Prioritization of lakes and impoundments for modified dam management to improve downstream flow in Massachusetts


Kate Bentsen and Michelle Craddock
Massachusetts Division of Ecological Restoration, Department of Fish and Game

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Introduction

Many lakes and impoundments in Massachusetts have dams at their outlets that can be used to manage lake levels and downstream flow. Lake drawdowns–the process of lowering lake water levels during winter and refilling water in the impoundment during spring–are used for a variety of reasons, including controlling aquatic invasive plants and protecting infrastructure.

Dam management can have varying hydrological, thermal, and biological effects on downstream ecosystems. When lakes are drawn down, higher flows are observed downstream; conversely, when lakes are refilled in the spring, the high flows that would normally occur are reduced. Additionally, lack of management in the summer months can result in low and no-flow periods. Many organisms, such as fluvial fishes, are adapted to seasonal flows that occur at certain times of the year.


High winter flows in Pecks Brook during lake drawdown at Onota Lake, Pittsfield.


Low spring flows in Pecks Brook during lake refill at Onota Lake, Pittsfield.

Objective This project aims to identify and prioritize lakes and impoundments where dam management may be able to be altered to provide ecological benefit to downstream ecosystems, while balancing in-lake needs.

Next steps

Once candidate sites are identified, feasibility will be assessed by conducting outreach to dam owners and performing site reconnaissance to evaluate dam structure, outlet structure, and release mechanisms. Monitoring and modeling will be conducted at selected sites to quantify flow impacts and possible operational strategies.

Methods

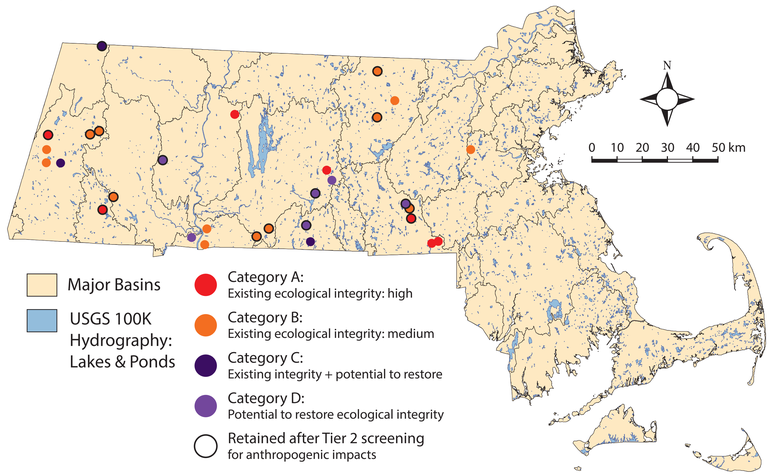
2921 ▽ Dams mapped in the MA DER Restoration Potential Model were used as the basis for analysis.

407 ▽ In 2013, Jason Carmignani (UMass Amherst) conducted a statewide survey of Lake and Pond Associations and Conservation Commissions about lakes with drawdowns.

104 ▽ Dams with a history of winter drawdowns were retained.

30 ▽ Tier 1: Ecological integrity was assessed using MassGIS datalayers. Distance to nearest downstream impoundment was calculated along NHD flowlines; dams with connectivity >1.0 miles were retained. Dams located within or immediately upstream of BioMap2 Aquatic Core or Aquatic Buffer and/or Coldwater Fish Resources (CFRs) were retained.

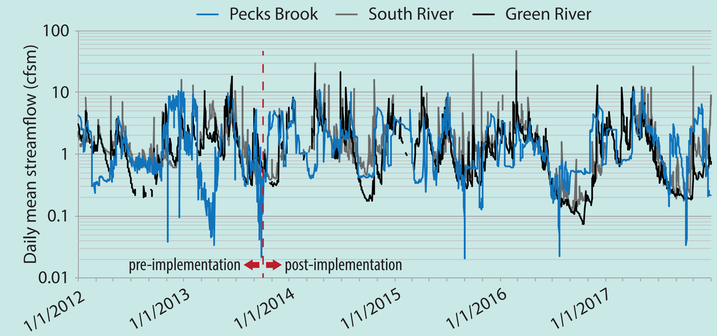
16 Tier 2: Anthropogenic impacts were assessed: sites with flow surcharges (>+25% August flow alteration); lakes on the Integrated List of Waters for certain pollutants; and likely stormwater impacts (>10% watershed impervious cover) were eliminated.



Case study: Onota Lake

Lake drawdowns have been conducted at Onota Lake in Pittsfield, MA for several decades. In October 2013, the City of Pittsfield implemented a modified dam management program based on technical guidance developed with DER and other partners.

