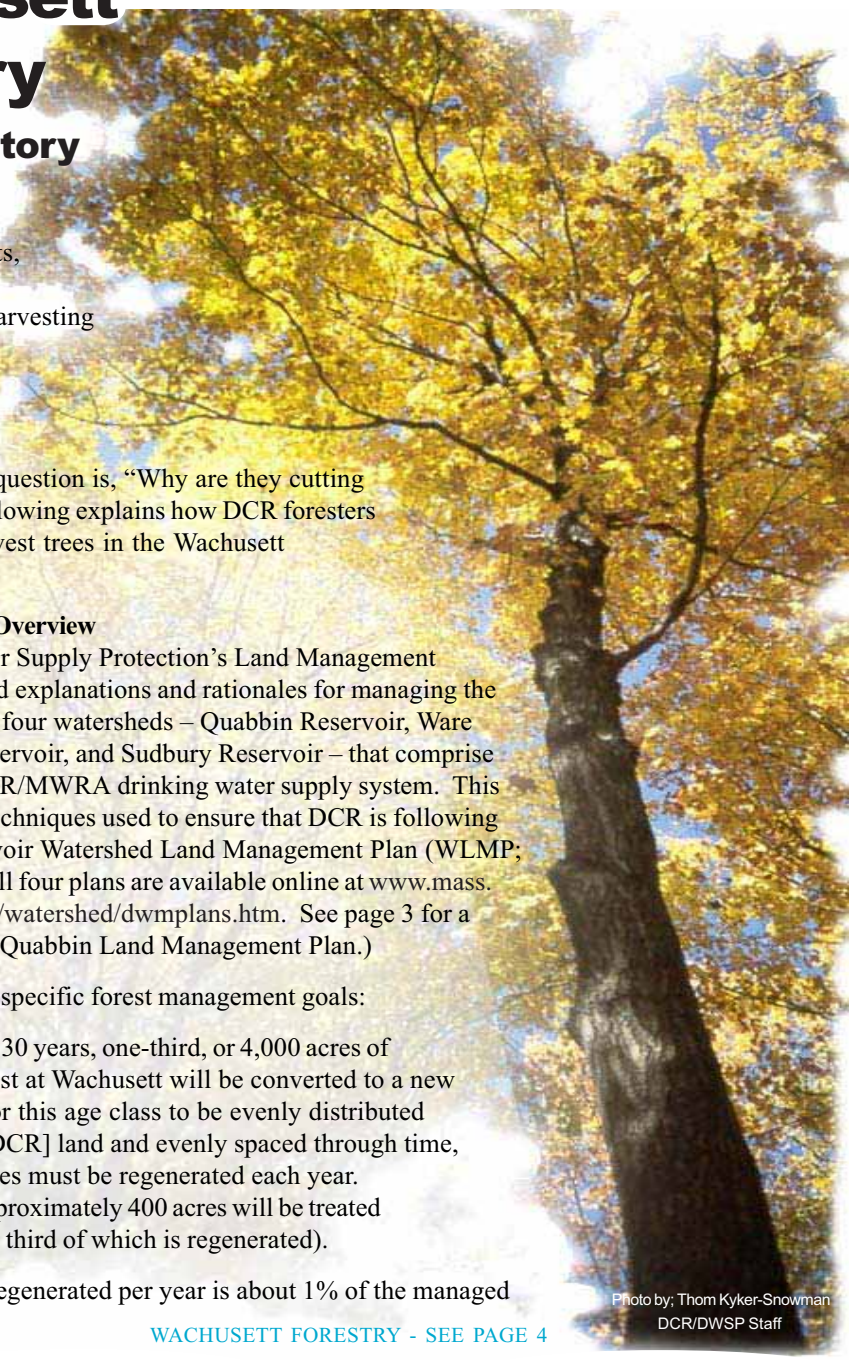
Wachusett Forestry

The 'Hole' Story



Traveling around central Massachusetts, one will inevitably notice some timber harvesting operations on DCR land. People often ask, "Why are they cutting down trees?" Frequently, the next question is, "Why are they cutting *those* trees?" The following explains how DCR foresters choose where to harvest trees in the Wachusett Reservoir watershed.

