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Grassland Habitat

Managing the ecosystem of Wachusett's North Dike

Ken MacKenzie, DCR Wildlife Biologist



A kestrel nest box stands sentry in the middle of Wachusett Reservoir's North Dike. DCR has started managing a portion of the dike's expanse as habitat for several breeding birds.

During the construction of the Wachusett Dam (completed in 1906), some areas of new shoreline required fortification with earth and stone dikes to ensure a safe and stable container for the 65 billion gallons of water soon to be stored in the reservoir. The North and South Dikes, located on either side of the dam, comprise 2.5 miles of shoreline, averaging just over 380 feet in width and covering 116 acres. The history of these earthen berms' management is very interesting, as is their modern function as wildlife habitat for uncommon migratory birds.

The dikes have gone through many transformations over the years. From 1916 until about 1936 the land was leased as hay fields. In 1940, the North Dike was planted with red pine and arborvitae. A December 1973 storm destroyed most of the red pine, and by February of 1974 it was all removed. Once again, the land was leased to local farmers for corn, wheat, soybeans and hay. Agriculture ceased in 1997 because the crops were attracting geese, which degrade water quality. The following year, 3,000 seedlings of red oak, white oak and sugar maple were planted. Unfortunately, most of the seedlings did not survive that dry summer. Since then,

the dikes have become grasslands, kept open by mowing on an irregular schedule.

Due to damage inflicted in 2005 by Hurricane Katrina to New Orleans, the Federal Emergency Management Agency (FEMA) devised new guidelines for dikes and dams. The revised FEMA guidelines consider trees and other woody plants growing on earthen dams and dikes a safety issue. Not only do they interfere with safety inspections, but decaying roots could create seepage paths or internal erosion. Trees and woody brush can also attract burrowing animals, which can cause structural or hydraulic problems. As a

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Maintenance at Quabbin's Winsor Dam

How do they mow that steep slope? By Scott Campbell, DCR Regional Engineer, Quabbin Reservoir

Winsor Dam and the Good-nough Dike, constructed between 1935 and 1939, are two earthen dam structures that together impound about 412 billion gallons of water from the Swift River Valley and Ware River Diversion. Winsor Dam, the larger of the two structures, spans 2,640 feet in length and rises 170 feet above the original bed of the Swift River. Goodnough Dike is only slightly smaller, spanning 2,140 feet and rising 135 feet above the original bed of Beaver Brook. Combined, the two structures contain more than 55 acres of grassed landscape areas, roughly eight acres of



A slippery slope? This view of the back of Quabbin Reservoir's Winsor Dam shows the daunting task facing the mower (in the center of the picture). It takes two days to mow the whole face of the dam.

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- Page 7 Top - Kris Keevan
Bottom - Joy Trahan-Liptak
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Taking a walk on the North Dike.

rip rap stone embankment, and more than two miles of drainage ditches and subsurface piping. The varied landscapes and positions present unique challenges with maintaining stable and vegetated conditions that support the function and performance of the dams.

Labor crews stationed at the Quabbin Administration Building in Belchertown are charged with caring for the grounds and landscapes associated with the dam and dike. Regular maintenance duties include brush cutting, ditch and catch basin cleaning, leaf collection and removal, clearing of snow from driveways and general lawn maintenance. One of the more daunting tasks is the regular mowing of the predominately grassed landscape that covers much of the embankment slopes and toe areas of the dam.

A healthy, dense cover of low growing grass is the preferred vegetative cover for earthen dams because it offers a maintainable, stable vegetative

cover that is easily inspected and resistant to erosion. As many homeowners could personally attest to, challenges to maintaining a healthy turf cover are many, including competing weeds, soil drought, and nutrient deficiencies to name a few. These conditions are only made worse on steeply sloping grounds such as those that occupy the downstream embankments of the two structures whose grades approach 50% (i.e., 1 on 2 - rise to run). It is a daunting task to operate equipment that can traverse these steep slopes.

