Office of the **PLANNING & ZONING OFFICIAL**
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MEMORANDUM

To: Planning and Zoning Commission
From: Jeremy DeCarli
Date: March 6, 2019
Re: Update to Section 3.1 Lake Pocotopaug Protection Zone

As previously discussed, the Lake Pocotopaug Protection Zone can be re-written to include better protections for the Lake from future development without discouraging development altogether in the watershed. There are regulations in place in towns throughout the State and across the county that can be used as models. Included with this memo are regulations from:

- Brookfield CT
- Columbia CT
- Groton CT
- Huntersville, NC
- New Milford CT
- Salisbury, MA
- Whatcom County, WA

Also included is information from the States of Vermont and New Hampshire, where statewide policies are in place in order to protect the watershed of lakes, ponds, and streams. Other articles that may be helpful in updating the regulation are attached including "Overlay Zoning to Protect Surface Waters" by Joel Russell, " Crafting a Lake Protection Ordinance" by Karen Cappiella and Tom Shueler. An excerpt regarding best management practices from the Nine Point Plan prepared by Northeast Aquatics is also included.

Elements from these various regulations include:

- Required vegetative buffer areas at lake shore
- Required infiltration areas for driveway and roof runoff
- Preservation of tree canopy (permits for removal)
- Time of year restrictions for certain activities

Things to consider in crafting an update to Section 3.1:

- Small lot sizes in watershed area
- Impervious coverage throughout the watershed area
- Lack of controls over tree cutting
- Lack of controls over single-family home development

Next Steps:
Develop a plan for updating which should include public input (workshops)
Review materials
Craft first draft of updated regulation

The water-holding capacity of the floodplain, except those areas which are tidally influenced, shall not be reduced. Any reduction caused by filling, new construction, or substantial improvements involving an increased footprint to the structure shall be compensated for by deepening and/or widening of the floodplain. Storage shall be provided on site unless easements have been gained from adjacent property owners. It shall be provided within the same hydraulic reach and a volume not previously used for flood storage. It shall be hydraulically comparable and incrementally equal to the theoretical volume of floodwater at each elevation, up to and including the 100-year flood elevation, which would be displaced by the proposed project. Such compensatory volume shall have an unrestricted hydraulic connection to the same waterway or water body. Compensatory storage can be provided off site if approved by the Town of Brookfield.

5.6 Watershed Protection District (WPD)

A. Candlewood Lake Watershed District, (CLW)

1. Background

Candlewood Lake, the state's largest lake and one of its most important inland water resources, has experienced a gradual deterioration of water quality since about 1950. Studies of the lake shoreline development area have recommended planning to avoid the need to install a public sewer system.

Brookfield is one of five Connecticut towns that border the lake shore. The lake's watershed area is 26,461 acres, and Brookfield's portion is 1,177 acres or 4 percent of the total. However, the watershed in Brookfield, especially the lake shore area, is generally intensively developed and a primary source of stormwater runoff that can carry nutrients and pollutants that contribute to the eutrophication of the lake and deterioration of lake and groundwater quality.

These regulations are designed to minimize, and where possible reduce, the negative impact of stormwater runoff affecting Candlewood Lake and the watershed area, thereby reducing the rate of lake eutrophication and avoiding the need for a public sewer system.

2. Purpose

The purpose of the Candlewood Lake Watershed District is to prevent nutrient enrichment or contamination of Candlewood Lake and its watershed and to avoid the need for sewers in this densely developed area of Brookfield. Specifically, the purposes are:

a. To minimize the impervious surfaces and maximize infiltration of stormwater runoff

b. To reduce peak stormwater flow and minimize the likelihood of soil erosion, stream channel instability, flooding, and habitat destruction

c. To preserve and/or create vegetative buffers of native plantings to control and filter stormwater runoff

d. To minimize disturbance of natural grades and vegetation and utilize existing topography for natural drainage systems

e. To contain stormwater runoff on the site wherever possible to reduce the volume of stormwater runoff before it reaches the groundwater or surface water bodies

f. To prevent and minimize potential groundwater pollution from improper waste disposal, release of hazardous materials, and other sources

3. Land to which these regulations apply

These regulations apply to all land within the boundaries of the Candlewood Lake watershed as delineated on a map on file in the offices of the Commission entitled "Candlewood Watershed District, Town of Brookfield."

4. Compliance

Within Town boundaries, the Candlewood Watershed District shall be superimposed on existing zoning districts. The provisions of these regulations shall be in addition to all other requirements of applicable statutes, codes, regulations, or ordinances. In the event of conflict between the provisions of this Regulation and any other Town regulation, the more restrictive requirement shall apply.

5. Permitted Uses

Permitted uses are all uses permitted in the underlying districts except those cited in Section 5.4D(2).

6. Required Stormwater Management Plan and Data

All new building construction, or an addition, alteration, or enlargement that results in an increase in the amount of impervious surface (paved drives, walks, patios, etc.) on a lot where the total impervious surface is ten percent or greater, shall require a Stormwater Management Plan. In addition to the data required elsewhere in these Regulations, the following data shall be required:

a. A narrative report prepared by a licensed engineer indicating:

- Any risk or threat to Candlewood Lake or the water resources in its watershed from site development, site improvements, or on-site operations proposed in the application and measures

- Methods of assessment and best management practices to prevent and reduce any such risk or threat
- Supporting documentation, including calculations and engineering details, shall be provided to illustrate the existing and proposed development's compliance with these Regulations, which development shall be designed in accordance with the stormwater management design guidelines of the "Connecticut Stormwater Quality Manual" of 2004, as revised.

b. A site plan indicating

- All relevant data required under Section 5.4(F)
- Location and area of all impervious surfaces on the site
- Location and area of turf cover (lawn areas)
- Location and area of all existing woodland areas
- Location and area of all existing and proposed vegetative buffer areas
- Location and description of all potential runoff and pollution sources including erosive soils and steep slopes
- Location and specification of all existing and proposed stormwater best management practices

7. Best Management Practices

The following practices and methods shall be incorporated into all Stormwater Management Plans where practicable:

- Vegetated swales, buffers, filter strips
- Level spreaders
- Grassed drainage swales, wet or dry
- Maintain or restore predevelopment vegetation
- Minimize creation of steep slopes
- Bioretention structures/residential rain gardens
- Rainwater harvesting/rain barrels
- Dry detention ponds
- Underground detention ponds
- Proper location and reduction of impervious surface area on site
- Disconnect flows from multiple impervious surfaces
- Permeable pavement choices
- Groundwater infiltration systems (curtain drains, drywells, galleries, etc.)

8. Approval Considerations

a. Prior to the issuance of Zoning Approval or Certificate of Zoning Compliance, the Commission, acting through its authorized agent, the Zoning Enforcement Officer, shall give consideration to the simplicity,

reliability, and feasibility of the individual Stormwater Management Plan prepared for the site.

b. The Commission, or its agent, may solicit the opinion of the Health Department, Town Engineer, Inland Wetlands Commission, and the Planning Commission concerning any application involving the Candlewood Lake Watershed District.

c. Approval shall not be granted until the Zoning Enforcement Officer determines that the proposed plan will employ best management practices to substantially reduce and improve the on-site cleansing of stormwater runoff from the site.

21.4 Columbia Lake Watershed Protection Overlay Zones on the Residential Agricultural District:

Zoning Regulations For Zoning Compliance For New Zoning/Building Permits *(effective 10/15/2003)

21.4.1 Intent and Purpose

It is the intent of this section to promote the health and general welfare of the community by preventing the nutrient enrichment or contamination of Columbia Lake to ensure a present and future high quality lake resource for a variety of valuable functional uses including recreation and habitat. The Lake Protection Areas are designated as overlay zones on the Residential Agricultural or RA District.

The purpose of this section is to facilitate the adequate provision of clean water by prohibiting, within the Lake Protection Areas, land uses which can contaminate water resources and by regulating other land uses which may have the potential to contaminate or down grade existing water resource quality.

The Columbia Lake Ecosystem is a high quality mesotrophic, dimictic lake. The Lake exhibits mean Summer Transparency greater than 4m; Minimum Transparency exceeding 3m between Memorial Day and Labor Day, and greater than 1 mg/L of dissolved oxygen to a depth exceeding 6m at all times. Columbia Lake is capable of supplying habitat to an array of desirable wildlife species, water-based recreational activities, and influences the value of real property and quality of life in the Town of Columbia. Its protection is critical.

Columbia Lake is highly susceptible to increased enrichment with nutrients, particularly phosphorus, because of its mesotrophic productivity state, morphometry, and hydrologic relationships. Preventing eutrophication is critical to maintaining the functional value of Columbia Lake. Columbia Lake is primarily supplied with water from precipitation that runs off from land surfaces within the watershed. The three Lake Protection Sub-Areas indicate immediate areas which drain directly to Columbia Lake, areas which drain through more extensive flow paths to tributary streams, and more remote areas which first drain to a large wooded swamp (providing natural renovation capacity for runoff water quality).

21.4.2 Applicability

These regulations shall be in addition to the requirements for the underlying RA District as designated on the Zoning Map of the Town of Columbia. Both the requirements of the Zoning Regulations as set forth in other sections and the requirements contained herein for the Columbia Lake Protection Areas shall apply within such zone. In the event of a conflict, the more restrictive requirements shall apply.

21.4.3 Columbia Lake Protection Area Overlay Zone Maps

The Lake Protection Areas are hereby established on those lands serving as the immediate (LAR), intermediate (LBR), and remote (LCR) watershed areas to Columbia Lake. The Lake Protection Areas are delineated on a map entitled: "Columbia Lake Protection Areas" and is overlaid on the Columbia Connecticut Zoning Map dated

effective 09/30/2003 or as amended. scale 1" = 3500' prepared for The Town of Columbia by staff and consultants and approved by action of the Columbia Planning and Zoning Commission in the regular meeting of 09/09/2003.

21.4.4 Columbia Lake Protection Area Overlay Zone Requirements

All new activities governed by the Zoning Regulations of the Town of Columbia within the Columbia Lake Watershed Protection Overlay Zones LAR, LBR, and LCR superimposed on top of the Columbia Residential Agricultural or RA District and which require a Planning and Zoning, Inland Wetlands, Zoning Boards of Appeals, or Zoning Compliance Certificate shall meet the following specific requirements for the protection of Columbia Lake water quality or for stabilization of adjacent and town-wide property values.

21.4.4.a Nutrient Allocation Compliance

Prior to approval of zoning compliance on a building permit application, the projected annual export of total phosphorus in pounds per acre per year in estimated stormwater from the subject parcel shall be computed both for the parcel with existing improvements thereon and for the existing parcel based on the completed project for which the building permit is sought. These computations shall be made in accordance with the methods defined in "Columbia Lake Watershed Management Plan" (hereafter called the Management Plan) approved 1998, or as may be amended from time to time based on newer information including but not limited to basic scientific understanding of nutrient dynamics, infiltration rates of various soils or ground covers and proximal monitoring data from Columbia Lake. Data for computing the nutrient export estimate, as defined in the Management Plan shall be provided by the applicant on the site plans, or similar documentation if site plans are not required by underlying zone requirements for a building permit application.

If the computed annual export of total phosphorus for the existing parcel with the completed project for which the building permit is sought is less than the allocation defined in the Management Plan (total phosphorus in pounds per acre per year for the Lake Watershed Overlay Zone in which the residential agricultural parcel is located, namely LAR, LBR, or LCR) the application shall be deemed "in compliance" with Overlay Zone Requirements and consideration of the application for compliance with any other requirement of the underlying residential agricultural district may proceed.

If the computed annual export of total phosphorus for the existing parcel with the completed project for which the building permit is sought is greater than the allocation defined in the Management Plan, the applicant shall apply adequate best management practices (BMPs) singly or in combination to reduce the total phosphorus export either to comply with the allocation requirements of the overlay zone in which the parcel is located on the Zoning Map or to produce a computed annual export of total phosphorus at least 10% less than the computed annual export of total phosphorus from the subject parcel with existing improvements thereon on the date of the permit application. For these purposes, total phosphorus export shall be recomputed with credits assigned for BMPs where infiltration coefficients are available and as defined in the Management Plan.

A worksheet provided as part of the building permit application materials will include spaces for all required input variables, levels of total phosphorus to be achieved, and suggested infiltration or other coefficients as available for nutrient allocation calculation. The applicant will fill in this worksheet and annotate these input numbers to details of a site plan included in the building permit application package. With the applicant supplied information, the Agent (ZEO) will input this applicant data into a computer spreadsheet analysis to estimate the levels of total phosphorus (lb/acre/year) in surface storm water coming off the specific site or land parcel. The worksheet shall be based on the latest revision of a nutrient allocation model and level of total phosphorus permissible in each of the Columbia Lake Watershed Overlay Zones on the Residential Agricultural District, LAR, LBR, and LCR.

21.4.4 b Best Management Practices for Reduction of Phosphorus

The applicant who is designing or redesigning a project application site plan may use a number of manuals or texts to find examples or diagrams of what are the current Best Management Practices or BMPs. The Connecticut Storm water Quality Manual (draft 2003 or as amended) and the Connecticut Erosion and Sedimentation Guidelines (2002 or as amended) contain some examples, explanations, and diagrams for BMPs that might be available and appropriate to include in the building permit application site plan.

Generally, applicants for building permits can reduce total phosphorus in storm water by increasing the storm water infiltration and the detention of storm water before it reaches Columbia Lake. To the greatest extent possible, BMP's shall be located between the development area (or area of greatest impact) and the lake.

The most valuable and practical BMPs are included but not limited to those in the following list:

- Permeable pavement choices
- Bio-retention structures/residential rain gardens
- Vegetated swales, buffers, filter strips
- Drywells for roof drains/leaching trenches
- Rainwater harvesting
- Dry detention ponds
- Underground detention facilities
- Vegetative filter strips/level spreaders
- Grassed drainage swales, wet or dry
- Proper location and reduction of impervious area on site
- Maintain or restore pre-development vegetation by type
- Encourage sheet flow versus channelization of storm water
- Disconnect flows from multiple impervious surfaces
- Minimize creation of steep slopes/vice versa
- Replanting with trees, underbrush, groundcovers, flowerbeds

Infiltration coefficients to calculate credits for the site plan worksheet may or may not be available for the above list of BMPS. The most current list of infiltration coefficients

available in the scientific literature will be available on the worksheet page of the building permit application.

For impervious surfaces greater than 100 s.f., the first 1" flush of storm water shall be treated with a BMP as identified in Sec. 21.4.4.b of these regulations, the nutrient allocation worksheet or other methods not listed but approved by staff.

All BMPs shall be maintained and kept in working condition by the owner. If the BMPs have not been adequately maintained, then no further zoning permits shall be issued until the BMPs have been brought back to working condition.

21.4.4.c Provision and Procedures for Reduction of Lake Watershed Protection Requirements

In a case where a proposed activity governed by Section 21.4.4 is unable to comply with Section 21.4.4a, the Commission may receive and evaluate a written request, site plan, other relevant materials, and verbal testimony to consider reduction of the requirements of Section 21.4.4.a. Reduction may only be granted by the Commission as an action during a regular meeting after a public hearing conducted as if Section 52.4 were applicable and after the finding that the following requirements have been satisfied: 1.) the annual export of total phosphorus for the subject parcel with existing improvements thereon on the date of the application shall not be exceeded after completion of the project for which a building permit is sought; 2.) a so-called first flush infiltration system either has been employed to the maximum extent possible or is not possible; and 3.) other reasonably available BMPs have been satisfactorily employed.

If a reduction is granted and a letter from the Commission describing the reasons for the action granting the reduction is obtained and attached to the building permit application, the applicant can proceed to demonstrate compliance with all other applicable regulations required in the underlying Residential Agricultural or RA District.

21.4.4.d Possible Waivers Upon Demonstration Parcel Not Within Columbia Lake Watershed

In a case where the proposed activity governed by Section 21.4.4 appears upon site inspection by the Zoning Enforcement Officer to be located on a land parcel whose storm water does not flow in the direction of Columbia Lake, the Commission may consider information such as topography of the parcel and direction of storm water either overland or in road drainage system and may authorize the Chairman and the ZEO to issue a letter to file which would waiver this parcel or portion of a parcel from the requirements of Section 21.4.

21.4.5 Additional (Non-Regulatory but Suggested) Columbia Lake Protection Actions Not in the Purview of the Commission.

In addition to the requirement of compliance with the Nutrient Allocation of property within the designated Columbia Lake Protection Overlay Zone, residents are encouraged to take additional voluntary actions to protect the quality of Columbia Lake as described in the Management Plan, including but not limited to:

- Proper maintenance and pump-out frequency of on-site wastewater disposal systems (septic systems),
- Consider installation of septic tank effluent filters when service is performed,
- Use of sand fill materials with a phosphorus attenuation capacity exceeding 0.01 kg P / cubic ft when constructing or repairing septic system leaching fields,
- Design leaching field geometry to maximize down-gradient soil contact volume and avoid intersecting septic groundwater plumes,
- Avoid the use of septic system additives,
- Maximize phosphorus removal from wastewater by approved innovative designs,
- Only use fertilizers that have low, or no phosphorus content made available at local vendors. *****(effective October 15, 2003)

HUNTERSVILLE NC

3.3.3 LAKE NORMAN WATERSHED OVERLAY DISTRICT

Intent: The intent of the Lake Norman Watershed Overlay District is to provide for the protection of public water supplies as required by the NC. Water Supply Watershed Classification and Protection Act (G.S 143-214.5) and regulations promulgated there under. The Lake Norman Watershed Overlay may be applied in any zoning district. The Lake Norman Watershed Overlay District supplements the regulations of the underlying zoning district within the Lake Norman Watershed Protection Area to ensure protection of public drinking water supplies. All other uses and regulations for the underlying district shall continue to remain in effect for properties classified under the Lake Norman Watershed Overlay District.

.1 Applicability: The Lake Norman Watershed Protection Area is that area within the jurisdiction of the Town of Huntersville which contributes surface drainage into that portion of the Catawba River known as Lake Norman and its tributaries. The Lake Norman Watershed Protection area is specifically defined on the Huntersville Zoning Maps.

.2 Exceptions to Applicability:

a) Existing development, as defined in Section 12.2.3, is not subject to the requirements of the Lake Norman Watershed Overlay District. Expansions to structures classified as existing development must beet the requirements of this section, however the built-upon area of the existing development is not required to be included in the impervious calculations.

b) An existing lot, as defined in Section 12.2.3, owned prior to the effective date of this ordinance, regardless of whether or not a vested right has been established, may be developed for single family residential purposes subject only to the buffer requirements of Section 3.3.3-A, f) and g) whichever are applicable.

c) Existing public utilities may expand without being subject to the restrictions of this part provided that:

(i) Such expansion complies with all applicable laws of the State of North Carolina and the United States of America; and

(ii) Discharges associated with the existing public utilities may be expanded, however the pollutant load shall not be increased beyond presently permitted levels.

.3 Watershed Subareas Established:

a) Critical Area. The Critical Area is defined as the land area which begins at the normal pool elevation of Lake Norman and extends one-half mile inland or to the ridgeline, whichever is closest, as shown more specifically on the Huntersville Zoning Maps.

b) Protected Area. There is no Lake Norman Protected Area located within the jurisdiction of the Town of Huntersville.

CHAPTER 104
CANDLEWOOD LAKE WATERSHED DISTRICT
(CLWD)

Section 104-010 Background

Candlewood Lake, the State's largest lake and one of its most important water resources, has experienced a gradual deterioration of water quality since about 1950. Studies of the lake shoreline development area have recommended planning to avoid the need to install a public sewer system.

New Milford is one of five Connecticut towns that border the lakeshore. The lake's watershed area is 26,461 acres and New Milford's portion is 2,629 acres or 10% of the total. Major segments of the watershed and lake shore area are intensively developed and a primary source of stormwater runoff that can carry nutrients and pollutants that contribute to the eutrophication of the lake and deterioration of lake and ground water quality.

These regulations are designed to minimize, and where possible, reduce the negative impact of stormwater runoff affecting Candlewood Lake and watershed area thereby reducing the rate of lake eutrophication and avoiding the need for a public sewer system.

Section 104-020 Purpose

The purpose of the Candlewood Lake Watershed District is to prevent nutrient enrichment or contamination of Candlewood Lake and its watershed and to avoid the need for sewers in the Candlewood Lake area of New Milford:

1. To minimize the impervious surfaces and maximize infiltration of stormwater runoff.

2. To reduce peak stormwater flow and minimize the likelihood of soil erosion, stream channel instability and flooding and habitat destruction.

3. To preserve and/or create vegetative buffers of native plantings to control and filter stormwater run-off.

4. To minimize disturbance of natural grades and vegetation and utilize existing topography for natural drainage systems.

5. To contain stormwater runoff on the site, wherever possible to reduce the volume of stormwater runoff and to cleanse the runoff before it reaches the groundwater or surface water bodies.

6. To prevent and minimize potential groundwater pollution from improper waste disposal, release of hazardous materials and other sources.

Section 104-030 Land to Which These Regulations Apply

These regulations apply to all land within the boundaries of the Candlewood Lake watershed as delineated on a map on file in the offices of the Zoning Commission entitled "Candlewood Watershed District, Town of New Milford".

Section 104-040 Compliance

Within town boundaries, the Candlewood Watershed District shall be superimposed on existing zoning districts. The provisions of these regulations shall be in addition to all other requirements of applicable statutes, codes, regulations or ordinances. In the event of conflict between the provisions of this regulation and any other Town regulation, the more restrictive requirement shall apply.

Section 104-050 Permitted Uses

1. All uses permitted in the underlying district.

Section 104-060 Required Stormwater Management Plan and Data

All new building construction, or any addition, alteration or enlargement that results in an increase in the amount of impervious surface (paved drives, walks, patios, etc.) on a lot where the total impervious surface is 20% or greater shall require a Stormwater Management Plan in accordance with the following requirements:

A. A narrative report prepared by a licensed engineer indicating:

    1. Any risk or threat to Candlewood Lake or the water resources in its watershed from site development, site improvements, or on-site operations proposed in the application and measures.

    2. Methods of assessment and best management practices to prevent and reduce any such risk or threat.

    3. Supporting documentation, including calculations and engineering details shall be provided to illustrate the existing and proposed development's compliance with these regulations which shall be designed in accordance with the stormwater management design guidelines of either the "Connecticut Stormwater Quality Manual" published by the University of Connecticut Cooperative Extension Service, NEMO Project and/or the Connecticut DEP's "Manual for the Best Management Practices for Stormwater Management".