Forest Management Overview

The Division of Water Supply Protection's Land Management Plans provide detailed explanations and rationales for managing the forests in each of the four watersheds – Quabbin Reservoir, Ware River, Wachusett Reservoir, and Sudbury Reservoir – that comprise the source for the DCR/MWRA drinking water supply system. This article explores the techniques used to ensure that DCR is following the Wachusett Reservoir Watershed Land Management Plan (WLMP; the complete text of all four plans are available online at www.mass.gov/dcr/waterSupply/watershed/dwmplans.htm. See page 3 for a separate story on the Quabbin Land Management Plan.)

The WLMP contains specific forest management goals:

> Over the next 30 years, one-third, or 4,000 acres of managed forest at Wachusett will be converted to a new age-class. For this age class to be evenly distributed throughout [DCR] land and evenly spaced through time, about 130 acres must be regenerated each year. Therefore, approximately 400 acres will be treated annually (one third of which is regenerated).

The 130 acres to be regenerated per year is about 1% of the managed

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Photo by; Thom Kyker-Snowman
DCR/DWSP Staff

In This Issue:

As summer fades and the trees change over to festive fall colors, it's time to take a moment to appreciate their life cycle and how it affects the surrounding environment. Poets have seen trees as something of permanence, but as a tree takes root, grows to maturity and is replaced by another, it interacts with its surroundings in subtle ways, such as the cooling shade or uptake and release of moisture. DCR foresters very closely observe and understand this process.

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NUMBER 18
Fall 2007

dcr Massachusetts

Department of Conservation and Recreation
Division of Water Supply Protection
www.mass.gov/dcr/waterSupply.htm

Fishing Line Follow-Up

First Season Success for Fishing Line Recycling at the Wachusett Reservoir

J Taylor

In the previous issue of *Downstream*, new efforts were announced to eliminate discarded fishing line along the shores of the Wachusett Reservoir. This update answers several questions about the Fishing Line Recycling Program.

The Wachusett Reservoir is very popular with local fishermen, most of whom are good stewards of the environment. However, carelessly discarded fishing line was becoming an increasingly serious problem – wildlife were becoming entangled, usually with fatal results. The Fishing Line Recycling Program was started at the beginning of the 2007 fishing season to help keep the reservoir pristine and to stop the needless loss of wildlife.

Please Recycle Your Old Fishing Line!

To date, 10 fishing line recycling canisters have been set out at various locations around the Wachusett Reservoir. The recycling canister shown at left has been located near the Old Stone Church at the Wachusett Reservoir for this past summer's fishing season. The fishing line recycling program reports a very successful first season, estimated to have collected nearly 33,000 feet (almost 6 miles!) of line at the Wachusett Reservoir. Canisters have also been placed at the 3 Quabbin Reservoir fishing areas with excellent results. Next spring, more canisters are expected to be installed at both reservoirs in anticipation of even greater success as well as safer, healthier wildlife.

- Paula Packard -DCR/DWSP Aquatic Biologist

Photo; J Taylor.

What are the goals of the Fishing Line Recycling Program?

- To raise awareness of the danger that discarded fishing line poses to wildlife.
- To enable fishermen to dispose of line easily and safely.
- To reduce the loss of wildlife due to entanglement.
- To responsibly recycle fishing line.
- To reduce line at landfills, where it can blow away threatening additional wildlife.
- To keep the reservoir water clean.

What species are affected by improperly disposed fishing line?

- Birds, especially diving birds such as loons, mergansers, and cormorants. Ducks and geese may become entangled in line along the shore. Balls of fishing line have been retrieved from eagle and osprey nests.
- Muskrats, otters and beavers may become entangled in line as they dive for food. Any mammal that utilizes the shoreline may also be affected.
- Turtles can also become entangled by fishing line.

What happens to animals that become trapped by fishing line?