To overcome these inherent challenges and dangers, DCR and its predecessors have employed numerous tools and equipment, including the use of manual scythes, conventional farm tractors, and specialized slope tilting mowers. Annual Reports made between 1939 and 1945 also make reference to an experimental goat grazing program that was employed

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Dam Inspections and Maintenance

DCR's efforts to keep them safe and secure By Joel Zimmerman, DCR Regional Planner, Bill Moulton, DCR Regional Engineer, Wachusett Reservoir, and Ed Connor, DCR Civil Engineer

When you say dams and watershed management, one thinks immediately of Winsor or Wachusett dams – magnificent feats of engineering holding back billions of gallons of water. Did you know, however, that DCR's Division of Water Supply Protection also has care and control of 28 other dams, most of them very small, throughout the watershed system? Engineers based at the Quabbin and Wachusett field offices inspect and maintain these structures, keeping them in compliance with all federal and state regulations.

Dam maintenance is an expensive venture. MWRA utilizes its Capital Improvement Program (CIP) to budget the significant funds - more than \$20 million since 2005 - required for necessary infrastructure rehabilitation and improvements to the four largest dams and two dikes in the watershed system – Winsor (Quabbin), Wachusett, Sudbury, and Foss Dams, as well as the North and South Dikes at Wachusett Reservoir. All other expenses are covered by DCR's Watershed Management annual budget.

State Dam Safety regulations, 302 CMR 10.00, are administered by the Office of Dam Safety, which is a separate section within DCR. These regulations classify dams into four sizes: large, intermediate, small, and non-jurisdictional. Dams are also classified by hazard type:

Hazard Classification	Description	Inspection Frequency
High (Class I)	Failure will likely cause loss of life and serious damage.	Two years
Significant (Class II)	Failure may cause loss of life and damage.	Five years
Low (Class III)	Failure may cause minimal property damage and loss of life is not expected.	Ten years

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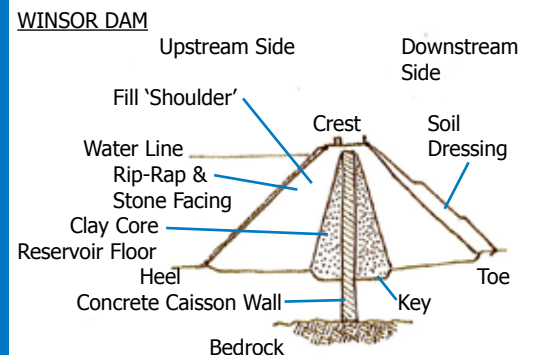
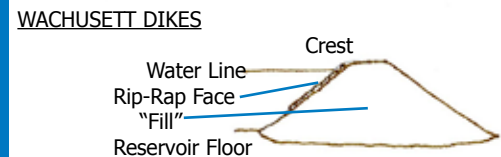
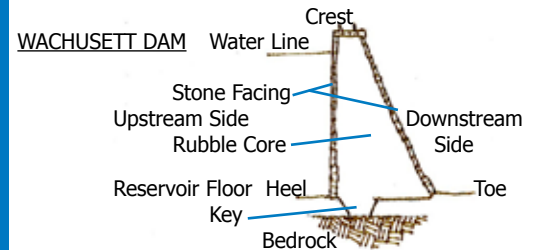
What's the difference between a dam and a dike?

Dams and dikes have similar functions: to hold back water. The difference? A dam has active features, such as a spillway to send excess water on its way downstream, as well as control structures, like intakes, valves and gates. A dike merely functions as an impounding 'shoreline', keeping water in place. There are a variety of dam and dike designs. These cross-section diagrams of the Wachusett Dam, Wachusett Dikes, and Quabbin Reservoir's Winsor Dam are common designs used in the New England area.

The Wachusett Dam utilizes a rubble and concrete core, with a 'key' reaching down to bedrock. The dam is encased on both sides with concrete and cut stone construction.

Wachusett's North and South Dikes are constructed of layers of fill and silt excavated during construction of the reservoir, bermed up to a flat top and faced with stone rip-rap on the reservoir side.

