete drainage ditch along the North side of the westbound lane between the road and Lincoln Plaza be replaced by a perforated channel with infiltration trenches and that a sedimentation infiltration basin be constructed at the inlet to the culvert running under the highway to Coal Mine Brook.

It is recommended that MDPW enter into a cooperative venture with the City of Worcester to divert the Lincoln Street-Plantation Street storm sewer at the drainage ditch along the north side of I-290 between

Plantation Street and the Lake and replace the ditch and storm sewer diversion with a perforated pipe infiltration system.

It is recommended that the drainage ditch along the south side of I-290 between Plantation Street and the Lake be replaced with a perforated pipe infiltration system.

4. Parking Lots and Boat Ramps

There are several major parking lots serving both commercial and industrial complexes throughout the drainage basin. The following recommendations are made applicable to parking lots and boat ramps:

Parking lots

Parking lots should be dry-swept or vacuum cleaned at least once every twelve to fifteen days.

Drainage systems serving existing lots should be evaluated to determine the feasibility and costs of retro-fitting the systems with perforated pipe or other infiltration device.

Construction of new parking lots or expansion/modification of existing lots should be required to provide infiltration capacity to accommodate 0.50 inches of rainfall.

Plowing of snow directly into the lake or any tributary should be prohibited. Provisions for snow removal and dumping at a site removed from these water bodies with good soil permeability should be made.

Boat Ramps

Boat ramps and associated parking areas should be dry-swept or vacuum-cleaned at least once every twelve to fifteen days during periods of active use.

Litter receptacles should be provided and emptied frequently at all facilities.

Facilities for the receipt of waste oil are required by law at all outlets where such materials are sold. Such facilities should either be provided at all boat ramps or a list of facilities available to the public should be made available at all boat ramps.

Laws and regulations regarding littering and the disposal of waste oil and other materials should be strictly enforced.

F. Flint Pond Management Plan

The major problems affecting Flint Pond are the proliferation of aquatic plants in addition to nutrients and heavy metals in the pond sediments.

Based upon an analysis of various control options, technical feasibility, environmental impacts, and cost, the following control plan recommendations for Flint Pond are presented:

1. Weed harvesting should be performed on an "as-needed" basis with initial priority being given to the northern basin, followed by the southern basin followed by the middle basin. Although this is considered a temporary control, the cost of harvesting compared to dredging indicate that the pond could be harvested over 25 times for the same cost of dredging. The approach may be made more effective over the long term if recommendations regarding the control programs for South Meadow Brook and Bonnie Brook are implemented.
2. A study of the cove at the outlet of Bonnie Brook should be undertaken to determine if the cove can be recovered by dredging. If the cove cannot economically be recovered, it may be advisable to culvert Bonnie Brook directly into the southern basin and fill in the cove.
3. A study of hydraulic modifications to increase the flushing rate and the flow-through velocity or to improve water circulation in various portions of Flint Pond should be undertaken. Such modifications might serve to scour material from the water-sediment interface and/or prohibit or limit the amount of material allowed to settle within the pond. Hydraulic modifications might include the following:

Changing the gate structures at Stringer Dam and Irish Dam from "overflow" weirs to "under-flow" type gates.

Open a channel between the middle and southern basins at the southerly end of the peninsula separating the two basins.

Open a channel through the small peninsula just above Irish Dam.

This study should also consider proposed modifications to Hovey Pond.

G. Tributary Watershed Management Plans

1. Poor Farm Brook

Segment 1 - Headwater to Clark Street

This segment of the watershed includes portions of West Boylston and Worcester. Recommended plan elements for the West Boylston portion of this segment include the following:

1. A septic system maintenance and inspection program and ordinance should be implemented including the specification of a minimum acceptable pumping frequency, for both industrial-commercial and residential systems;

2. Street sweeping activities should be increased during the early spring to remove sand and other substances accrued during the winter;
3. Drain clearing and stream maintenance activities should be conducted in spring and fall to remove sediment and leaves;
4. Additional stream maintenance should be conducted along the utility right-of-way parallel to Shrewsbury Street to include removal of material accumulated behind fences crossing the brook and to effect streambank stabilization. A minimum 25-foot vegetated buffer zone should be maintained along this reach;
5. Livestock at the Worcester County Jail Farm should be restricted from congregating at the brook near Shrewsbury Street and Briar Lane. An on-site detention basin or farm pond in a pasture area at the top of the hill might be constructed to accommodate the cattle.

Recommended plan elements for the portion of Segment 1 in the City of Worcester, which includes the stream reach from the West Boylston-Worcester line to Clark Street, include the following:

1. Streambank stabilization including a 25-foot vegetated buffer strip should be undertaken from East Mountain Street to Clark Street. Tree cover should be an integral part of the vegetation plan for the buffer strip;
2. Stripped and exposed slopes along the westerly side of the brook behind the Mountain Village and Quabbin Estates apartment developments should be covered and seeded to halt erosion problems. Terraces, runoff diversion berms and vegetative cover should be carefully designed and selected to prevent erosion and to blend into the buffer zone recommended in 1 above. Any proposed development of this area should include these considerations and recommendations in a site development plan;
3. The in-line detention basin located in the brook behind Quabbin Estates should be re-designed and constructed to serve as an integral element of the flood control and storm-water control plan for the watershed. Outlet design, storage capacity and bank stabilization should be included in a feasibility study; and
4. The Health Department should investigate the storm drainage systems at Gothic Avenue and Clark Street to identify any sources of bacterial pollution and, upon identification, take corrective action.

Segment 2 - Clark Street to Route 70

1. The 25-foot buffer strip initiated in Segment 1 should be extended along this segment;

2. Upon completion of the new Maplewood-Northwest Interceptor sewer projects, manholes and appurtenances of the original line should be removed from the brook channel and stream banks;
3. Stream bank stabilization measures should be taken along the stream from East Mountain Street up along the playground area abutting the Great Brook Valley project; and
4. Both Worcester and Shrewsbury should conduct sand collection and removal operations early in the spring along East Mountain and Clark Streets and the Northeast Cutoff respectively.

Segment 3 - Route 70 to Lake Quinsigamond

1. A plan should be developed to rehabilitate City Farm Pond for flood control and stormwater detention purposes. The plan should include consideration of providing a control gate at the outlet; dredging the pond to remove accumulated solids and eroded material; design of slope stabilization measures and erosion control measures along the southern and eastern shores of the pond;
2. Erosion control measures should be designed and implemented along the steep slopes south and east of the outlet of City Farm Pond;
3. Stream cleaning should be conducted from the outlet of City Farm Pond to the Lake to remove tires, gas tanks, abandoned barrels and other litter and debris;
4. A 25-foot vegetated buffer strip should be maintained between the brook and the Goddard Industrial Park along the brook and the Lake;
5. A stormwater drain discharging to the brook from the Jamesbury Corporation facility should be replaced with perforated pipe. Oil and sand trap catchbasins should be installed and maintained to prevent oil pollution from entering the brook through this system; and
6. The City of Worcester and the town of Shrewsbury should establish an aquifer protection district from the outlet of City Farm Pond to the Lake to protect primary drinking water supply wells located in this area. Limits to access and allowable/permissible uses of the land area within this district should be included in any rules and regulations issued pursuant to the establishment of the district.

2. Coal Mine Brook

Segment 1 - Source to Lincoln Plaza Drain

An investigation by both the City of Worcester's Public Health Department and Department of Public Works of the storm drain system

should be conducted in the Goldwaithe Road-Colby Avenue area and from LaSalle Avenue to Wellesley Avenue to locate any probable misconnections, cracked pipes, leaky joints, broken seals, etc. Identified problems should then be corrected as soon as possible.