Fishing line is unlike anything found in nature – it is fine, very strong and remains a threat for years. When an otherwise healthy animal is snared by line, capture by a predator may be preferable to what would otherwise be inevitable suffering. Drowning may result if the animal is entangled under water and can not reach the water's surface. Loons and diving birds may still be able to swim and get air, but they become increasingly weary as they struggle with this burden, eventually becoming so weak that they succumb to starvation, exposure to the elements, or predation. Death as a result of entanglement in fishing line is usually a slow, painful process.

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The Quabbin Land Management Plan Update

The Quabbin Reservoir on a quiet fall morning. Photo: DCR/DWSP Staff

The Land Management Plan for the Quabbin Reservoir watershed has been updated by the Division of Water Supply Protection, Office of Watershed Management. The *2007-2017 Quabbin Land Management Plan* sets out principles, goals, and objectives for managing DCR owned land in the Quabbin Reservoir watershed, with the express purpose of protecting the public water supply for the next ten years. The plan provides principles from the current state of the science of watershed and natural resources management. It also states agency goals, and specific objectives for accomplishing these in the areas of Land Protection, Forest Management, Wildlife Management, Management and Protection of Biodiversity, and Cultural Resources Protection. The plan builds on advancements in science and management techniques, the agency's own experience over six decades of managing the watershed and its resources, and accumulated input from advisory groups and the concerned public. It is designed as an adaptive plan, utilizing annual reviews to build immediately on new information and changes in the science that supports management decisions, and revising objectives, as necessary, within the ten year time frame of the plan.

The plan continues DCR's on-going efforts to establish an uneven aged forest. The mix of forest types and ages across the watershed at any given time produces a predictable volume of water delivered to the reservoir, while the inherent diversity in species composition provides the watershed forest with a level of redundancy in maintaining itself that rivals the most responsibly engineered water treatment plant. The diverse structure in the living green filter across the watershed, like diversity in an investment portfolio, yields more consistent performance through the vagaries of climate fluctuations, wind, snow, ice, rainfall intensity, and damaging native and alien pests than a forest (or an artificial filter) built to a single design. The range in structural and species composition across the forested watershed represents built-in multiple barriers, providing a forest biofilter that functions 24 hours a day on free solar

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Reservoir Watch - What's Happening on the Water

Recently you may have noticed that the water level at the Wachusett Reservoir is low. This is due to work being performed on the Wachusett Dam spillway.

This project includes disassembly of the old manually operated wooden stop log system used to regulate the water level and lowering of the spillway crest by two feet. New hydraulically-operated steel crest gates will be installed to control reservoir water level. The downstream channel (sometimes called the "waste weir" because at one time water through the spillway was considered "wasted") will be expanded with a new channel around the historic arch railroad bridge, which will remain as a public access point.

The combination of new crest gates and auxiliary discharge channel will allow the reservoir to safely pass the Probable Maximum Flood, further protecting the integrity of the main dam.

DCR/DWSP Quabbin Visitors Center

North Dike structural improvements are also part of this project, where rock from the new auxiliary channel will be placed behind about 800 feet of the Dike for added structural stability.

The crest gates are scheduled to be installed and tested by December 2007. The auxiliary discharge channel is open but will see structural and cosmetic work for several more months and Dike stabilization work is currently underway.