The Winsor Dam at the Quabbin Reservoir is more elaborately constructed, with a concrete caisson wall set on bedrock, rising up through the center of the dam. This wall is further encased on both sides by a clay core and fill is used as a 'shoulder' to give the dam its shape. The reservoir side of the dam is faced with rip-rap near the top, graduating to finer crushed stone beneath the water's surface. The back of the dam is dressed with topsoil and maintained turf.

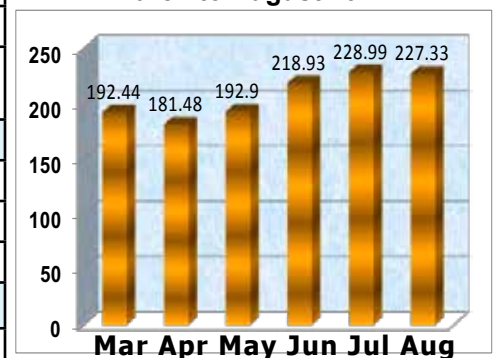


- Reservoir Watch -

Reservoir levels and 6-month precipitation

Reservoir	Quabbin	Wachusett
Minimum	524.95'	388.1'
% Full	90.7%	86.4%
Date(s)	3/3/14 3/12/14	3/10/14
Maximum	529.26'	391.06'
% Full	98.6%	92.1%
Date(s)	5/28/14	5/3/14
Precipitation	26.23"	24.12"
Seasonal Avg	25.22"	23.36"

System-wide 6-month Water Usage (in million gallons per day) March to August 2014



Grasslands From Page 1

result, trees are no longer allowed to grow on the dikes or near the toes and abutments; all existing trees, stumps, and roots must be removed.

The Massachusetts Water Resources Authority (MWRA) and the DCR Division of Water Supply Protection (DWSP) finalized plans in 2012 to remove all trees, mostly white pine, spruce and arbor vitae, from the North and South Dikes. After cutting and stumping, the earthen dikes were graded and stabilized with grass cover.

FEMA recommendations require routine inspection of the dikes for

seeps, sink holes and other damage. In order to best perform these tasks, vegetation on sloped areas needs to be kept short, which requires frequent mowing.

Soon after the grass was established, DWSP's Natural Resources Section recognized the habitat potential of the dikes. The three new expanses of tree-free, open land could be managed for wildlife species of concern that do not impact water quality or dam infrastructure.

A cooperative effort between DWSP Engineers and the Natural

Resources Section, resulted in a draft mowing plan in 2014, accommodating FEMA recommendations while also promoting large open grasslands, which are a declining habitat in the northeast.

The challenge was to find a place on the dikes where grass could be allowed to grow tall enough to provide nesting habitat for grassland birds, but was still short enough to allow DCR engineers the ability to conduct routine inspections. A 30 acre site on the North Dike (see below) was identified that could be managed for breeding

Wachusett Dikes Grassland Habitat

The figure below shows the northeast portion of the Wachusett Reservoir, with the two dikes denoted in patterned color. Tan colored tones show areas that must be kept mowed for regular dike inspections, while green areas (dark for existing, light for proposed) are left undisturbed from May to July, providing increasingly uncommon tall grassland habitat. While these "Habitat Areas" provide nesting and cover, mowed areas also contribute to the open character required by grassland dwelling wildlife.

