SHARON GREAT CEDAR SWAMP

Restoration and Revitalization

FIELD GUIDE
Atlantic White Cedar Symposium Field Trip
May 25, 2016

Instructors
Peter Fletcher, Neal Price and Pamela Polloni

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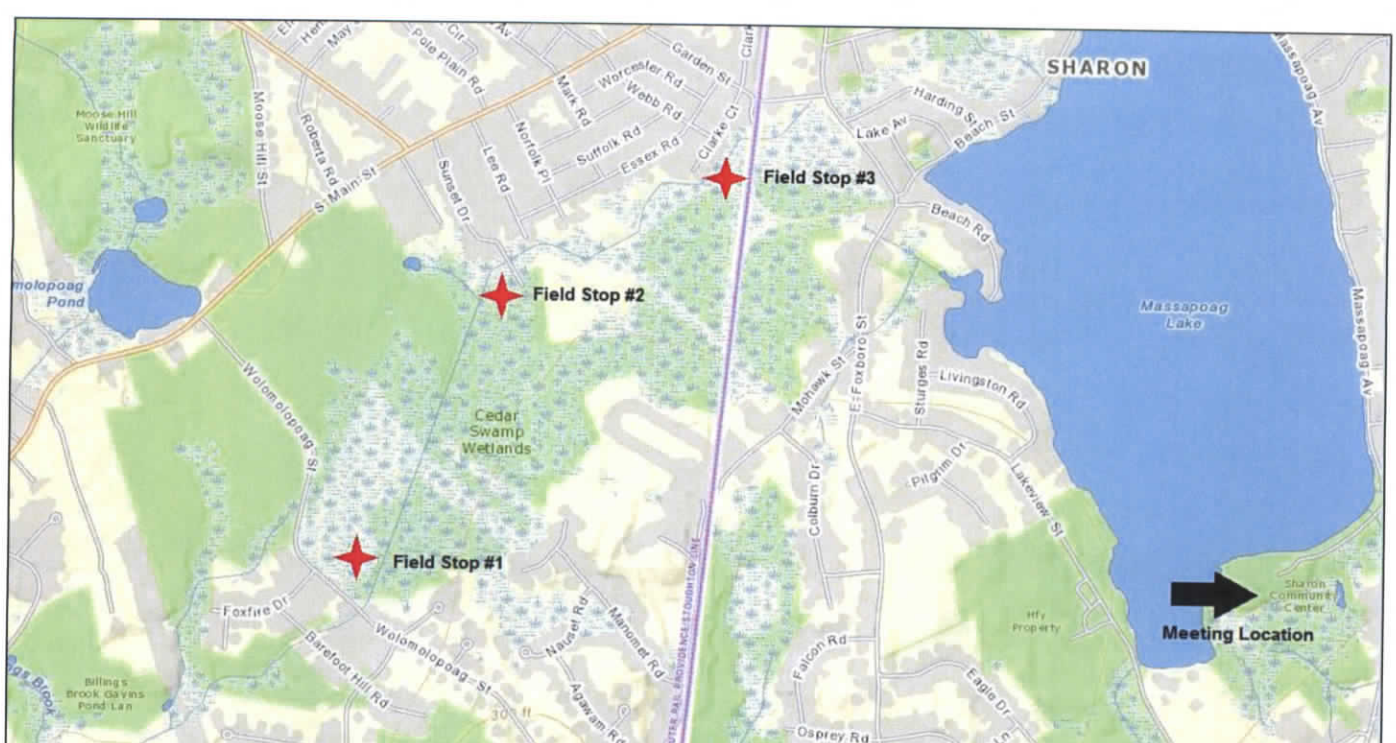
Sustainable Environmental Solutions



2016 Atlantic White Cedar Symposium – Field Trip to Sharon Great Cedar Swamp

AWS takes you to the town of Sharon, MA – a Boston Metrowest suburb consistently ranked among the best places to live in America. National recognition speaks for the town's plentiful protected open space, agricultural lands and outdoor recreational opportunities abound to residents.

On this field trip, you'll have the unique opportunity to visit the lifeblood of the municipality: the Sharon Great Cedar Swamp. An inland Atlantic White Cedar wetland forest spanning 250 acres, GCS is the silent supplier of millions of dollars' worth of clean, abundant water and free flood control. Straddling two major regional watersheds, it contributes headwaters to the Neponset River and Taunton River systems, in addition to the myriad functions it affords its own hometown. GCS provides high quality groundwater recharge for all six of Sharon's wells and feeds Lake Massapoag, a 353-acre priority habitat and celebrated recreational attraction.

Today Sharon's GCS is seriously compromised – having faced decades of degradation. In 2010, an ambitious study and restoration project was initiated by the town's Conservation Commission and Lake Management Study Committee. AWS joins the technical team on-site to explore this diverse work in progress, encompassing several unique areas of restoration. You'll witness the results of work done so far, juxtaposed with the visible impacts of ongoing threats by outdated stormwater engineering, a debilitating ditch and declining water table. Field instructors will report on changes observed in vegetation, soils and hydrology as a result of years of inaction. As a critical resource, the decline of Sharon's Great Cedar Swamp threatens the very attributes the Town of Sharon prides itself on.

Field Stop #1 – Soil Investigations and Monitoring

Topics covered include: On-site soil investigations - natural verses drained organic soil, soil subsidence in drained areas and development of a restrictive layer; monitoring well transects; stream gauges, stream baffle.

Field instructors: Peter is a Certified Professional Soil Scientist with over 40 years of field experience. Peter has 25 plus years of field mapping experience as a soil scientist with the USDA Natural Resources Conservation Service, where he authored and/or coauthored three published soil survey reports.

Paul Lauenstein is a volunteer with River Instream Flow Stewards (RIFLS), Department of Ecological Restoration.

Field Stop #2 – Hydrology

Topics covered include: Hydrologic impacts of the drainage ditch; Stormwater discharge from the adjacent neighborhood; inflow and infiltration to the stormwater drainage system; monitoring well transects, and stream stage monitoring.

Field instructors: Neal Price – Neal is Senior Hydrogeologist at the Horsley Witten Group with 20 years of professional experience conducting hydrogeologic and hydrologic studies.

Field Stop #3 – Plant Communities and Mosquito Control Management

The upper end of the drainage ditch is situated between the Sharon Heights residential subdivision and a narrow portion of Section 1 swamp land bordered on the east by the Amtrak rail line.

Field Instructors: Pam Polloni, Botanist working with Aimlee Laderman PhD, will describe the anthropogenic impacts on the cedar swamp where the changes in groundwater level have resulted in major plant community changes in two of the three Sections. Pam serves as Curator of the Woods Hole Herbarium (SPWH) and has participated in botanical investigations in Eastern Massachusetts, particularly on Cape Cod and the Islands. She has worked with Mass. Natural Heritage and Endangered Species Program botanists on rare species investigations.