An evaluation of highway deicing practices should be undertaken by the City of Worcester's Public Works Department and the Commonwealth of Massachusetts Highway Department to determine if sand and salt applications may be reduced in this area.

Segment 2 - Lincoln Plaza Drain to Plantation Street

Highway runoff from I-290 and soil erosion from the embankment behind the Lincoln Plaza Shopping Center contribute to the increased solids level found in this segment.

To prevent further erosion of this slope, perennial vegetation such as evergreens or shrubs should be established. In addition some structural measures such as diversion berms and terraces may be required to reduce the quantity and velocity of runoff.

Additional protection can be gained by the construction of a sedimentation basin equipped with a sand filter sub-drain at the Lincoln Plaza/I-290 culvert. This type of facility will serve to trap and detain sediment from the drainage area above.

Replacing the I-290 drainage culverts with a system such as a grassed waterway channel with a perforated pipe underdrain will re-route runoff to the groundwater for recharge. Erosion resistant grasses or other vegetation should be established to protect the drainage channel. A perforated pipe underdrain constructed of corrugated steel along with crushed stone backfill will act to store the runoff until infiltration occurs.

A considerable amount of material has been discarded on the Notre Dame Institute property. This site should be cleaned and dumping in this manner should be prohibited as well as the burning that also occurs in this area.

Segment 3 - Plantation Street to Lake Quinsigamond

The relatively high concentration of bacteria and nutrients within this segment can be attributed to the storm drain system which originates on Lincoln Street and discharges to Lake Quinsigamond at the bridge abutment at Plantation Street. This system has been inspected and found to have leaks, misconnections, and broken pipes. The City of Worcester's

Health Department and Public Works Department are in the process of correcting problems as they are identified. In order to protect a municipal water supply pumping station located at the mouth of the brook, consideration should be given to a relocation of this drain so that it discharges to the Lake at I-290. It is recommended that the City of Worcester and the Massachusetts Department of Public Works enter into a cooperative agreement to address this problem.

3. Medical School Drain

The monitoring data has indicated that solids and heavy metals, particularly lead and zinc, are introduced through stormwater runoff. Paved areas in this drainage system may be a major source of these pollutants. A regular program of dry sweeping of the University of Massachusetts Medical School parking lot system as well as regular cleaning of the drainage system should be undertaken. In addition, the outfall and box culvert on North Access Road should receive regular inspection by the City of Worcester's Public Works Department and the Regatta Point Park Superintendent to determine the need for cleaning and other maintenance requirements.

It is further recommended that, under any plans to expand the extent of impermeable surface (by either parking lot or building expansion) the Medical School provide infiltration capacity for the first one-half inch of rain via perforated pipe drain systems, infiltration trenches, detention storage or other means.

4. Fitzgerald Brook

An investigation by the City of Worcester's Public Health Department has revealed that a major source of the bacterial related pollution in Fitzgerald Brook was due to misconnections and broken or leaky sewer pipes. Misconnections were issued reconnection orders and maintenance problems were reported to the City Public Works Department for repair. Further monitoring by the Health Department will reveal the impact these measures have on water quality.

An evaluation of street sweeping and deicing practices should be conducted by the Worcester Public Works Department in this area.

The Worcester Public Works Department should continue its brook channel maintenance and cleaning program. Particular areas in this drainage system that deserve attention include Cohasset Street and

the section of brook from Coburn Avenue to Lake Quinsigamond. A preventative approach to halt the dumping of lawn trimmings, leaves and brush along stream channels can be taken by instituting a public awareness program to inform residents that actions of this nature may clog stream channels and contribute to the degradation of water quality by the release of nutrients to the brook. A program during summer and fall to collect brush and leaves by the Public Works Department would also serve to alleviate this problem.

Modifications to the wetlands between Trahan and Ernest Avenues which serve as the headwaters of Fitzgerald Brook should be strictly regulated and monitored to prevent excessive sediment and nutrient loadings from entering the brook.

5. O'Hara Brook

It is recommended that the storm drain system be investigated for misconnections, broken pipes, etc., through the cooperative efforts of the Worcester Public Health Department and Public Works Department and corrected as soon as possible. A septic system inspection and maintenance program should be implemented by the City's Public Health Department to identify and eliminate contamination from subsurface sewage disposal systems.

A small tributary which meets O'Hara Brook near Sunderland Road has its origins in the wetlands located in the Blithwood Avenue area. Extensive modifications to this site should be prohibited and the wetlands should be preserved.

It is recommended that the City of Worcester's Public Works Department review its deicing practices in this area to determine if a reduction in the use of sand and salt would be feasible.

A good deal of leaves, grass and brush are dumped on the banks of this stream. A public awareness program conducted by the Worcester Conservation Commission to educate people as to the detrimental effects these actions have on water quality would be beneficial as would special collections of leaves and brush by the Public Works Department during critical seasons.

6. Newton Pond

It is recommended that the land surrounding Newton Pond, be maintained in private ownership with certain restrictions placed upon the

land.

The wetlands situated in the northern portion of this drainage area should be retained in their natural state as wetland districts.

It is recommended that at least a 25-foot buffer strip be maintained around the gravel pit owned by the Worcester Sand and Gravel Company to take advantage of the filtration and purification functions of the land.

7. Billings Brook

Segment 1 - Source to Main Street

The Slocum Meadow marsh situated between Route I-290 and Main Street acts as a flood control mechanism, removing nutrients and other pollutants. As such, this environmentally sensitive area should be retained in its natural state as a wetlands district.

Segment 2 - Main Street to Lake Quinsigamond

A small wetland upstream of Quinsigamond Avenue should also be maintained since it serves an important function in this gravel mining area of trapping sediment prior to the Brook's discharge to Lake Quinsigamond at Eagle Head Cove.

A sedimentation basin near the F & G Sand and Gravel Company should continue to be maintained in order to curtail erosion and downstream siltation from mining operations.

A regular inspection of the lagoon found above the culvert at Quinsigamond Avenue should be undertaken by the Town of Shrewsbury's Water and Sewer Department and cleaning performed if necessary.

8. Tilly Brook

Segment 1 - Source to Mill Pond

A public information program should be designed to inform residents of the harmful effects of overfertilization as well as providing instruction on the proper usage, application and storage of fertilizers.

An extensive upland wetland, the Slocum Meadow marsh, through which the brook flows serves many beneficial functions including filtration, purification, wildlife habitat and flood storage. To take full advantage of these valuable natural functions, this ecologically sensitive area should be retained as a wetlands district.

Segment 2 - Mill Pond to Culvert at Spag's

The Town of Shrewsbury is currently employing the technique of lowering the water level to control the dense growth of macrophytes which have become a problem in Mill Pond. An evaluation of the effectiveness of this technique will determine the need for further action.

A program to monitor the brook should be conducted by the Shrewsbury Board of Health in order to determine the impact of connecting a large capacity septic system at the Worcester Foundation for Experimental Biology to the sewer system. If any subsequent problems exist, they may be more clearly identified and corrected.

Segment 3 - Culvert at Spag's to Lake Quinsigamond

An investigation of the culvert should be undertaken jointly by the Town of Shrewsbury's Board of Health and the Sewer and Water Department to determine the source of possible sewage contamination. A program of both visual and televised inspection in addition to dye tracer testing would serve this purpose. Corrective action should then be initiated on any identified problems.