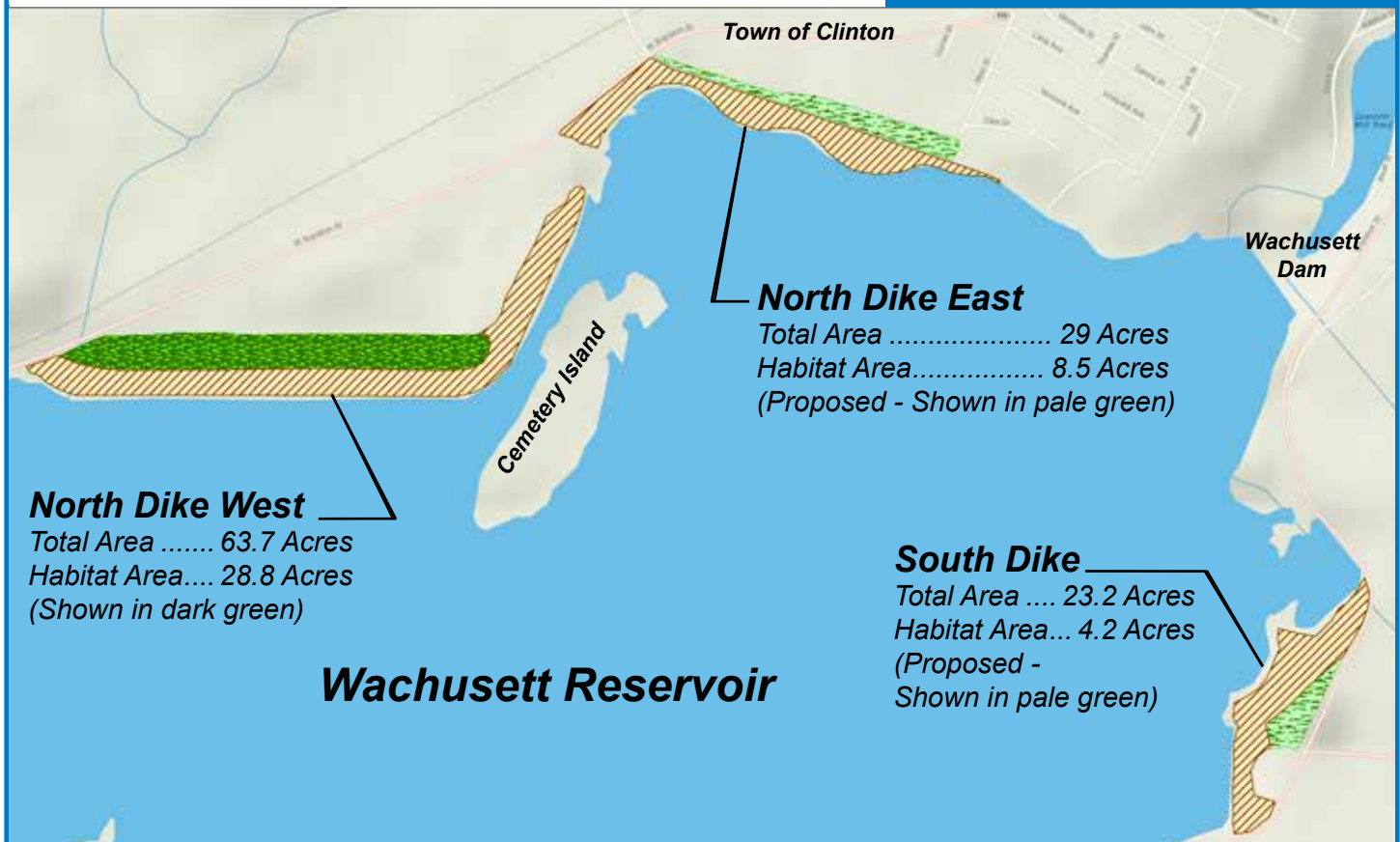
Wachusett Dike Characteristics

Length:

North Dike West.....	6,500'
North Dike East.....	4,200'
South Dike.....	2,500'
Total Length of All Dikes	13,200'

Area:

Mowed Area	74 acres
Habitat Area (existing and proposed)	42 acres
Total Area	116 acres





A meadowlark rests in the North Dike grasslands.

grassland bird species habitat.

This long, rectangular-shaped area will serve as a pilot project to determine the feasibility of this type of habitat management. If successful, additional areas can be similarly managed on another 30 acre portion of the North Dike as well as 25 acres on the South Dike. While the most critical areas of the dikes, particularly slopes, are to be mowed regularly for safety inspections, habitat areas will be allowed to grow taller from early May to the middle/end of July to accommodate the nesting season of grassland birds. The primary target species of this habitat plan are two migratory birds, the Eastern Meadowlark and the American Kestrel.