Caroline Haviland, Field Operations Manager, and Kaitlyn O'Donnell, Entomologist, will demonstrate procedures used by Norfolk County Mosquito Control District (NCMCD) personnel to monitor and manage outbreaks of biting mosquitoes in Sharon. The District uses Integrated Pest Management (IPM), utilizing surveillance, source reduction, larviciding and adult control methods to provide the best control while minimizing harm to people and the environment.

Sharon Great Cedar Swamp Project

Overview:

This project has been undertaken to examine existing conditions and make recommendations for restoration of the Sharon Great Cedar Swamp (GCS), a globally rare plant community and primary source of municipal water supply, which has been degraded over a period of more than fifty years. This wetland forest is a 250-acre gem of open space near the center of the town of Sharon, Massachusetts. It is a gem in desperate need of resuscitation. Thousands of its beautiful cedar trees are dead, many standing as a forlorn reminder of its past glory, many others lie crisscrossed on the surface of the peat.

The GCS supplies high quality groundwater recharge that contributes to six municipal wells in Sharon. In its pristine state, a cedar swamp functions to purify the groundwater with no artificial intervention. The groundwater reservoir protected beneath the wetland also feeds Lake Massapoag year-round, providing a wealth of recreation for its residents and excellent habitat for its fish. A healthy forested wetland reduces drought in times of low rainfall; stormwater percolates slowly through the complex sediments, moderating damaging floods for the entire region.

The situation deteriorated in the late 1950's when a poorly engineered residential subdivision, the Heights, was built right on the swamp's western border. These homes soon experienced localized flooding during storms: flooded basements, flooded streets, and poorly functioning septic systems. To eliminate excess water from the residential area, the town authorized construction of a ditch. This large drainage ditch extends about 1.25 miles through the western portion of the swamp. At its start just east of Garden Court, the ditch is about 2 feet deep by 8 feet wide. Where it exits the Swamp beneath Wolomolopoag Street the ditch is currently about 10 feet deep and 30 feet wide at its top.

Unfortunately, this huge ditch has effectively drained a large area of the western portion of the Swamp. Large quantities of pristine groundwater, once held within the Swamp, now discharge into the ditch only to flow out of Town. This valuable supply of clean water is now lost to the citizens of Sharon. Lowering of the groundwater table has had major detrimental effects on the wetland ecosystem. Remains of the formerly vigorous stands of cedar now lie on the ground. The characteristic assemblage of wetland species is being replaced by more common plants, some of which are exotic and dangerously invasive. Extensive areas of formerly thick black organic soils are now dry. Rather than accumulating and sequestering organic matter to form peat, the organic matter now decomposes and volatilizes at an accelerated rate. The ground surface has subsided by several feet in much of the western portion of the Swamp. The oxidation of peat has global implications: the formerly sequestered carbon is released as greenhouse gases, contributing to global climate change.

Personnel and Partnership

Principal Sponsors:
Sharon Conservation Commission
Sharon Lake Management Study Committee with critical assistance from the Sharon Finance Committee

Technical Team Members:
Peter C. Fletcher, Soil Scientist
Aimlee D. Laderman, Ph.D., Limnologist/Ecologist
Pamela Polloni, Botanist
Neal Price, Hydrogeologist: Horsley Witten Group

Principal Sponsor Contacts:
Gregory E. Meister, Conservation Administrator and Project Manager Sharon *Great Cedar Swamp* Restoration
Cliff Towner, Citizen Representative to the Project, Chairman of the Lake Management Study Committee

Town of Sharon:
Eric Hooper, Superintendent, Public Works Department
David Masciarelli, Supervisor, Water Division
April Forsman, GIS Coordinator, Engineering and GIS Division
Mary Tobin, Chairperson, Sharon Environmental Subcommittee,
Kurt Buermann and Paul Lauenstein, River Instream Flow Stewards

Critical Supporting Agencies/Participants:
Massachusetts Department of Fish & Game, Division of Ecological Restoration, Franz Ingelfinger
Horsley Witten Group
Watershed Access Lab, Bridgewater State University: Kevin D. Curry, Director; Kim McCoy, Coordinator
Norfolk County Mosquito Control Project (NCMCP)

Other Project Contacts:
Local and Regional:
Massachusetts Audubon Society, Christine Turnbull, Moose Hill Wildlife Sanctuary Director
Taunton River Watershed Project
Neponset River Watershed Association (NepRWA)
State agencies:
Massachusetts Natural Heritage & Endangered Species Program, Division of Fisheries & Wildlife (MA-NHESP); Riverways Program, Massachusetts Dept. of Fish & Game (Riverways); Wetland Restoration Program (MA-WRP); Massachusetts Office of Coastal Zone Management (CZM); Massachusetts Department of Environmental Protection (MA-DEP) Southeast Region; Massachusetts Exec. Office of Energy & Environmental Affairs, Dept. of Conservation & Recreation (MA-DCR); University of Massachusetts, Dartmouth

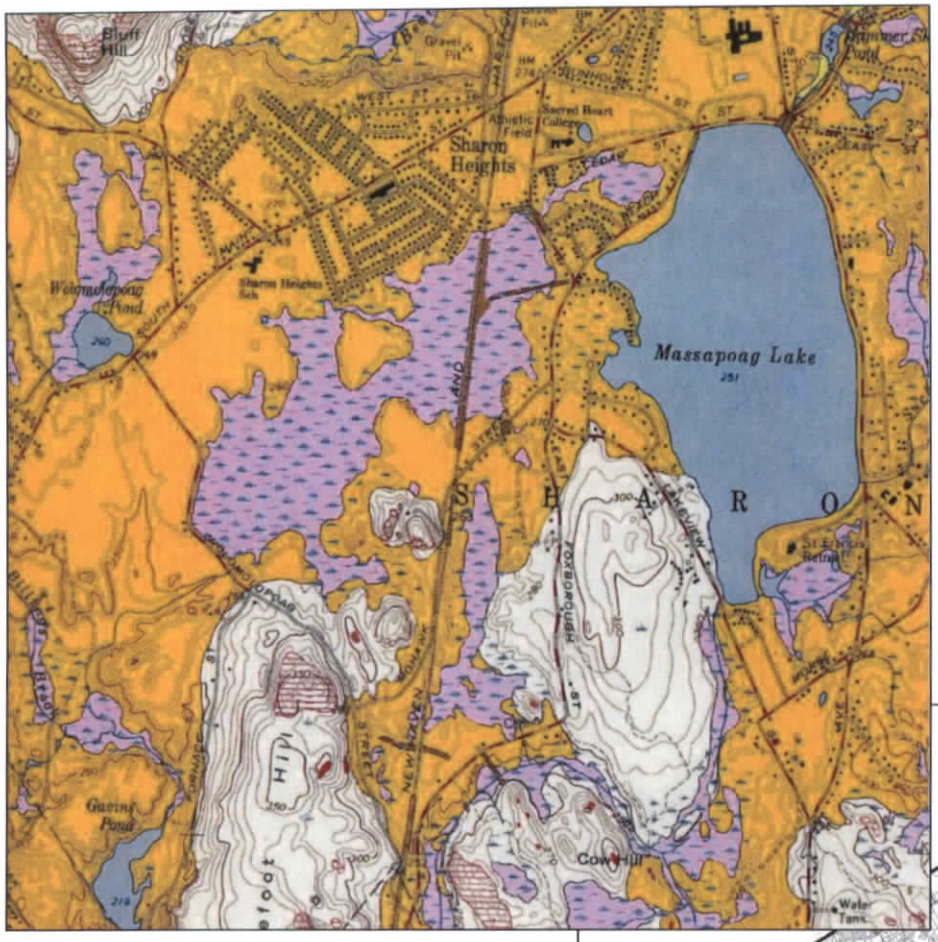


FIGURE 1. Geologically, the SGC Swamp is located within an area of stratified sands and gravels (glacial outwash). It is an area of groundwater recharge.