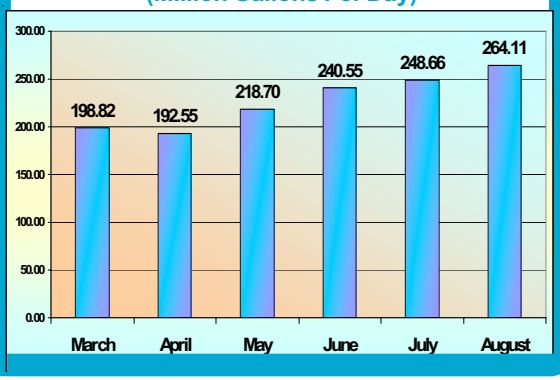
Data and text provided by MWRA

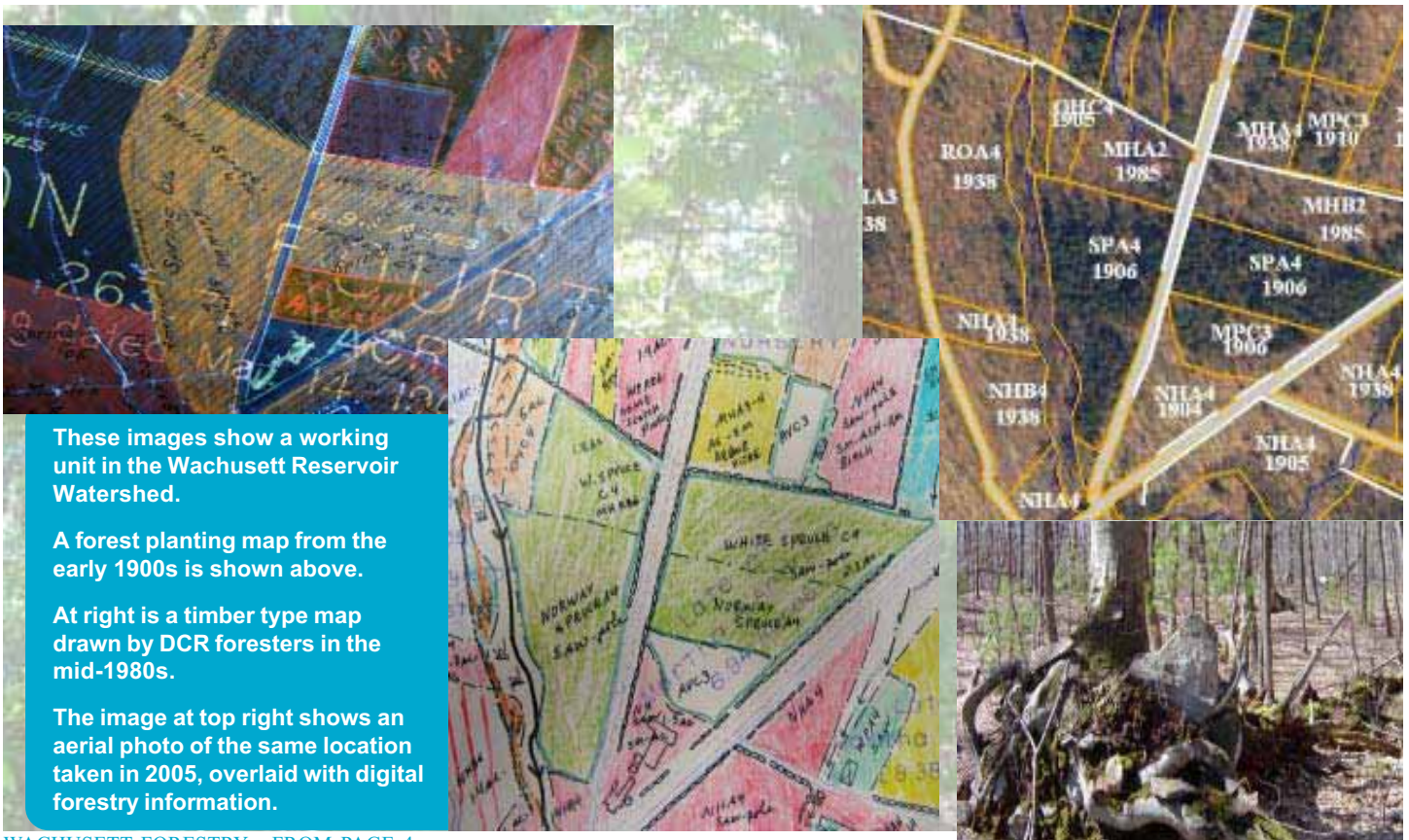
Reservoir Levels and 6-month Precipitation

Reservoir	Quabbin	Wachusett
Minimum*	526.60'	387.71'
Percent Full	93.7%	85.3%
Date	8/31/07	8/17/07
Maximum*	530.79'	394.57'
Percent Full	101.6%	99.1%
Date	4/18/07	4/19/07
Precipitation	22.4"	10.9"
(Seasonal Avg. = 23.9")		

*Reservoir Depth in Feet Above Mean Sea Level

2007 System-wide 6-Month Water Usage (Million Gallons Per Day)





These images show a working unit in the Wachusett Reservoir Watershed.