Meadowlarks are a colorful relative of the blackbird family that eat mostly insects, but may eat seeds and fruits as well. The females usually migrate to Massachusetts in early May and often start laying eggs immediately. Their nest, a well-concealed cup made of woven grasses and other plant material, is usually located in tall grass. A major threat to this birds population is repeated mowing of hay fields during the nesting season. According to the most recent Massachusetts Breeding Bird Atlas, published by Mass Audubon, Eastern Meadowlarks have suffered one of the sharpest declines of any species in the state.

DCR biologists documented three

pairs of meadowlarks on North Dike West during the early breeding season in 2014. Of those three pair, two fledged young. If this habitat management continues to promote meadowlark breeding, their numbers could grow and may expand into the other managed sections of the Dikes.

Populations of American Kestrels, a small falcon also known as a sparrow hawk, have also declined significantly due to farmland being reclaimed as forest and suburban development. The preferred habitats for the Kestrel — pastures, hay meadows, and old fields — are becoming increasingly rare in Massachusetts. The North Dike presents an ideal place for this target species to breed and forage.

Kestrels, like meadowlarks, primarily eat insects such as grasshoppers, crickets, cicadas, and beetles. They can also eat moles, voles and other small mammals as well as snakes and frogs. Large open grassy areas like the Wachusett dikes provide good dietary diversity which helps to encourage successful breeding.

After seeing kestrels hunting on North Dike West in the spring of 2013, MassWildlife Ornithologist Dr. Andrew Vitz proposed installing a kestrel nest box on the Dike. Generally an open area of 50 acres is needed to support a breeding pair of kestrels, but smaller patches like the North Dike will suffice if there is a considerable amount of open habitat around the nest box. In early 2014 the nest

box was erected on the eastern portion of North Dike West. The results were better than expected: the pair occupied the box in its first year. MassWildlife banded the adult female and five nestlings in early July 2014. They fledged less than two weeks later and were



Many different species, including these wild turkeys, are taking advantage of the dike's new grassland habitat.

seen hunting the grassy plains. Many other wildlife species also benefit from grasslands on the dikes.

Other bird species, including red-wing blackbirds and turkeys, benefit from the increased amount and type of food available with taller grass. The managed fields also provide habitat to small mammals such as meadow voles and jumping mice, which are important food sources for many birds of prey. Coyotes and red foxes regularly visit the area, helping to control burrowing animals such as woodchucks. Tiger swallowtails, monarchs and fritillaries are some of the butterflies that can be seen feeding on an abundance of wildflowers.

Following the first year's success of the pilot cutting plan, the two other proposed locations will also be managed to provide breeding areas for meadowlarks and other grassland nesting bird species. DCR and MassWildlife will also explore the possibility of installing two more kestrel boxes. The efforts on the Wachusett dikes demonstrates how DCR constantly strives to balance the impacts of wildlife on drinking water quality while being a steward for a vast range of species. 🌊



The expanse of wildflowers at the North Dike attracts many butterflies.

Winsor Dam Maintenance

- from Page 2

at the Dike. Today, DCR utilizes a specialized, dual-tired slope mower that offers a low center of gravity and built-in weight transfer system specifically designed to improve stability and traction on steep slopes.

Vegetation management efforts on the dams are an important compliment to the regular inspection program that is carried out by DCR Engineers, Natural Resources, and Maintenance staff. Periodic inspections provide surveillance for developing or potentially threatening conditions. They also offer an assessment of the structural integrity of the dam and document that dam behavior and conditions are as expected. Uncontrolled vegetation in these areas is unwanted because it obscures visual inspections of slope

and ground conditions. Vegetation may also provide habitat and sheltering for burrowing animals. If left unchecked and uncontrolled, deep penetrations from roots of woody vegetation or burrowing animals could penetrate and structurally compromise

components of the dam. Mowing and other vegetation management efforts are critical components of the dam maintenance and inspection programs that DCR implements to ensure the safety and long-term dependability of the infrastructure holding back billions of gallons of drinking water. 💧



View of Case Mower on upper slope at Quabbin Dike
Photo Albertine - 8/10/49 #2902



Mowing at Quabbin Reservoir, past and present. While the equipment has been upgraded over the years, maintenance staff still have to lean into their work to keep the dam and dike neat and safe.