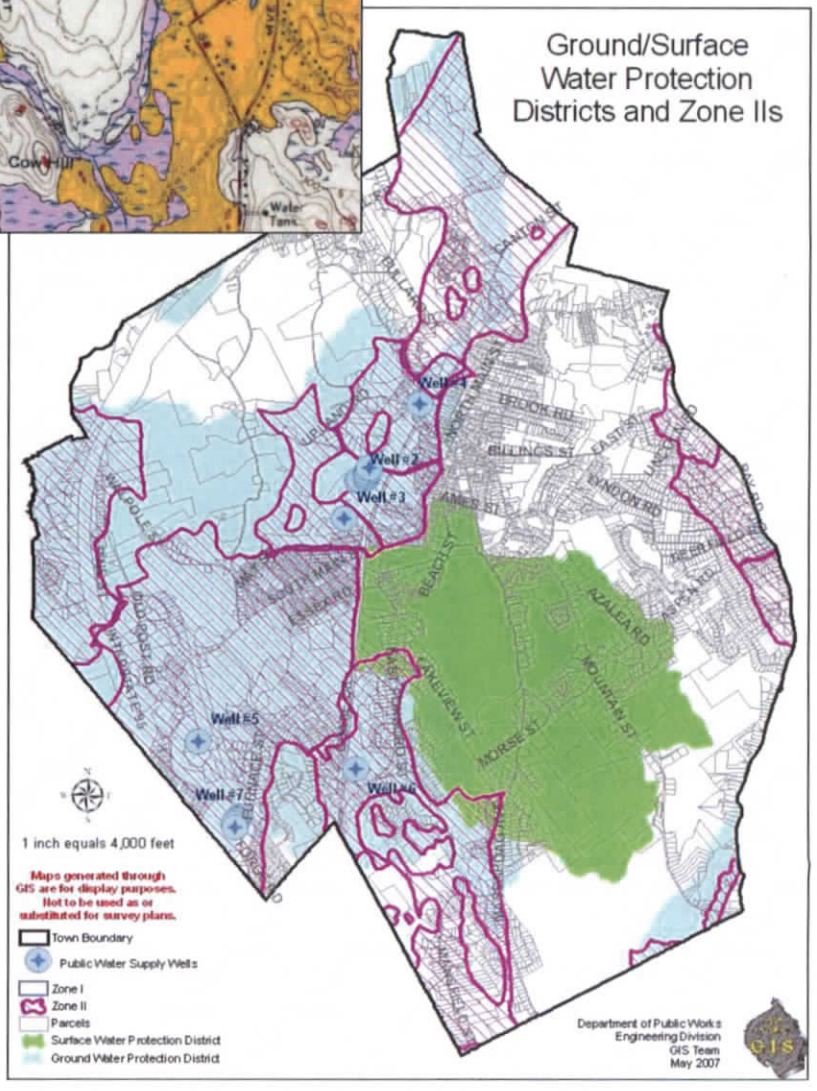


FIGURE 2. Ground/Surface Water Protection Zones – Groundwater originating from the SGC Swamp supplies high quality groundwater recharge to all of the municipal wells in the Town of Sharon.

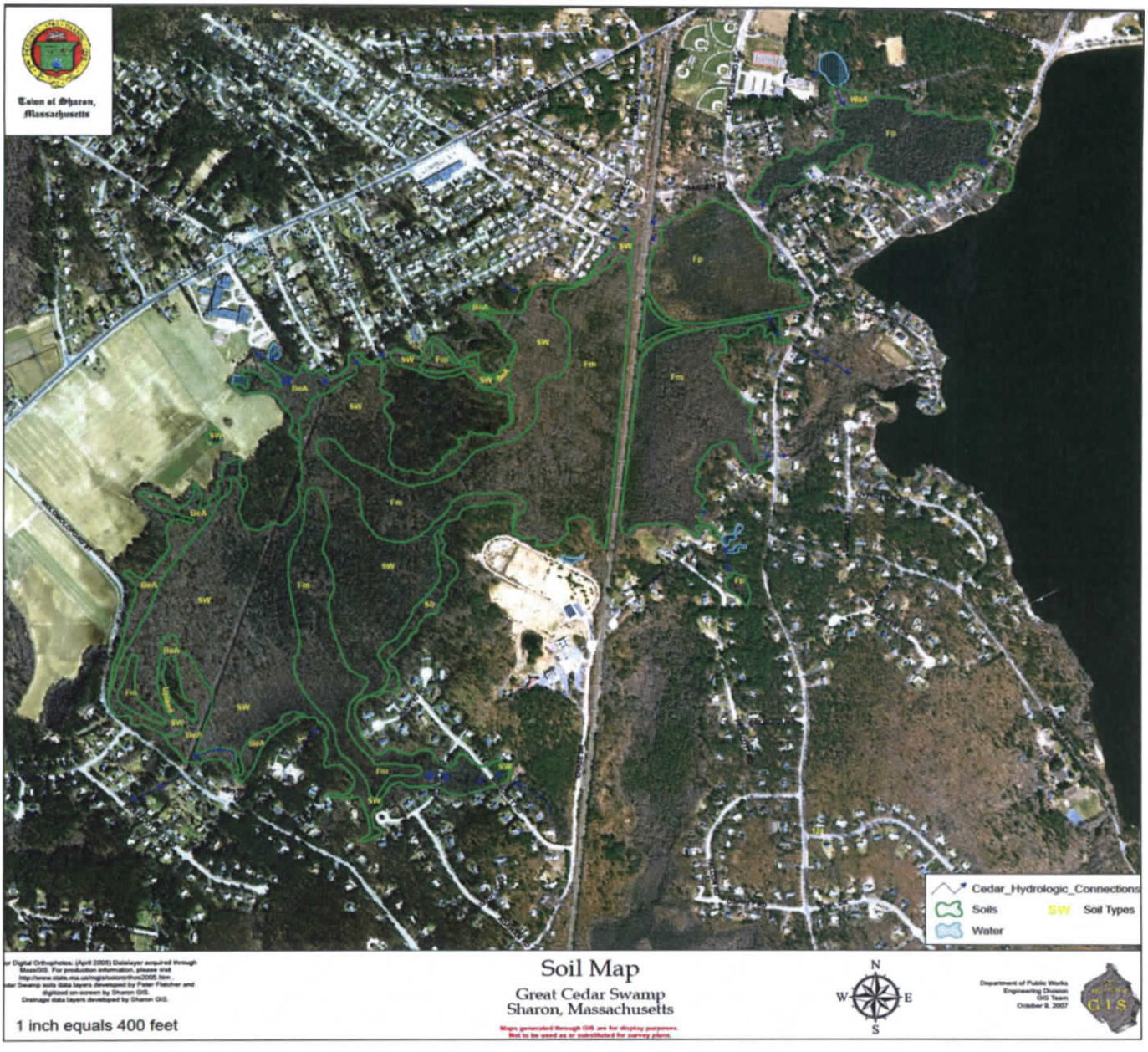


FIGURE 3. The soil conditions within the Swamp are primarily very poorly drained soils that formed in the shallow and thick deposits of well-decomposed organic matter.