The many roads, commercial/industrial parking lots and other paved areas throughout this segment deserve particular attention to reduce the loadings of solids, nutrients and metals to the brook. A program of regular dry-sweeping of the numerous industrial/commercial lots should be instituted and the washing down of paved areas should be prohibited. Route 9 and Quinsigamond Avenue with its many commercial areas would benefit from an intensified street sweeping program by the Town of Shrewsbury's Highway Department.

The Harvey Place pumping station should continue to be regularly inspected by the Sewer and Water Department for leaks, broken seals and other malfunctions because of its close proximity to a major recreational area on the Lake as well as for the protection of residents in the area.

9. Jordan Pond

The sewer system should be investigated by the Town of Shrewsbury's Sewer and Water Department, for leaks, misconnections or connections that were never made. Corrective action should then be taken. A septic

system maintenance and inspection program operated by the Board of Health would aid in identifying system failures and eliminating contamination from subsurface disposal systems. Similarly, the Jordan Pond pumping station should be regularly inspected by the Sewer and Water Department for leaks, broken seals, or other system failures.

A street sweeping program with special emphasis placed on the Route 9 - Edgewater Avenue area would act to combat solids loadings in this drainage area.

Jordan Pond tends to act in much the same manner as a detention basin for Lake Quinsigamond. Since this is such an active recreational area for both contact and non-contact activities, Jordan Pond should be further evaluated to determine what impacts stormwater exerts on it.

10. South Meadow Brook

Segment 1 - Source to Route 9

The Town of Shrewsbury's Highway Department should evaluate its deicing program to determine if sand and salt applications might be reduced on these primarily residential streets.

Segment 2 - Route 9 to Flint Pond

South Meadow Brook originates in a small upland wetland and much of the drainage area of this brook is dominated by a wetland known as Peat Meadow. Measures should be taken to maintain these areas in their natural state as wetland districts.

It is strongly recommended that a mandatory septic system inspection and maintenance program be instituted by the Town of Shrewsbury's Board of Health as a preventative measure.

In addition to a 400 foot buffer zone established around the Oak Street well, care should be taken within the aquifer recharge area to assure that groundwater supplies are recharged by infiltration and are safeguarded from contamination. Minimum lot sizes, regulation of the amount of impervious surface and regulation over the use and storage of potential contaminants are examples of techniques which may be utilized to protect groundwater supplies.

11. Bonnie Brook

With the removal of stormwater flows and waste treatment discharges from the brook by the Wyman-Gordon Company, the major problem to be addressed in this brook is the quantity and chemical nature of the brook channel sediments. These sediments have been shown to contain high concentrations of heavy metals and have also resulted in severely clogging an eight-acre cove at the southern end of the southern basin of Flint Pond. This cove is nearly filled in and is completely clogged with dense growths of aquatic vegetation.

There are basically two approaches available to overcome the present situation. The first approach would involve dredging the brook channel from Wyman-Gordon to the cove, stabilize the channel and coordinate channel rehabilitation with the rehabilitation of the cove. The alternative approach would involve culverting the brook from Wyman-Gordon directly to the southern basin, by-passing both the cove and the existing channel. The selection of one alternative over the other cannot be made until a final decision is reached regarding the implementation of control/rehabilitation measures for Flint Pond. It is imperative to recognize the importance of the flow contribution of Bonnie Brook to Flint Pond. Bonnie Brook contributes nearly 18 per cent of the total flow to the pond. As such, decisions regarding the brook can have a significant impact on the water budget for the pond. It is recommended that Bonnie Brook be included in the study previously recommended for the cove area of the southern basin of Flint Pond in the management plan section for Flint Pond.

II. INSTITUTIONAL FRAMEWORK

A. Introduction

There are many different agencies that can assume a role in implementing the Lake Quinsigamond watershed management plan. This chapter will serve to define these agencies and their functions, power and authority. It should be noted that in describing these agencies the emphasis has been placed on the particular aspects of the agency as they pertain to the watershed management plan and is not intended to be a full description of that agency.

At the federal level agencies such as the Environmental Protection Agency and the Soil Conservation Service provide funds and technical assistance. They also have the power to impose sanctions for noncompliance with applicable statutes, regulations and standards. It is at this level that the national mandate and resources to address pollution problems exists.

The state acts to provide effective regulation, coordination and integration of governmental functions. State agencies carry out a number of activities which are important to water quality management. This includes the regulation of point sources of pollution and many nonpoint sources, such as, landfills and septic tanks. State agencies monitor water quality and set water quality standards. They also supervise the construction of treatment facilities and provide funds for such construction. Funding is also provided for the acquisition of land as well as other pollution abatement activities.

Regional agencies act to plan, encourage, and coordinate the activities of various organizations involved in water quality management. In this manner, groups of communities can collaborate to plan to meet their mutual needs. They can respond to local concerns as well as other regional concerns such as land use, transportation, housing and economic development. A key part of the regional role is the ability to deal across jurisdictions through cost-effectiveness arrangements.

Municipal agencies have broad authority to provide services and exercise control over water quality programs. It is at this level that the greatest control over land use is exercised through zoning, subdivision regulations, health regulations and the permitting of activities in wetlands.

The private sector can also play an important role through activities such as public education programs, advocating environmentally sound

programs, sponsoring legislation and coordinating activities of various groups.

B. Federal Government

1. U.S. Environmental Protection Agency

The Environmental Protection Agency (EPA) assumes responsibility for the federal government's major programs in air pollution, water pollution, solid waste management, drinking water protection and toxic substances control. Broadly stated, it is responsible for maintaining and enhancing the environmental quality of our land, air and water resources. EPA strives to formulate and implement actions which lead to a compatible balance between human activities and the ability of natural systems to support and nurture life.

EPA also administers funds to local, regional and state agencies to support their pollution abatement activities. EPA works closely with state environmental agencies to maintain environmental quality and can set standards in cooperation with the state. Enforcement of standards may also be shared with the state.

2. Soil Conservation Service

The Soil Conservation Service (SCS) was established to plan and carry out a program to conserve and develop the nation's soil and water resources through conservation districts. SCS personnel provide planning and direct technical assistance to soil and water conservation districts. Technical assistance is available to land users in determining alternative land uses and non-point source treatment needs and in developing a conservation plan reflecting these land use and treatment decisions. Technical assistance is also available to cooperating land users in installing planned conservation practices. Thus, SCS personnel and conservation districts provide technical assistance to landowners and land users; help prepare and revise conservation plans; make field investigations and recommendations on land use; and provide technical information to government bodies for use in enacting zoning ordinances, land use regulations, health codes and earth removal ordinances.

3. Agricultural Stabilization and Conservation Service

The Agricultural Stabilization and Conservation Service (ASCS)

administers various farm action programs through state, county, and community farmer committees. The ASCS conducts the Agricultural Conservation Program which makes grants to individuals or groups for conservation measures. It assists agricultural producers through cost-sharing programs to conserve agricultural soil, water, woodland, and wildlife resources, and improve the prospect of their multi-purpose use in providing adequate food, fiber, water and wildlife for the future.

4. U.S. Army Corps of Engineers

The U.S. Army Corps of Engineers administers permit programs to protect waterways from activities deemed contrary to the public interest. It is involved in the planning, design, construction, operation, and maintenance of projects for navigation, beach erosion control, hurricane protection, flood control, streambank protection, urban development, irrigation, and emergency measures. Technical and analytical services, legal information, regulatory enforcement and human health and environmental information is provided.