A forest planting map from the early 1900s is shown above.

At right is a timber type map drawn by DCR foresters in the mid-1980s.

The image at top right shows an aerial photo of the same location taken in 2005, overlaid with digital forestry information.

Above: A tip-up mound, of what was once a white pine blown down in the hurricane of 1938. Evidence of the original tree can be seen on the right as a birch tree has grown in the exposed soil.

WACHUSETT FORESTRY - FROM PAGE 4

forest at Wachusett. This is well within the estimated rate that the forests of southern New England would naturally regenerate due to small-scale disturbances. Significant scientific evidence suggests that the Wachusett watershed forest is well adapted to disturbance that occurs at this rate, and that biodiversity and over-all ecological integrity is best maintained by working within this natural pattern.

A "working unit" is a block of land treated as a single timber sale area; there are over 300 working units averaging about 50 acres each. To provide resilience to catastrophic wind events as well as varied habitats for the mix of plant and animal species that depend on these forests, DCR strives for working units to contain a mosaic of at least three age classes. A diverse mix of species well-suited to the soils on which they are growing is an additional goal for the regenerated forests, which will also limit DCR's need to re-enter a working unit to every 25-35 years in order to release another age class.

How Old?

It's easy to conclude that if forest management is based on age structure, then it is important to know the current age distribution. Most managed forests are mapped to some extent into "stands," areas of similar species and sizes. Mapping of the Wachusett forests began in the early 1980s and continues as new lands are purchased. The categories used for mapping timber are traditionally based on tree species, stem density, and average diameter and height; these characteristics, however, only loosely approximate age. This system, though useful, lacked the precision required to implement the WLMP. A "year of origin" was needed for every mapped stand, which meant estimating ages for the standing trees, unless previously recorded information could be referenced.

Maps: From Paper to Computer

DCR began shifting its Wachusett forestry mapping from paper to GIS (Geographic Information Systems – see *Downstream* #16) about seven years ago, after realizing the advantages of computer-based information management. Wachusett Section Forestry staff slowly built all the data layers that would be used daily: property lines, stone walls, roads, trails, and cover types. During this arduous process, old maps were corrected to match the high-resolution orthophotos provided by MassGIS, as well as integrating all newly purchased lands to the data library. This transformation to an all-digital mapping process set the stage for adding the final piece to the management puzzle, stand age.

Over 4.5 million trees were planted on lands around the Wachusett Reservoir from 1902 - 1945, either to reforest old fields or areas damaged from storms and fires, or to add pines to areas growing only hardwoods. Foresters kept records of those plantings and made careful maps that are kept in the Wachusett Forestry office. These maps were used as a first attempt at identifying the trees' age, but many of these plantations had been harvested, blown over, or failed in some other way. The timber stand mapping often accounted for these changes, but unfortunately there was no coding for age. Major storm events like the hurricane of 1938 and the tornadoes of 1989 are well-

This sequence at left shows the tree coring process with the extracted core shown below.

The table at right shows the charted results the forester found in the working unit shown on maps on the facing page.

Working Unit Characteristics	
Age Category	Forest Acres
0-20 years	4.6
21-40 years	3.6
41-60 years	0.0
61-80 years	15.0
81-100 years	1.1
>100 years	11.8
Manageable Forested Acres	35.9
Unmanageable Forested and Non-Forested Acres	8.2
Total Unit Acres = 44.1	

This White Pine core shows distinct growth rings revealing the trees age. Lighter areas denote spring growth and darker areas fall/winter growth.

Photos: Greg Buzzell DCR/DWSP Forester

documented; the stand maps were updated on paper and later in GIS. Additional data, however, would need to be collected for the areas beyond these accounted stands.