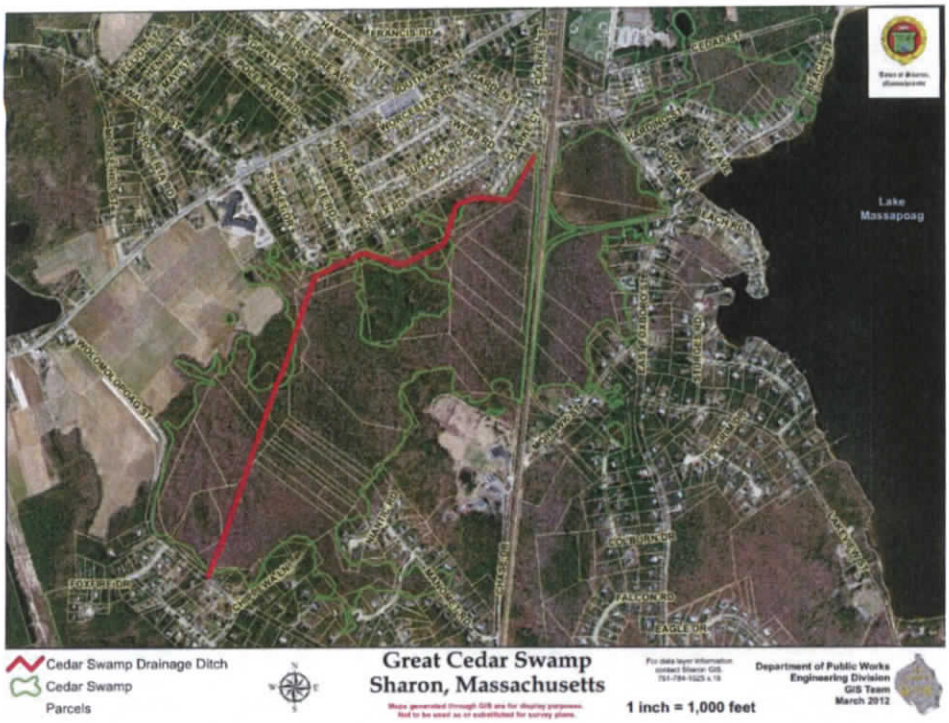
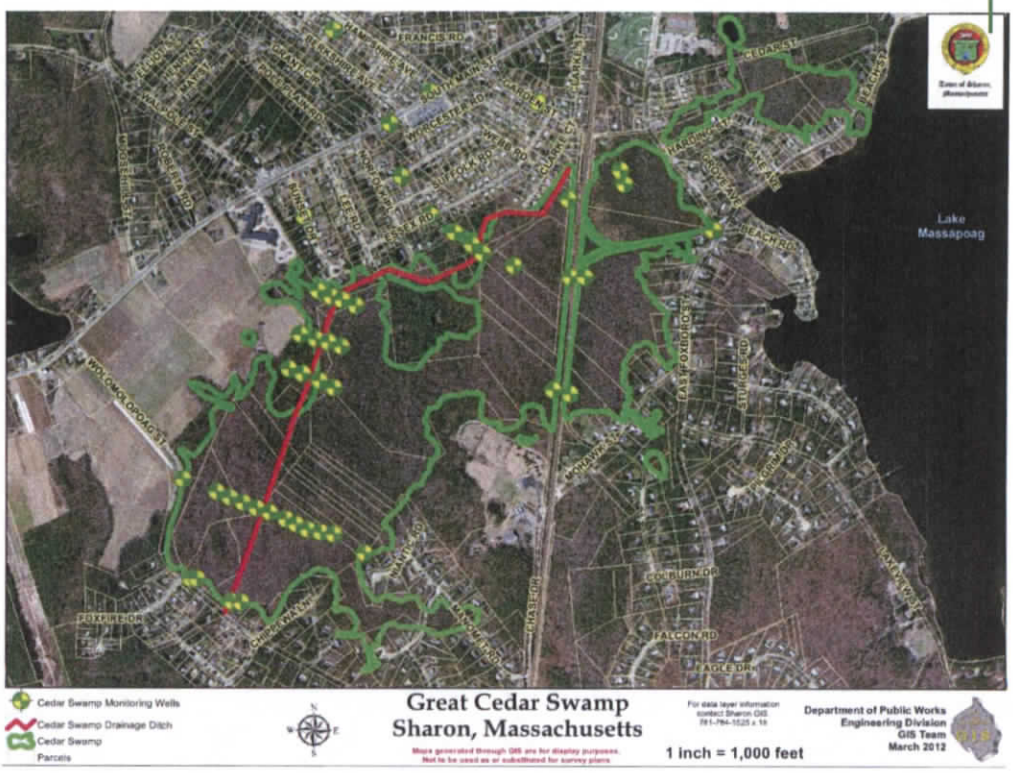


FIGURE 4. The situation deteriorated in the late 1950's when a poorly engineered residential subdivision, the Heights, was built right on the swamp's western border. These homes soon experienced localized flooding during storms: flooded basements, flooded streets, and poorly functioning septic systems. To eliminate excess water from the residential area, the town authorized construction of a ditch. This large drainage ditch extends about 1.25 miles through the western portion of the swamp. At its start just east of Garden Court, the ditch is about 2 feet deep by 8 feet wide. Where it exits the Swamp beneath Wolomolopoag Street the ditch is currently about 10 feet deep and 30 feet wide at its top.

FIGURE 5. A network of monitoring wells was installed to better understand the flow of groundwater within and from the Swamp.