5. Department of Housing and Urban Development

The Department of Housing and Urban Development (HUD) through its Comprehensive Planning Assistance Program provides money for planning activities. These planning activities will have a significant impact on where growth will or will not take place and therefore plans are required to include an environmental component that assures environmental issues are addressed. Plans must also provide for the coordination of local, areawide and state land use policies, and achieve consistency between the land use plan and capital improvement programs and transportation, housing, open space and public utility plans.

HUD also administers a flood insurance program in which communities with areas designated as subject to serious flood hazards must adopt adequate land use control measures in order to be eligible for federally subsidized flood insurance. In adopting land use controls, communities are required to consider state and local water pollution control requirements and the coordination of land use, sewer and drainage regulations both within the community and in neighboring areas.

6. U.S. Geological Survey

The U.S. Geological Survey (USGS) serves to appraise and describe

the quantity and quality of the nation's water resources. Among its services are geologic and mineral resource surveys and mapping; cartographic information; topographic surveys and mapping; and water resources investigations. It also monitors streamflow and fluctuations in groundwater elevations.

7. Farmers Home Administration

The Farmers Home Administration (FmHA) is a federal agency under the U.S. Department of Agriculture which provides financial assistance to municipalities, farmers, and other rural residents in the form of loans and grants which may be used for water supply and wastewater treatment. The terms and interest rates vary in accordance with each individual situation.

8. Small Business Administration

The Small Business Administration (SBA) provides direct loans and guaranteed/insured loans to small business concerns to meet pollution abatement requirements.

C. State Government

1. Executive Office of Environmental Affairs

The Executive Office of Environmental Affairs (EOEA) is a cabinet-level agency which has the authority to implement and oversee state policies aimed at preserving, protecting and regulating the natural resources and environmental integrity of the Commonwealth of Massachusetts.

The operating units within the EOEA which report directly to the secretary are listed below:

Division of Conservation Services (DCS)

Division of Law Enforcement (DLE)

Massachusetts Environmental Policy Act and Review (MEPA)

The following departments are also contained within the EOEA:

Department of Environmental Quality Engineering (DEQE)

Department of Environmental Management (DEM)

Department of Food and Agriculture (DFA)

Department of Fisheries, Wildlife and Recreational Vehicles (FW&RV)

The secretary of the EOEa together with the appropriate departments and divisions have the following water quality related powers and duties:

- develop policies, plans, and programs for carrying out their assigned duties;
- provide for the management of air, water, and land resources to assure the protection and balanced utilization of such resources within the Commonwealth, realizing that providing safe water to drink and clean air to breathe is a basic mandate;
- develop statewide policies regarding the acquisition, protection, and use of areas of critical environmental concern to the Commonwealth;
- promote the best usage of land, water, and air to optimize and preserve environmental quality by encouraging and providing for, in cooperation with other appropriate state agencies, planned industrial, commercial, recreational, and community development;
- provide for the elimination and abatement of water, land, air, noise, and other pollution or environmental degradation;
- provide for the control of insects, plant diseases, and pests, and regulate the use and disposal of pesticides;
- develop programs relating to the reclamation or disposal of solid waste material and the operation of sewer and water distribution systems;
- assist other state and regional agencies in developing appropriate programs and policies relating to land use planning and regulation in the Commonwealth;
- monitor the environment to identify changes and to ensure efficient and effective control practices;
- develop environmental data management capabilities to aid environmental planning and decision-making;
- encourage, support, and undertake research facilities to produce information relating to the ecological system, pollution abatement, resource management, and other areas essential to implementing the environmental policies of the Commonwealth;
- advise and assist local governments, private and public institutions, organizations and associations, businesses, industries, and individuals by acting as a clearinghouse for environmental information, data, and other materials;

- represent and act on behalf of the Commonwealth in connection with federal grant programs;
- advise and assist state agencies, cities and towns, and other units of local government in the preparation of grant or loan applications with respect to any environmental protection or enhancement programs;
- promulgate rules and regulations necessary to carry out their statutory responsibilities.

In addition, the secretary is authorized to coordinate the activities and programs of the departments and divisions to attain improved administrative organization, procedures and practices. Administrative and jurisdictional conflicts within the agencies may be resolved by the secretary.

2. Division of Conservation Services

The Division of Conservation Services (DCS) assists regional conservation districts and municipal conservation, park, and recreation commissions to acquire and preserve open space, conservation and recreation areas. Technical and financial assistance is provided to manage and properly develop these natural resources.

The DCS acts as the conduit through which financial assistance is made available to other state or county agencies or special districts for outdoor recreation facility acquisition or development.

3. Massachusetts Environmental Policy Act & Review

The Massachusetts Environmental Policy Act (MEPA) program is an interdisciplinary program which examines environmental impacts of state actions (including permitting, approvals, and funding).

4. Division of Law Enforcement

The Division of Law Enforcement is responsible for the enforcement of all laws and regulations relating to environmental affairs which are implemented by the Executive Office of Environmental Affairs. The duties of the division's Natural Resource Officers may range from enforcement of the water pollution control laws to searches for lost persons and other policing activities relating to Fish & Game, Marine Fisheries, Forests & Parks, etc.

5. Department of Environmental Quality Engineering (DEQE)

The Department of Environmental Quality Engineering (DEQE) administers the majority of the State's environmental regulatory programs. Among DEQE's authorities and responsibilities are the following: regulating activities affecting waterways and wetlands; overseeing and regulating drinking water quality; preventing and controlling the pollution of air and water; controlling aquatic vegetation; and regulating the disposal and storage of solid wastes. The Department of Environmental Quality Engineering contains the following divisions:

a. Division of Waterways

The Division of Waterways regulates activities on and within the Commonwealth's tidelands, rivers, streams and great ponds. (Great ponds are defined by the Commonwealth of Massachusetts General Laws as naturally created ponds over 10 acres in size.) It regulates construction activities in coastal waters, rivers, streams and great ponds; ensures the public safety and the right to access and use of navigable waters is not infringed upon by any structure or activity. In addition, it provides for the maintenance and improvement of shores, rivers, streams, and ponds within Massachusetts.

b. Division of Wetlands Protection

Wetland areas include fresh water and coastal wetlands, beaches, swamps, marshes, flood plains, dunes and land subject to flooding. To protect these important resources the legislature passed the Wetlands Protection Act which is administered by DEQE in cooperation and conjunction with local conservation commissions. The Wetlands Division develops policies and regulations for use by local Orders of Conditions developed by conservation commissions and, if necessary, serves as the appellate agency in a wetlands case.

c. Division of Water Supply

The Division of Water Supply monitors all proposed surface or groundwater sources to ensure the availability of a safe and adequate source of water supply for public use; protects public water supply facilities from possible pollution; regulates crossconnections between water supply sources to prevent bacterial or dangerous chemical contamination of public water supplies and administers a construction grants program for water purification plants.

d. Division of Water Pollution Control

The Division of Water Pollution Control is responsible for improving water quality and preventing water pollution. This includes: establishing programs for the prevention, control and abatement of water pollution control; adopting minimum water quality standards; conducting water quality sampling programs; review and regulation of wastewater treatment facilities; administration of a construction grants program for wastewater treatment facilities; supervision of the clean-up of oil spills; and issuing permits regulating pollution discharge.

6. Department of Environmental Management

The Department of Environmental Management is responsible for managing the land and waters of the Commonwealth, protecting and enhancing their present recreational use, and developing plans and policies for the future enjoyment of these resources. A description of the divisions found within the Department of Environmental Management is provided below.

a. Division of Forests and Parks

The Division of Forests and Parks manages approximately 250,000 acres of land and water: all State-owned forests, beaches, swimming pools, skating rinks, and parks which includes Regatta Point and Lake Park in the Lake Quinsigamond watershed.

b. Division of Water Resources

As the Commonwealth's primary water planning agency, the Division of Water Resources is responsible for insuring the wisest use of the State's water resources and identifying future needs for agriculture, industry, recreation, wildlife, and domestic consumption through studies on water conservation and flood damage prevention.