B. A site plan indicating:

1. All relevant data required under section 185-010 “Application for Use Permit”.

2. Location and area of all impervious surfaces on the site.

3. Location and area of turf cover (lawn areas).

4. Location and area of all existing woodland areas.

5. Location and area of all existing and proposed vegetative buffer areas.

6. Location and description of all potential runoff and pollution sources including erosive soils and steep slopes.

7. Location and specifications of all existing and proposed stormwater best management practices.

Section 104-070 Best Management Practices

The following practices and methods shall be incorporated into all stormwater management plans wherever possible:

1. Vegetative swales, buffers, filter strips
2. Vegetative buffer or filter strips and level spreaders
3. Grassed drainage swales, wet or dry
4. Maintain or restore pre-development vegetation
5. Minimize creation of steep slopes
6. Bio-retention structures/residential rain gardens
7. Rain water harvesting/rain barrels
8. Dry detention ponds
9. Underground detention ponds
10. Proper location and reduction of impervious surface area on site
11. Disconnect flows from multiple impervious surfaces
12. Permeable pavement choices
13. Groundwater infiltration systems (curtain drains, dry well galleries, etc.)

Section 104-080 Approval Considerations

1. Prior to the issuance of Zoning approval or a Certificate of Zoning Compliance, the Commission, acting through its authorized agent, the Zoning Enforcement Officer, shall give consideration to the simplicity, reliability and feasibility of the individual Stormwater Management Plan prepared for the site and shall approve or disapprove the Plan accordingly.

2. The Commission, or its agent, may solicit the opinion of the Health Department, Town Engineer, Inland Wetlands Commission and the Planning Commission

concerning any application involving the Candlewood Lake Watershed District.

3. Approval shall not be granted until the Zoning Enforcement Officer determines that the proposed plan will employ best management practices to substantially reduce and improve the on-site cleansing of stormwater runoff from the site.

(*Effective: November 24, 2003*)

a. Substances, which are toxic, flammable, corrosive, explosive, radioactive or infectious.

Salisbury, MA

b. Substances listed in the U.S. Environmental Protection Agency Titled 111 list of list Chemicals subject to reporting under Title 111 of the Superfund Amendments and Reauthorization Act (SARA) of 1986 as revised and in quantities exceeding those identified in SARA.

c. Acids and alkaloids outside the Ph range of 2 to 10.

d. Petroleum products, including fuels and waste oils.

e. Synthetic organic solvents.

d. Any soil materials, which if exposed to water will leach or dissolve to form a hazardous material as defined above. Exceptions: Hazardous Materials used only in conjunction with residential use of property for non-commercial purposes or for the handling or storage of agricultural chemicals in the ordinary course of agriculture or farming operations as defined in Section 1-1 (q) of the Connecticut General Statues as amended.

Exceptions: Hazardous materials used only in conjunction with residential use of property for non-commercial purpose or for the handling or storage of agricultural chemicals in the ordinary course of agriculture or farming operations as defined in Section 1-1 (q) of the Connecticut General Statutes as amended.

804 LAKE PROTECTION OVERLAY ZONE

804.1 STATEMENT OF PURPOSE

This overlay zone is established on the shoreline of the following lakes in the Town of Salisbury, Wonomscopomuc Lake, East and West Twin Lakes and Wononpakook Lake. These lakes are experiencing euthrophication a natural lake aging process, which is accelerated by development and other human activities occurring along the shoreline and its watershed. Signs of a eutrophic lake are excessive lake algae growth and diminishing lake water transparency.

This lake overlay zone is designed to establish a protected buffer strip along the lakeshore for the following purposes.

a. To avoid water pollution and acceleration of lake euthrophication.

b. To maintain the lake's ecological, recreational and aesthetic qualities.

c. To prevent water pollution caused by erosion, sedimentation, nutrient or pesticide run-off and waste disposal facilities and to encourage retention of shore vegetative cover, including diversity of nature species, age distribution and ground cover density to provide a protected buffer and pollution filter along the lakeshore.

d. To conserve the ecological, water supply and flood storage functions of the lake's flood plain and related groundwater table and to protect life, public safety and property from flooding hazards.

e. To protect valuable fisheries in the lake along the lakeshore area.

f. To conserve and enhance the natural scenic and topographic conditions in the lake shore corridor and its environmental quality recognizing that these are vital to the economic and environmental health of the Town and to preserve the natural scenic quality of the lake.

g. To carry out the recommendations of the Town Plan of Conservation and Development and the State Plan of Conservation and Development.

804.2 ESTABLISHMENT OF THE LAKE PROTECTION OVERLAY ZONE

This zone shall consist of the area between natural mean high water level (or where the lake level is controlled by a dam the normal maintained level of the lake) to a distance of 300' landward. The natural mean high water level or normal maintained water level shall be referred to herein as the "reference line".

Where there is a question or dispute over the District boundary, the burden of proof shall be upon the owner/applicant to determine this level. The Commission may require an applicant to have the mean high water level determined by a certified soil scientist or other qualified person and to show its location on a site plan prepared by a Connecticut Registered Land Surveyor.

804.3 PERMITTED AND SPECIAL PERMIT USES

The Permitted Uses and Special Permit Uses allowed in Lake Protection Overlay Zone should be the same as allowed in the underlying zone with the following exceptions. The following activities and uses as shown on the Table of Uses not be allowed in the Lake Protection Overlay Zone:

a. Multi-family dwelling (A.3 on Tables of Uses)

b. Permanent sawmill (B.5)

c. Commercial livery, Boarding or Riding Stables, Commercial Kennel, Vet Hospital (B.8)

d. Hospital, Clinic, Convalescent Home, Nursing Home, Extended Care Facility and Similar Use (C.6)

e. Cemeteries (D.3)

f. Hotel (F.6)

g. Motel, Tourist Cabin (F.8)

h. Golf Course operated by a non-profit organization (G.9)

i. Natural Resources Removal (H.10)

j. Undertaker (l.1)

k. Commercial vehicle and equipment storage as an accessory use (J.12)

The following activities shall not be permitted in the association with any use:

a. Bulk storage of chemicals

b. Bulk storage of petroleum products or hazardous materials.

804.4 LOT, LOCATION AND OTHER REQUIREMENTS FOR A SITE PLAN IN A LAKE PROTECTION OVERLAY ZONE

SITE PLAN REQUIREMENTS: All development activities, including new or expanded septic system installation, within the Lake Protection Overlay Zone shall require submission and approval of a Site Plan meeting the following lot and location requirements of the underlying zone.

a. Principle buildings shall be located a minimum of 75’ from the lakeshore reference line as defined herein.

b. Accessory buildings or structure shall be located a minimum of 75’ form the lakeshore reference line as defined herein, except as permitted subject to the requirements of Section 423.2b.

c. For the portion of any lot in the Lake Protection Overlay Zone the total coverage by impervious surfaces including building footprint, roads, driveways or other impervious cover shall not exceed 10% of said area.

d. Leaching fields and septic systems, septic – leach field systems for new construction shall not be within 150 feet of the reference line except where the applicant can demonstrate there is no other feasible location on the lot and the septic location has been approved by the Inland Wetland Commission.

The requirements of this subsection shall not apply to repairs or replacements to an existing septic system – leaching field located within a Lake Protection Overlay Zone.

New septic – leaching field systems shall not be permitted in areas of the Overlay Zone where there is less than 4 feet of naturally occurring soil.

e. The Site Plan shall demonstrate that within the Overlay Zone natural vegetation has been retained, protected or supplemented, wherever practical. Where stripping of vegetation is necessary measures shall be taken to minimize soil erosion and appropriate control measures shall be installed prior to removal of vegetation.

f. The Site Plan and erosion and sediment control plan shall show that any sediment from the project will not impact the lake and the area and duration of soil disturbance has been kept to a minimum.

g. Trapped sediment and other disturbed areas shall be permanently stabilized within two weeks of the completion of a project. The Zoning Administrator may require that any disturbed areas associated with a project that remains idle for more than two weeks be permanently stabilized and shall require immediate correction and enforcement of any site in violation of the erosion and sediment control plan.

h. The Site Plan shall demonstrate that the site design protects natural drainage system including streams, wetlands, swales and drainage ditches.

i. Buildings located in the Overlay Zone shall be:

- Fitted to the natural topography to avoid extensive grading that would alter drainage patterns or create steep slopes, and
- Located to minimize the potential for erosion and to maintain existing vegetation

EXAMPLES: Buildings located on a slope should be sited with the long dimensions of the building parallel to the slope, with one wall buried into the slope and multiple levels should be considered to reduce the amount of the grading required.

j. New public roads or streets shall not be permitted within the Lake Protection Overlay Zone.

k. Wherever possible driveways in the Overlay Zone should be laid out parallel to the natural slope winding up on a hill rather than perpendicular to the hill.

Crafting a Lake Protection Ordinance

by Karen Cappiella and Tom Schueler

Introduction

Lake protection ordinances are an essential tool for protecting the quality of the 41 million acres of lakes and reservoirs in the United States that are under increasing development pressure. This article describes how to craft an ordinance to protect and maintain the quality of lakes from the pressures of both shoreline and watershed development. An effective lake protection ordinance extends over four major zones: the actual shoreline, a forested buffer extending landward, a shoreland protection area that extends further, and finally, a watershed-wide zone used to control pollutant loadings to the lake or reservoir as a whole.

A lake protection ordinance (LPO) is particularly critical around urban lakes, to guide how and where new development will occur. Historically, there has been limited guidance on how to craft an effective LPO that protects lake resources, maintains the quality of the recreational experience, and accommodates the property rights of landowners. Traditionally, most LPOs have primarily focused on a relatively narrow ring of land around the shoreline where development is most visible. However, given that lakes are so strongly influenced by runoff from their watersheds, they often need to be managed from a watershed perspective.

Key Factors to Consider in Lake Protection

Techniques for protecting lakes are markedly different from those used to protect streams. A watershed manager must account for nine factors that are unique to the ecology of lakes and the nature of development that occurs around them:

Shoreline development is a unique form of development.

Lake shorelines are a valuable piece of real estate, and command premium land prices. Purchasers often use these lots to build summer homes or cottages, and seek both good access to the water and an unobstructed view of the lake. Consequently, individual homes are oriented toward the lake. Over time, a ring of development is formed around the lake, with the greatest density of homes within 500 feet of the lake, and less density further away (Figure 1).

Lake shorelines also tend to be developed incrementally over time. It is rare that the lakefront is developed as a single subdivision (which would be much easier to regulate). Rather, shoreline development often happens on a "lot-by-lot" basis, whereby individual lakefront lots are sold and subdivided to build second homes or cottages, often on a custom basis. In addition, each home and its accessory structures tend to be continuously "improved" or expanded by successive owners, to meet their changing tastes and recreational needs. Consequently, an LPO should be written to provide continuous regulation of the shoreline development process.

Techniques for protecting lakes are markedly different from those used to protect streams.

Since lakefront property is so desirable, it is quite common to have intense lakefront development in otherwise lightly developed watersheds. This presents a real challenge for protecting lakes in rural areas, since these communities typically have limited staff and development review experience.

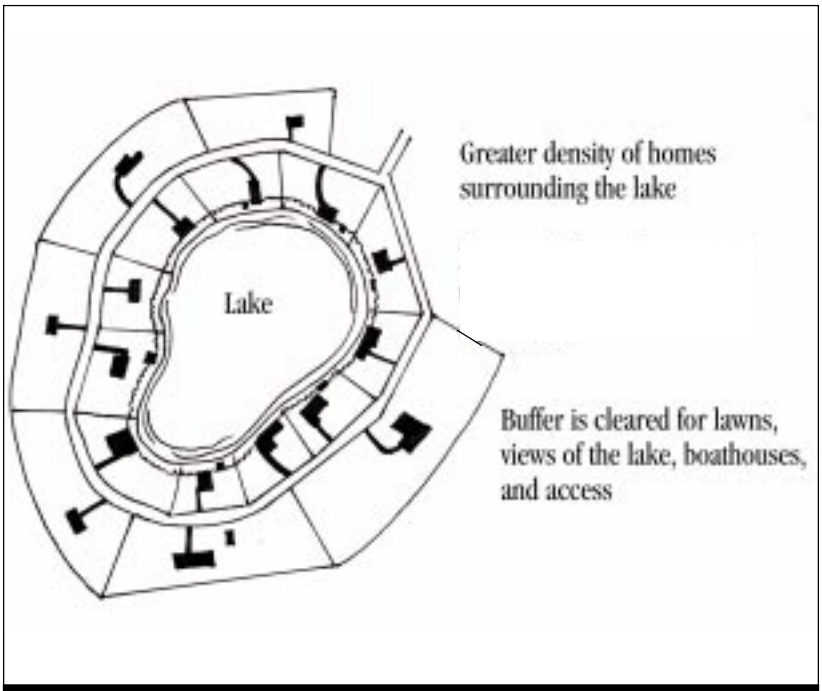


Figure 1. Typical Development Pattern Around a Lake

Lake protection focuses on phosphorus reduction.

An explicit goal of many LPOs is to maintain the trophic state of the lake, which usually means preventing or reducing phosphorus inputs. Most lakes are extremely sensitive to additional phosphorus inputs from future waterfront or watershed development. Consequently, the overall development density in these watersheds should generally be very low.

Lake managers have several tools to reduce phosphorus inputs from new development in a lake watershed. They include limits on the total amount of new development, shoreline and stream buffers, and the use of stormwater treatment practices designed to remove phosphorus from stormwater runoff. In practice, most managers elect to use all of these tools, and to apply them across the entire watershed draining to the lake. In particular, stormwater treatment practices are often designed to achieve a specific target for phosphorus removal. The LPO often provides very specific instructions to engineers on which stormwater treatment practices to use, how much runoff they need to treat, and how they should be designed to promote greater phosphorus removal. A handful of communities have adopted stormwater performance criteria that call for no increase in phosphorus loading from new development sites (MDEP, 1992; Kitchell, this issue).

Shoreline buffers can be justified based on a common economic interest as much as an environmental one.

Importance of a natural shoreline.

The natural beauty of a lake's shoreline, with its ever-changing panorama of water, light and wildlife, is a prime attraction for lakefront development. Lake property owners as well as lake users consistently report that their primary use of the lake or reason for visiting is to view the scenery (Warbach *et al.*, 1990; Anderson *et al*., 1998). This is why lakefront properties nearly always command a considerable premium in terms of land prices. To the extent that a LPO will preserve the natural look of the shorelines, they can maintain or enhance the value of property (CBP, 1998). In one Maine case study, increased water clarity due to the addition of lake buffers increased property values by $11 to $200 per foot of shoreline property (Michael *et al.*, 1996). Consequently, shoreline buffers can be justified based on a common economic interest as much as an environmental one.

Direct influence of shoreline vegetation on fish and wildlife.

Natural shoreline vegetation has a direct influence on the ecological integrity of a lake, as it provides shade, leaf litter, woody debris, protection from erosion, and littoral habitat. These benefits are extensively reviewed in Engel and Pederson (1998), and selected research is profiled in Table 1.

Studies in a variety of lake settings have demonstrated a strong relationship between declining fish abundance or diversity and increasing shoreline development, as measured by several indices (Hinch and Collins, 1993; Hinch *et al*., 1994; Bryan and Scarnecchia, 1992; Chick and McIvor, 1994). Fish foraging and spawning have also been shown to decline as a direct function of cottage or home density around the lakeshore (Engel and Pederson, 1998). Most fish species spend at least part of their lifecycle in the littoral zone of the shoreline. Emergent and submergent plants and coarse woody debris are critical habitat elements in the littoral zone, and each of these is highly vulnerable to shoreline development (Christensen *et al*., 1995).

Many birds, such as eagles, loons and songbirds, tend to avoid developed lakes, and several researchers have noted that they depart at a relatively low rate of cottage development (Johnson and Brown, 1990; Voight and Broadfoot, 1995; Heimberger *et al.*, 1983). In some cases, the avoidance is due to a loss of nesting sites or perches to spot prey, while in others it reflects a lack of tolerance for noise or disturbance within or along the lakeshore. In contrast, some bird species favor a densely developed shoreline, such as mallards, geese and gulls.

Similar relationships have been discovered for amphibians and reptiles, which utilize the lakeshore to bask, feed, nest and overwinter (Engel and Pederson, 1998). Natural lakeshore habitat has also been found to be important for deer and other mammals (Buehler *et al*., 1991). Conversely, many species suffer from increased predation and harassment by pets along more developed shorelines.

Intense pressures for shoreline improvement and clearing.

A lake shoreline is unique in that it remains under continuous pressure for shoreline "improvements" well after the initial development has been completed. Many lakefront property owners install docks, piers, stairs, gazebos, boathouses, boat ramps, bulkheads and other structures on or near the shoreline. At the same time, the forest buffer is under relentless pressure to be converted into a tidier lawn or an unobstructed view.

Figures 2 and 3 are examples of shoreline lots with unregulated and regulated "improvements."

While the individual effect of each of these improvements is relatively minor, their cumulative impact on the integrity and attractiveness of a shoreline buffer can be severe. For example, a survey of users in a Minnesota lake found that a majority of the respondents felt that multiple shoreline structures and lawns had a negative impact on the lake (Warbach *et al.*, 1990).

When a person is on a lake, he wants to see a natural shoreline. Yet, when the same person is on the shore, he wants to see a lake. This can create a lot of pressure on the buffer, as property owners clear trees and remove vegetation to promote a better view of the lake. However, one individual's quest for a better view of the lake diminishes the quality of the view for another. Thus, all property owners share a common interest in limiting clearing along the shoreline to screen their neighbors, while still getting at least a decent glimpse of the lake themselves. Consequently, an LPO needs to carefully prescribe how and where view corridors can be created, and include realistic measures to inform land owners on what uses, structures and activities are restricted or prohibited in the shoreline buffer zone.

Recreational issues are paramount management concern.

Lakes that are actively used for fishing, boating, swimming and other forms of recreation require direct access to the shoreline and across the buffer. While some lakes do have public access and central facilities (such as boat ramps, swimming beaches, etc.), many do not. In these lakes, each waterfront owner creates his or her own recreational access. This can create an inherent conflict between the property owners and outside users of the lakes. Therefore, although the shoreline buffer usually remains in private ownership, it is important to address issues of both public and private recreational access in an LPO.

Table 1. Recent Research Documenting Ecological Benefits of Shoreline Buffers

Key Finding	Reference	Location
Coarse woody debris positively correlated with riparian tree density and negatively correlated with lakeshore cabin density	Christensen *et al.*, 1996	17 north temperate lakes in northern Wisconsin and the Upper Peninsula of Michigan
Less fish activity, less fish feeding, and increased wave disturbance in fringe zones adjacent to lawns versus undeveloped shorelines	Collins *et al.*, no date	2 sites on Lake Rosseau, Ontario, an oligotrophic lake
Increase in development and decrease in vegetative cover is correlated with decrease in lakeside populations of white-tailed deer	Voight and Broadfoot, 1995	Lake Muskoka, Ontario
Increase in development and decrease in vegetative cover is correlated with decrease in shoreline populations of nesting bald eagles	Buehler *et al.*, 1991	Chesapeake Bay Shorelines
Increase in development and decrease in vegetative cover is correlated with decrease in lakeside populations of loons	Heimberger *et al.*, 1983	Northern Ontario lake
Increase in development and decrease in vegetative cover is correlated with decrease in lakeside populations of songbirds	Johnson and Brown, 1990	Eastern Maine lake
Species richness and abundance of fish were greater along undeveloped shorelines versus developed shorelines in nearshore and intermediate depth zones	Bryan and Scarnecchia, 1992	Spirit Lake, Iowa 2266 hectare glacial lake
Decrease in plant cover from human activity is correlated with a decrease in fish abundance	Chick and McIvor, 1994	Lake Okeechobee, Florida
Decrease in plant cover from human activity is correlated with a decrease in fish abundance	Hinch and Collins, 1993	Ontario

Figure 2. Typical Shoreline With Unregulated "Improvements" (PZC, 1992)

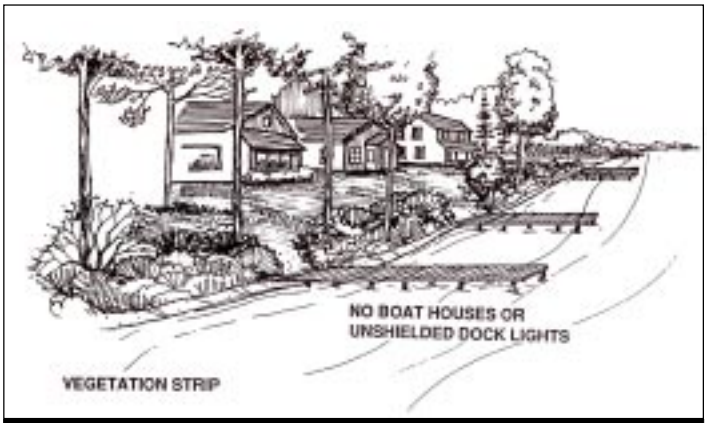


Figure 3. A Shoreline With Limited "Improvements" Is More Attractive and Ecologically Beneficial (PZC, 1992)

Recreational conflicts are not only confined to the shoreline buffer, but often extend into the lake itself. A recurring conflict involves whether or not motorized water craft will be allowed on the lake, either because of concerns over noise, safety, wakes or potential pollutant sources. Many water utilities restrict or prohibit motorized watercraft on water supply lakes, since two-stroke engines can be a significant source of hydrocarbons, lead and phosphorus to the lake. In recent years, conflicts have erupted over the noise, wakes and safety of personal watercraft, such as jet skis. Figure 4 is an example of how conflicts over lake recreational use can be managed by designating specific areas of the lake to each activity. Consequently, residents or local agencies may want to address these issues as part of the LPO or a lake management plan.

Prominence of septic systems.

Lakefront developments are often serviced by septic systems because of their seasonal use or distance from wastewater treatment plants. Because of their proximity to the lake, septic systems can become a potential source of subsurface phosphorus seepage to a lake. Indeed, many researchers have identified failing or poorly functioning waterfront septic systems as an important and controllable source of phosphorus and nitrogen in a wide range of lake systems (Harper, 1995; Childs *et al*., 1974; Gilliam and Patmont, 1983; Grant, no date; Kerfoot and Skinner, 1981; Robertson and Harman, 1999; and Arnade, 1999). One of the primary functions of the shoreline buffer is to create distance from the leach field and the shoreline, thereby providing as much soil treatment as possible in such a confined area. Watershed-wide septic system regulations may also be a key element of an LPO, particularly in watersheds that have potentially high septic system density or unsuitable soils. More information about septic system impacts on lakes can be found in Swann (this issue).

Lake associations available for enforcement or education.

The lake and its shorelines are a classic case example of the "commons," where the actions of one user or owner can diminish the quality of life for another. Often lakefront property owners recognize that they share a common interest in some form of self-regulation. This has led to the formation of hundreds of lake associations across the country to promote better local lake management. In many lakes, these associations are similar to homeowners associations, in that they are self-governing and self-financing. As such, a lake association can play a pivotal role in education and enforcement of the LPO, through legally binding covenants on individual properties. The North American Lake Management Society (NALMS) has excellent materials on its website on how to establish a new lake management association or energize an older one (www.nalms.org). Lake associations are particularly valuable in educating shoreline landowners about LPO provisions that directly affect them.