Dam Inspections

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DCR Watershed Management staff perform monthly assessments on the High Hazard dams and semi-annual assessments of the smaller dams. MWRA funds and manages Professional Engineers that specialize in dam safety to complete full inspections on all the dams in the watershed system based, at a minimum, on the regulation's potential hazard classification.

State and federal guidelines require that dam inspectors should be aware of a wide range of issues while surveying a dam, including: faulty drainage, undesirable vegetation, debris, poor joint condition, failure of previous repairs, and poor environmental conditions that can potentially pose a safety hazard to personnel or hinder the inspection. While walking along the dike or dam, DCR engineers have to keep their eyes peeled for a wide variety of potential problems, such as misalignments, cracks, settlement, animal burrows, seepage, slides, scarps, bulges, bald spots, erosion gullies,

depressions, sinkholes, deterioration of mortar that joins the stones, loosening or movement of the blocks, and leakage along the joints or between the blocks.

DCR engineers do not rely solely on visual assessments. Water pressure and temperature data at the Wachusett and Sudbury Dams is collected using a vibrating wire piezometer. This bullet shaped tool encases a sensitive stainless steel diaphragm that reacts to changing water pressure, which in turn affects an attached wire's tension



The Wachusett Dam is designed to impound up to 65 billion gallons of water.

and frequency of vibration. Changes in an electromagnetic field, along with temperature, are automatically sent to a remote monitoring station at the base of the dams. This information informs the engineers if there is a problem developing with the dam long before there is any evidence from the surface assessment.

Investments in dam inspections and maintenance by DCR and MWRA will keep these critical structures functioning for years to come. The two agencies have developed federally mandated Emergency Action Plans for each High and Significant Hazard Dam. These documents contain procedures that will be followed in the unlikely event of a dam failure, including contact information for local, state, and federal responders and media.

The Office of Watershed Management is committed to keeping all of the dams under its control inspected and maintained so these Emergency Action Plans will never have to be implemented. 💧

Kids Corner

The Dams and Dikes Crossword

Most of this puzzle's answers are relate to dams, dikes, the Reservoir System and its surrounding environment. There may be clues in the other articles. Good luck!

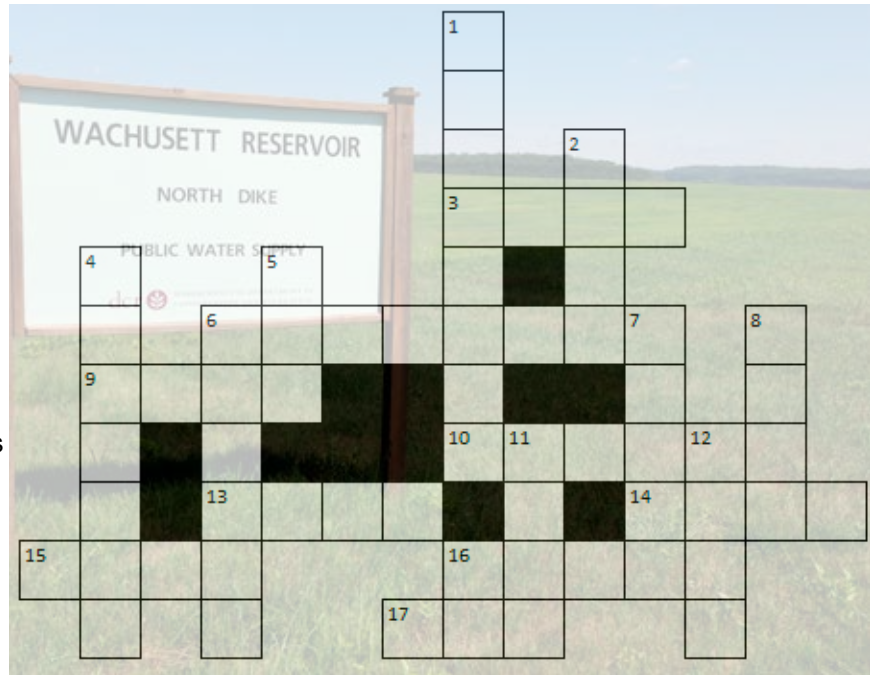
(answers at bottom of page)