That Tree's Older Than You Are

DCR Foresters took carefully constructed photographic maps into the woods, visiting each stand in the Wachusett Reservoir watershed. Previously unknown hurricane evidence would often be found; the stand could thus be recorded as having originated in 1938. Another way to determine a tree's age was by examining a stump from a recently felled tree and counting the rings back to the center. Barring either of these opportunities, the Foresters would choose a few representative trees in each stand, for coring.

Most children learn in school that you count tree rings to age a tree. The combination of genetics, environment, and growth variations change the type of wood cells grown within one growing season. A ringed appearance results from accumulated annual layers of this variable growth, when looked at in cross-section (the wood of course is grown as a continuous sheath over the whole tree, just under the bark, just over and slightly larger than last year's sheath).

To count the rings on a standing tree, the Foresters extracted a core of wood by boring through from the bark to the pith (center) with a tool called an increment borer. The 3/16" diameter cylinder of wood was carefully pulled out, leaving a small hole in the tree, and the rings are counted. Some species, like oaks, ash, and pine, are easily read in the field since they have very distinct annual rings. Birch, maple, and aspen cores usually need to be brought back to the office for a staining process that enhances ring visibility. Occasionally, cores will need to be read under a dissecting microscope if the rings are extremely thin.

An average age for the stand was then chosen based on the samples. The year that stand originated was entered into the GIS database. This database currently contains over 4,800 forested polygons, totaling over 14,600 acres, with years of origin ranging from 1829 to 2007.

The coring process does leave holes in the trees. Wachusett foresters expect the holes to heal over, but research shows that a fair portion of them will lead to some decay through fungal invasion. However, only a tiny fraction of all trees were sampled by coring, and those trees are still very much alive. While this process is not perfect, it is the best available practice, especially considering that sampling will never have to be repeated on the same acreage.

Summing Up – Every Acre Counts

With the data collection complete, the analysis of stand age began. All of the land polygons were further segmented using GIS software based on intersecting layers of sub-basins, working units, soil types, cover types and ages, and manageability. (*Unmanageable lands* are: administrative or non-forested, including buildings, roads, fields, and shorelines; wetlands; very steeply sloped hillsides; lands cut off by wetlands or steep slopes; and areas designated for no management. Lands can change status given technological improvements or improved access through new land acquisition. Currently, 4,500 acres are open water/ reservoir, and 3,700 acres are unmanageable). The software calculated acreage for each new area it created.

A program was developed to help DCR visualize the results of these intersections.

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FISHING LINE - FROM PAGE 2

What is DCR doing at Wachusett Reservoir to make it easier to recycle fishing line?

- Ten clearly labeled PVC canisters were installed at popular fishing areas around the reservoir to make recycling easy and convenient.
- Letters explaining the program were sent to all local bait shops, rod & gun clubs, and fishing equipment supply stores.
- Posters to raise general awareness and to describe details about this program were placed at many locations around the reservoir.
- A display box was placed at the main entrance to DCR Regional Headquarters building in West Boylston.

Is it working?

Yes! DCR staff are finding significantly less fishing line along the shore, and the problem appears to be getting better. Every canister is well utilized and packed with recyclable fishing line that will never pose a threat to wildlife. With the success of the Fishing Line Recycling Program at the Wachusett Reservoir, the DCR has expanded these efforts to the fishing areas at the Quabbin Reservoir. DCR, as well as our wild friends, would like to thank everyone who has taken part in this worthwhile program.

- Paula Packard - DCR/DWSP Aquatic Biologist

QUABBIN PLAN - FROM PAGE 3

energy. Forested watersheds supply this unparalleled drinking water protection while simultaneously maintaining undeveloped open space and its associated values, protection for both rare and common species and their habitats, and renewable, sustainable wood production that supports rural economies and reduces dependence on long-distance transportation of natural resources.