Lake protection ordinances must be customized for unique lake conditions and water quality goals.

While this article presents an overall framework for crafting an LPO, it is important to keep in mind that the actual details of each ordinance will differ for every lake. For example, more stringent criteria are often applied to lakes that are a primary water supply, as compared to a reservoir used for recreation or flood control. Similarly, managers will usually adopt more stringent criteria in order to maintain the character of a phosphorus-sensitive lake in a wilderness setting, as compared to a highly eutrophic lake in a more urban setting. In some lakes, the LPO is primarily used to regulate competing recreational or shoreline interests, while others may be driven more by the need to reduce phosphorus loads.

In nearly all lakes, the ability to achieve management goals for a lake is heavily influenced by the amount and type of prior development along the shoreline or within the watershed. Thus, lake managers should engage both lake users and watershed residents to set realistic goals for lake protection very early in the ordinance process. In addition, communities that have many lakes and reservoirs may want to classify them in order to manage them better. An example is the state of Minnesota's lake classification system shown in Table 2.

Table 2. Example of Lake Classification System (Bernthal and Jones, 1998)

Lake Class	acres water per shoreline mile	# homes per shoreline mile	lake depth
Natural Environment	< 60	< 3	<15 feet
Recreational Development	60 - 225	3 - 25	> 15 feet
General Development	> 225	> 25	> 15 feet

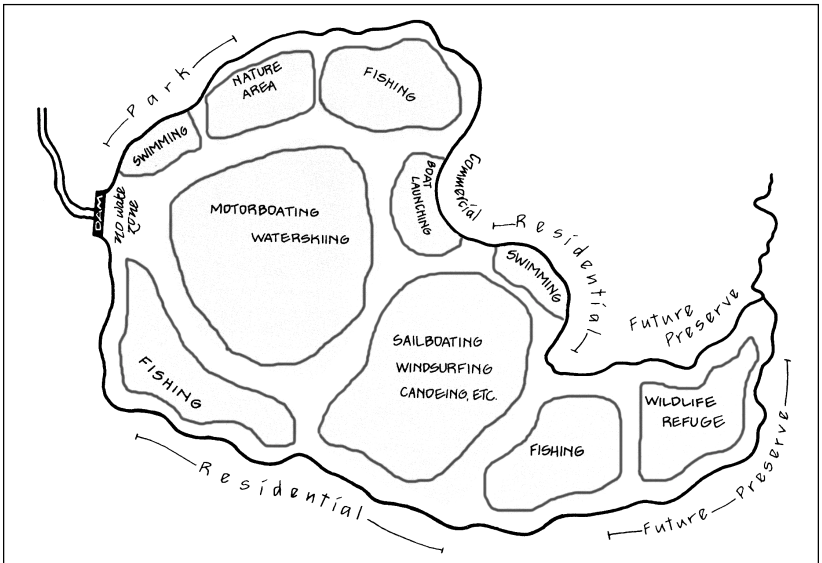


Figure 4. A Lake Use Plan Can Resolve Conflict Over Recreational Use (NIPC, 1995)

The Four Zones of Lake Protection

The four primary zones of lake protection are the shoreline, shoreline buffer, shoreland protection area, and the lake's contributing watershed (see Figure 5). The development criteria within each of the four zones are often different and include the following:

1. Zone geometry
2. Vegetative target
3. Allowable uses
4. Restricted uses
5. Septic system siting
6. Stormwater treatment practice design
7. Residential lot design requirements
8. Zoning
9. Enforcement
10. Education

The key development criteria for the four zones of an LPO are compared in a condensed fashion in Table 3.

In general, the four-zone approach to lake protection is most restrictive at the shoreline, and is more flexible as one progresses further up into the watershed. Greater detail on the key criteria for a lake protection ordinance is provided in the following pages.

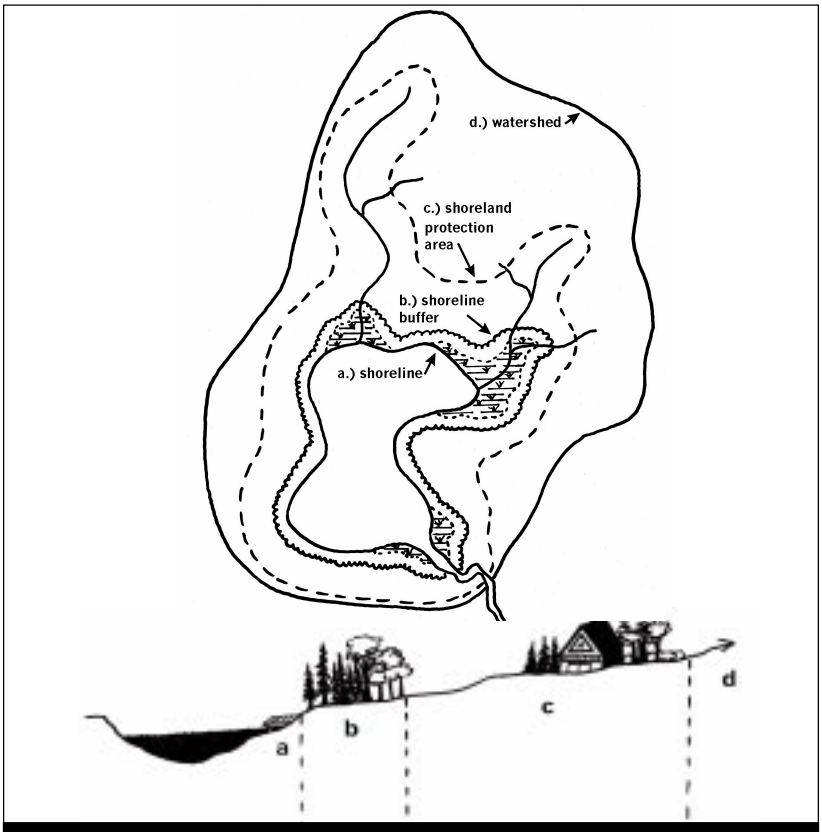


Figure 5. The Four Zones of Lake Protection

Zone 1: Shoreline

The shoreline begins as the point where the mean high water mark meets the land. Given the importance of the shoreline to lake ecology and screening, it is essential that this zone be retained in a natural state, with minimal disturbance of native vegetation. A common approach to manage the shoreline is to require shoreline permits for any activity that modifies, alters, clears or otherwise disturbs the natural shoreline. Permits, which can be required by a local or state agency, place limits on tree clearing, bulkheading and riprapping. Exceptions may be granted to clear small

areas for allowable uses, as defined later. The permit process should require the applicant to demonstrate that natural methods of shoreline stabilization, such as bioengineering, are not feasible before retaining walls, riprap or bulkheads are allowed to stabilize the shoreline. Some communities may also specify low or no wake areas, set boat speed limits and exclude motorized watercraft in their LPOs in order to prevent shoreline erosion (Standing *et al*., 1997).

Allowable Uses

Most communities allow minor alterations along the shoreline to provide reasonable access and recreational use. For example, most typically allow only one pier or dock on each frontage lot, along with a limitation on its total length and extension into the lake (50 feet is common; Standing *et al*., 1997). This provision prevents the proliferation of docks from detracting from the scenic character of the natural shoreline. Most communities also permit a single stairway or ramp down to the water, but may restrict its

Table 3. Development Criteria for the Four Zones of an LPO

Criteria:	Shoreline	Shoreline Buffer	Shoreland Protection Area	Watershed
Defined as:	high water mark (HWM)	50 to 150 feet from HWM, 300 feet for source water	250 to 1000 feet from HWM	divide of contributing watershed
Vegetation target for the zone	maintain natural shoreline, no disturbance without permit	forest or native vegetation, maximum view corridor of 30 feet	maximum clearing limits on individual lots of 25 to 50%	forested buffers for tributary streams
Allowable Uses	Bioengineering, 1 pier or dock per frontage, 1 stairway	walkways, boathouses within the view corridor	residential homes, septic systems	most are allowed
Restricted Uses	boathouses and other accessory structures, rip rap, bulkheads	no permanent structures, no impervious cover or other land disturbing activity	commercial or industrial zones, uses with hazmat spill risk	uses with hazmat spill risk
Septic Systems	n/a	not allowed	setback 100 to 200 feet from HWM	design, feasibility or inspection criteria to reduce failure
Stormwater	no new pipe outfalls to lake	no stormwater practices allowed (except for practices at boat launching)	presumed to be achieved by environmentally sensitive site design	stormwater treatment practices required to remove target phosphorus levels
Lot Requirements	n/a	n/a	minimum lot size, minimum frontage, max impervious cover, limit rooftop runoff	open space subdivisions and better site design to reduce impervious cover
Zoning	establish requirements and density in a lake protection overlay district or a comprehensive plan			
Enforcement	local or state permit	local development review process		
Education	lake association and/or resource agency			lake association or watershed organization

width to six feet or less. Normally, pre-existing structures are exempted from the shoreline permit process, but they may not be significantly expanded without one (Bernthal and Jones, 1998).

Restricted Uses

Many communities prohibit tree clearing or grading along the shoreline, although individual trees can be removed for safety purposes. Boathouses and other accessory structures are generally prohibited within the narrow shoreline zone. In addition, no new stormwater outfalls should be allowed that discharge to the shoreline.

Zone 2: Shoreline Buffer

When natural shoreline buffers are maintained, they protect the integrity of the shoreline, provide habitat for wildlife and fish, reduce the likelihood of erosion, and help to reduce runoff and pollutant loads (Engel and Pederson, 1998; Wenger, 1999; Fuller, 1995). In addition, natural shoreline buffers support the aesthetic and recreational values that make lakefront development so desirable and economically attractive. Natural shoreline buffers also protect the physical and ecological integrity of lakes by providing shade, leaf litter, woody debris, erosion protection, and habitat.

A common base width for a shoreline buffer is 75 feet (Heraty, 1993), although widths typically range from 50 to 150 feet. If a lake is used as a source of drinking water or is very pristine, buffer widths of 200 to 300 feet are often used (RICRMC, 1994; Standing *et al*., 1997; Kitchell, this issue). The base width of a shoreline buffer should be expanded to include steep slopes or wetlands, or contracted when pre-existing development is located close to the shoreline. Some communities set the base width of the shoreline buffer based on the surface area of the individual lake, and require wider buffers around their larger lakes. Most communities now clearly prescribe how the buffer will be delineated within the LPO. For natural lakes, the natural mean high water level is a good benchmark, whereas the water line at "full pond" is often used for reservoirs.

Vegetation Management

The vegetative target for the shoreline buffer is mature forest or native vegetation. This may involve actively re-vegetating areas or letting them gradually return to their natural state. Depending on the region, the natural state will not always be a forest. The use of native plants within the buffer usually requires less maintenance, and these plants are easier to establish. Some communities set specific restoration goals for the shoreline buffer. For example, New Hampshire requires that a plan be submitted that describes the species, number, and basal area of trees proposed for replanting a natural woodland buffer (Springs, 1999).

Tree clearing for view corridors or access trails is inevitable, so many LPOs do allow for some clearing, or have guidelines for thinning or removing of dead trees. For example, Rhode Island Coastal Zone Buffer Program and Maine Shoreland Protection Standards indicate that shoreline access paths can be no more than six feet wide and follow a winding path that does not promote erosion (see Figure 6).

In addition, clearing for a view corridor is generally limited to no more than 25% of the length of the shoreline for residential lots of two acres or less (RICRMC, 1994). Other communities have opted for a more operational criteria, allowing a single view corridor per lot, and no opening greater than 250 square feet in the forest canopy

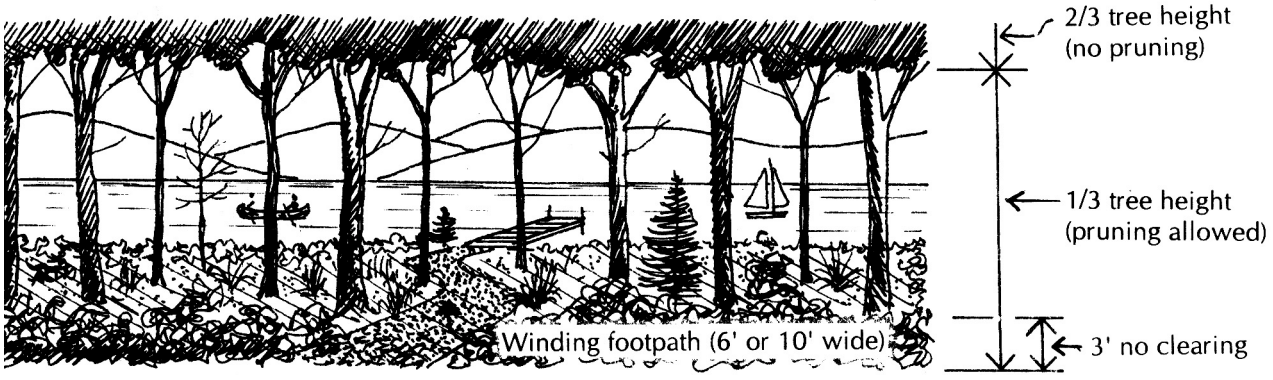


Figure 6. Example of Guidelines for Vegetation Thinning in the Shoreline Buffer for View Corridors and Footpaths (Illustration by Brian Kent)

as measured from the outer limits of the tree crown (MDEP, 1999). Still others allow clearing of no more than 40% of the basal area of trees within 100 feet of the shoreline (Bernthal and Jones, 1998).

Allowable Uses

Allowable uses in the shoreline buffer should be limited to clearing for shoreline access paths and view corridors. Many communities also permit trails and passive recreation within the buffer zone. In addition, boathouses and other accessory structures may be allowed within the buffer, but must be set back at least 25 feet from the shoreline. Some shoreline zoning ordinances also place limits on the number and square foot area of boathouses and other structures (Bernthal and Jones, 1998). An exemption is usually provided for public recreation facilities such as boat ramps and public beaches. Careful planning is needed to develop public facilities in a manner that minimizes clearing of the shoreline. In some cases, stormwater practices such as perimeter sand filters can be installed to treat direct runoff from boat ramps and associated parking lots.

The LPO should specify who is responsible for enforcing and maintaining the shoreline buffer.

Restricted Uses

Many land uses and activities are restricted or excluded from the shoreline buffer zone. These include paved surfaces, primary structures, grading, pesticide application, mowing, motorized vehicles, or any other activity that causes soil disturbance or contributes to pollution. In addition, septic tanks and drain fields are excluded from the shoreline buffer, and often must be set back an even greater distance into the shoreland protection zone.

Stormwater Treatment

The natural vegetation of the shoreline buffer acts to slow down and spread out runoff and promotes infiltration in the soil, thereby reducing the need to treat the quality of stormwater runoff. In this sense, the natural shoreline buffer is the last line of defense for treating stormwater. More importantly, stormwater treatment practices designed to treat stormwater from upland sources should not be located within the buffer. Many communities also prescribe that no new pipes or channels be constructed to convey stormwater across the shoreline buffer (i.e., sheetflow conditions must be maintained).

Enforcement and Education

The LPO should specify who is responsible for enforcing and managing the shoreline buffer during and after construction. A lake association can be a good candidate to perform this role, since the shoreline buffer often falls within the boundaries of most lake associations. In addition, lake associations may have the authority to extend covenants from their members to establish shoreline buffers on existing waterfront lots that otherwise might be grandfathered. The North American Lake Management Society publishes several useful lake management references (www.nalms.org). The Terrene Institute also publishes *The Lake Pocket Book* as a useful guide.

Regardless of whether the shoreline buffer is enforced by a lake association or a local agency, it is important that the LPO contain provisions to notify owners and contractors about the boundaries and restrictions of the buffer. Some useful techniques include marking buffer boundaries with permanent signs that describe allowable uses; clearly delimiting the buffer boundaries on all construction plans, maps, deeds and property surveys; and verifying that new owners are fully informed about uses/limits when waterfront property is sold.

The LPO should contain a series of progressively tougher enforcement actions for owners and contractors who violate the provisions of the buffer, beginning with a notice of violation with time to correct. If these administrative remedies fail, then fines, property liens, stop work orders, restoration liability and other sanctions should be available.

Enforcement measures can and will create needless conflict with many waterfront owners if they are not accompanied by strong and continuous programs to educate residents about the value of shoreline buffers, and the limits that they impose on their land. Lake managers should strive to reach every landowner with a mailing, meeting or visit to ensure they understand the rules. The enforcement agency can directly educate owners during annual buffer walks to check on encroachment, and provide information on how residents can become better stewards through reforestation and shoreline bufferscaping programs. Lake managers should strive to integrate buffer education with other water quality and recreation messages they want to deliver, whether they are boating or fishing regulations, septic system cleanouts or lake management issues. Waterfront owners may also want to know about techniques to slow the spread of invasive species such as zebra mussels and Eurasian water milfoil, which are an increasing problem in many lakes (Klessig *et al.*, 1993). Techniques to prevent the spread of invasive species may include boat cleaning or boat pumpout facilities at centralized locations.

Zone 3: Shoreland Protection Area

The shoreland protection area extends beyond the shoreline buffer and is primarily intended to regulate the geometry and nature of development on lots adjacent to a lake. In a way, the shoreland protection area is a special overlay zone for residential development, and includes various setbacks, impervious cover limits and forest conservation requirements.

The width for a shoreland protection area typically ranges from 250 to 1,000 feet, as measured from the shoreline. The state of Minnesota has a similar zone where shoreland standards apply to all land within 1,000 feet of the lake (ILCC, 1996). The actual width depends on the underlying lot size or zoning category in the area. In general, as lot size increases, the width of the shoreland protection area increases. At a minimum, the shoreland protection area should extend at least two lot lengths outward from the lake. Often, the exact boundaries of the shoreland protection area are expanded to account for bluffs, wetlands, steep slopes, erodible soils, or other sensitive natural features around the lake.

Vegetation

Since development will occur in the shoreland protection area, vegetative targets are much less restrictive than along the shoreline or in the shoreline buffer zones. Maximum clearing limits are imposed in this zone to keep the building footprints as small as possible and conserve natural areas. A typical example is prescribed under the Maine Shoreland Zoning guidelines, which limit clearing during construction to no more than 25% of total lot area or 10,000 square feet, whichever is less (MDEP, 1999, see Figure 7). In Waupaca County, Wisconsin, no more than 50% of each shoreland lot or 25,000 square feet, whichever is less, may be disturbed for residential or commercial construction (Standing *et al.*, 1997).

Restricted Uses

A primary reason for establishing the shoreland protection area as a zoning district is to exclude or set back uses or activities that have the potential to degrade the water quality of the lake or detract from its scenic character. Consequently, a long list of uses and activities are often excluded from the shoreland protection area.

Examples of land uses that are frequently considered to be non-conforming include livestock operations; facilities that generate, store or dispose of hazardous materials; landfills; junkyards; surface discharges from sewage treatment plants; golf courses (unless they have an approved integrated pest management plan); above or below ground storage tanks; stormwater hotspots (MDE, 2000); and non-residential roads.

In addition, most communities consider the shoreland protection area to be an exclusively residential zone, with exceptions for water-dependent operations (such as boat launching areas, private campgrounds, and the like). Consequently, industrial, commercial, or institutional developments are often excluded from this zone, particularly if the lake is a primary drinking water supply.

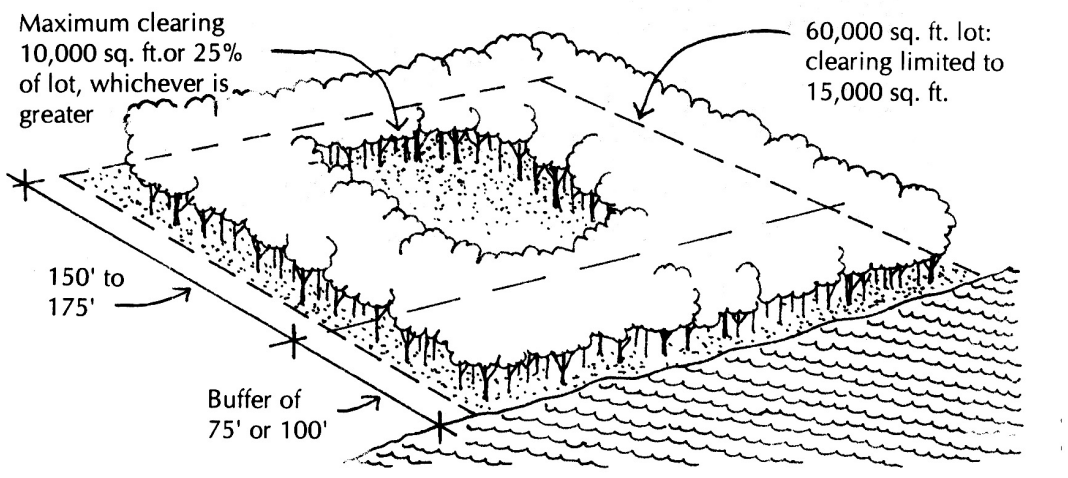


Figure 7. An Example of Limits on Clearing for a Shoreline Lot (Illustration by Brian Kent)

Shoreland protection areas frequently require setbacks, the most common being a 100 to 200 foot setback for septic tanks and drain fields, as measured from the shoreline. From a practical standpoint, this means that septic systems need to be located well beyond the outward boundary of the shoreline buffer. Figure 8 illustrates this concept.

Setbacks for septic systems may vary depending on the lake's use and watershed characteristics. For example, the state of Virginia requires a 100 foot septic system setback from a stream; New Hampshire requires a 125 foot septic system setback for areas with porous soils; the New York City reservoir system has a 300 foot setback for absorption fields, and a 500 foot setback for septic systems; and the state of Maine prohibits septic systems in Resource Protection Districts (CWP, 1995a; Spring, 1999; NRC, 2000; MDEP, 1999).

It is very difficult to effectively treat the quality of stormwater runoff within the shoreland protection area with conventional stormwater practices.

A few LPOs regulate the use of fertilizer or pesticides in the shoreland protection area. For example, the New Hampshire Comprehensive Shoreline Protection Act limits the use of any fertilizer in protected areas, and limits fertilizer use outside these areas to low phosphate, slow release nitrogen fertilizer or limestone (Springs, 1999). In other watersheds, the use of pesticides is prohibited in this zone. For example, the herbicide atrazine may not be applied within 200 feet of natural lakes or reservoirs in the New York City reservoir watersheds (NRC, 2000). While these restrictions are admirable from an environmental standpoint, they are often difficult or impossible to enforce with individual property owners.