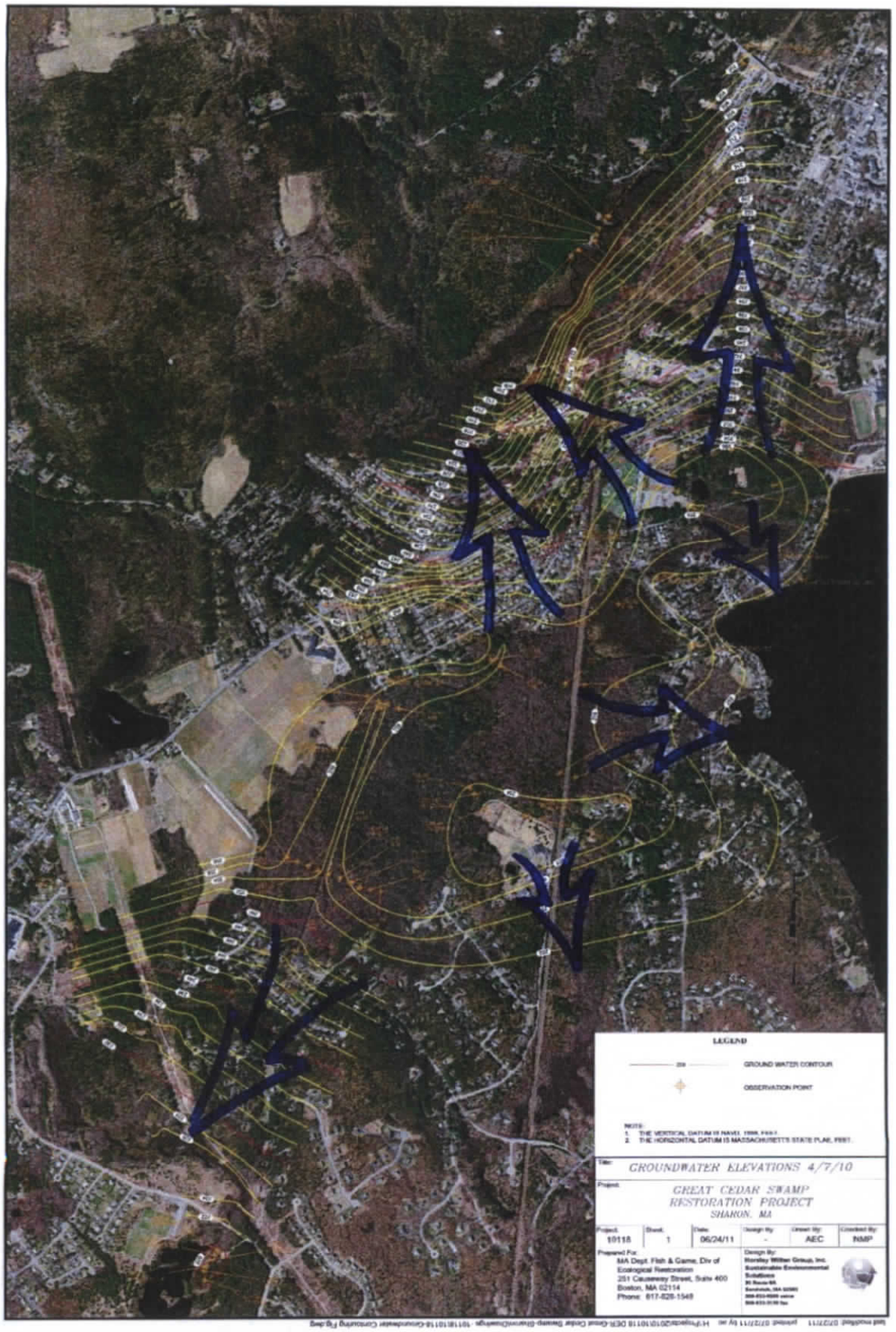


FIGURE 6 & 7. With combined Town and State funding, the Horsley Witten Group was contracted to develop a groundwater contour map of the area.

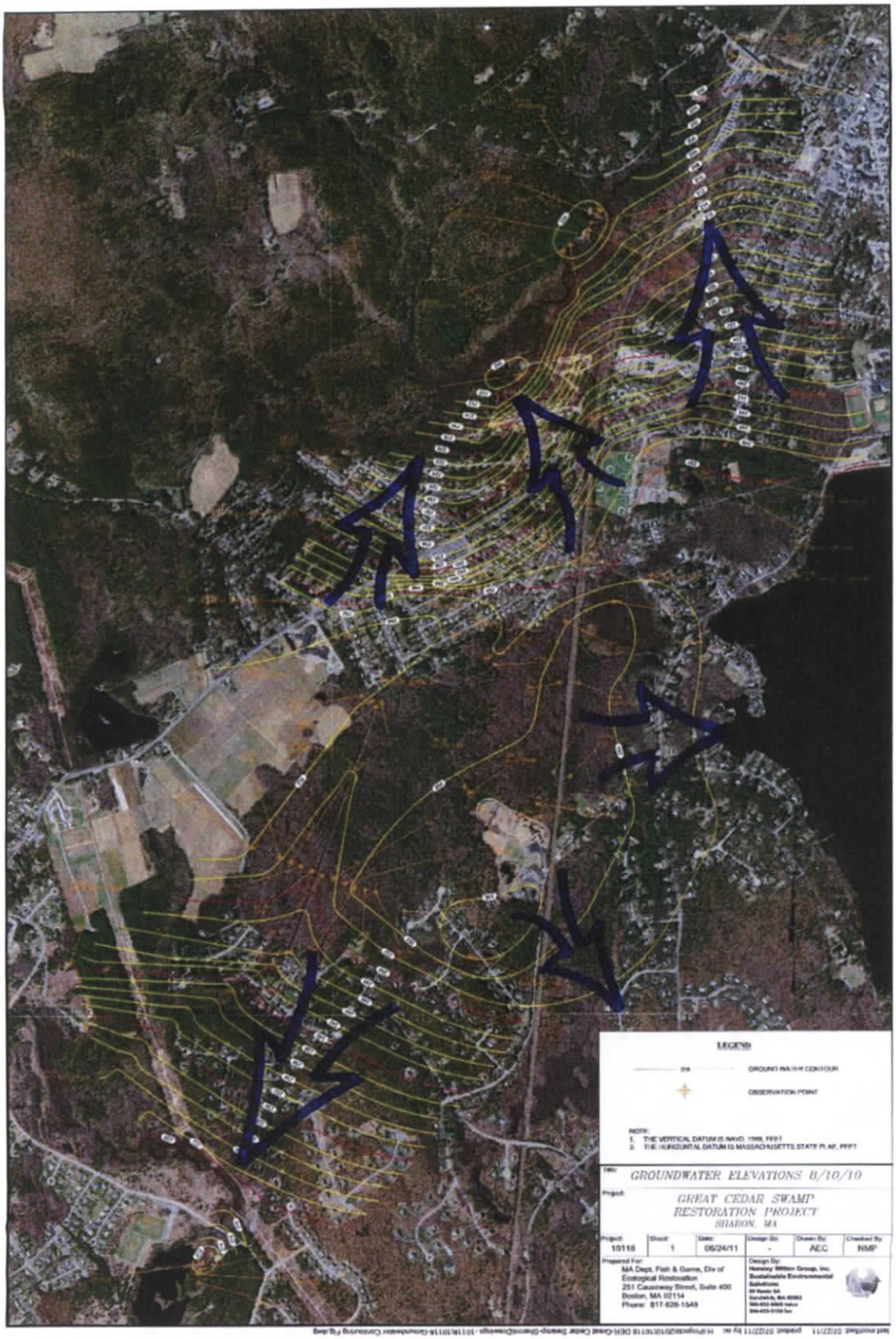
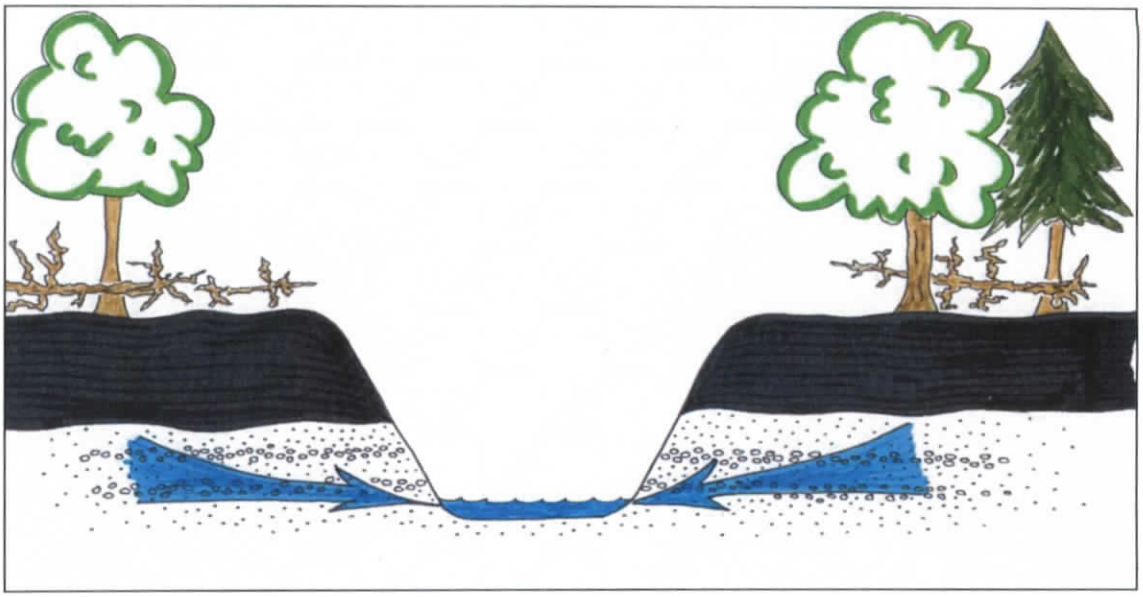