The *2007-2017 Quabbin Land Management Plan* was developed by DCR personnel over a two year time frame, kicking-off with a public meeting in 2005, and culminating with the publication of a draft in June 2007 and a public hearing in July 2007. DCR worked with the Quabbin Watershed Advisory Council, the Quabbin Science and Technical Advisory Committee, professional foresters, and the general public in devising the goals, objectives, and management strategies laid out in the plan. DCR Commissioner Rick Sullivan officially adopted the *2007-2017 Quabbin Land Management Plan* on September 17, 2007. The complete plan is available on-line at www.mass.gov/dcr/waterSupply/watershed/quablmp.htm. Copies are also available at all libraries in the Quabbin watershed as well as the Quabbin Visitor Center. For more information on the *2007-2017 Quabbin Land Management Plan*, please contact Thom Kyker-Snowman at thom.kykersnowman@state.ma.us or 413-323-6921 x551.

- Joel Zimmerman - DCR/DWSP Planner

WACHUSETT FORESTRY - FROM PAGE 5

This analysis helps achieve the forest management goal of distributing age classes equally throughout time as well as space. Using the database, the acreages can be organized in different ways - for a working unit, or a sub-basin, or for the whole watershed.

So Why Those Trees?

To prioritize forest management activities, the sub-basins that have the most imbalanced age distribution, especially those with very little acreage in the youngest age classes, are identified first. Looking more closely, working units are then chosen based on the degree to which young age classes are lacking. After the harvesting proposal has gone through an internal review process, it's time to start laying out the harvest.

Every tree needs water and sunlight in order to grow. Different species have different needs, and those needs can change over time. Oaks and pine, the preferred species, germinate well under partial light but require full light to continue to grow to maturity. The strategy when entering a working unit is to first determine which areas have enough seedlings and saplings present to be released with patch cuts of overstory removal. These patches (sometimes referred to as "holes") range from ¼ to 2 acres in size and are targeted to amount to a third of the total unit area. The patches are mapped and added to the GIS database, and the year of origin is set to the date the trees get cut. Between the patches, partial cutting is often used to help establish new regeneration or to improve the condition of the remaining overstory.

The original question has been answered: trees are cut to improve the forest, either by cycling patches of old forest back to young forest or by thinning out stands to grow better trees. As for the follow-up question, DCR knows exactly where to go because of the Wachusett Section Foresters' efforts to gather, map and analyze all the necessary information. All of this data will be catalogued, with the intent of providing future foresters with a complete and easy-to-use record of the history of the Wachusett forest.

- Brian Keevan - DCR/DWSP Forester

Tree Planting at Wachusett - from back page

A crew plants Sugar Maples and White Pines in the spring of 1903.

Foresters today make management decisions designed to leave healthy, diverse, and productive forests for the future, when forester managers yet unborn will continue the work The future of our forests, and the pristine water supplies they protect, depend on management strategies that provide ongoing resilience to disease, storm events, and the loss of wildlife habitat and species diversity. This all started at Wachusett more than a century ago with the planting of the first seedling.

- Jim French - DCR/DWSP Land Acquisition Coordinator

For More Information About Trees...

Check out these books:

Stepping Back to Look Forward.
Foster, Charles H. W., editor (1998)
Harvard Forest.
(A Massachusetts forest history)

Forest Stand Dynamics.
Oliver, Chadwick D. and Larson, Bruce C. (1996).
John Wiley & Sons.
(Very technical, but informative)

Stone by Stone.
Thorson, Robert M. (2002)
Walker & Company.
(An interesting history of the New England Landscape)

And for kids...

The Big Tree.
Hiscock, Bruce (1991)
Atheneum Books.
(Follows the life and times of a Sugar Maple)

Outside and Inside Trees.
Markle, Sandra. (1993)
Simon & Shuster.
(How a tree lives and grows)