In its planning capacity, the division provides technical representation on a number of regional, statewide, and interstate water resources studies, cooperating with agencies such as the New England River Basins Commission, the U.S. Army Corps of Engineers, the U.S. Soil Conservation Service, and the U.S. Geological Survey. The division also conducts studies at the request of the State legislature.

The division is the State coordinating agency for the H.U.D. National Flood Insurance Program; it establishes priorities for flood insurance

studies in identified flood-prone communities and provides advice to communities which wish to qualify for the federally subsidized program.

Lastly, the division maintains over 200 rainfall and snow course monitoring stations throughout the State for the purpose of surveying water resource conditions.

c. Board of Environmental Management

Assisting the Commissioner of Environmental Management is a five-member board which meets once a month. The members are appointed by the Secretary, with the approval of the Governor, for staggered five-year terms and are drawn from the spectrum of interests represented by environmental management.

In addition to general advisory functions, the Board of Environmental Management is empowered to approve the appointment of deputy commissioners, directors, acting commissioners, and acting directors; approve all departmental regulations; review programs and policies at least annually; review and approve departmental budget submissions; and perform such other specific duties as might be required by law.

d. Office of Planning

The Office of Planning and Program Development serves as the planning, design and program development staff for the Department.

Major programs and projects include:

- Master Planning and design of major DEM capital outlay projects, including Urban Heritage Parks in several cities.
- Preparation of the Statewide Comprehensive Outdoor Recreation Plan which qualifies the Commonwealth for receipt of federal Land and Water Conservation Funds.
- The Mass. Natural Heritage Program, a comprehensive information clearinghouse concerning rare plant and animal species, their habitat and significant landscape features of the Commonwealth.
- Development of a state trail system.
- A Management Information System for recreational, conservation, and forestry information.
- The State Scenic Rivers Program, which designates and protects state scenic rivers.

e. Wetlands Restriction Program

This office administers the Wetland Restriction Program and is authorized to designate coastal and inland wetland areas worthy of preservation and to adopt orders which prohibit, restrict, or regulate any alteration or pollution of these designated wetlands.

7. Department of Food And Agriculture

The Department of Food and Agriculture's goal is to maintain and strengthen the State's agricultural economy. To improve the state's agriculture, the department has developed a comprehensive food policy for the Commonwealth which promotes the marketing of Massachusetts-grown agricultural products and emphasizes the maintenance of prime agricultural land for farming. The divisions described below are contained within the Department of Food and Agriculture.

a. Division of Agricultural Land Use

The Division plans and organizes community garden and commercial farm programs, maintains inventory of agricultural land, and develops programs to preserve and improve land for agricultural use.

b. State Reclamation Board

This three member board, consisting of an employee of the Department of Environmental Quality Engineering, an employee of the Department of Food and Agriculture, and a third member designated by the heads of said departments acting jointly and with the approval of the Governor, may investigate a question of utilizing wetlands including meadows, swamps, marshes, beaches and other low lands, and may determine what lands may be advantageously drained for agricultural or industrial uses, the protection of the public health (including mosquito control), the utilization of deposits therein or other purposes. It also may publish facts determined in its investigation.

c. Pesticide Board

This division controls the use and application of pesticides, including investigation of alleged misuse of pesticides. It also licenses those who deal in restricted pesticides, certifies those who use or supervise the use of restricted pesticides, and licenses certain others who apply pesticides to land of another. In addition, the division provides technical and administrative support to the Pesticide Board

and technical consultation relative to pesticides and their use to state municipal agencies and the general public.

d. Agricultural Preservation Restriction Program

After field inspection, this program processes applications received from farmland owners wishing to have their property considered for agricultural preservation. An eight member voting committee meets periodically to approve applications for development rights purchase. Properties selected are then appraised and purchase prices negotiated for state payment.

8. Department of Fisheries, Wildlife, and Recreational Vehicles

The Department of Fisheries, Wildlife, and Recreational Vehicles maintains and improves the quality and quantity of the State's resources of fish, shellfish, game and non-game wildlife species. It also maintains and improves the State's lakes, ponds, streams and coastal waters through programs of research and restoration development, designed to provide major commercial and recreation resources for the Commonwealth. It also enforces rules and regulations relating to recreational vehicles. The Department of Fisheries, Wildlife, and Recreational Vehicles contains the following departments:

a. Division of Fisheries and Wildlife

The Division of Fisheries and Wildlife is responsible for the protection and management of the fish and wildlife resources of the State. This includes the licensing of Massachusetts residents each year for fishing, hunting and trapping.

Fish and wildlife management is affected by improving the habitat of and manipulating animal populations. Wildlife lands and waters are preserved through an aggressive acquisition program. Trout and game birds are annually stocked throughout the Commonwealth, and Atlantic salmon, wild turkey, and other species are being reintroduced. Research and conservation of non-game wildlife is an increasingly important facet of the division's program.

The division also informs the public about fish and wildlife resources and their wise use through the publication of magazines and special reports, news releases, and regulations. Films, slide presentations, speakers, and exhibits are provided by the division.

b. Division of Marine and Recreational Vehicles

The Division of Marine and Recreational Vehicles is responsible for the registration and licensing of boats and recreational vehicles, and for the enforcement of the rules and regulations governing these vehicles. The division also operates a safety education program of instruction in the use of boats and recreational vehicles, and gives lectures concerning safety on request.

c. Public Access Board

The Public Access Board designates locations of public access to great ponds and other waters in the Commonwealth and of trails and paths for snowmobiling, hiking, skiing, or other uses. After public hearing in a city or town, the board acquires property easements for the purpose of such access. It designates roads and facilities to be built, improved, operated and maintained, and adopts rules and regulations governing the use of such land and waters.

9. Water Resources Commission

The Water Resources Commission exercises supervisory and policy responsibilities relative to DEQE's Division of Water Pollution Control and DEM's Division of Water Resources. The commission studies the needs, supplies and resources of the state concerning water conservation and flood prevention. Public hearings are held for these purposes and recommendations are made for legislation to provide the state with a basic water policy. With other state and federal agencies, the commission carries out water conservation and flood prevention programs. The commission is authorized to acquire lands, waters or easements to protect water impoundment sites and adjacent land. It is also authorized to construct and maintain reservoirs for purposes of providing low-flow augmentation and flood control.

10. Department of Public Works

The State Department of Public Works (DPW) is responsible for the planning, building, maintenance, reconstruction and repair of all state highways and bridges. It cooperates with cities and towns in some local road construction. It is also responsible for all waterways and adjacent land belonging to the Commonwealth. The DPW is empowered to secure federal aid funds for road building.

11. Office of the Attorney General

The office of the Attorney General is the state's chief legal officer. It represents the Commonwealth and its officers in all court actions in which they may be involved. It enforces all laws of the Commonwealth and investigates all matters for which there may have been violations and institutes proceedings to correct the situation. This office also provides legal advice to state officers and departments relating to business of the state.

D. Regional Government

1. Central Massachusetts Regional Planning Commission

The Central Massachusetts Regional Planning Commission (CMRPC) develops regional plans which serve as the foundation of regional policy. The commission assists its member communities in land use planning issues such as housing, transportation, economic development and water and environmental quality. Technical assistance is provided to communities on an individual, sub-regional, and regional basis with planning and problem solving.