Across

3. Water transportation
6. Baby trees
9. Eagle found at Quabbin and Wachusett
10. *Down* _____, famous publication
13. Predator's lunch
14. Animals leave this behind
15. The visible side of a mountain or dam
16. Swift _____ Valley
17. Winsor _____

Down

1. Bundles of dry grass
2. Fills reservoirs
4. "_____ area" created on Wachusett Dikes
5. _____ pine, destroyed by 1973 storm
6. Steep _____ can make mowing difficult
7. Honkers that can degrade water quality
8. Federal rule maker for dams and dikes
11. Take a little off
12. Area measure
16. Sun god



And another thing...

by J. Taylor



The "Wach-ness" Monster?

Weighing in at 24.2 pounds and just over 40" long, this Lake Trout was recently net-caught (and released!) by DCR's Jaimie Carr as part of Mass Wildlife's annual fish survey at the Wachusett Reservoir. Believe it or not, this whopper was topped in weight by a 29.2 pounder captured at the Quabbin Reservoir. Sorry anglers, we can't tell you exactly where to find the big fish.

For more information about...

Northeast Grassland Habitat:

New Hampshire Cooperative Extension

<http://extension.unh.edu/Grassland-Habitats>

Cornell Cooperative Extension

www.rauscherfarm.org/Fields-Grassland_Birds.pdf

Dam Inspections and Maintenance:

DCR Office of Dam Safety

www.mass.gov/eea/agencies/dcr/conservation/dam-safety

Association of State Dam Safety Officials

www.damsafety.org

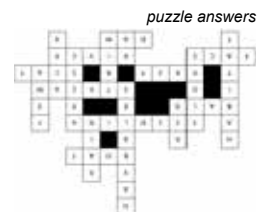
DCR Archives:

DCR Office of Cultural Resources,

Archives Management

[www.mass.gov/eea/agencies/dcr/conservation/cultural-resources/](http://www.mass.gov/eea/agencies/dcr/conservation/cultural-resources/archives-management.html)

[archives-management.html](http://www.mass.gov/eea/agencies/dcr/conservation/cultural-resources/archives-management.html)



Then and Now

The Digital Commonwealth


By Sean Fisher, DCR Archivist

DCR, MWRA, and the Massachusetts State Archives recently announced the availability of 8,800 photographic images that document the Metropolitan Water Works (MWW) System between 1895 and 1926 through the Digital Commonwealth website – www.digitalcommonwealth.org. This treasure trove of photographs documents the construction and early operation of the water supply distribution system throughout metropolitan Boston at the start of the 20th Century.

The collection covers the Wachusett Reservoir, Wachusett Dam, Wachusett Aqueduct, Sudbury Reservoir, Sudbury Dam, Weston Aqueduct, Weston Reservoir, and the associated pipe lines, pumping stations, reservoirs, and standpipes. The images include homes, businesses, mills, town build-

ings, schools, churches, cemeteries, and railroad stations. About 50 different cities and towns, as well as several Boston neighborhood districts, can be seen in this collection. These pictures, mostly derived from 7,839 glass plate negatives, represent the Boston area's drinking water system prior to the 1926-1940 expansion that culminated in the construction of the Quabbin Reservoir.

The Boston Public Library Digital Services, through its partnership with Digital Commonwealth, utilized federal and state grants to digitally transform the collection at

no cost to the inter-agency collaborators. More details about this project will be published in the next issue of *Downstream*. 



An example of one of the 8,800 detailed images of the Boston drinking water system's early construction now available through Digital Commonwealth.

downstream

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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 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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