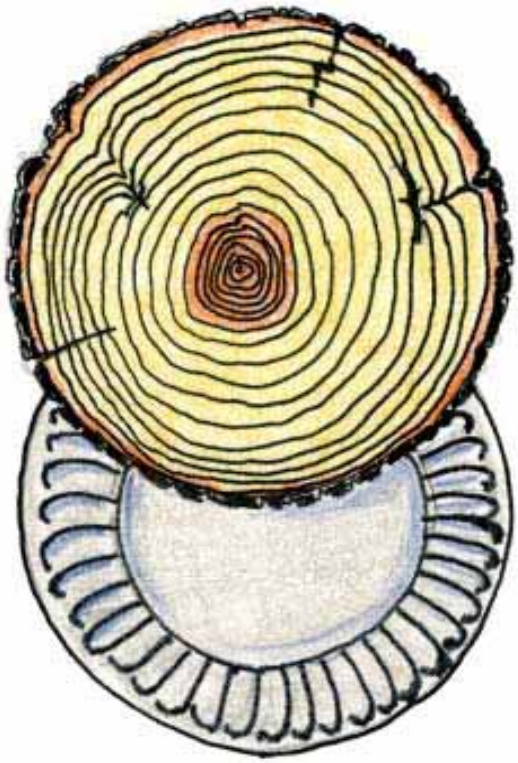
And Another Thing...

by J. Taylor

"Yuck! This wood in the middle tastes kind of old!"

Kids Corner

Your Personal Tree Cookie



The rings found on a slice of tree trunk - or tree cookie - tell how old the tree is, as well as other clues about the tree's life. These rings appear as a light and dark alternating pattern. One dark and one light pair of rings represent a year of growth. The light color shows the spring growth when sap flows quickly, while the dark color is the later season growth.

Other clues about the tree's life can also be found in the tree cookie, or cross section, of the tree. Rings are wider during a good growth year and narrower if there was a drought, if there aren't many nutrients available or if there was a lot of competition with other trees. Insect attacks, fire damage and other injuries and weather conditions also show up on a tree cookie and tell interesting facts about events in the tree's lifetime.

Here's how to making your own personal Tree Cookie!

Materials: Tree cookie, paper plate, crayons or pencil

Procedure: Examine a tree cookie and count the rings to find out the age of the tree. Look closely at the tree cookie to see if there are any marks that might show an interesting event in the tree's life. Branch growth, insect damage, a fire ring around the tree or an injury to the tree from a person, an animal or another tree will sometimes show up in a tree cookie.

Take the paper plate and draw a tree cookie showing your own life. The outside edge will be the bark.

Start on the center with a dot indicating the year you were born. Draw a ring around it to show your first year. The next ring you draw will be your second year. Keep going so there will be a ring for each year of your life.

Now you can go back and put some marks or notes on your tree cookie to show events in your life. Was there a year when you remember scraping your knee or breaking a bone? You could put a little mark on that year. What year was your brother or sister born? You could put a mark or note on that year.

Continue working on your own tree cookie to have it show things that are special to you in your life.

- Jim Lafley - DCR/DWSP Wachusett Education Coordinator

Early Tree Nurseries of the Wachusett Reservoir

More than 4.5 million trees were propagated, nurtured, collected, and planted on the newly acquired lands surrounding the Wachusett Reservoir between 1898 and the outbreak of World War II. Croplands, meadows, wetlands, woodlots, and pastures taken by the Metropolitan Waterworks Commission to serve as buffer lands for water supply purposes would come to support a vibrant maturing forest in our time. It was clearly understood back then, and even centuries before, that the purest water is the product of a forested landscape maintained with minimal disturbance. Many hard lessons have been learned throughout European and Asian history of the loss of essential potable water sources due to poor land use practices that have left landscapes denuded, eroded, and impoverished – conditions which doom sustainable water yields.

These photographs, taken in 1903, show tree planting crews tending saplings at the West Boylston Nursery (below) and the planting of saplings on the banks of what was to become the Wachusett Reservoir (right).

Forestry is a multi-generational endeavor – with the fruit of efforts, by such men as these, not being realized until long after their work is done.

TREE PLANTING - SEE PAGE 6

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Downstream **is produced twice a year by the Massachusetts Department of Conservation and Recreation, Division of Water Supply Protection. It includes articles of interest to residents of the watershed system communities. Our goal is to inform the public about watershed protection issues and activities, provide a conduit for public input, and promote environmentally responsible land management practices.**

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