2. Upper Blackstone Water Pollution Abatement District

The Upper Blackstone Water Pollution Abatement District (UBWPAD) is authorized to manage, design, construct, operate and maintain treatment works. It has the authority to assure that each participating community pays its proportionate share of treatment costs and can accept industrial wastes for treatment.

3. Northeastern Worcester County Conservation District

The Northeastern Worcester County Conservation District functions to conserve, promote and wisely use natural resources. It acts as a coordinating and initiating agency between public, federal and state agencies. The district conducts surveys, investigations and research relating the conservation and development of natural resources; works to control and prevent soil erosion and sediment damage; and works toward the conservation, development, utilization and disposal of water. Assistance is provided in soil planning, small watershed projects, and the inventorying of natural resources.

4. Lake Quinsigamond Commission

The Lake Quinsigamond Commission was created to establish rules and regulations for the protection and policing of Lake Quinsigamond. Regulations could be adopted to prohibit the discharge of sewage or any other substance which might be injurious to public health or detrimental to the quality of the lake. Since the creation of the Division of Water Pollution Control, the regulatory and enforcement powers of the commission have been in question. The issue is presently before the Attorney General to determine what regulatory power the Commission has.

5. Central Massachusetts Mosquito Control Project

The Central Massachusetts Mosquito Control Project works to control the mosquito population throughout its member communities in Central Massachusetts. As part of its project, it conducts a water management program which includes the cleaning of several waterways in the Lake Quinsigamond watershed where work has previously been conducted.

6. Westborough Treatment Plant Board

The Westborough Treatment Plant Board is a six man board responsible for the planning, construction and operation of a joint wastewater treatment plant for the towns of Shrewsbury and Westborough.

E. Municipal Government

1. Planning Boards

The powers and responsibilities of the Planning Board include the following:

- (a) Make studies and prepare plans of the resources, possibilities and needs of a city or town and to submit reports with their recommendation;
- (b) To approve subdivisions;
- (c) File reports with the City Council or town meeting on all proposed changes in the local zoning law;
- (d) To act as a special permit granting authority, if authorized by the local zoning ordinances;
- (e) To act as park commissioners when authorized by vote of the town meeting; and

- (f) To make master or study plans of the city or town or parts thereof which the board deems advisable.

Planning Boards have real power in their role in approving subdivisions and in their ability to function as a special permit granting authority. Under this special permit granting power, Planning Boards could function very effectively in granting permits for Planned Unit Development, cluster developments, and other special permit cases consistent with a local water quality management plan.

2. Conservation Commissions

Local Conservation Commissions are established for promotion and development of the natural resources and for the protection of watershed resources of the city/town. They may develop conservation and passive outdoor recreation plans for the community, and may acquire land as authorized through the Wetlands Protection Act.

Under the Wetlands Protection Act, local Conservation Commissions and the Department of Environmental Quality Engineering share authority for review and regulation of various development activities in wetland areas. A person intending to remove fill, dredge, or alter a wetland must file a Notice of Intent with the local Conservation Commission which, if it determines that the area of the proposed work is significant to public or private water supply, to the ground water supply, to flood control, to storm damage prevention, to prevention of pollution, or to the protection of fisheries, is mandated to issue a written order imposing conditions on the work. In the event of unsatisfactory action or a failure to act on the part of the Conservation Commission, an aggrieved party (including the applicant, abutters or 10 residents of the municipality) or the Commissioner of DEQE can request a new determination of significance and order of conditions from DEQE. The Commissioner has authority to promulgate rules and regulations to effectuate the purpose of this section. Final orders are recorded with the property's deeds in the appropriate Registry of Deed and are binding upon subsequent owners of the property.

3. Boards of Zoning Appeal

Boards of Appeal exercise considerable power in local land use matters due to their general administration of local zoning ordinances.

The Board of Appeals has the following powers:

- to hear and decide appeals by any person unable to obtain a permit or enforcement action, by the regional planning agency, or by any person aggrieved by an order or decision under the Zoning Act.
- to hear and decide applications for special permits upon which the board is empowered to act under the zoning bylaw.
- to hear and decide petitions for variances.
- to hear and decide appeals from decisions of a zoning administrator, if any.

4. Boards of Health

Boards of Health exercise considerable power with respect to maintaining water quality. Boards of Health have the following responsibilities:

- Make and enforce regulations relative to house drainage and connection with common sewers;
- Assign sites and monitor the operation of sanitary landfills or any other works for treating or disposing of refuse.
- Examine, destroy, remove or prevent nuisances including those which affect public water supplies.
- Regulate private and semi-private water supplies.
- Assign locations where offensive trades or employment which may result in a nuisance, be harmful to the inhabitants or dangerous to the public health can only be carried on.
- Make regulations necessary to remove or prevent nuisances.
- Determine all health questions with respect to the disposal of sewage in a subdivision which will not be connected to a municipal sewer.

5. Building Inspectors

Building inspectors carry out a number of ministerial duties including the issuance of building permits, the enforcement of state laws relating to fire prevention, and the inspection of dangerous buildings. The most relevant authority with respect to water quality management is the role of the building inspector as enforcer of the zoning bylaw. As a building inspector is generally the first person notified of proposed construction, his determination as to whether a proposed use required

detailed site review, a special permit or a zoning variance is critical.

6. Sewer Departments

At the municipal level, wastewater treatment works and collection systems can be controlled by a number of government entities. These include a sewer commission or board consisting of three elected commissioners, or the board of selectmen which acts as the sewer commission and delegates its authority to a local sewer or public works department. A city or town is authorized to lay out, construct, maintain and operate a system of common sewers and main drains necessary for the public convenience and health. Such works for sewage treatment and disposal may include any wastewater treatment facility for treating, neutralizing or stabilizing sewage including treatment or disposal plants; the necessary intercepting, outfall and outlet sewers; pumping stations integral to such facilities; and equipment and appurtenance related to the foregoing.

A city or town is also authorized to make rules and regulations regarding the use of common sewers to prevent the entrance or discharge of any substance which might interfere with the flow of sewage or the proper operation of the sewerage system.

7. Water Department

Town water departments are controlled by a board of water commissioners which have exclusive charge and control of the water department and water system. This includes the power to take by eminent domain water or land necessary for water supply and the protection of the water supply.

Cities and towns may also elect to purchase or contract for water.

8. Highway Departments

Highway Departments are responsible for the general upkeep, maintenance and repair of roadways within the community. Functions performed include street sweeping, snow and ice removal, catch basin cleaning and installation and repair of storm drains.

9. Engineering Departments

Engineering Departments give engineering support to other town departments such as, the highway department, sewer department, planning

board, conservation commission, and board of health. They act as a liaison with the various departments and provide research and technical advice to them.

10. Public Works Agencies

Public Works Agencies serve to consolidate the functions performed by road commissioners, surveyors of highway, superintendents of streets, water commissioners, sewer commissioners, park commissioners etc. The types of activity which a public works agency undertakes includes maintenance and repair of streets, refuse disposal, engineering services, snow and ice removal, and water and sewer systems maintenance.

11. Other Municipal Offices

Table 1 indicates the departments contained within the individual municipalities that have some control over water quality. In addition to the departments that have already been described, the city of Worcester contains an Office of Planning and Community Development and a Bureau of Land Use Control.

The Office of Planning and Community Development works to promote economic and community development in Worcester. It also functions in the preserving and promoting of parkland and open space. It administers and monitors a grants program for these purposes.