LEGEND
GROUNDWATER CONTOUR
OBSERVATION POINT
NOTE:
1. THE VERTICAL DATUM IS (NAVD 1988, FEET
2. THE HORIZONTAL DATUM IS MASSACHUSETTS STATE PLANE, FEET
GROUNDWATER ELEVATIONS 8/10/10
GREAT CEDAR SWAMP
RESTORATION PROJECT
SHARON, MA
10118
1
05/24/11
AEC
NMP
MA Dept. Fish & Game, Div of
Ecological Restoration
251 Causeway Street, Suite 400
Boston, MA 02114
Phone: 617-626-1549

FIGURE 7.

FIGURE 8. Because the bottom of the ditch extends down into the underlying sands and gravel, it has effectively drained a large portion of the swamp



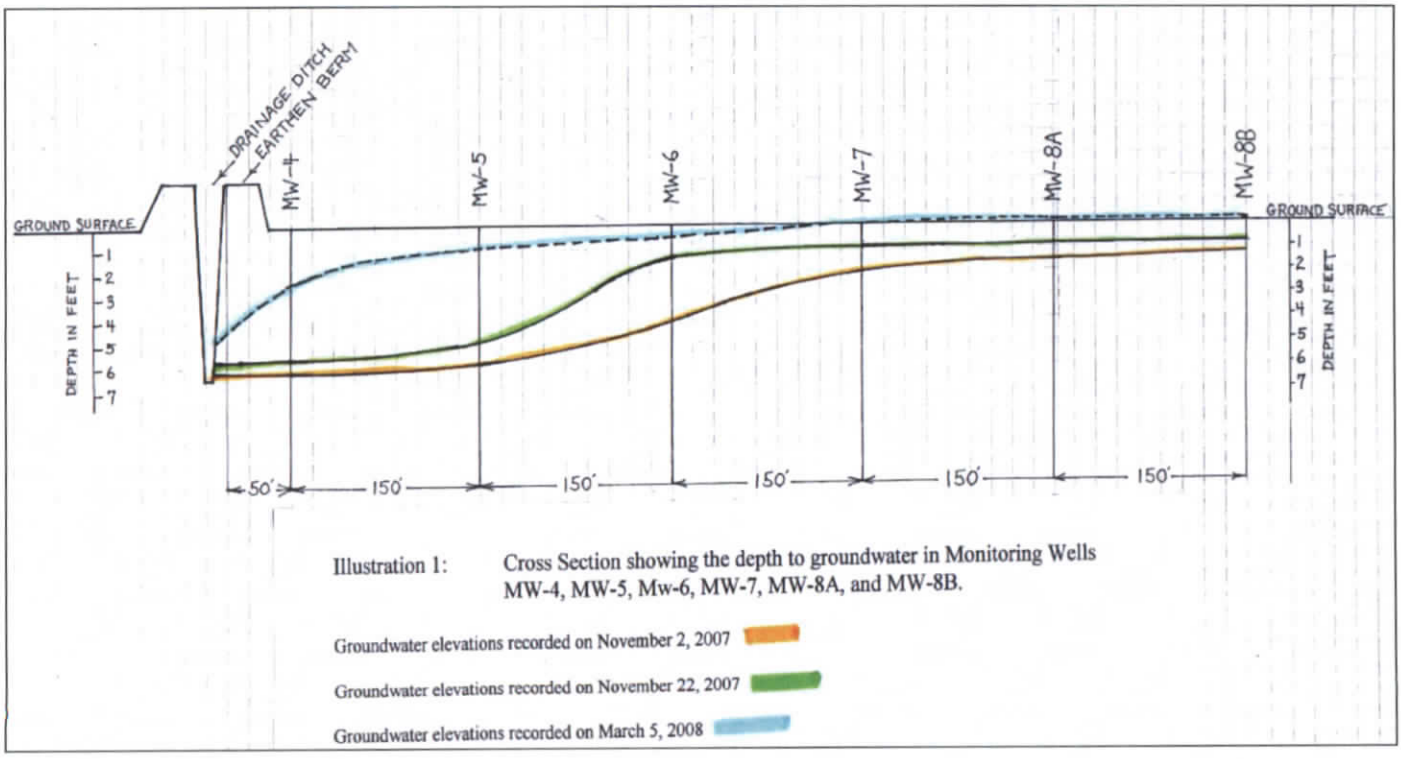


FIGURE 9. The effects of the drainage ditch.