Prior to October 2013, flows in Pecks Brook downstream of Onota Lake differed markedly from flows at USGS reference sites on the South River in Conway and Green River in Great Barrington. There were frequent periods of very low flow, rapid rates of change around drawdown and refill periods, and lack of flow variability. After changes to dam management started in fall 2013, flows in Pecks Brook better mimicked the flows observed at reference sites, fewer low-flow periods were observed, and rapid rates of change were minimized.



Fishes and macroinvertebrates were sampled in Pecks Brook before and after changes to dam management. Higher fish species richness was documented in 2014 compared to 2013 in Pecks Brook, although the relative abundance of fluvial fishes decreased. While macroinvertebrate assemblage scores stayed relatively the same between 2013 and 2016 at nearby Larrywaug Brook and West Branch Housatonic, scores at Pecks Brook nearly doubled, indicating a healthier macroinvertebrate community.

Results

This table shows the 30 sites determined to have existing or potential ecological integrity, as well as the remaining 16 sites that do not have confounding or diffuse flow-related anthropogenic stressors. Within each category, sites are ordered by distance to the nearest downstream impoundment, from greatest to least. The final columns provide preliminary feasibility information, including spilling potential (ratio surface area to drainage area) and dam ownership.

			Tier 1: Ecological Integrity						Tier 2: Anthropogenic Impacts					Tier 3: Feasibility		
			Existing			Potential (proximate)										
	Category	Description	BioMap2		CFR	BioMap2	CFR	Sites remaining	Flow alteration: surcharged	Water quality: lake impaired	Stormwater: high impervious	Other: Public Water Supply	Sites remaining	Spilling potential (SADA ratio)	Dam ownership	Additional comments
	A	Existing ecological integrity: high	Aquatic Core		(+) CFR			Silver Lake, Bellingham			X					
								Taft Pond, Upton					Taft Pond, Upton	0.02	Town of Upton	potential to counteract high level of GW withdrawals
								Lake Hiawatha, Blackstone	X							
				Aquatic Buffer	(+) CFR			Otis Reservoir, Otis					Otis Reservoir, Otis	0.10	State - DCR	SADA ratio indicates low spilling potential
								Richmond Pond, Pittsfield					Richmond Pond, Pittsfield	0.04	Private	potential to improve downstream WQ impairment
								Lake Wyola, Shutesbury		X						
								Browning Pond, Spencer		X						
	B	Existing ecological integrity: medium	Aquatic Core					Stockbridge Bowl, Stockbridge								
					CFR			Ashmere Lake, Hinsdale					Ashmere Lake, Hinsdale	0.06	State - DCR	
								Long Pond, Blandford					Long Pond, Blandford	0.18	Town of Blandford	SADA ratio indicates low spilling potential
								Old Grist Mill Pond, Upton					Old Grist Mill Pond, Upton	0.00	Town of Upton	potential to counteract high level of GW withdrawals
								Lower Root Reservoir, Lenox				X				
								Longmeadow Country Club Dam, Longmeadow			X					
								College Pond, Weston	X							
								Calkins Lower Pond, Monson					Calkins Lower Pond, Monson	0.01	Private	
								Dean Pond, Brimfield					Dean Pond, Brimfield	0.01	State - DCR	
								Lake Shirley, Lunenburg		X						
								Pearl Hill Brook, Townsend					Pearl Hill Brook, Townsend	0.00	State - DCR	potential to counteract high level of GW withdrawals
								Plunkett Reservoir, Hinsdale					Plunkett Reservoir, Hinsdale	0.04	Town of Hinsdale	
								Lake Samoset, Leominster					Lake Samoset, Leominster	0.02	Private	
								Watershops Pond, Springfield		X	X					
	C	Existing ecological integrity + potential to restore	Aquatic Core				(+) CFR proximate	Mausert's Pond, Clarksburg					Mausert's Pond, Clarksburg	0.03	State - DCR	
				Aquatic Buffer			(+) CFR proximate	Laurel Lake, Lee	X	X						
					CFR	(+) Aquatic Core proximate		Southbridge Reservoir #3, Southbridge				X				
	D	Potential to restore ecological integrity				Aquatic Core proximate		Cedar Pond, Sturbridge					Cedar Pond, Sturbridge	0.06	Town of Sturbridge	
								Lake Lashaway, East Brookfield					Lake Lashaway, East Brookfield	0.02	Town of East Brookfield	potential to improve downstream WQ impairment
							CFR proximate	Sugden Reservoir, Spencer		X						
								Pine Island Lake, Westhampton					Pine Island Lake, Westhampton	0.12	Private	SADA ratio indicates low spilling potential
								Silver Lake, Agawam		X	X					
								Davidson Pond, Upton					Davidson Pond, Upton	0.01	Private	

For more information, contact: Kate.Bentsen@state.ma.us, 617-626-1533