Environmentally-Sensitive Shoreland Design

In practice, it is very difficult to effectively treat the quality of stormwater runoff generated by development within the shoreland protection area with conventional stormwater practices such as ponds, wetlands, or filters. Constraints such as the proximity to the lake, small drainage area, poor conveyance and the need to stay out of the shoreline buffer make it a major challenge to engineer treatment practices in the zone. Therefore, the stormwater strategy in the shoreland protection area is to minimize the creation and concentration of stormwater runoff through environmentally sensitive shoreland development techniques. These development techniques include site fingerprinting, impervious cover limits, minimum lot sizes and natural conveyance. As a practical matter, then, stormwater treatment is achieved through site design requirements within the shoreland protection area. Lots that meet the design requirements are presumed to automatically comply with any stormwater requirements. Figure 9 illustrates how environmentally sensitive shoreland design can be applied in a typical lakefront residential lot.

Environmentally sensitive shoreland design techniques for residential lots include the following:

Minimum Lot Sizes and Minimum Shoreline Frontages

Since the shoreline is a finite resource, many communities have sought to limit the intensity of lakefront development through minimum lot sizes and shoreline frontage distances. Minimum lot sizes tend to range from slightly less than one acre to five acres or more. For Maine lakes, minimum lot size for residential development in the shoreland zone is 60,000 square feet, with a corresponding minimum shoreline frontage of 300 feet (MDEP, 1999), while Minnesota lots adjacent to Natural Environment lakes have a minimum lot size of 80,000 square feet (Bernthal and Jones, 1998). Once again, lakes or reservoirs that are a primary source of drinking water or undeveloped lakes that are being protected because of their natural beauty tend to use very large lot zoning typically greater than five acres (Standing, 1997; Kitchell, 2001, this issue).

A Maximum Limit for Impervious Cover on the Lot

The LPO often specifies a maximum amount of imperviousness for the shoreland zone. We generally recommend a 10 to 15% as an impervious cover limit

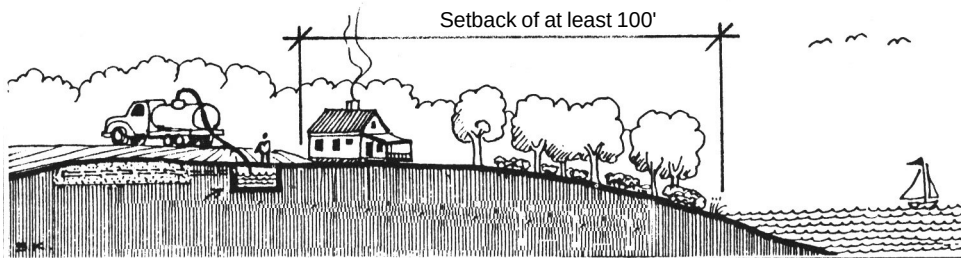


Figure 8. A Septic System Setback in Relation to the Shoreline Buffer (Illustration by Brian Kent)

for residential lots in the shoreland protection area. However, this percentage can vary depending on land use, lot size, and the desired level of development around a lake. For example, Shawano County, Wisconsin has a limit of 8% impervious cover on lots within 300 feet of the lake's ordinary high water mark (Standing, 1997), while the state of New Hampshire has a 20% impervious cover limit for alternative developments such as PUDs, which incorporate residential and commercial areas in a planned community (Bernthal and Jones, 1998).

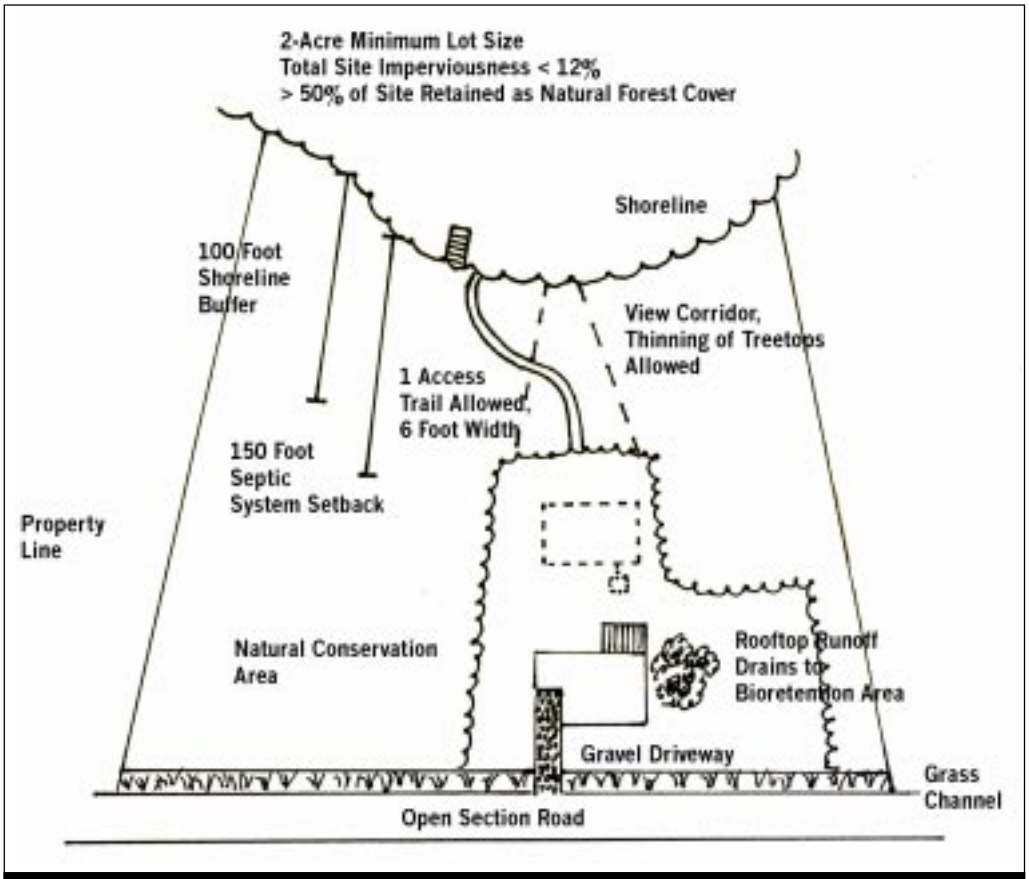


Figure 9. Example of Environmentally Sensitive Design for a Residential Shoreline Lot

Site Fingerprinting

Many communities specify that a minimum fraction of the lot be conserved in natural cover, and mandate that the lot cannot be cleared or otherwise disturbed during site construction, nor converted to lawn afterwards. Normally, area that must be conserved includes the shoreline buffer and additional areas within the shoreland protection area. For the lot as a whole, the target for natural cover conservation will vary according to zoning category, but typically ranges 40 from 75%. Figures 10 and 11 contrast conventional and alternative techniques for clearing a site for development.

Grading Limits

Any grading at the site should promote sheetflow, and avoid concentrating runoff. Often, driveways comprise much of the grading in the shoreland protection zone. In this respect, driveways should be graded to follow contours and avoid the need for ditches. Otherwise, driveways should be constructed of more permeable material, such as river rock, blue stone, gravel or grass pavers. If the lot has a slope greater than 10%, or is less than one acre in size, berms, depressions or terraces may be required to capture runoff and encourage infiltration at the outer boundary of the shoreline buffer.

Rooftop Disconnection

Residential rooftop runoff can be easily disconnected and conveyed as sheetflow across vegetated areas or into the buffer. In practical terms, this means that downspouts should not be connected to any conveyance system. If soils are not suitable, then dry wells, french drains or rain barrels can be used to store rooftop runoff. Figure 12 illustrates how to use a rain barrel to store rooftop runoff.

Limitations on Back Lot Development

Lake managers constantly struggle with the issue of backlot development, which drives up the overall density of shoreline development. Backlot development allows off-water lots to share a narrow strip of waterfront land that provides access to the water. This often results in over-development of the lakeshore to accommodate docks and access points for a large number of people. Several zoning techniques can limit backlot development. First, zoning regulations can prohibit the development of shore lots with more than one owner or establish limits on the number of off-water lots served by one access lot (Standing, 1997). Alternatively, minimum lot sizes can be established for off-water lots by extending the width of the shoreland protection area further from the lake. Figure 13 illustrates the backlot or "keyhole" development concept.

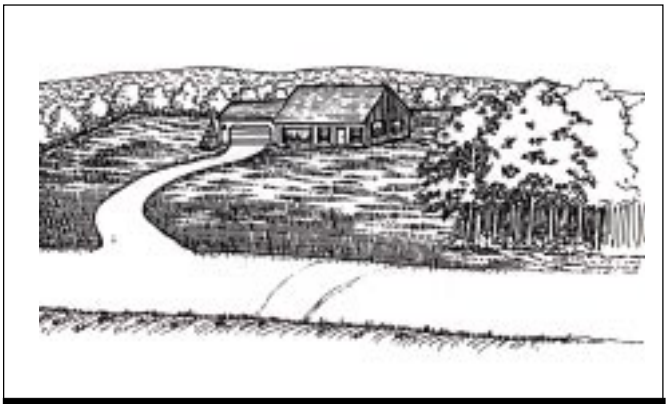


Figure 10. Conventional Clearing and Grading Techniques Leave the Majority of This Residential Lot Bare (PZC, 1992)

Figure 11. Site Fingerprinting Was Used on This Residential Lot to Reduce Clearing and Preserve Trees (PZC, 1992)

Zone 4: Watershed

Establishing shoreline buffer zones may not always be enough to protect a lake from the impact of land development, particularly if it is sensitive to increased phosphorus inputs. If significant land development is expected in a lake watershed, the LPO must be designed to create a fourth management zone that encompasses the watershed as a whole.

From a watershed perspective, it may be necessary to control all sources of phosphorus to the lake in order to meet water quality goals. In this case, the LPO should define how and where the eight tools of watershed protection should be applied (CWP, 1998). Often, this may require a watershed plan that estimates current and future impervious cover, and investigates major (and controllable) phosphorus sources. Still, some generalizations can be made on how the eight tools can be applied to protect lakes, as discussed in the following paragraphs.

Watershed Zoning/Land Use Planning

Given the current limits of stormwater treatment described by Caraco (this issue), it is evident that the water quality of many lakes can only be maintained if limits are set on the cumulative amount of watershed development. While the exact development threshold often depends on the combined geometry of each individual lake and its watershed, most lakes can sustain only a rather low density of development, as measured by indicators such as impervious cover or lot size. The notion that a carrying capacity for development exists for many lakes has long been advanced by many limnologists (Wetzel, 1975; Wetzel, 1990; Vollenweider, 1968 and 1975).

Consequently, one of the first tasks of a lake manager is to compute current and future phosphorus budgets for the watershed as a whole. These budgets help determine how much extra phosphorus load can be expected in the future, and how much this load can be reduced by stormwater treatment practices in the watershed. If the budget indicates that phosphorus loads will still exceed desired targets even if stormwater treatment practices are widely applied across the watershed, then additional land use controls may be needed. Lake managers have typically relied on three complementary land use strategies to minimize development density in lake watersheds.

Large-lot Zoning

Residential land in the watershed is often zoned for large-lot development, with minimum lot sizes of one, two, five or even 20 acres. The basic reasoning is that large lots have comparatively low impervious cover, even if it spreads development over a potentially greater area than would otherwise occur. In addition, communities may allow developers the option to cluster development within these large lot zones, if shared septic systems are allowed.

Land Use Exclusion

Commercial and industrial zones are often minimized or excluded from the watershed in order to minimize spill risk, and to reduce impervious cover. Often these zones are not feasible for development if a community elects not to extend sewer into the watershed, given the larger volumes of wastewater that they generate.

Reliance on Septic Systems

Communities often choose to rely on septic systems for wastewater disposal within lake watersheds for two reasons. First, most communities find that it is not economical to service large lot development with sewers. Second, the presence of sewers can often induce more development density than originally intended. Therefore, a lack of sewer capacity acts as a secondary growth control, and can reduce pressures to rezone land to a higher density in the future.

While these land use strategies have been widely applied, they may not be appropriate for every lake watershed. For example, it may not be desirable to extend large lot zoning or exclude commercial development when a lake has a very large watershed, or has already experienced a great deal of past development. The strategy can also backfire if unsuitable soils or site conditions make widespread septic system failure likely, or if the community has no capacity to inspect and manage septic systems over time. These situations call for a more sophisticated land use strategy that may involve down-zoning, transferable development rights, or watershed-based zoning (CWP, 1998).

Another important component of zoning is a careful assessment of existing water pollution hazards in the watershed, with a strong emphasis on land uses or activities that may pose a risk of spills or accidental discharges. In particular, the potential risk of spills from existing or planned roadways should be assessed, and contingency response plans prepared.

Land Conservation

Land conservation is a critical tool for limiting where land development takes place in a lake watershed. Many communities have secured easements or acquired land in the watershed for the express purpose of lake protection. Generally, shorelines, shoreline buffers, and tributary streams are the key land acquisition priorities, although large wetlands and public access areas may also be preferred.

Stream Buffers

Stream buffers are an integral part of any watershed protection strategy, and an LPO should strongly recommend establishing them throughout the watershed. The buffer should apply to all perennial streams that drain to the lake. The basic design of stream buffers is described in Schueler (1995), and model ordinances can be found at the Stormwater Manager's Resource Center (www.stormwatercenter.net). In some cases, stream buffers in lake watersheds have a variable width depending on the distance of the stream from the primary water intake. A good example of this concept can be found in Georgia's reservoir protection standards, which require a 150 foot buffer around the reservoir, a 100 foot buffer along streams within a seven mile radius of the reservoir, and a 50 foot buffer along streams outside the seven mile radius for watersheds less than 100 square miles (Burnett and Ashley, 1992).

Better Site Design

Communities may also want to encourage open space designs for residential subdivisions located outside of the shoreland protection area, since clustering has been shown to reduce the phosphorus loadings (Zielinski, 2000). Narrower road standards and the use of roadside swales are also particularly appropriate in most lake watersheds.

Figure 12. Rooftop Runoff is Collected in a Rain Barrel and Stored for Later Use

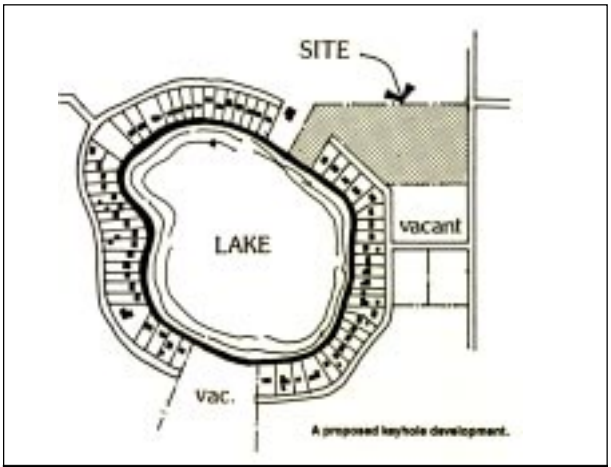


Figure 13. An Example of a "Keyhole" or Backlot Development (Warbach *et al.*, 1990)

Erosion and Sediment Control

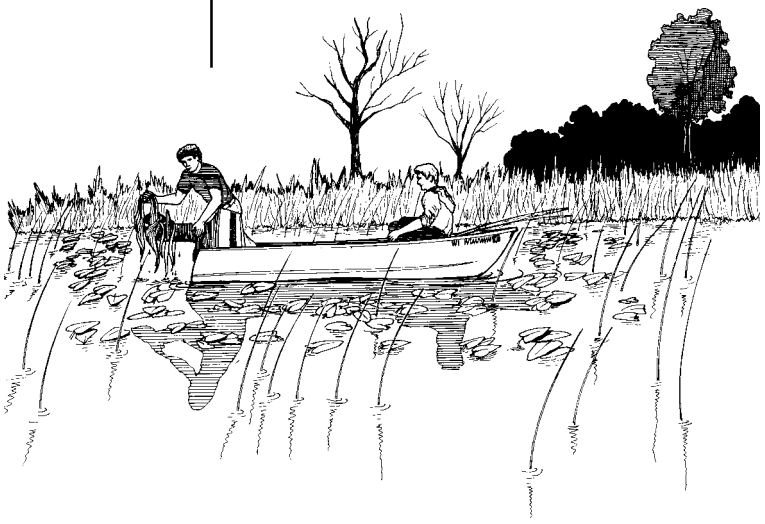
Lakes are especially vulnerable to the impacts of sedimentation and turbidity generated from upstream construction sites. Consequently, erosion and sediment control (ESC) plans are normally required at new development sites in lake watersheds. ESC requirements need to be adjusted to reflect the prevailing development conditions around lakes. For example, if most of the development will be constructed on large lots or by individual contractors working on a single lot, it may be important to have both a low area threshold for triggering ESC plans, as well as a simple checklist approach for preparing ESC plans for individual lots.

Lakes are especially vulnerable to the impacts of sedimentation and turbidity generated from upstream construction sites.

Stormwater Treatment Practices

Stormwater treatment practices in the watershed are often designed to achieve a specific target for phosphorus removal. Local ordinance and design manuals often give very specific instructions to engineers on what stormwater treatment practices to use, how much runoff they need to treat, and how they should be designed to promote greater phosphorus removal. Depending on the phosphorus sensitivity of the lake and the amount of future development forecasted, lake managers may elect to establish specific stormwater phosphorus removal targets in the LPO.

A number of communities have adopted stormwater performance criteria that set forth specific phosphorus load reductions from new development sites. Typically, they require an engineer to calculate the phosphorus load before and after the site is developed, and then design a stormwater treatment system that can eliminate the difference (MDEP, 1992; Kitchell, this issue). Most communities prescribe the Simple Method (Schueler, 1987) to compute post development loads, and provide tables that indicate the estimated phosphorus removal capability associated with each practice (see Caraco, this issue). Depending on the site, the engineer may need to choose a stormwater practice with a higher phosphorus removal capability, reduce the impervious cover of the site, capture a greater volume of stormwater runoff, or install more than one practice on the site. If a designer still cannot meet their phosphorus load reduction target, they may have the option of providing an offset or a fee in-lieu for phosphorus reduction elsewhere in the watershed.



Wastewater Discharges in Lake Watersheds

Communities are often sharply divided on how to manage and dispose of wastewater in lake watersheds, given that treated wastewater is often a major component of a lake's phosphorus budget. Most have adopted one of three broad strategies to manage wastewater, depending on the degree to which they wish to limit development and their confidence in septic systems:

Reliance on Septic Systems

This strategy prohibits any surface discharges of treated wastewater within a lake watershed, and relies instead on septic systems to dispose of wastewater on individual sites. The strategy is frequently employed in drinking water reservoirs and to maintain low residential density in other lake watersheds. The success of this strategy requires effective phosphorus removal by septic systems, which in turn may require stringent requirements throughout the watershed, particularly if the overall density of tanks is high (Swann, this issue). Regulations in the watershed typically establish criteria for soil suitability, minimum lot size and drainfield area and a greater shoreline setback from the lake during initial construction. Of equal importance is the establishment of a management authority to inspect, maintain and rehabilitate septic systems after they are built.

Limited Sewer Relief

Failing septic systems are sometimes found to be a major water quality problem along the shoreline, and a common remedy is to extend a sewer to connect to clusters of failing units. Sewers may also be needed to accommodate denser development elsewhere in the watershed. In either case, while wastewater is collected by sewers, it is pumped out of the lake watershed for subsequent treatment and discharge.

Reliance on Sewer

In some watersheds, communities have had such poor experience with septic systems that they rely instead on sewers to dispose of wastewater. Often, these communities are concerned with bacteria and phosphorus discharges from failing septic systems or package plants, or have large areas of the watershed that are simply not suitable for septic treatment. Some communities pump the sewage out of the watershed for treatment, while others rely on advanced wastewater treatment within the watershed.

In phosphorus-sensitive lakes, it is important to deal with all sources of phosphorus in the watershed. Many developing watersheds still have active agricultural operations that can contribute significant nonpoint phosphorus loads. Consequently, lake managers should carefully evaluate agricultural sources, such as row crops, confined animal feeding operations, dairies, hobby farms and grazing livestock, and cooperate with farmers and ranchers to implement needed best management practices.

Watershed Stewardship

The watershed is often the best scale at which to perform public education and outreach. In lake watersheds, the outreach effort strives to meet two broad objectives. The first objective is to create an awareness among all watershed residents that they are connected to the lake downstream. Once residents become more connected to the lake, the next objective is to educate them about specific ways they can have a positive influence on lake quality through their daily actions. These include activities such as lawn fertilization, car washing, septic cleanouts, fall leaf disposal, and pet waste disposal (CWP, 2000). Indeed, many of the most progressive watershed education programs have been created for lake watersheds. Examples include Lake Sammamish, Washington, and Lake Harriet, Minnesota (PCP, 1998; MDA, 1998). Figure 14 shows a graphic used on a billboard for the Lake Harriet Watershed Awareness Project.

Lawn care has traditionally been the primary focus of many lake education efforts, which is not surprising given the potential phosphorus inputs from careless fertilization (CWP, 1995b). A handful of communities have gone as far as to place restrictions on the use of fertilizer/pesticide applications throughout the watershed (Springs, 1999; NRC, 2000). Other communities promote fertilizer formulations that do not include phosphorus. Most communities have stressed direct technical assistance to homeowners on how to reduce or eliminate the use of fertilizer and pesticides. Several excellent fact sheets have been developed to educate lake residents about environmentally friendly shoreline landscaping techniques (PWD, 1995; UWEX, 1994).

Summary: The Lake as a Commons

Garret Hardin, in his famous essay on the tragedy of the commons, observed that the quality of a shared resource will always be degraded when everyone has access, but no one has control or ownership. Resource degradation can only be averted, he argued, if the parties agree to some form of self-regulation in order to minimize their collective impact on the resource (Hardin, 1968).

In this sense, a lake is a classic example of a commons. Most of the residents in the watershed use the lake in some way, and all residents influence it directly through their impact on the watershed. The very qualities that attracted current residents to a lake are likely to lure new ones. As a consequence, most lakes will expe-

Figure 14. Graphic used for Lake Harriet Watershed Awareness Project (MDA, 1998)

rience constant growth pressures along their shorelines and in their watersheds. An LPO is an effective framework for regulating the nature of development within the lake "commons."

The quality of a shared resource will always be degraded when everyone has access, but no one has control or ownership.

While lake communities often face tough choices about which precise criteria to apply within each of the four lake protection zones, they possess an inherent advantage when it comes to watershed protection. Most residents already place a high value on lake quality, whether it means natural scenery, good fishing, pure drinking water or a place to float. These shared values provide a strong foundation to reach a consensus for greater lake protection.