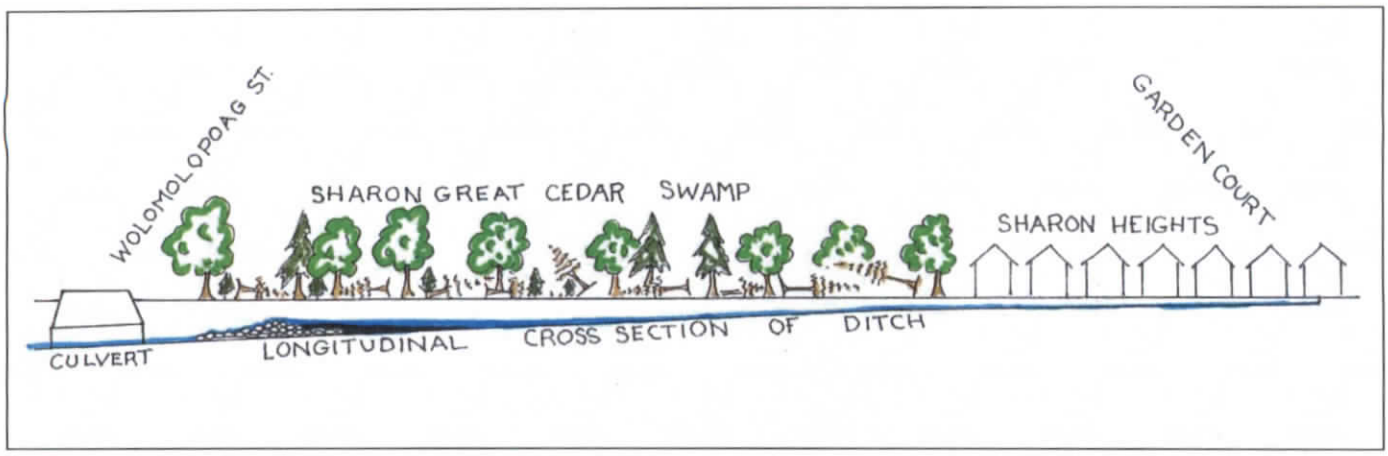
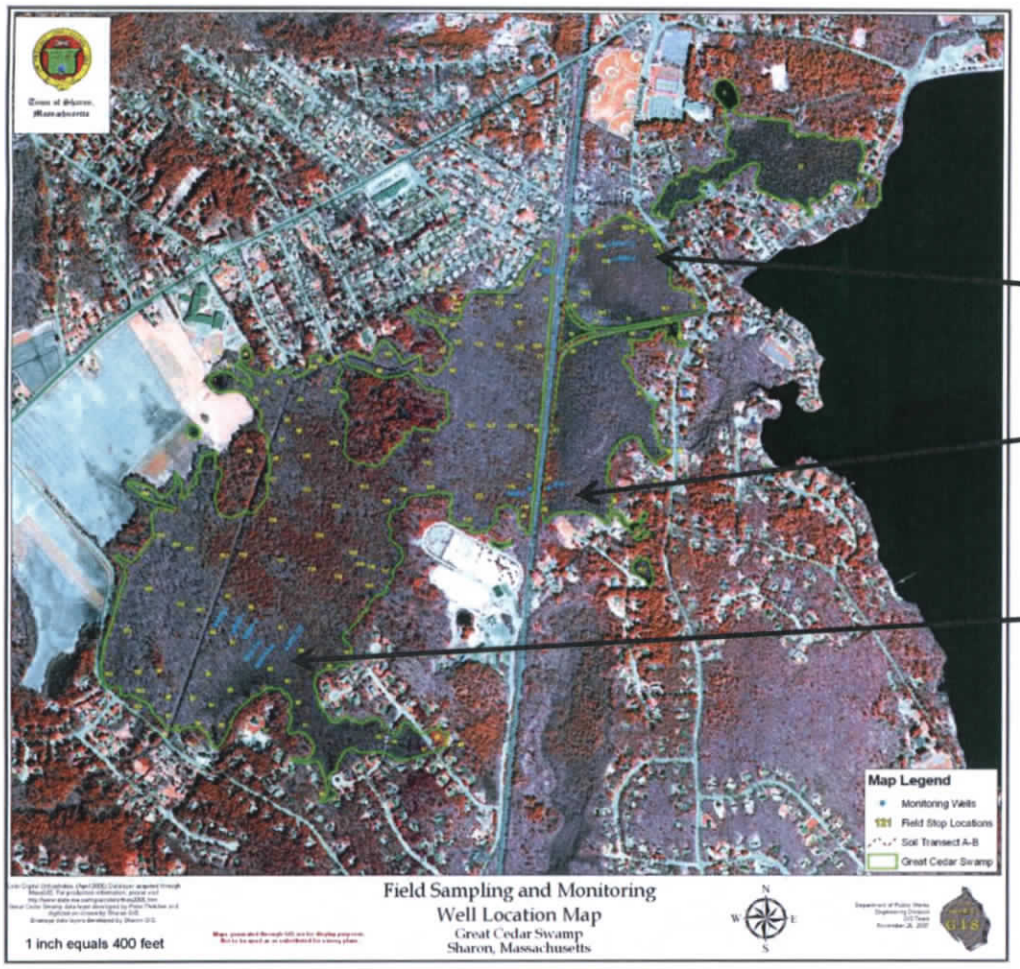


FIGURE 10. A temporary structure (stream baffle) has been placed within the ditch to assess the impacts of raising the groundwater elevation within portions of the Swamp.

FIGURE 11. The most important concern when evaluating the feasibility of restoring the hydrology within areas of the Sharon Great Cedar Swamp was to prevent any deleterious hydrological impact on the abutting residential development (Heights Area).

To measure the impacts of the baffle within the ditch, monitoring well transects were positioned at different intervals along the length of the ditch to record groundwater elevations. In addition, stream gauges were placed within the ditch to record flow elevations



Section 3 is recovering with mostly shrub swamp vegetation and some cedar trees evident.

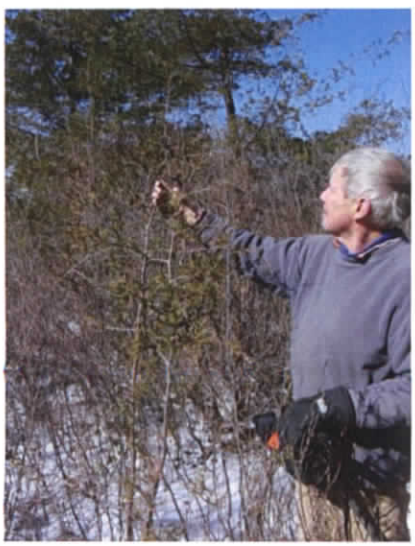
Section 2 has a narrow band of relatively healthy AWC community, which is close to the rail line

Section 1 is west of the rail line and includes areas east and west of the ditch. The cedar swamp community here is in serious decline. A restoration test plot may be established here if hydrologic conditions become suitable.

FIGURE 12. Baseline vegetation study plots were centered on monitoring wells, most of which are shown in blue on the above map. This aerial infrared view gives a picture of the plant community types in the three areas of the SGCS. Bright red areas are dominated by white pine and indicate upland conditions. Gray indicates hardwood trees in winter condition, and the lighter scattered red with finer texture indicates the presence of conifers including Atlantic white cedar and eastern hemlock.