The Bureau of Land Use Control serves as staff to the Planning Board in matters concerning physical planning. It also serves as a technical advisor to the City Council, and various Boards, Commissions and Agencies. Among its duties and responsibilities are the following:

- Redrafts zoning maps and updates the official map;
- Prepares reports and plans for the Board of Appeals, Planning Board and Conservation Commission;
- Administers the Subdivision Control Law including review of site plans and inspection of previously approved developments to insure compliance with approved plans and regulations;
- Works with the Conservation Commission in updating its Five-Year conservation and Open Space Program.
- Approves or denies petitions from the City Council regarding zoning.
- Works with the Zoning Board of Appeals to prepare reports for Special Permit and Variance Appeals.

Table I

LAKE QUINSIGAMOND WATERSHED MUNICIPALITIES
AND DEPARTMENTS CONCERNED WITH WATER QUALITY

City of Worcester

Planning Board
Office of Planning and Community Development
Bureau of Land Use Control
Conservation Commission
Zoning Board of Appeals
Department of Public Health
Department of Code Inspection
Department of Public Works
Police Department

Town of Shrewsbury

Planning Board
Conservation Committee
Board of Appeals (Zoning)
Board of Health
Engineering Department
Building Inspector
Sewer and Water Department
Highway Department
Police Department
Park and Cemetery Commission

Town of Grafton

Planning Board
Conservation Commission
Board of Appeals
Board of Health
Engineering Department
Building Inspector
Board of Sewer Commissioners
Highway Department

Town of Millbury

Planning Board
Conservation Commission
Board of Appeals
Board of Health
Building Inspector and
Zoning Agent
Sewerage Commission
Highway Department
Hazardous Waste Coordinator

Town of West Boylston

Planning Board
Conservation Committee
Board of Appeals
Board of Health
Highway Department
Sewage Disposal Study Committee
Building Inspector

Town of Boylston

Planning Board
Conservation Commission
Board of Appeals
Building Inspector
Board of Health
Earth Removal Board
Highway Department

Both the City of Worcester and the Town of Shrewsbury maintain a lake patrol through their police departments which serves to police and patrol Lake Quinsigamond.

The Shrewsbury Parks and Cemetery Department is responsible for preparing, cleaning, repairing and otherwise maintaining parkland and neighborhood facilities throughout the community.

The Town of Millbury retains a Hazardous Waste Coordinator who is responsible for investigating and monitoring the use and disposal of hazardous materials.

An Earth Removal Board in Boylston reviews any earth disturbing activities and establishes guidelines for all earth-disturbing activities within the town to minimize erosion.

F. Private Sector

1. Regional Environmental Council

The Regional Environmental Council (REC) is a non-profit citizen organization dedicated to the conservation, protection and restoration of natural resources. It is involved in several areas of concern including land use policies and water quality in Worcester County. The Regional Environmental Council may introduce, support or oppose legislation affecting the environmental quality of the area. It sponsors programs to educate citizens and local officials on important issues and environmentally sound means of dealing with them. The REC also serves to coordinate the activities of local environmental groups.

2. Blackstone River Watershed Association

The purpose of the Blackstone River Watershed Association (BRWA) is to work toward improved water quality and the wise use and proper management of water and related natural resources in the Blackstone River Watershed. The BRWA works to promote programs and projects that will increase public awareness.

3. The Water Quality Consortium

(Worcester Consortium for Higher Education)

The Water Quality Consortium is a consortium of scientists, administrators and technical personnel from colleges and municipal agencies in central Massachusetts. The consortium acts to provide the technology and

education to maintain safe public water supplies and to conduct research on water quality issues and their relationship to public health. The consortium was formed to: give additional educational opportunities to students interested in water quality; offer faculty expertise via the Health Department and individual colleges to individuals and agencies concerned with water quality maintenance; assist municipal personnel in performing functions that require facilities or equipment not readily available to them within their departments.

4. Massachusetts Congress of Lake and Pond Associations, Inc. (COLAPA)

The major activity of the Congress of Lake and Pond Associations (COLAPA) is to forward the cause of lakes and ponds on every front. COLAPA is dedicated to the promotion and development of environmental quality standards essential for satisfactory life styles and conditions in the natural community. It is also committed to preserve the aesthetic, recreational, and commercial values of lakes and lakeshore properties through maintenance and improvement of environmental factors such as, watershed ecology, water quality, lake water levels, shoreline woodland management, agricultural soils practices, recreational and residential building standards, and related influences, such as water and boating safety.

III. IMPLEMENTATION OF RECOMMENDATIONS

A. Introduction

As can be seen from the preceding chapter, there are a number of organizations, agencies and programs that deal with some aspect of water quality. This chapter will recommend specific actions that need to be taken, assign responsibility and identify sources of funding.

Federal and state grant assistance programs are the primary inter-governmental sources of capital. Other mechanisms that are available for public funding outside the local area include revenue-sharing, state fines or fees and non-local taxes. In this manner, funds can be transferred to particular areas that show a definite need for pollution abatement.

Local sources of revenue for communities within the watershed include property taxes, personal property taxes, motor vehicle excise taxes, utility charges and user fees. A variety of license fees, permit fees and fees for special services are also collected. Included in these categories are items such as building permits, permits for septic system repair or construction, driveway permits, permits to excavate in the streets for public utilities, etc. Special or betterment assessments are also used to recover part or all of the expense for capital expansion projects. In this manner, the property which benefits from the construction is assessed. General obligation bonds which offer a low interest rate as money is paid back over a period of years are also used to raise revenue.

The major water quality management objectives which have been identified for the Lake Quinsigamond/Flint Pond drainage area can be summarized by the following statement:

Improve/maintain water quality conditions to provide the maximum utilization of the most significant natural resource in the Central Massachusetts region for the most appropriate beneficial uses of Lake Quinsigamond, Flint Pond and other waterbodies in the watershed.

In keeping with this management objective, the following sections will recommend specific implementation measures.

B. Restoration Techniques

Recommendations have been made to the City of Worcester and the towns of Shrewsbury and Grafton for in-lake restoration techniques which include the following:

- 1) Lake Quinsigamond
 - a) Weed harvesting in the northern portion of Lake Quinsigamond above Main Street, Shrewsbury.
 - b) Dredging of channel at Belmont Street drain.
- 2) Flint Pond
 - a) Weed harvesting with initial priority given to northern basin, followed by southern basin, followed by middle basin.

Communities should apply to the Department of Environmental Quality Engineering for funding and technical assistance in implementing these recommendations. DEQE has established a Clean Lakes program under Chapter 628 for the restoration, preservation and maintenance of publicly owned lakes and ponds in Massachusetts. The goals of the program are to diagnose lakes and ponds and to implement long-term solutions and methods designed to improve or preserve water quality. Maintenance programs that are shown to be expedient and cost-effective in providing relief from severe aquatic nuisances will also be considered.

C. Protection of Water Supplies

One of the main water quality management objectives identified for Lake Quinsigamond was to protect all primary and secondary water supply groundwater aquifers from contamination and degradation. To protect a municipal water supply pumping station located at the mouth of Coal Mine Brook, it has been recommended that a storm drain be relocated so that it discharges to Lake Quinsigamond at Interstate 290. In order to implement this recommendation, the City of Worcester and the Massachusetts Department of Public Works should enter into a cooperative agreement to address this problem. Further assistance may be obtained from the Department of Environmental Quality Engineering. The DEQE administers a matching grant program for leak detection and water system rehabilitation and has established a drinking water contamination clean-up fund which provides technical assistance to identify the extent and source of contamination, provide the most suitable treatment and clean-up and protect the water supply in the future.

The City of Worcester should consider allocating funds for this type of activity from a proposed increase in water rates.