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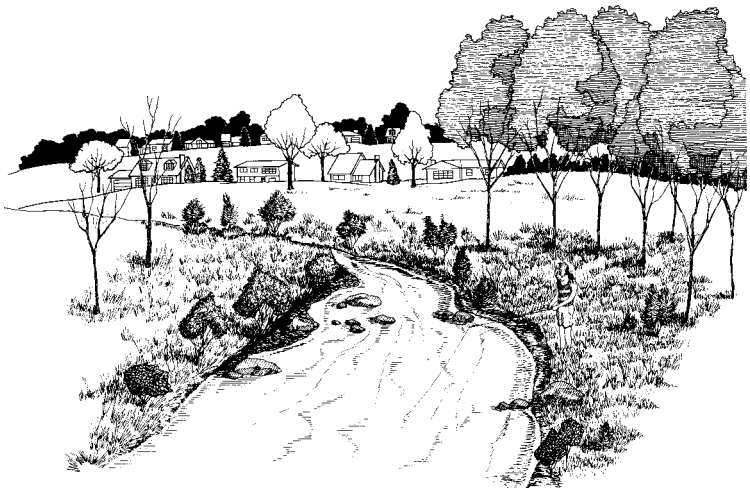

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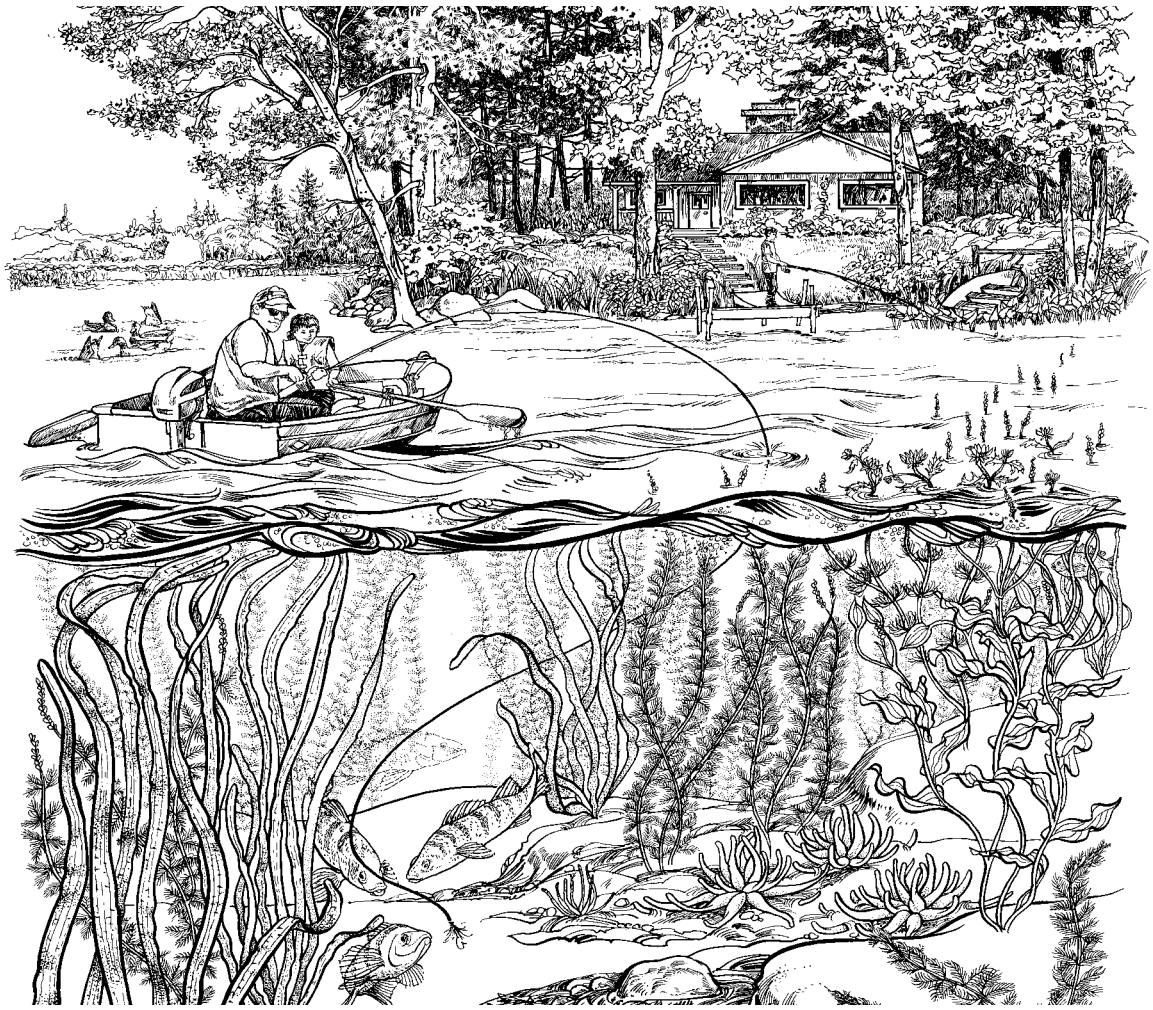


Critical Areas Requiring Nonpoint Management Measures (element C)

Management Measures

Best Management Practices & Low Impact Development

The following section discusses observed percent pollutant reductions of varying stormwater controls based on the scientific literature. Wherever possible, stormwater management should focus on increased infiltration and natural filtering; however, nutrient filtration systems are more appropriate where onsite infiltration is not feasible[7].

Rainwater Harvest Systems (rain barrels)

Based on a recent EPA literature review of 23 cities over varying climatic regions, onsite rainwater storage from roof gutter systems reduce long term stormwater runoff volumes from residential areas by about 20%. This percentage, however, is heavily dependent on local impervious surface cover and population density. In the case of Lake Pocotopaug, the high density residential areas in the direct watersheds A, B, & C would greatly benefit from onsite rainwater harvest barrels. Rain barrels capture roof runoff during storm events and temporarily store the water for household use, e.g. watering gardens and onsite infiltration.

Dry Detention Area

Dry detention basins are designed to store and infiltrate stormwater runoff in a level, vegetated depression. Nutrient reduction is variable but TP reductions are near 16–29%. Dry detention reduces TN by about 10–26% and TSS at 66–80%. The variation in nutrient decrease can be attributed to differing soil characteristics and is also dependent on the design of the dry detention system. Improper grading will prevent even dispersal of rainwater and reduce pollutant reduction. If water is allow to pool for long periods of time, phosphorus may be released from the sediments as biologically available ortho–phosphorus. To restate, proper design and construction are critical and pollution control can be further increased by manipulating underlying fill.

[7]: Jiang et al. 2015, Piza et al. 2011, Yang et al. 2014, Barret et al. 2004, U.S. EPA 2000, Young et al. 1996,

Wet Detention Ponds

Wet stormwater detention ponds, such as the ponds at Paul & Sandy's and Lake Vista, are designed to let particles settle out, thereby reducing TSS up to 94%. However, if the pond is not designed large enough to handle incoming stormwater it will merely act as a flow through system. Improperly designed wet detention ponds may also have the inflow and outflow too close together, negating any particulate-holding ability. On average, TN concentration reductions for these types of ponds are around 9-32%. Wet detention ponds are not designed to retain phosphorus; TP reductions in the scientific literature are recorded around 5% while there is research to suggest that orthoreactive P concentrations in effluent may be up to 266% greater than influent stormwater.

In the case of very large water volumes from impervious surface runoff, wet detention ponds may be necessary, but these systems should be combined with additional phosphorus reducing mechanisms to limit nutrient pollution to the Lake.

Constructed Wetlands

Constructed wetlands are similar to wet detention ponds in that they are consistently flooded, yet these marsh areas are designed to be shallow and well-vegetated. Stormwater nutrients in constructed wetland systems are partially used by plants. More robust wetland plants, such as cattails, uptake and store nutrients before they reach the Lake. Constructed wetlands create wildlife habitat and are aesthetically pleasing, but they also require periodic inspection to ensure proper pollutant filtering. Ongoing research suggests that initial TP reduction of constructed wetlands can be as high as 60%, but as nutrients saturate the system over 10-20 years, retention capacity declines (Micsh et al. 2000). Like all forms of stormwater treatment, an understanding of the underlying sediment is critical to initial design, maintenance, and lasting efficiency.

Floating Treatment Systems

Like traditional constructed wetlands, floating wetlands act by storing nutrients via vegetative uptake, but instead in a hydroponics treatment system. Existing wet stormwater retention ponds can be retrofitted with floating wetland systems for increased nutrient uptake. Published research suggests that floating wetlands can reduce TP outflow by approximately 27% (Borne 2014). Further studies indicate that some integrated floating wetland systems with biofilm carriers increase periphyton growth and TP uptake to over 80% (Zhang et al. 2015). This type of technology is relatively new, but experimental sites in Christopher Brook Pond or Paul & Sandy's retention pond may reduce the high inlet concentrations to Lake Pocotopaug, thereby limiting summer cyanobacteria blooms. Floating treatment systems, however, require more frequent maintenance than other types of stormwater controls.

Bio-retention (rain gardens)

The primary goal of a bi-retention system is to infiltrate stormwater onsite in a shallow depression. With proper design and construction rain gardens are excellent at reducing the overall water volume entering a lake system as road runoff or through underground culverts. Depending upon the design, rain gardens are also capable of reducing sediments and nutrients.

Porous Pavement /

Porous pavement systems are designed to infiltrate stormwater and reduce overland runoff during heavy rain. Typical sidewalks, parking lots, and roadways are built using impervious materials that do not allow rainwater to penetrate into the underlying soils. Porous pavement, made of either cement or asphalt, is constructed with tiny holes that allow water to filter through and infiltrate onsite, rather than being directed into storm drains. Flow reduction studies determined that permeable interlocking concrete and porous pavement with an underlying gravel sub-base reduce overland runoff by 33-38%. However, permeability relies on the void spaces in the pavement material and can be easily clogged if not maintained. Porous pavement should not be sanded during winter months and biennial vacuuming may be necessary.

Vegetated Swale

A dry vegetated swale is a depression in the land that captures stormwater runoff from impervious surfaces, such as roadways and sidewalks. Vegetated swales are designed in completely infiltrate the runoff and should not be a zone of standing water. Infiltrate capacity may be enhanced by manipulating the underlying sediments, but dry swales need to be engineered and constructed based on the estimated water load that they would be expected to handle. Recent studies have suggested that Total Phosphorus and Nitrogen reductions are near 30% for well-designed swales, but that a poorly designed system that creates standing water may actually increase dissolved P significantly.

Critical Management Areas

Sub-basin details

Several of the important sub-basins are discussed in-detail in this section (**Table 12**). Estimated loading values and reductions using proscribed measured are given. Where possible we show comparisons between 2014-2016 data and pre-2008 data. The location of the important sampling stations where stream flow and nutrient chemistry was tested are given in **Table 12** and shown in **Map 3**.

Table 12 – Inlet stations

Sampling Location	Basin Name
Poco_14, Poco_15	Christopher Brook (E)
Poco_5	Hales Brook (H)
Poco_8, WPT_338, WPT_347	Sub-basin (C)
Poco_7	Fawns Brook (K)
Poco_1 – Poco_4	Sub-basin (A)
Poco_9	O'Neil's Brook (M)
Poco_10	Days Brook (N)

ENVIRONMENTAL
Fact Sheet

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

29 Hazen Drive, Concord, New Hampshire 03301 • (603) 271-3503 • www.des.nh.gov

WD-SP-5 2017

Vegetation Management for Water Quality

New Hampshire's waterbodies provide benefits and uses we all enjoy: fishing, boating and natural beauty to name a few. As communities grow and New Hampshire's landscape changes, the quality of our public waters depends on each of us managing the trees, shrubs and low-growing plants on our property. Nature's most economical and efficient stormwater purification system is a combination of native shoreland plants.

The best vegetation for healthy waterbodies are trees and plants such as oaks, pines, willows and blueberry bushes; they slow down, absorb and purify much more stormwater than low-growing plants with shallow roots such as lawns and mulched garden beds. Trees and plants help remove the oils, salt, heavy metals, fertilizers, and other contaminants from stormwater runoff and spring snowmelt before they enter our lakes and rivers. Even the dense mat of leaves and needles under our trees plays a unique role in purifying our water. Plus, birds, fish and insects rely on the shade, protection and fruits provided by native shoreland plants.

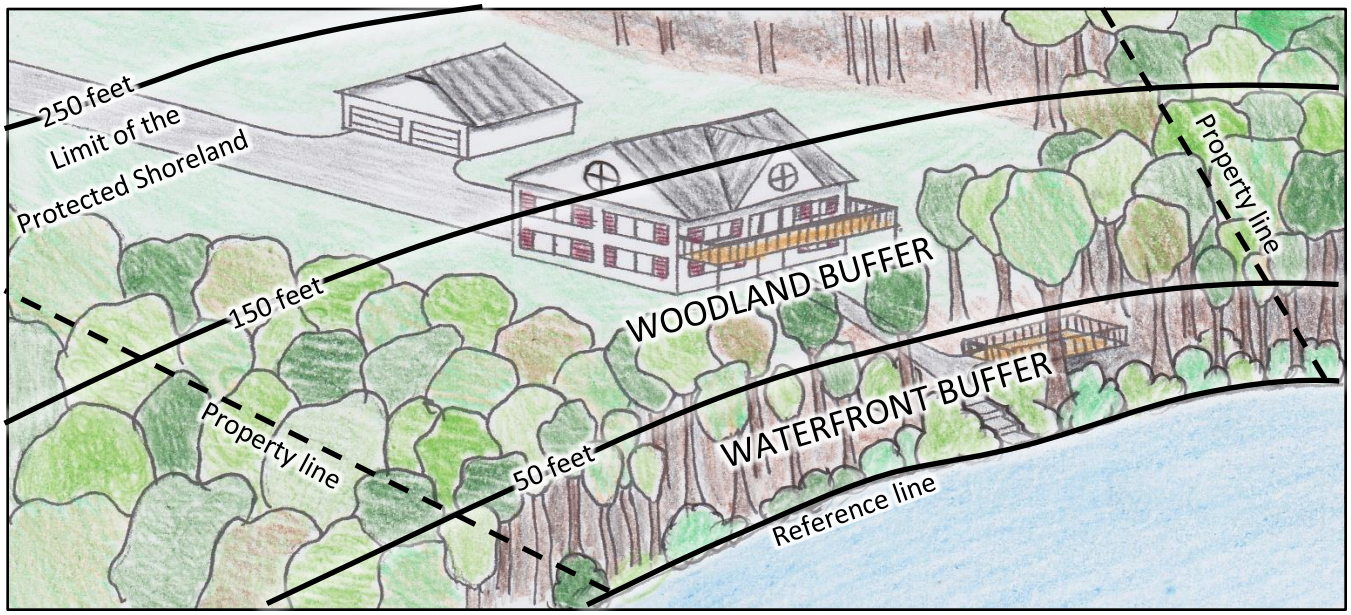


Figure 1: The Waterfront Buffer and the Woodland Buffer located within the Protected Shoreland.

In order to protect water quality and wildlife habitat, the Shoreland Water Quality Protection Act (SWQPA) regulates the removal of ground cover, shrubs and trees within 150 feet of protected waters. This distance is measured from the reference line (high water line). Within 150 feet of the reference line there are two distinct regions, the **waterfront buffer** and the **woodland buffer,** shown above**.** The regulations on vegetation management are different within each of these regions and are explained in detail on the following pages.

Waterfront Buffer Requirements

Within 50 feet of the reference line, ground cover and shrubs may not be removed, landscaped or converted to lawn. Ground cover and shrubs may only be trimmed to a height of no less than 3 feet. Trees may also be pruned as long as the health of the tree is not endangered. Pruning only the bottom 1/3 of a tree is recommended to maintain property aesthetics and tree health. Always determine if a tree can be pruned before removing it. Pruning trees often increases views while providing wildlife habitat and privacy.

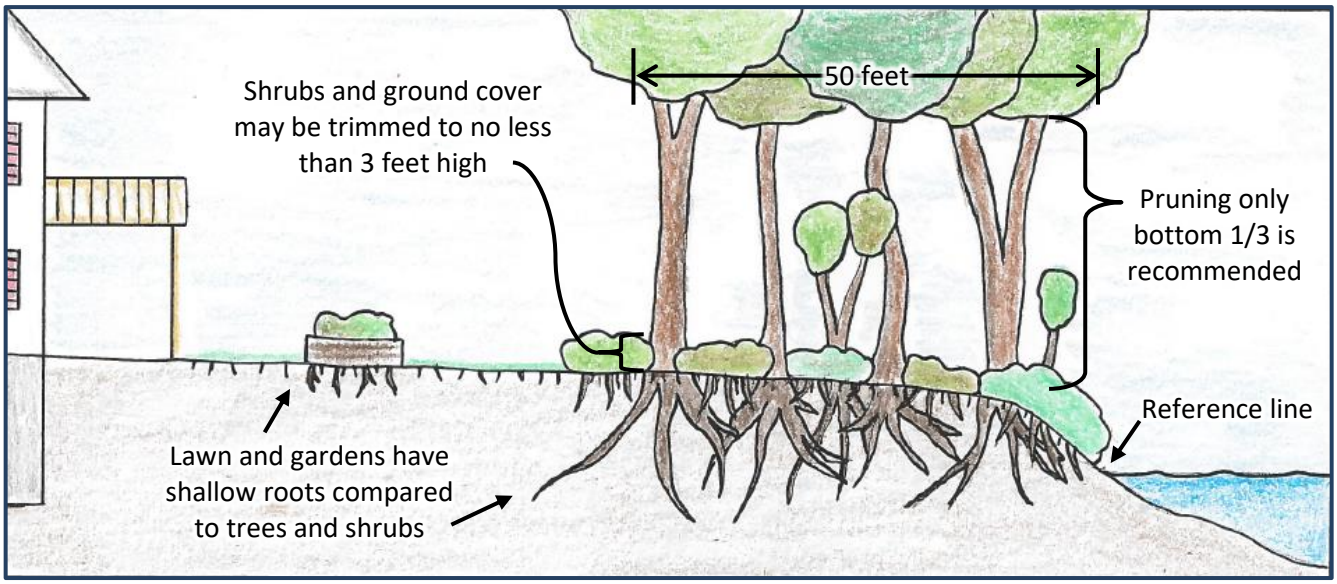
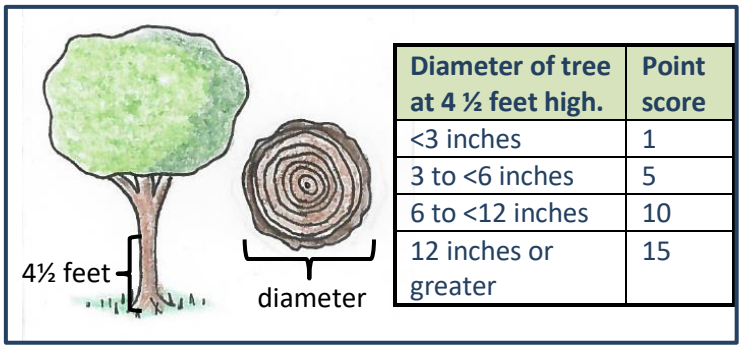


Figure 2: Waterfront buffer profile view

Removing trees within the waterfront buffer *may* be permissible, but there are limitations based on a *grid segment and point score* system. In order to remove trees within the waterfront buffer, property owners must maintain a minimum number of "points" within the "grid segment" from which they propose to remove trees. To determine if trees can be removed, always beginning from the most northerly or easterly property boundary, divide the waterfront buffer into 25-foot by 50-foot grid segments (see **figure 3**). Properties that have shoreland frontage that does not divide to an even number of 25-foot segments require fewer points in the last segment.

Next, to determine if trees can be removed from a grid segment, calculate the grid segment's total tree and sapling point score. Each tree is awarded a point score based on its trunk diameter (width) 4½ feet above the ground on the uphill side (See **figure 4**). Dead, diseased or dying trees are not awarded points.

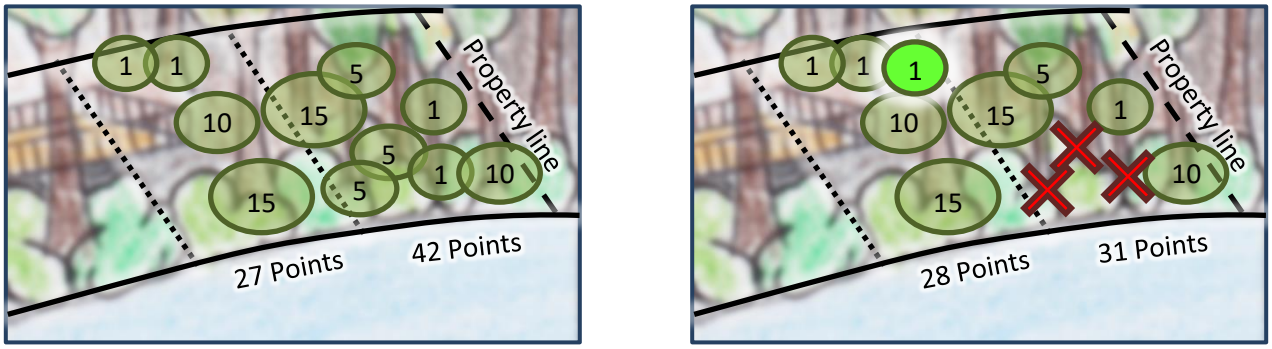
Figure 3: Mapping out each grid segment



Diameter of tree at 4 ½ feet high.	Point score
<3 inches	1
3 to <6 inches	5
6 to <12 inches	10
12 inches or greater	15

Figure 4: Scoring each trunk by its width

Trees may be removed from any grid segment provided that, after removing the trees, the sum of the tree and sapling point score within the affected grid segment will be at least 25 points (see figure 5).



Before management **After management**

Figure 5: Managing trees within the Waterfront Buffer; here three trees are removed and one is planted.

Property owners are encouraged manage grid segments by strategically planting additional saplings, especially within grid segments that do not meet the 25 minimum point score so that, once the saplings mature, and the grid segment's total point scores increases above 25 points, trees may then be removed.

Woodland Buffer Requirements

Between 50 and 150 feet from the reference line, at least 25% of this area must be managed as Natural Woodland where all existing native ground cover, shrubs and trees are allowed to grow. Property owners have the freedom and flexibility to elect which region(s) of the Woodland Buffer are designated as Natural Woodland. This area does not have to be contiguous and many people place it on the edges of their property to provide a dense area of vegetation for privacy.

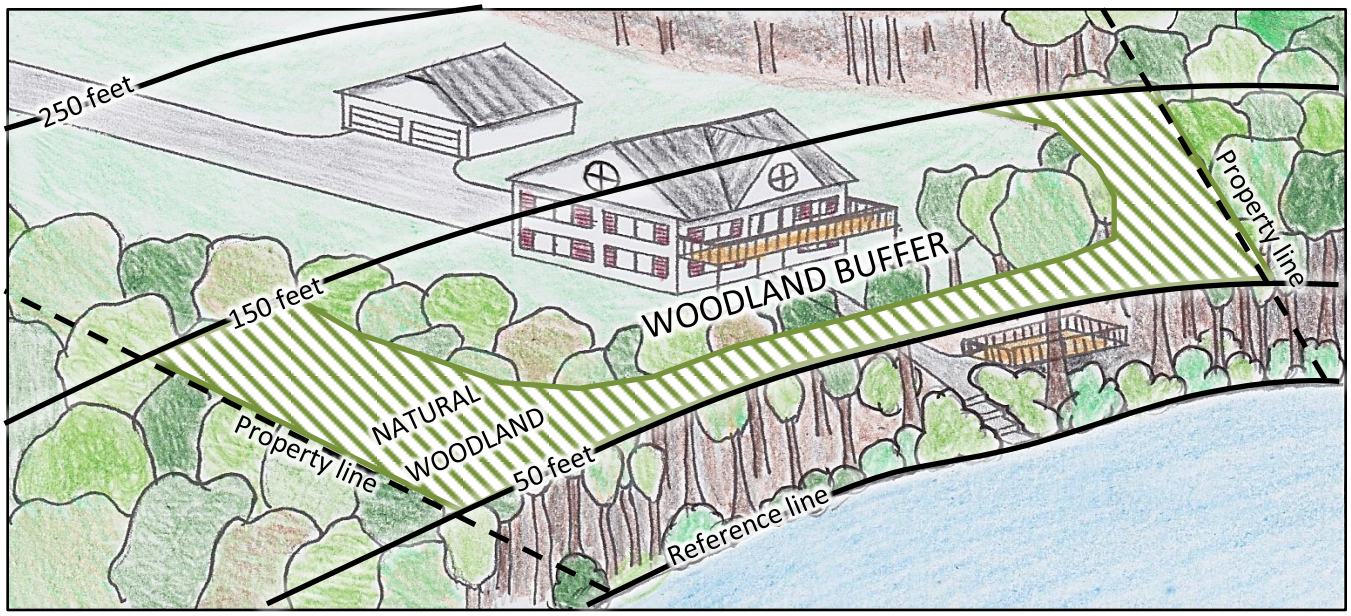


Figure 6: At least 25% of the Woodland Buffer must be designated as "Natural Woodland."

Areas of the property with the highest density of native trees, shrubs, and ground cover should be given priority for designating as Natural Woodland. Managing vegetation within the Natural Woodland is done by allowing the native plants to grow without cutting except as needed to maintain or improve plant health.

The Natural Woodland may appear very different depending on site conditions. See **figure 7** for some examples.

This natural woodland has native trees with some native shrubs and leaf litter for ground cover.

This natural woodland has native shrubs and ground cover. This may have been an abandoned cleared area.

This natural woodland contains mostly grandfathered cleared areas, so most of it only contains native trees.

Figure 7: Examples of natural woodland areas.

Permitting Requirements

- A NHDES shoreland permit is not required for vegetation management provided it occurs in accordance with the limitations described within this fact sheet. This includes planting vegetation, removal of limbs, ground cover, shrubs, trees and invasive species.
- Any dead, diseased or unsafe tree which has a structural defect and poses an imminent hazard may be cut to ground level at any time without a shoreland permit. NHDES recommends property owners retain documentation of the tree's condition at the time of removal such as clear photos and/ or written confirmation from a horticultural professional describing the tree's defect or condition.
- A NHDES shoreland permit is required for any excavation, fill, or construction within 250 feet of the reference line. Examples include using mechanized equipment to plant trees, removing stumps or large rocks, constructing a walkway, patio, or other structure, or grading. *Any earthwork or construction of structures on the bank, in the water, or on the bed of a waterbody are regulated by the NHDES Wetlands Bureau* and are subject to the NHDES Wetlands Permitting Process.
- Areas cleared of ground cover, shrubs, or trees in excess of these requirements prior to July 1, 2008, may be maintained but not enlarged; examples of cleared areas include lawn and mulched landscaped areas.
- Before removing trees, always check local ordinances as well. Many municipalities have standards that are stricter than the NH Shoreland Water Quality Protection Act.

Chemical Application

No fertilizer may be applied within 25 feet of the reference line. Between 25 and 250 feet from the reference line, only slow or controlled release fertilizer may be used. No other chemicals, including pesticides or herbicides of any kind, can be applied within 50 feet of the reference line, except by a licensed, permitted professional.

For more information:

For more information about the Shoreland Water Quality Protection Act and the NHDES Shoreland Program, please go to http://des.nh.gov/organization/divisions/water/wetlands/cspa/index.htm or contact the Shoreland Program at (603) 271-2147 or lrm@des.nh.gov.

Overlay Zoning to Protect Surface Waters

by Joel Russell

The use of zoning to protect water quality represents the "second generation" of water quality regulation in the United States. The original regulatory thrust was the reduction of "point source" pollution, such as direct discharges from factories and sewage treatment plants into waterways. These discharges were responsible for the appalling condition of most American rivers and lakes in the first half of the 20th Century.

As the Clean Water Act brought point source discharges under control in the 1970s and '80s, the worst pollution was cleaned up. Attention has increasingly turned to the problem of "non-point source" pollution, primarily stormwater run-off from surfaces such as roofs, parking lots, roads, farm fields, and lawns. *See page 14.*

Regulating land use practices near streams can significantly reduce the run-off of sediment and other pollutants into water bodies. But conventional zoning, which divides a jurisdiction into zoning districts and establishes use and dimensional regulations for each district, can actually contribute to the problem of non-point pollution by ignoring the impacts of nearby development. For example, if a lot has a stream running through the rear yard, a large minimum front setback (required under the zoning district regulations) might force a building to be located very close to that stream, resulting in possible degradation to its water quality.

By creating a system of "overlay zones" that cross conventional zoning district boundaries and protect stream corridors, lakeshores, and watersheds, it is possible to maintain and improve the water quality – even as the community becomes more developed.[1]

A water protection overlay zone is a special kind of zoning district designed to protect a stream corridor, lake, or watershed.[2] It "overlays" existing zoning districts and adds additional requirements to the underlying district zoning, which remains in effect except to the extent the overlay zone provisions specifically modify it.

ONE OF THE MAIN FACTORS AFFECTING WATER QUALITY IS THE TOTAL PERCENTAGE OF LAND COVERED WITH IMPERVIOUS SURFACES

An overlay zone protects water quality by setting additional standards for development and by incorporating site-specific review procedures.

Developing an Overlay Zone

1. Boundaries

An essential first step in developing an overlay zone is to map the zone's boundaries. In the case of stream corridors or lakeshores, these boundaries are typically determined by drawing a boundary line a specified horizontal distance from the bank or shore of the stream or lake (usually between 100 and 200 feet).

In the case of the watershed of a lake or reservoir, an overlay zone boundary is usually the actual physical boundary of the watershed. Establishing the location of such a boundary requires study of topographic maps. A field investigation by an engineer or a hydrologist may be needed to establish an exact boundary location for specific sites.

Note that delineating an overlay zone boundary is not the same thing as establishing a setback or buffer (which will be discussed shortly). While this can be a confusing distinction, the difference is simply that the overlay zone is the broader geographic area within which standards such as setbacks and buffers apply.

2. Standards

The purpose of development standards used in overlay zones is to reduce or mitigate adverse impacts that development might otherwise have on the water body. Among the most common standards:

• *Limitations on impervious surface coverage*. One of the main factors affecting water quality is the total percentage of land covered with impervious surfaces such as buildings, pavement, and highly compacted soil. Overlay zones may set a lower level of impervious surface coverage than would otherwise be allowed in the underlying zoning district. For example, an overlay zone might provide for a maximum of 10 percent impervious coverage, compared to 40 percent in the underlying zoning district (if that district regulates impervious surface coverage at all).[3] Again, the overlay district's stricter limits would control.

• *Setbacks*. Setbacks establish a required minimum distance between buildings and the stream or lakeshore. Setbacks

1 Stream corridors, in addition to protecting water quality, can offer other benefits such as minimizing property damage from floods, preserving wildlife corridors, and providing areas for hiking and bicycle trails

2 Overlay zoning is a technique used in a variety of ways, not just for protection of natural resources such as lakes and streams. For example, overlay zones can be designed to better protect historic structures or improve roadway corridors. For an overview of overlay zoning, see "Making Use of Overlay Zones," by Elizabeth A. Garvin, Esq., in PCJ #43 (Summer 2001). Also note that in some Western states, the term "combining districts" is used instead of "overlay zones."

3 Once the area of an entire watershed has over 10 percent impervious surface coverage, water quality begins to decline. It is possible to have higher percentages of impervious surface coverage if measures are taken to filter the stormwater, but in relatively undeveloped areas maintaining a low impervious surface coverage ratio is the most effective tool.

J. RUSSELL

Dover, New York, has adopted a stream corridor overlay to protect the Swamp River.

may vary for different types of structures. For example, overlay standards would likely require greater setbacks for houses than for small accessory structures such as gazebos. Structures such as boathouses and docks, which by their very nature need to be located along the stream or lake, will obviously not have any required setbacks.

• *Buffers.* Buffers are like setbacks, except that they not only limit building but also restrict other land use practices within a specified distance of the water's edge. Such practices may include tree-cutting, mowing, grading, excavation, the use of fertilizer and pesticides, and paving. Buffer regulations may also require beneficial land use practices such as the maintenance of natural vegetation.

• *Restrictions on the use of hazardous materials.* This applies mostly to industrial types of uses, but there are also materials used commonly in the household, such as cleansers, solvents, fertilizer, gasoline, and oil, that should be kept away from water bodies.

• *Septic system regulations.* Septic systems situated close to water bodies are often unseen sources of serious water pollution. Depending upon soil conditions and the density of development, even failing septic systems that are some distance from the water's edge can have adverse effects. While all septic systems are regulated under health codes, an overlay zone may establish greater setbacks or more stringent design requirements.

• *Erosion control.* Within overlay zones it is especially important to have high standards for erosion control to ensure that land disturbance does not result in the sedimentation of water bodies.

• *General standards.* Sometimes there is a general requirement that an applicant for a land use permit within an overlay zone must show that the proposed use will not adversely affect the water quality of a protected stream or lake. This requires the submission of plans under a review procedure as described shortly.

Watershed overlays typically incorporate stream corridor overlays, but also contain regulations that affect the entire watershed. These often include limitations on: impervious surface coverage; clear-cutting of trees; and large-scale land disturbance such as excavation, grading, and construction. Such overlay zones may also require low density zoning throughout the watershed; mandatory clustering of development; and the use of public sewer infrastructure to minimize septic discharges.

Watershed overlays designed to protect public drinking water supplies will

continued on next page

Wetlands and Aquifer Protection

by Joel Russell

The protection of water quality requires attention not only to surface water bodies (the focus of this article), but also to wetlands and groundwater.

Wetlands Protection. The importance of wetlands has been recognized since the 1970s when Congress and most state legislatures passed laws to protect them. Federal wetland protections are administered through the Army Corps of Engineers under Section 404 of the Clean Water Act. For larger projects, this can require obtaining a permit from the Corps. Smaller projects falling below designated thresholds typically do not require an individual permit. State level regulation of wetlands varies greatly. Some states regulate wetlands through state agencies, while others delegate this function to local governments.

Aquifer (Groundwater) Protection. In communities that rely on an aquifer for potable water, it is essential to protect the groundwater from contamination. Overlay zones identify the surface area that can affect underground water within the aquifer.

With the exception of "sole-source aquifers," which enjoy federal and state protection, aquifer protection is primarily a matter of local regulation, usually through overlay zoning. Unlike wetlands and surface waters, which can be studied by direct inspection, groundwater is not visible. Aquifer studies therefore require inferences based upon the results of well tests, mapping of surface watersheds, and studies of soils and geology.

Aquifer protection overlays typically prohibit certain uses which employ chemicals or hazardous materials (such as gas stations, dry cleaning establishments, and car washes), and also usually prohibit underground storage of fuel oil. Other uses often barred in aquifer overlay zones (or allowed only as conditionally permitted uses) include waste disposal, animal feedlots, and storage of road salt. Aquifer overlays may also cover other issues such as residential density and impervious surface coverage.

Committee Work

by Bryan Stumpf

Using a broad-based committee when drafting an overlay zone has many benefits. A diverse committee of stakeholders can work through contentious issues, create standards that are acceptable to the community, and set the foundation for easier administration of the ordinance. This is what happened when Monroe County, Indiana, developed an overlay for Lake Monroe (the state's largest lake).

Lake Monroe is valued for its scenic beauty and is an important recreation and tourism destination. Equally important, it is the primary source of drinking water for the county. The lake has also been subject to increasing development pressure.

In seeking to implement the county's comprehensive plan policies to better protect the lake, the County Commissioners established a special committee to develop a zoning overlay district. The committee included developers, environmentalists, natural resource professors, attorneys, utility representatives, and engineers. Over a five month period, sometimes with impassioned discussions, the committee prepared a draft ordinance. The County Commissioners adopted the ordinance with only minor changes.

The overlay divided the Lake Monroe watershed into four areas based upon distance from the edge of the lake or its main tributaries and the availability of public sewer and water services. Each of the areas contained development standards that regulated the maximum slope that could be disturbed; limited density; established where natural vegetation must be protected; and set standards for the placement of houses on lots.

Despite this level of complexity (with varying standards for the four areas within the overlay), the ordinance has been relatively easy to administer. Much of the credit goes to the work of the committee. They anticipated potential problems that could have made administration of the overlay difficult, and ensured that the intent and wording of the overlay were clear.

Bryan Stumpf, AICP, is a project manager in the Indianapolis office of HNTB, a national architecture, engineering, and planning firm.

Look to the Plan

by Joel Russell

Local zoning, whether for the protection of water quality or for other purposes, should be based on a sound planning rationale. The best way to do this is through the community's comprehensive plan (sometimes known as the general plan or master plan). Local or regional plans can address water quality issues by:

- Mapping and describing streams, ponds, lakes, reservoirs, and aquifers.
- Establishing community goals for the protection, use, and enhancement of water resources, sometimes differentiating among various kinds of water resources (e.g. a stream running through a town center vs. a recreational lake vs. a drinking water supply).
- Recommending implementation strategies, which may include a range of actions such as development of overlay zones, public land acquisition, or health regulations on septic systems.

The more clearly the community frames its goals, and supports those goals with sound information, the more legally defensible will be the implementation tools, provided that they are tailored to accomplishing the goals and based on the available information.

There are two caveats: First, while water resources protection can be used to regulate and control growth, it should not be used as an excuse to stop growth. Second, the water resource goals and implementation tools should be coordinated and balanced with other community objectives, such as affordable housing and economic development, so that the plan does not result in conflicting recommendations.

Overlay Zoning to Protect Surface Water

continued from previous page

likely contain more stringent standards. The construction of water and sewer infrastructure within public water supply watersheds can be controversial. While sewer systems are generally better for water quality than septic systems, some communities' watershed overlay regulations ban sewers. The reasoning is that having sewers will lead to higher density development which, in turn, will generate more run-off. However, this outcome can be avoided if the underlying zoning sets a low overall density, while requiring clustered development that protects surface waters with large open space buffers.

3. Review Procedures

While some overlay zone standards, such as setbacks, are relatively straightforward to administer, other standards may necessitate a site-specific review and analysis. In many communities, the existing zoning ordinance will already require subdivision or site plan review for large-scale residential developments and most kinds of commercial development. In such instances, consideration of the overlay zone standards can be incorporated into the existing review process.

However, smaller-scale development, such as building a house on an existing lot, will typically require only a building permit. If overlay zoning standards are adopted, it may be necessary

to include provision for a streamlined form of site plan review for small projects. This can be administered by a municipal board or commission (such as the planning commission), or by a zoning administrator or building inspector. Some activities regulated within the overlay zone (such as clearing of vegetation or the use of fertilizer) will not normally require any special review. Violations brought to the attention of the zoning administrator or building inspector will typically result in fines and/or corrective measures.

Non-Zoning Approaches

It is worth noting that there are a number of non-zoning approaches that can also be important to achieving a community's water quality protection objectives. These include:

• *Public education.* To deal with those practices that are especially hard to regulate, such as the use of pesticides, herbicides, and hazardous substances near waterways, public education campaigns by municipalities and watershed associations have often been effective.

• *State river and lake protection legislation.* Many states have adopted river and lake protection programs that function in much the same way as overlay zones, requiring setbacks, buffers, and regulated areas near water bodies.

• *Installation of water protection infrastructure.* This may include upgrading existing sewage treatment plants, building new plants, and providing subsidies to upgrade individual septic systems.

• *Water supply watershed protection regulations.* In many states, providers of public water have regulatory powers outside of their jurisdictional boundaries to protect water quality in their reservoirs. For example, New York City is able to regulate land uses within the watersheds of its reservoirs in the Catskill Mountains under authority given to it through the state health department.

• *Acquisition of riparian and watershed land.* The acquisition of land by public agencies or non-profit land trusts for conservation purposes is perhaps the surest way to ensure water quality protection. However, land acquisition can be quite costly.

• *Wetlands regulation.* The regulation of wetlands at the federal, state, and local level has done a great deal to protect water quality and will continue to do so.

• *Development patterns.* The importance of the overall pattern of development in a community should not be ignored. Development that takes a "smart growth" or "new urbanist" form can result in much lower impervious surface coverage and greater setbacks from waterways. This enables the community to protect its water resources by virtue of its overall development pattern, rather than just by site-specific regulations.

JEAN COLEMAN, CR PLANNING, INC

Minnesota's Pomme de Terre River, which runs through agricultural areas, is protected by a vegetative buffer.

Summing Up:

Overlay zones can be a highly effective tool in local efforts to protect water quality. Used in combination with other planning and zoning tools, overlay zones can preserve and maintain a natural resource that is vital to health, quality of life, and economic well-being. ◆

Joel S. Russell is a planning consultant and land use attorney based in Northampton, Massachusetts. He works with municipalities, land trusts, landowners, and developers on natural resource protection, open space preservation, land use regulation, traditional neighborhood design, and community consensus building. Russell has previously written for the PCJ on street standards, land trusts, and other topics.

The Land of 10,000 Lakes

by Jean Coleman

Minnesotans love their lakes. This is proven by the fact that the only state-wide zoning requirement in Minnesota is that communities must adopt shoreland management overlay districts for lakes and rivers. In response to water quality concerns, the Legislature enacted (in 1970) the Minnesota Shoreland Management Act. At least 250 local governments have adopted shoreland ordinances, including 85 of the state's 87 counties.

Based on a lake and river classification system, local ordinances are required to contain minimum standards and best management practices for shoreland development that include: minimum lot sizes and width at shoreline; restrictions on types of uses; structure and septic setbacks from shorelines and bluffs; limits on impervious surfaces; stormwater management requirements; and restrictions on the removal of vegetation to minimize runoff and minimize visual impacts of development for lake users. Many local ordinances include provisions that exceed the minimum requirements.

The Minnesota Department of Natural Resources and the Minnesota Erosion Control Association promote education for local officials on the connection between land use and water quality through Northland NEMO (Non-point Education for Municipal Officials); <www.mnerosion.org/nemo.html>.

Jean Coleman is an attorney and land use planner with CR Planning, Inc., in Minneapolis.

The Vermont Shoreland Protection Act

A Handbook for Shoreland Development

Version 1.2, April 2015

Acknowledgements

Vermont's Shoreland Protection Act (Vermont law, Chapter 49A of Title 10, §1441 *et seq.*) was modeled, in part, after Maine's shoreland rules, and this publication follows Maine's lead in providing a homeowner's guide to understanding their state's shoreland regulations. Many of the graphics used in this handbook are from the Maine Department of Environmental Protection's publication, *Maine Shoreland Zoning – A Handbook For Shoreland Owners*.

Thanks also to those within Vermont who provided their time and energy through testimony, concern, and suggestions to help shape the Vermont Shoreland Protection Act.

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Representative Robert Krebs, Grand Isle-Chittenden
Chip Paison, Lake Dunmore/Fern Lake Association
Jackie Sprague, Federation of Vermont Lakes and Ponds

Vermont Agency of Natural Resources
Department of Environmental Conservation
Watershed Management Division
Lakes and Ponds Program, Lake Encroachment & Shoreland Permitting
1 National Life Drive, Main 2
Montpelier, Vermont
05620-3522
http://dec.vermont.gov/watershed/lakes-ponds

Front cover photo - Boulder Beach State Park, Lake Groton

Table of Contents

The Purpose of this Handbook

This handbook informs shoreland property owners, municipal officials, landscapers, contractors and others about the Shoreland Protection Act, what activities are exempt, what activities require a permit and how to obtain a permit.

Introduction

Intent of the Shoreland Protection Act

The Vermont Legislature passed the Shoreland Protection Act, effective July 1, 2014, that regulates activities within 250 feet of the mean water level of lakes greater than 10 acres in size. The intent of the Shoreland Protection Act is to allow reasonable development along the shorelands of lakes and ponds while protecting aquatic habitat, water quality, and maintaining the natural stability of shorelines.

Administration of the Act

The Vermont Agency of Natural Resources administers the Shoreland Protection Act through the Department of Environmental Conservation's Shoreland Permitting. Shoreland Permitting reviews applications for shoreland permits and ensures that new development or redevelopment within Protected Shoreland Areas is conducted according to the standards set forth in the Shoreland Protection Act.

Shoreland Permitting Regional Contacts

County	Contact
Addison	**Region 1** Laura Dlugolecki laura.dlugolecki@vermont.gov 802-490-6133
Bennington	
Rutland	
Windham	
Windsor	
Chittenden	**Region 2** Michaela Stickney michaela.stickney@vermont.gov 802-490-6117
Franklin	
Grand Isle	
Lamoille	
Washington	
Caledonia	**Region 3** ANR.Shoreland@vermont.gov 802-490-6199
Essex	
Orange	
Orleans	

Part One

Using this Handbook

This handbook explains the Shoreland Protection Act to residential shoreland owners and others. Terms with specific meanings under the Shoreland Protection Act are highlighted in red and defined in an inset box the first time they are used in the handbook. A complete glossary of defined terms is found on page 13.

What activities are covered by the Shoreland Protection Act?

Creation of cleared area or impervious surface within 250 feet of the mean water level on lakes greater than 10 acres in size.

Cleared areas: Areas where vegetative cover has been permanently removed or altered. Vegetative cover includes tree canopy, understory, groundcover and the duff layer.

Impervious surface: Those manmade surfaces, including paved and unpaved roads, parking areas, roofs, driveways, and walkways, from which precipitation runs off rather than infiltrates.

Mean water level: the mean water level of a lake as defined in the Rules for Determining Mean Water Level. Some lakes have a specific elevation that has been established through rule or a permit.

Duff layer: Leaf litter plus small fragments of plants and organic debris.