D. Erosion and Sedimentation Control

By controlling erosion and sedimentation, significant improvements in water quality can be gained through a reduction of solids and nutrients. The City of Worcester and the towns of Shrewsbury and West Boylston should jointly petition the Northeastern Worcester County Conservation District for the assistance of the Soil Conservation Service to implement the recommendations made for Poor Farm Brook. A comprehensive watershed management plan should be developed to include the design of erosion control measures, stream bank stabilization measures, detention basins, rehabilitation of City Farm Pond and other related elements of the tributary management plan as appropriate.

Additionally, erosion and sedimentation problems from the embankment behind the Lincoln Plaza Shopping Center should be addressed to the Soil Conservation Service.

The Agricultural Stabilization and Conservation Service should also be contacted for technical and funding assistance.

E. Infiltration Measures

Dissolved phosphorus was identified in the watershed management plan as a key to the rate of eutrophication and hypolimnetic dissolved oxygen depletion rate. Because of the diffuse and uncontrollable nature of many dissolved phosphorus sources, management practices and designs which encourage water infiltration were recommended as an effective means of controlling the eutrophication of Lake Quinsigamond.

In keeping with this management objective, the Massachusetts Department of Public Works and the City of Worcester should evaluate the feasibility of replacing the I-290 culverts with a perforated pipe infiltration system which will increase groundwater recharge and reduce the amounts of solids entering Coal Mine Brook.

Other measures, such as replacing a stormwater drain discharging to Poor Farm Brook from the Jamesbury Corporation facility with perforated pipe and installing sandtrap catchbasins may be financed through a betterment assessment.

F. Land Use Control

The control of land use, including controlling and directing the growth of a community can be an effective means of preventing water quality problems and the need for expensive structural solutions to water pollution problems. Local governments exercise the greatest control over land use through zoning, subdivision regulations, health regulations, building permits, and wetland permits. Conservation commissions, planning boards and health boards in the

watershed should review their regulations to be certain that water quality is protected. Measures that have been recommended in the watershed management plan include buffer strips, aquifer protection districts, preservation of wetlands and minimum lot sizes. Regulations to control erosion and sedimentation from all earth-disturbing activities and regulations requiring that a proposed development does not result in any net change in either the quantity of runoff or the rate of runoff are also recommended. The Central Massachusetts Regional Planning Commission should be contacted by municipal agencies for assistance in adopting or modifying regulations.

In addition to the land use measures outlined above, the Division of Conservation Services administers three programs--the Federal Land and Water Conservation Program, the State Self-Help Program, and the State Urban Self-Help Program--which provide for partial reimbursement to the state and its political sub-divisions for the purchase and development of recreation lands.

The Land and Water Conservation Fund Program provides matching grants to the state, and through the state, to its political subdivisions for the acquisition and development of public outdoor recreation areas and facilities.

The Self-Help Program provides grants to Municipal Conservation Commissions to cover up to 50 percent of the costs of land acquisition for passive recreational use. Only land acquisition costs are eligible and only municipal conservation commissions may apply.

The Urban Self-Help Program reimburses local Park and Recreation Commissions of municipalities with a population of greater than 35,000 for up to 80 percent of the costs of land acquisition for park and recreational facilities. Only land acquisition costs (including appraisals) are eligible for reimbursement.

The Department of Environmental Quality Engineering has also established a fund for the acquisition of land for the protection of aquifers. Matching grants are provided to municipalities who wish to protect future groundwater supplies from development and contamination.

G. Septic System Maintenance Program

The implementation of a septic system maintenance and inspection program requiring registration, periodic inspection and cleaning of subsurface disposal systems would aid in alleviating water quality problems throughout the

watershed from this source.

In implementing a program, it is recommended that inspection of the subsurface disposal system be conducted by an official of the Board of Health or by a private firm with the cost of inspection borne by the system owner. Since town-owned pumpers are totally user-supported, municipal cleaning costs may exceed average private fees, especially if only a small number of systems are pumped annually. This would certainly be the case in all the municipalities in the watershed which individually have a relatively small number of septic systems due to sewerage or low populations. It is, therefore, recommended that a private pumping service be utilized with the cost again borne by the septic system owner. In implementing a program it is important to keep inspection and pumping interests separate to avoid compromising the objectivity of inspectors.

The Board of Health should also provide information to new home-owners when a system is initially installed on proper septic system maintenance and operation procedures. Information on the use of water conservation measures should also be supplied.

H. Operation and Maintenance Practices

Many operation and maintenance practices are conducted by communities and the Commonwealth of Massachusetts on a regular basis. Funds are included annually in municipal budgets for items such as street-sweeping, catch basin-cleaning, stream channel maintenance, inspection of pumping stations and inspection of storm and sewer systems for leaks, misconnections, broken seals, etc. To make maximum use of funds and to increase efficiency, these practices should be evaluated with high priority given to those areas identified in the watershed management plan for flood and pollution control.

I. Deicing Control

Public works departments and highway departments can target and concentrate on critical areas by evaluating their deicing programs.

A road salt control program can be designed to educate officials and employees. A program should focus on the following aspects:

Development of maps showing local drainage basins and road networks with locations of salt-sensitive targets (aquifers, wells, streams, and tributaries to reservoirs).

Development of a selective application program from such maps that designate specific parts of the road network as no-salt or minimum salt zones.

Identification and site-review of snow-dumping areas.

Training of highway crews in salt application procedures.

Maintaining equipment in excellent condition.

The cost of implementing these practices is low, and in the long run, money will be saved by lower expenditures for salt, less expense for the repair or purchase of equipment and a reduced cost for the repair of corrosion damage to highway structures.

J. Public Education Programs

Public education programs can be used to educate the public on a variety of topics important to maintaining water quality in the watershed. Information can be disseminated on application rates and practices for the use of lawn and garden chemicals, on water conservation measures, on the detrimental effects of dumping debris or brush on streams, and on the proper handling of petroleum products to reduce the deposition of gasoline and oil residuals on paved surfaces. The Blackstone River Watershed Association, the Regional Environmental Council and Municipal Conservation Commissions are all an excellent media for such efforts. There are several techniques which can be used to minimize costs. Volunteers can be used to write and produce leaflets. Local banks, industries and businesses should be approached to sponsor programs. Information can be distributed through either a special mailing or included with other town-wide mailings such as water bills or tax bills. Campaigns utilizing volunteers can be organized and conducted to remove litter and debris from areas throughout the watershed. In addition, the creation of a Lake Quinsigamond Association sponsored by the Regional Environmental Council will be instrumental in educating the public on water quality and environmental issues.

K. Further Studies

Recommendations that have been made for further study in the watershed include the following:

- 1) A study of hydraulic modifications to Flint Pond
- 2) A study of the cove at the outlet of Bonnie Brook to determine if the cove can be recovered by dredging or if the brook should be culverted directly to the southern basin, by-passing both the cove and the existing channel.

- 3) Develop preliminary design and cost information for the use of Hydro-brakes^R in conjunction with either oversize or perforated pipe to achieve stormwater volume control in the Belmont Street drainage basin.

Assistance in carrying out these projects may be available through DEQE's Clean Lakes program which has been previously described.

The Department of Environmental Quality Engineering also administers a Research and Demonstration Program which provides technical assistance and grant aid for studies and demonstration projects involving improved or more efficient methods of water pollution control.

EPA administers project grants to support and promote the coordination and acceleration of research, development and demonstration projects relating to the causes, effects, extent, prevention, reduction and elimination of water pollution. It also administers grants for the establishment and maintenance of adequate measures for prevention and control of water pollution.

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