What activities do not require a Shoreland permit?

The following activities are **exempt** and do not require a permit.

- Maintaining existing (as of July 1, 2014) buildings, driveways, gardens, and lawns, without enlarging them;
- Reconstruction of existing impervious areas without increasing or changing the current footprint, such as rebuilding a house, deck or driveway in the exact same footprint;
- Changing one kind of impervious surface for another, such as building a house addition in an area previously occupied by a deck;
- Removal of 250 square feet of vegetation under three feet in height, at least 25 feet from the mean water level, is allowed as long as the Vegetation Protection Standards are met and the duff layer is not removed (see page 6);
- Tree removal and pruning in accordance with the Vegetation Protection Standards (see page 6);
- Removal of dead, diseased or dangerous trees, and invasive species, nuisance plants and noxious weeds;
- Creation of a path to access the lake no more than six feet wide (see page 6) ; and
- Replacement, maintenance, repair or installation of septic systems and potable water systems.

See page 19 for more Exemptions.

What about land within 250 feet of the water, but across a road from the lake?

Land located on the non-lake side of a municipal or state road, but within 250 feet of mean water level, does not have to conform to the Shoreland Protection Act. Land on the non-lake side of a private road, however, does have to comply with the Shoreland Protection Act.

What about non-residential uses within the Shoreland?

Some residential or non-residential land uses regulated pursuant to other state rules may not need a Shoreland permit. See page 19 for further detail.

What activities require approval from Shoreland Permitting?

Certain projects can be approved through a simplified permitting process called **Registration**:

- Creation of up to 100 square feet of cleared area or impervious surface (such as a storage shed or gazebo) between 25 and 100 feet of mean water level; and
- Creation of up to 500 square feet of cleared area or impervious surface more than 100 feet from mean water level, provided the overall percent impervious cover of the parcel is 20% or less, the total cleared area is 40% or less and the slope is less than 20%.

Landowners proposing to carry out a project eligible for Registration should submit a Registration form to Shoreland Permitting. Shoreland Permitting has 15 days in which to review the application. If the landowner does not hear from Shoreland Permitting in 15 days, the landowner may proceed with the project. See page 17 for more detail on Registrations.

What projects require a Shoreland Permit?

Any new cleared areas or impervious surfaces that are not exempt or do not qualify under Registration require a permit.

Redevelopment: many shoreland projects requiring a permit will take place on an already cleared or developed parcel. Permit requirements will vary depending on the pre-existing conditions (i.e., those present as of July 1, 2014), the size of the parcel, and any site characteristics that affect where building can occur. Examples of these projects include but are not limited to:

- Expanding an existing building;
- Expanding a driveway or building a new garage;
- Building a new accessory building;
- Clearing more vegetation, expanding lawns or gardens into wooded areas; and
- Tearing down a building and replacing it on a different footprint.

New development: some shoreland projects will involve new cleared areas or impervious surfaces on an as yet undeveloped parcel. Such a parcel may be wooded, or already partially or totally cleared. Permit requirements will vary depending on the pre-existing conditions (i.e., those present as of July 1, 2014), the size of the parcel, and any site characteristics that affect where building can occur. New development will often include:

- Clearing of existing natural vegetation; and
- Creation of new impervious surfaces such as a house, accessory structure or driveway.

New cleared area or impervious surface on a parcel that was created before July 1, 2014: A principal purpose of the Shoreland Protection Act is to accommodate creation of cleared areas and impervious surfaces in a manner that allows for reasonable development. Some existing parcels may be too small to accommodate full compliance with the standards or include site limitations such as cliffs or wetlands; in theses cases Shoreland Permitting will work with the landowner to determine how to meet the standards to the greatest extent possible.

New development on a parcel created after July 1, 2014: Parcels created after the effective date of the Act must meet the standards. Landowners are urged to ensure new subdivisions of land create parcels large enough to ensure the standards of the Act can be met.

Part Two

Vegetation Protection Standards

Areas of vegetative cover within the Protected Shoreland Area must be managed according to the Vegetation Protection Standards.

Vegetative cover: Mixed vegetation within the Protected Shoreland Area, consisting of trees, shrubs, groundcover and duff. Does not mean grass lawns, noxious weeds or nuisance plants.

Exempt or **allowed** activities within vegetated cover areas include:

- Tree thinning in accordance with the Vegetation Protection Standards (see below);
- Pruning of branches from the lower one-third of a tree's height;
- Removal of 250 square feet of vegetation under three feet in height, at least 25 feet from mean water level, as long as the duff layer is not removed;
- Removal of dead, diseased or dangerous trees;
- Removal of invasive species, nuisance plants and noxious weeds, such as purple loosestrife, buckthorn or poison ivy;
- Creation of a path to access the lake no more than six feet wide; and
- Maintenance of garden or landscaped area, lawns, and beaches in existence as of July 1, 2014.

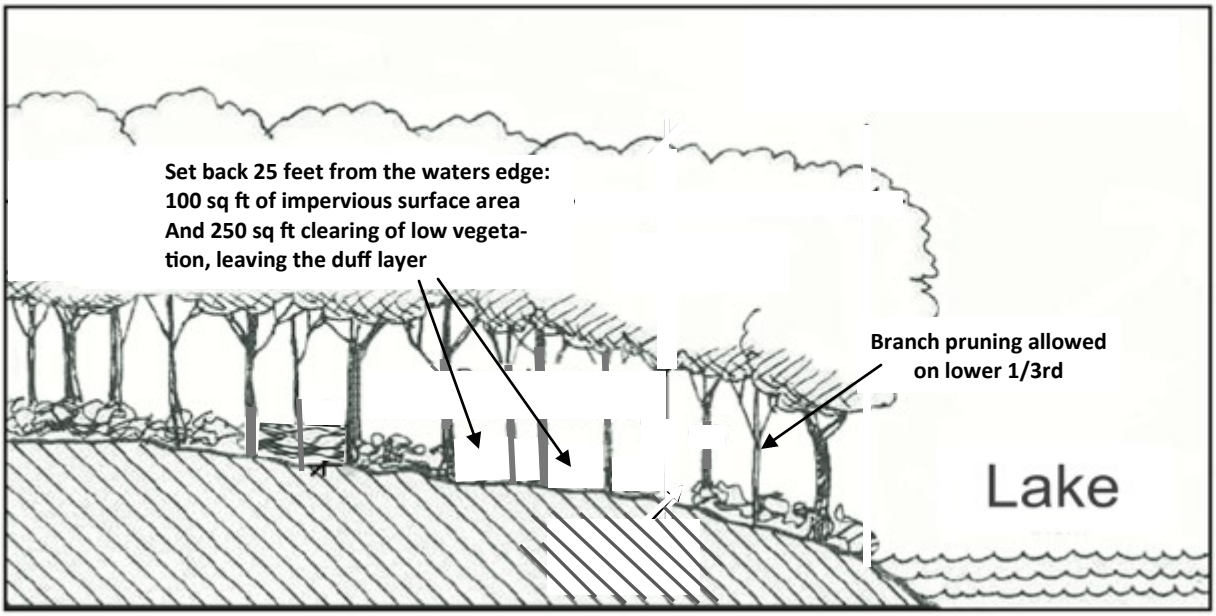
Vegetation clearing activities that can be **registered** include:

- Creation of 100 square feet of new cleared area between 25 and 100 feet of the mean water level.
- Creation of 500 square feet of new cleared area more than 100 feet from mean water level on a parcel, provided the overall percent impervious cover of the parcel is 20% or less and the total cleared area is 40% or less.

All other clearing requires a permit.

Vegetation Protection Standards

Vegetative cover within 100 feet of the mean water level must be managed according to the Vegetation Protective Standards. An existing (as of July 1, 2014) developed or cleared parcel must maintain any areas of vegetative cover remaining on the parcel.



Allowable Practices According to the Vegetation Protection Standards

Applying the Vegetation Protection Standards

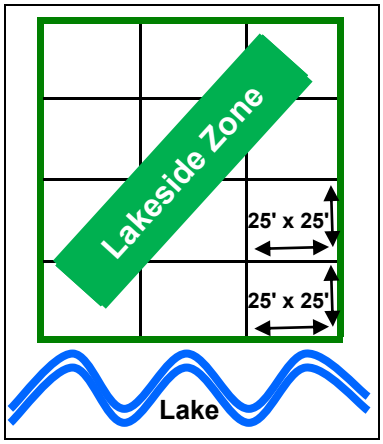
Prior to thinning, Vegetation Protection Standards are applied to a 25 foot by 25 foot section of the Lakeside Zone. Establish a 25 foot by 25 foot plot, starting at the water's edge from the corner of the property that is on your left as you face the lake. As other plots are measured, they will be adjoining but not overlapping one another.

Points are assigned to individual trees, based on the tree diameter at 4 ½ feet, referred to as diameter at breast height (DBH). Within the Lakeside Zone, a 25 foot by 25 foot plot must contain:

- A minimum number of 12 "points" worth of trees before additional tree thinning is allowable;
- At least five saplings (trees less than 2" DBH and greater than 3' in height) before additional sapling thinning is allowable
- The duff and groundcover.

The point and grid system allows the landowner or Shoreland Permitting to determine at any point in time if and how much tree thinning can occur. For more details, see Appendix D.

Step 1. Establish 25' x 25' Plots in the Lakeside Zone



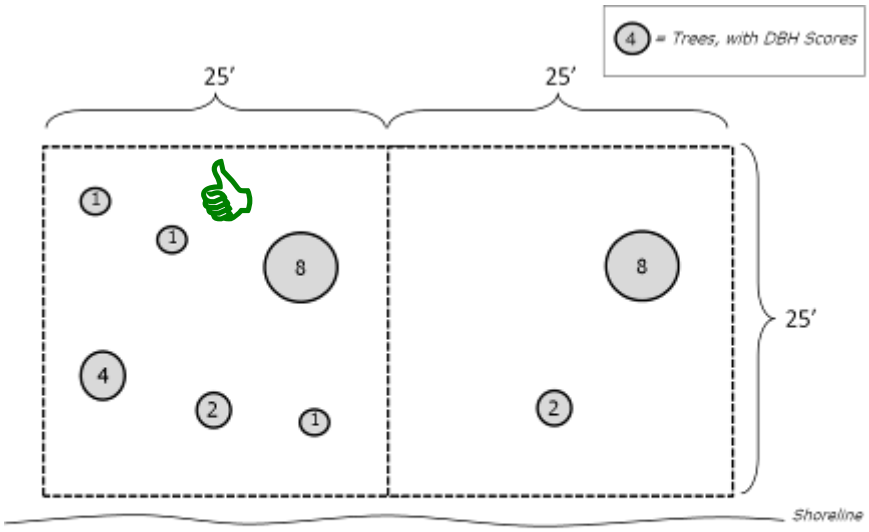
Step 2. Measure the trees in the plot and figure the points each is worth based on the table below.

e.g., 1 point for a DBH of 2 inches to less than 4 inches

Diameter (DBH)	Points
2"-<4"	1
4"-<8"	2
8"-<12"	4
≥12"	8

Step 3. Make Tree Removal Choices in Accordance with the Vegetation Management Practices

This figure represents two adjacent 25 foot by 25 foot managed Lakeside Zone plots. Trees can be removed in plots with more than 12 points, down to no fewer than 12 points. In this illustration, the plot on the left meets the DBH Standard with more than 12 points; the plot on the right does not have enough points with only 10. The left plot could have 5 points worth of trees removed and still meet the standards. If a plot has 12 points or less, no trees can be removed until a sufficient number of points has been achieved through new tree growth.



17 points in 25' x 25' area: Meets vegetation management practices for DBH points

10 points in 25' x 25' area: Does Not Meet vegetation management practices for DBH points

Part Three

Standards for Shoreland Permits

The Shoreland Protection Act requires **registrations** or **permits** for the creation of cleared areas or impervious surfaces in the Protected Shoreland Area that do not meet the exemptions outlined on pages 4 and 19**.** In addition, the Act sets standards for impervious surfaces, cleared areas, and slope. This means:

- New impervious areas within 250 feet of mean water level must be constructed on slopes less than 20%, unless the applicant demonstrates the slope will remain stable, and erosion and impact to water quality will be minimal (see page 10 for more details);
- Total impervious surfaces must be less than 20% of the parcel area located within 250 feet of mean water level , unless Best Management Practices are used to infiltrate the additional runoff (see page 11 for more details); and
- Total cleared area must be less than 40% of the parcel area located within 250 feet of mean water level, unless best management practices are used that are functionally equivalent to a well vegetated area (see page 12 for more details).

Slope: The vertical rise divided by the horizontal run of a plane expressed as a percentage.

Best management practices: Approved activities, maintenance procedures, and other practices to prevent or reduce the effects of impervious surface or cleared area on water quality and natural resources.

Some existing small parcels or those with site limitations will require adjustments in the above standards. In these cases Shoreland Permitting will apply the standards to the greatest extent possible. Consider the following examples:

I have a small parcel, it's all cleared, my camp is located 30 feet from mean water level, and I want to add an addition.

- This landowner may be permitted to expand the house away from the lake and use Best Management Practices. BMPs may include runoff infiltration areas or establishment of shrubs and trees on lake edge.

I have a parcel that is 200 feet deep, my house is 30 feet from mean water level and I have lawn around my house and down to the lake edge. I want to put an addition on my house.

- This landowner may be permitted to expand the house away from the lake, and if the new building increases the impervious coverage above 20%, Best Management Practices will be necessary. A possible Best Management Practice is revegetation of a portion of the near shore and bank area.

I bought an undeveloped parcel in 2002 where the only area with less than 20% slope is within 75 feet of mean water level. I want to build a camp.

- This landowner may be permitted to build on slopes steeper than 20% if they demonstrate that it will remain stable and avoid erosion, or the landowner may be permitted to build on the shallower slope area if needed to avoid slope instability. Because of the small developable area and its proximity to the mean water level, Shoreland Permitting may require a combination of vegetative cover along the lake edge and use of Best Management Practices to infiltrate runoff or limiting overall clearing.

Note: Parcels created after July 1, 2014 are required to achieve the Shoreland Protection Standards to the full extent.

The Protected Shoreland Area

The Shoreland Protection Act applies to the area within 250 feet, measured horizontally, of mean water level on lakes greater than 10 acres. This area is referred to as the Protected Shoreland Area. Understanding the standards and where they apply within the Protected Shoreland Area is easiest to describe, and therefore manage, by breaking the shoreland area into two zones: the Lakeside Zone and the Upland Zone.

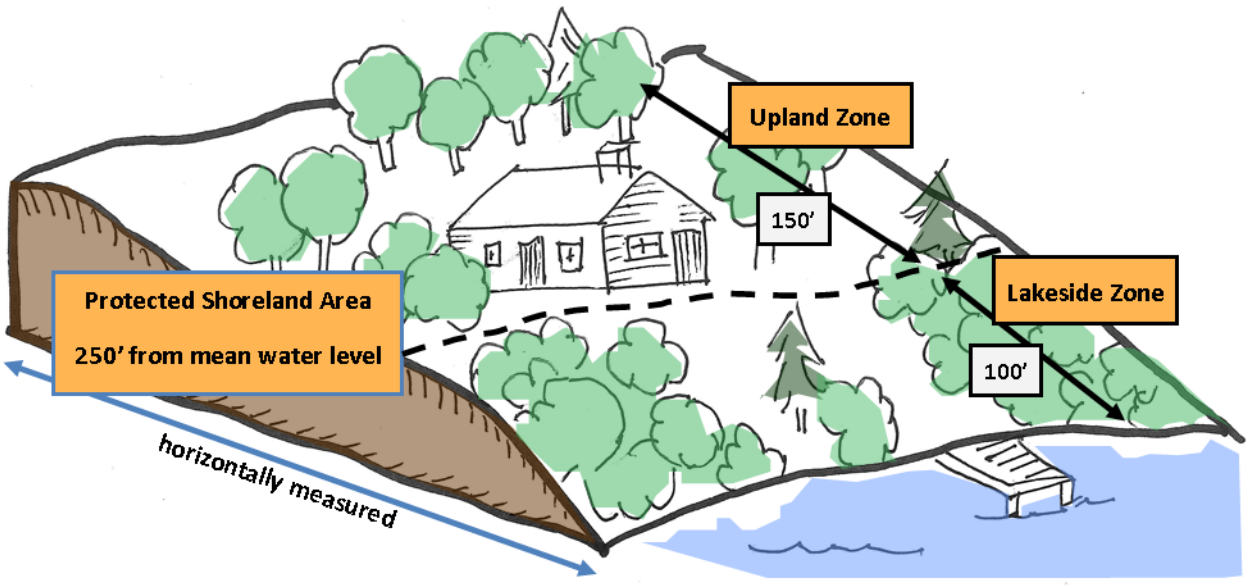
The Lakeside Zone

The Lakeside Zone encompasses the first 100 feet back from mean water level. Activities in this area shall meet the Vegetative Protection Standards. Within the Lakeside Zone, the Shoreland Protection Act limits clearing and creation of impervious surfaces. Many shoreland parcels are already developed within the Lakeside Zone or may be too small for implementation of the full set of standards, particularly the Vegetation Protection Standards and the 100 foot setback of non-exempt impervious surface. The Shoreland Protection Act grants Shoreland Permitting flexibility to permit "non-conforming" parcels.

The Upland Zone

The Upland Zone starts at the edge of the Lakeside Zone (100 feet from mean water level) and extends an additional 150 feet to the outer boundary of the Protected Shoreland Area. On existing lots of sufficient size and new lots created after July 1, 2014, most new development will take place in the Upland Zone. However, many parcels in existence as of July 1, 2014 may be significantly smaller than the full 250 foot depth of the Protected Shoreland Area.

The Protected Shoreland Area Consists of the Lakeside and the Upland Zones



The Twenty Percent Slope Standard

See Appendix B, "Determining Slope" for more information.

The Shoreland Protection Act requires permits be issued for new clearing or construction only on slopes under 20 percent unless the applicant demonstrates the slope will remain stable, and erosion and impact to water quality will be minimal through the use of BMPs.

Since slope can vary greatly within a single property, the slope of interest in terms of preventing erosion and runoff to the lake is for the project site, for instance where the construction of buildings and driveways is proposed. Measure the slope along a 100 feet long axis, intersecting the project site, using the Worksheet "Determining Slope" found in Appendix B. For new development the slope of the proposed project site must be determined before any grading occurs and the land is in its natural condition.

When the shoreland area of the proposed building site has a slope greater than 20 percent, Shoreland Permitting will require the use of Best Management Practices. Selecting appropriate Best Management Practices for challenging sites may require help from a professional (such as an engineer, landscape architect, licensed designer, or other site specialist). It is the responsibility of the applicant to include in their permit application the Best Management Practices as part of their project plan.

Slope Stabilization Best Management Practices

Slope plays an important role in selecting slope stabilizing practices, such as planting techniques and plant species. Below is a list of Slope Stabilization Best Management Practices which may be used when the land slopes greater than 20 percent.

- Waterbars
- Live staking or revegetating cleared areas
- Terracing
- Planting and maintaining vegetated areas
- Drainage ditches
- Establishing No-Mow zones (a means of converting from lawn to mixed species vegetation)
- Infiltration trenches

The Twenty Percent Impervious Area Standard

See Appendix C, "Calculating Percent Impervious Surface Area" for more information.

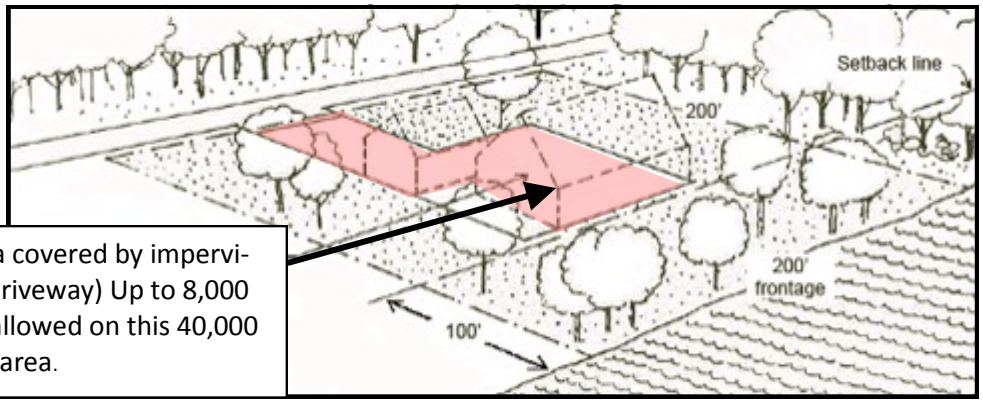
The Shoreland Protection Act requires a permit for new impervious surface area in the Protected Shoreland Area that is not exempt or eligible for Registration. Total impervious area, pre-existing plus new, must cover no more than 20 percent of the parcel area unless BMPs are used to mitigate the run-off from the additional impervious surfaces.

Impervious areas are those man-made surfaces from which precipitation runs off rather than infiltrates. When a public or private road crosses through Protected Shoreland Area, the Shoreland Protection Act dictates the area of the road will not be included the landowner's allowance of 20 percent impervious surface area.

Examples of Impervious Surfaces:

- Paved and gravel driveways, parking areas
- Tennis courts
- Structures (house, shed, garage)
- Decks, patios, large retaining walls
- Other compacted, non-vegetated areas

A Maximum of 20% Impervious Surface is Allowed in Protected Shoreland Area unless BMPs are used.



The pink space shows the area covered by impervious surfaces (house, garage, driveway) Up to 8,000 sq ft of impervious surface is allowed on this 40,000 sq ft lot, as it is 20% of the lot area.

Best Management Practices for Treating Impervious Surface Areas

Below is a list of Best Management Practices that can help to offset the impacts caused from impervious surface areas. These practices help slow, soak in and spread out runoff flowing off of impervious areas. It may be possible to use one or a combination of several of these techniques when applying for a project that will either exceed the 20 percent impervious surface area standard or is located on a parcel that already has more than 20 percent impervious surface area.

- Rain Gardens
- Vegetated Swales and/or Berms
- Waterbars
- Pervious Pavement
- Drip-line Trenches
- Infiltration Trenches
- Planting and maintaining vegetated areas
- Drainage Ditches
- No-Mow Zones

The Forty Percent Cleared Area Standard

See Appendix D, "Calculating Percent Clearing" for more information.

The Shoreland Protection Act requires a permit for new cleared area in the Protected Shoreland Area that is not exempt or eligible for Registration. Total cleared area, pre-existing plus new, must cover no more than 40 percent of the parcel area unless Best Management Practices are used to mitigate the loss of vegetated cover.

Clearing is defined as areas where the vegetative cover, soil, tree canopy, or duff layer is permanently removed or altered, except when managed according to the Vegetation Protection Standards. Certain maintenance activities such as roadside or utility cutting are exempt. See page 19 for a more detailed list of exempt activities.

Examples of Cleared Areas:

- Grass Lawns
- Gardens
- Landscaped areas
- Some pathways
- Impervious surfaces (driveways and buildings)

Exemptions for Cleared Areas:

- Tree cutting in accordance with the Vegetation Protection Standards
- Private or public road work
- Invasive species plant management work
- Utility line maintenance

Clearing for a six foot wide path to the lake may count towards the 40 percent clearing area standard. Clearing up to 250 square feet of vegetation under three feet tall, at least 25 feet from the Mean Water Level, does not count because the duff and tree canopy would remain.

Best Management Practices for Cleared Areas

The options for replacing natural shoreland vegetation with Best Management Practices that offer equivalent benefits are limited because there are not comparable man-made techniques that offer aquatic and wildlife habitat and natural woodland functions equivalent to what nature provides. Revegetation, establishing plantings in other already cleared areas within the Protected Shoreland Area, is one preferred Best Management Practice. Shoreland Permitting gives preference to revegetation that is:

- Proximate to lake;
- contiguous with established vegetated areas, e.g., a neighboring protected Lakeside Zone; and
- contains a diverse composition of native plants.

Terminology

Best Management Practices: Approved activities, maintenance procedures, and other practices to prevent or reduce the effects of impervious surface or cleared area on water quality and natural resources.

Cleared Area: An area where existing vegetative cover, soil, tree canopy, or duff has been permanently removed or altered.

Duff or Duff Layer: Leaf litter plus small fragments of plants and organic debris that provide a spongy substrate that absorbs the energy of falling water and allows runoff to infiltrate soil.

Existing Development: All disturbed areas, including cleared areas and impervious surfaces and permanent structures, such as structures, driveways, decks, patios; as well as landscaped features like lawns gardens, and pathways, and any graded, cleared or excavated areas necessary for construction or infrastructure, that were in existence prior to July 1, 2014.

Expansion: An increase or addition of impervious or cleared area.

Footpath: A footpath or passageway, six feet wide or less, that provides access to the lake and may include both pervious and impervious surfaces such as stairs, landings, or platforms.

Footprint: The total area that an impervious surface covers on a horizontal plane, including decks, driveways, patios, structures, overhangs, balconies, or cantilevered constructed spaces that expand beyond a structure's foundation.

Impervious surface: Manmade surfaces, including paved and unpaved roads, parking areas, roofs, driveways, and walkways, from which precipitation runs off rather than infiltrates.

Lakeside Zone: The portion of the Protected Shoreland Area surrounding the lake as measured horizontally 100 feet from the mean water level.

Mean Water Level: The mean water level of a lake as defined in the Rules for Determining Mean Water Level.

Non-Conforming Parcel: A parcel in existence as of July 1, 2014 on which it is impossible to locate cleared area or impervious surface at least 100 feet from the Mean Water Level.

Parcel: A portion of land or tract of land with defined boundaries created by dividing the land by sale, gift or lease, mortgage foreclosure, court-ordered partition or decree, or filing of a plat, plan, or deed in the records of the municipality where the act of division occurred.

Stormwater Runoff: precipitation or snowmelt that does not infiltrate into the soil, including material dissolved or suspended in it, but does not include discharges from undisturbed natural terrain or wastes from combined sewer overflows.

Protected Shoreland Area: All land located within 250 feet of the mean water level of a lake that is greater than 10 acres in size; comprised of the Lakeside Zone and the Upland Zone.

Slope: The vertical rise divided by the horizontal run of a plane expressed as a percentage.

Upland Zone: The portion of the Protected Shoreland Area as measured horizontally between 100 and 250 feet from the mean water level.

Vegetative Cover: Mixed vegetation within the Protected Shoreland Area, consisting of trees, shrubs, ground cover, and duff.

Vegetation Protection Standards: The criteria used to maintain healthy shoreland vegetation within the Lakeside Zone.

Measurements Required By the Shoreland Protection Act

Understanding these measurements will help landowners follow the shoreland protection standards and complete the registration and permit application forms.

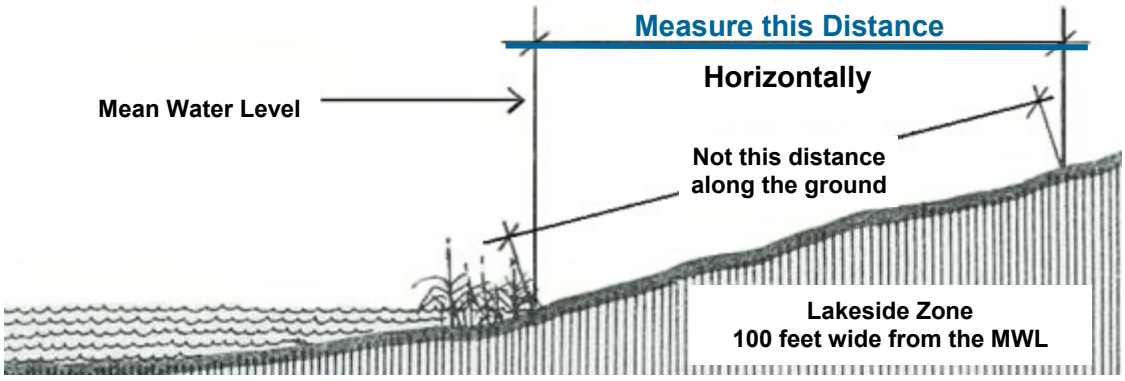
Mean Water Level

Some large lakes, like Lake Champlain and Lake Memphremagog, have established summer water level elevations that are considered the mean water level. Other lakes have summer water levels set through a dam permit or by records kept over many years by the Vermont Department of Environmental Conservation. However, on most lakes, mean water level must be estimated by making observations about the extent of the terrestrial plant growth along the shoreline during the summer season. Consult the worksheet, "Estimating Mean Water Level," for more details, Appendix A.

Mean Water Level

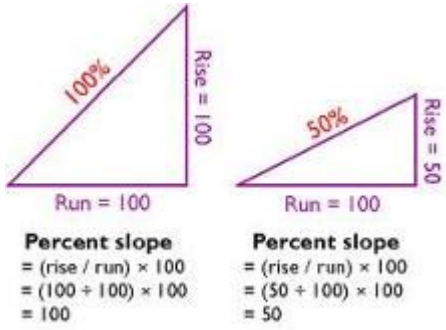
Horizontal Measurement

The 100 foot width of the Lakeside Zone as well as the 250 foot width of the Protected Shoreland Area are measured horizontally from the mean water level, regardless of slope. Refer to the graphic below. The worksheet, "Determining Shoreland Area," provides a table that converts "sloped" distance along the ground to "horizontal " distance, Appendix B.



Percent Slope Measurement

The slope of a land area, also called the grade, is expressed as the number of feet the land rises or falls over a given distance of the land. Stormwater runoff from steeper sites carries more velocity and potential for erosion than from flat areas. Therefore, slope is also an important factor in selecting erosion control practices like planting techniques and plant species for stabilizing steep banks. The worksheet, "Determining the Slope of Your Shoreland," explains methods for calculating the slope of a building site, Appendix C.



Change in Elevation (rise) ÷ horizontal distance (run) x 100 = % Slope

Percent Clearing

Percent clearing refers to all the spaces cleared within the Protected Shoreland Area. It includes footpaths, lawns, recreational areas, and impervious surfaces such as structures and driveways. To calculate the percent clearing of a parcel within the Protected Shoreland Area, add up the area of all these cleared spaces and divide it by the area of your lot within the Protected Shoreland Area and then multiply it by 100. Town or state roads crossing through your property do not have to be included as cleared areas in your calculations.

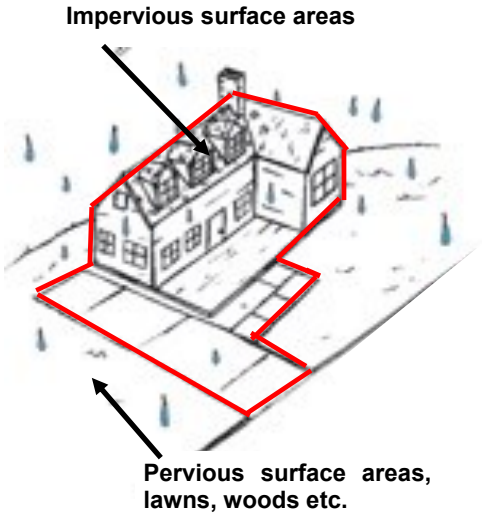
To best figure out the total percent clearing, use the "Calculating Percent Clearing Worksheet," Appendix E.

This property has a high percent of cleared area.

Percent Impervious Surface

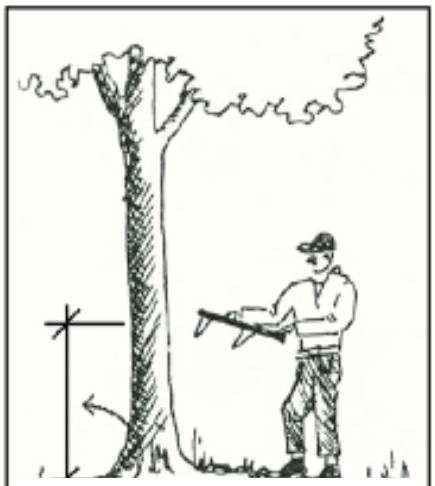
Impervious surfaces are manmade surfaces, including paved and unpaved roads, parking areas, roofs, driveways, and walkways, from which precipitation runs off rather than infiltrates. A higher volume of runoff results in higher flow velocity, increasing erosion and the amount of unfiltered stormwater entering and polluting the lake.

Calculating the percent impervious area on a parcel involves measuring the length and widths of various components, knowing the size of the parcel, and using some simple geometry equations. Town or state roads crossing through your property do not have to be included as impervious areas in your calculations. For more detail, use the "Calculating Percent Impervious Surface Worksheet," Appendix F.



Diameter at Breast Height (DBH)

DBH refers to the diameter of a tree measured 4½ feet above the ground. By measuring the circumference of the tree and using a simple geometric equation, the diameter is calculated. This measurement is used in the "point and grid" system to measure tree density in the Lakeside Zone. The Vegetation Protection Standards use this measurement to calculate the acceptable composition of vegetation needed to establish and maintain a healthy lakeshore.



Measure tree diameter at 4 1/2 feet above ground

Part Four

Permits and Application Process

Overview

The Vermont Shoreland Protection Act is administered by Shoreland Permitting. Permits may be required for certain projects, while Registrations may be the only requirement for some other smaller types of projects. Below are some steps to take to begin the Shoreland permitting process.

1. Decide whether your proposed shoreland project is one of the **exempt** or allowed **activities.** See pages 4 and 19 for lists. If your project is exempt or allowed, you may proceed without a permit from Shoreland Permitting. (Note: it is possible your project may need other state or local permits.)
2. If your proposed project is not exempt or allowed, contact your regional Shoreland Permit Analyst directly (see page 3 for contact information). Your regional analyst may decide to schedule a site visit with you to gather additional information or discuss the options for completing the project under the Shoreland Protection Act standards.
3. If your proposal qualifies as a **Registration** project, fill out the Registration form found on the Shoreland Permitting website, or contact your regional analyst and ask for one to be mailed to you. Once the submitted form is deemed complete by Shoreland Permitting (i.e., all the required information is provided and the fee is paid) the Program has 15 days in which to review the application. If the landowner does not hear from the Program in 15 days, they may proceed with the project.
4. If your proposal needs a Shoreland **Permit**, complete the Permit Application Form found on the Shoreland Permitting website, or contact your regional analyst and ask for one to be mailed to you. If you haven't yet spoken with your regional analyst, it might be helpful to do so to ensure you understand what information needs to be supplied on the application form. Once the application is deemed complete by the Program (i.e., all the required information is provided and the fee is paid) it will be placed on a required 30 day public notice. Shoreland Permitting expects to issue permit decisions shortly after the public notice period is up, unless there are still outstanding permit issues to address.

Some of the things you will need to know to complete the Registration or Permit Application forms:

- Parcel size within 250 feet of mean water level
- Location of mean water level (Appendix A)
- Area on the parcel occupied by impervious surfaces (see Appendix F)
- SPAN number (an identification number for the parcel found on town tax maps)
- Distance from mean water level to all impervious surfaces, such as houses, accessory buildings, and driveways.
- Area of the parcel consisting of cleared area (see Appendix E)
- Slope of the parcel (see Appendix B)

Registration Process

The Shoreland Registration Form is available as a PDF and as a Word document from the Shoreland Permitting webpage:
http://dec.vermont.gov/watershed/lakes-ponds/permit/shoreland

- Contact - Contact Shoreland Permitting staff with any questions before you begin planning your project (see page 3 for contact information).
- Registration Form - Submit a complete Shoreland Registration Form to Shoreland Permitting. Once deemed "administratively complete," ANR will post the Registration Form on their website for 15 days for informational purposes. Registration applications are not subject to the same public notice process as permit applications.
- Waiting Period - The registration applicant must wait 15 days after submitting their complete Registration Form before starting their proposed project, unless otherwise notified by Shoreland Permitting. During this period of time, Shoreland Permitting may request additional information or may notify an applicant that a Shoreland Permit is required for the project rather than a Registration. If an applicant is not notified by Shoreland Permitting, other than a confirmation that a Registration Form was received, after 15 days their project is automatically approved.
- Land Record Recording - The Permittee will record a copy of the Registration in the land records of the municipality in which the permitted project is located.
- Permit Expiration - Registrations are issued for an indefinite period of time provided the landowner complies with the requirements of the Registration and takes no additional action for which a permit is required.

Registration Fee

Description	Fee
Registration	$100.00

Permit Application Process

The Permit Application Form is available as a PDF and Word document from the Shoreland Permitting webpage: http://dec.vermont.gov/watershed/lakes-ponds/permit/shoreland

- Contact - Contact Shoreland Permitting staff with any questions before you begin planning your project (see page 3 for contact information).
- Application - Submit a complete Shoreland Permit Application to Shoreland Permitting that includes all project details as specified in the Application Instructions.
- Public Notice - At the time an applicant submits a permit application to ANR, they shall also provide a copy of the application form to the municipal clerk of the municipality in which the impervious surface or cleared areas are proposed. The municipality may post the application in the town clerk's office.
- Application Confirmation - Upon receipt of an application, program staff will determine if it is contains all the required information (deemed administratively complete). Shoreland Permitting will then post the application on their website for 30 days to provide the public and interested persons an opportunity for written comment, which will take place concurrently with Shoreland Permitting's permit application review. Program staff may also request additional technical information, or schedule a site visit with the applicant if necessary and discuss any needed changes in the project plan.
- Permit Decision and Notification - Upon close of the public notice period, Shoreland Permitting will notify the applicant of its decision to issue or deny a Shoreland Permit. Upon issuance of a decision, the applicant and interested persons will be notified of the decision, and be provided a copy of the decision or with information about where a copy of the decision can be obtained.
- Land Record Recording - The permittee will record a copy of the permit in the land records of the municipality in which the permitted project is located.
- Permit Expiration - Shoreland permits are issued for an indefinite period of time provided the permittee complies with the requirements of the permit and takes no additional action for which another permit is required.

Permit Fees

Description	Fee
Permit	
Administrative Fee	$125.00
Proposed Impervious Area	$0.50 per square foot

Exempt Non-Residential Activities

On Vermont lakes, in addition to residential uses, shoreland development can consist of uses other than residential: urban or downtown areas; marinas; resorts; and state and local road systems. Other non-residential types of shoreland development include providing public access to the lake through State Parks, Fish and Wildlife Access Areas, or town beaches. Certain of these activities are specifically exempt under the Shoreland Protection Act because they are addressed through other permit programs or standards.

Roads

Repair or maintenance of state, town, or private roads within the Protected Shoreland Area is exempt. Work on town roads must follow the Vermont Agency of Transportation Town Road and Bridge Standards ("Orange Book" Section 7.1) for controlling stormwater runoff and direct discharges to surface waters. Road re-pairs or improvements do not count toward a private landowner's maximum allowance for percent clearing or impervious surface area.

Property Sub-division

The Shoreland Protection Act does not set minimum parcel sizes and this jurisdiction is often part of municipal zoning. In addition, requirements under the state Wastewater System and Potable Water Supply Rules, creation of new lots must be permitted to ensure each new lot can accommodate both wastewater disposal and a drinking water well. In order for shoreland development on parcels created after July 1, 2014 to be permitted under the Shoreland Protection Act, parcels must be large enough to meet the Shoreland Protection Act standards. It is very important that new shoreland parcels, intended for development, be created large enough so the landowner will be permitted to build and develop the parcel as they had planned. (See also 2007 Vermont Wastewater System and Potable Water Supply Rules.)

Forestry Practices

Silvicultural activities within the Protected Shoreland Area must be in compliance with a Forest Management Plan approved by the Commissioner of the Vermont Department of Forests, Parks and Recreation and the Acceptable Management Practices For Maintaining Water Quality On Logging Jobs In Vermont. For more information contact your County Forester.

Agricultural Practices

Agricultural practices in existence before July 1, 2014 within the Protected Shoreland Area, must comply with the Accepted Agricultural Practices. Contact the Vermont Agency of Agriculture, Food and Markets for more information on acceptable farming practices near surface waters.

Vermont Wastewater Rules

The Vermont Drinking Water and Groundwater Protection Division administers the 2007 Wastewater System and Potable Water Supply Rules. A permit is necessary for all new wastewater systems or replacement or modification of existing systems. The most common reason for modification or replacement is the failure of an existing system. Permit information specialists are located in District Offices, see page 22 for specific contact information.
Contact information: Permit Specialist, (800) 823-6500 or
http://dec.vermont.gov/water/ww-systems

Part Five

Resources and Contacts

Other Vermont State Permit Programs

Although the Shoreland Protection Act is intended to avoid duplicate state permits as much as possible, in some cases more than one state permit may be required for development in shorelands. Below is a listing of several other state permit programs that may overlap with Shoreland Permits. In addition to the program information listed below, contact the Permit Specialists in the Agency of Natural Resources District Offices (see Page 22) for assistance identifying other permits that may be needed for your project.

Lake Encroachment Permitting

The jurisdiction of Lake Encroachment Permitting starts at mean water level and extends lakeward. If you have a project that involves work beyond the mean water level, then you may need to obtain a permit from Lake Encroachment Permitting. Examples of jurisdictional projects include shoreline stabilization, retaining wall replacements, fill, dredging, construction or commercial docks. If you have a project that is located onshore as well as in the water, you may need both a Lake Encroachment and Shoreland permit. In this case, the permit administrators of these programs will be coordinating to avoid duplication and delays. Contact your regional Shoreland Permit Analyst for more information.

Aquatic Nuisance Control Permit Program

An aquatic nuisance control permit is required to control nuisance aquatic plants or animals in Vermont surface waters using physical, chemical, biological or mechanical means. Permits are administered by this program for pesticides; pond dyes used to control algae or aquatic plants; copper based algaecides; chemicals other than pesticides; bottom barriers; powered mechanical devices; structural controls; and biological controls. Hand pulling aquatic plants is permissible without a permit. Contact the Aquatic Nuisance Control Permit Program Coordinator for more information, (802) 490-6133.

Wetlands Program

Under the Vermont Wetlands Rules, wetlands are defined and managed according to functions and values and are grouped as Class I, II, or III wetlands. Class I wetlands have a required 100 foot buffer zone Class II have a 50 foot buffer zone. Allowed activities in a wetland buffer zone are limited and would require a permit from the Wetlands Program. There will be some lake shoreland areas that are also jurisdictional wetlands and a permit may be needed from both the Wetlands Program and Shoreland permitting. In this case, the permit administrators of these programs will be coordinating to avoid duplication and delays. Contact your District Wetland Ecologist for more information (http://dec.vermont.gov/watershed/wetlands/contact).

Stream Alteration Program

Under the Vermont Stream Alteration Rules, perennial streams are defined and managed to avoid flood and erosion hazards and prevent significant damage to fish life and wildlife and the rights of riparian owners. The Program provides technical assistance and regulates activities which involve: 1) the movement, fill, or excavation of 10 cubic yards or more of instream material within the top-of-bank to top-of-bank, cross-sectional limits of perennial streams; 2) activities to construct or maintain a berm in a flood hazard area or stream corridor; and 3) instream emergency protective measures.
Contact the Stream Alteration Program for more information, (802) 490-6195.

Role of Municipalities

A Shoreland Permit applicant will need to also obtain any applicable town permits, as both municipal zoning and the Shoreland Protection Act applies to parcels within the Protected Shoreland Area.

The municipality in which your project is located may have been delegated to administer its own functionally equivalent shoreland standards, in which case you will not need a state Shoreland Permit, just a municipal permit. For a listing of the towns delegated to implement the shoreland standards on the local level, check the Shoreland Permitting web site, or contact Shoreland Permitting or your municipal office.

Under the Shoreland Protection Act municipalities can apply for delegation to administer permit construction of impervious surfaces and cleared areas within their town. Shoreland Permitting will review delegation requests and enter into a delegation agreement with municipalities whose bylaws or ordinances are found to be "functionally equivalent" to the state standards. At any time municipalities can adopt or improve their shoreland zoning in order to be eligible for delegation. The model shoreland ordinance, *Model Lake Shoreland Protection District Bylaw*, provided by the Vermont League of City and Towns, is considered functionally equivalent. Other ordinances may also be eligible for delegation. If a municipality applies to the state for delegation, then the municipality must also demonstrate that they have the capacity to administer their bylaws or ordinances in accordance with the agreed upon terms of the delegation agreement. Towns can contact Shoreland Permitting for more information (see page 3 for contact information).

Vermont Agency of Natural Resources Contacts

Main Offices:

Vermont Agency of Natural Resources
Secretary's Office
1 National Life Drive, Davis 2
Montpelier, Vermont 05620-3901
phone: (802) 828-1294

Dept. of Environmental Conservation
DEC Commissioner's Office
1 National Life Drive, Main 2
Montpelier, Vermont 05620-3520
phone: (802) 828-1556

VERMONT DEPARTMENT OF ENVIRONMENTAL CONSERVATION
WATERSHED MANAGEMENT DIVISION
LAKES & PONDS PROGRAM

1 National Life Drive, Main 2,
Montpelier, Vermont 05620-3520,
phone: (802) 828-1535

Regional Offices:

Barre
5 Perry Street
Barre, VT 05641
(802) 476-0190

Essex
111 West Street
Essex Junction, VT 05452
(802) 879-5656

Rutland
450 Asa Bloomer State Office Building
88 Merchants Row
Rutland, VT 05701
(802) 786-5900

Springfield
100 Mineral Street
Springfield, VT 05156
(802) 885-8855

St. Johnsbury
1229 Portland Street — Suite 201
St. Johnsbury, VT 05819
(802) 751-0130