Sharon Great Cedar Swamp Trees in Study Plots																
Sect.	Plot#	Date	Live Tree				Snag		% Dead Standing	% Cover Downed Trees	AWC Sapling			AWC Seedlings		
			Count	mean DBH (cm)	AWC#	%AWC	Count	AWC			Total Count	Dead	% Dead	Present	Dead	Browsed
2	1	7/2/08	32	21.5	20	62.5	2	1	6.3	~6%	8	2	25	<1%		
1	2	7/2/08	24	21.9	14	58	9	7	27.2	~26%	?	?				
1	A4E=4	7/30/08	7 (19 stems)	28.5	0	0	7	5	50 (36)	~26%	0	2	100			
1	A8E=8	7/16/08	5AWC+	25.2	5	~15-25	?	?	?	6-25%						
1	A4W=12	10/4/10	6 (10 stems)	37.4	0	0	1	0	10	32%	0	0	0			
1	A2W=11	10/18/10	7	33			1	0	12.5	6-25%	0	0	0			
3	E2S=9	**10/15/07**	13	15.7	12	92	0	0	0					<1%		
3	**E1N=10**	**10/15/07**	**4**	**12.3, 13.2**	**4**	**100**	**0**	**0**	**0**					common		
3	**E1N=10**	**3/18/14**	**4,+2 outside**	**16.6, 18.5**	**4**	**100**	**0**	**0**	**0**		**25**		**<1**	**44 <5cm, 106< 1ft; 17 1-3ft**	**11**	**>12**

FIGURE 13. Tree counts and measurements are summarized here. Atlantic white cedar regeneration in Section 3 is evident in plot 10 (photos below).



Sharon Great Cedar Swamp Vegetation baseline study																
				West of Railroad Bed							East of Railroad Bed				
			NCNE	Section 1							Section 2	Section 3			
				West of Ditch		East of Ditch								Repeat visits	
Strata	Species	Common Name		1-12	1-11	1-4	1-5	1-5	1-8	1-2	2-1	3-9	3-10	3-10	3-10
				10/2010	10/2010	07/2008	11/2010	05/2016	09/2008	06/2008	06/2008	06/2008	06/2008	08/2010	03/2014
Canopy	*Chamaecyparis thyoides*	Atlantic White Cedar	obl						2	2	3	3	1	2	2
Canopy	*Acer rubrum*	Red Maple	fac	3	3	5	2	2	4	2	2	1	1	1	1
Canopy	*Betula alleghaniensis*	Yellow Birch	fac	1	2		2	2	2	1	2				
Canopy	*Tsuga canadensis*	Eastern Hemlock	facu			3			1		2				
Canopy	*Pinus strobus*	White Pine	facu						1						
Canopy	*Betula populifolia*	Gray Birch	fac									<1			
Shrub	*Frangula alnus*	Glossy Buckthorn	fac									3	3	4	4
Shrub	*Clethra alnifolia*	Sweet Pepperbush	fac	5	5	3	2	4	3	3	2	3	2	3	3
Shrub	*Vaccinium corymbosum*	Highbush-blueberry	facw	1			<1	<1			<1	2	1	1	2
Shrub	*Chamaecyparis thyoides*	Atlantic White Cedar	obl									<1	1	2	2
Shrub	*Chamaedaphne calyculata*	Leatherleaf	obl										1	<1	1
Shrub	*Rhododendron viscosum*	Swamp Azalea	facw	1							<1	<1	<1	1	1
Shrub	*Acer rubrum*	Red Maple	fac									<1	<1	<1	<1
Shrub	*Lyonia ligustrina*	Maleberry	facw				<1	?			<1				
Shrub	*Eubotrys racemosa*	Fetterbush	facw				<1	?			<1				
Shrub	*Gaylussacia frondosa*	Dangleberry	fac								<1				
Shrub	*Betula alleghaniensis*	Yellow Birch	fac							1					
Shrub	*Nemopanthus mucronatus*	Mountain-holly	obl							<1					
Shrub	*Pinus strobus*	White Pine	facu						<1						
Shrub	*Aronia xfloribunda*	Chokeberry	facw				<1	<1							
Herbaceous	*Acer rubrum*	Red Maple seedling	fac	1	1	1	<1	<1	<1		1	<1	<1	?obscured from vie	
Herbaceous	*Aralia nudicaulis*	Sarsaparilla	facu								<1				
Herbaceous	*Betula alleghaniensis*	Yellow Birch seedling	fac		1	<1		<1	<1		<1				
Herbaceous	*Carex atlantica ssp. atlantica*	Eastern Prickly Sedge	facw						<1		<1				
Herbaceous	*Carex swanii*	Swan's Sedge	facu			<1									
Herbaceous	*Carex spp.*	sedges (vegetative)							<1			<1	<1	<1	
Herbaceous	*Chamaecyparis thyoides*	AWC seedling	obl								<1	<1		2	counted
Herbaceous	*Chamaedaphne calyculata*	Leatherleaf	obl										1	?	
Herbaceous	*Clethra alnifolia*	Sweet Pepperbush	fac									1	2	?	
Herbaceous	*Decodon verticillatus*	Water Willow	obl									<1	3	4	
Herbaceous	*Dryopteris intermedia*	Wood Fern	fac		<1	<1		2	<1						
Herbaceous	*Dulichium arundinaceum*	Three-square Sedge	obl									<1		<1	
Herbaceous	*Epilobium* sp.	Willow-herb							<1						
Herbaceous	*Erechtites hieraciifolius*	Pilewort							<1						
Herbaceous	*Frangula alnus*	Glossy Buckthorn	fac				<1		<1			2	2	2	
Herbaceous	*Iris sp*	Blue Flag	obl						<1						
Herbaceous	*Lysimachia borealis*	Starflower	fac			<1			<1						
Herbaceous	*Maianthemum canadense*	Canada Mayflower	facu	1	<1	1		2	1	1	1				
Herbaceous	*Onoclea sensibilis*	Sensitive Fern	facw						1						
Herbaceous	*Osmunda cinnamomea*	Cinnamon Fern	facw	<1	<1	<1		1	1	1	1				
Herbaceous	*Parthenocissus quinquefolius*	Virginia Creeper	facu								<1				
Herbaceous	*Pinus strobus*	White Pine seedling	facu		<1		<1				<1			<1	
Herbaceous	*Prunus serotina*	Black Cherry	facu				<1								
Herbaceous	*Pteridium aquilinum*	Bracken Fern	facu	1											
Herbaceous	*Quercus rubra?*	Oak seedling	facu						<1		<1	<1			
Herbaceous	*Symplocarpus foetidus*	Skunk Cabbage	obl						<1		1				
Herbaceous	*Toxicodendron radicans*	Poison Ivy	fac		<1				<1		<1				
Herbaceous	*Triadenum virginicum*	Marsh St. John's-wort	obl									<1	3	2	
Herbaceous	*Tsuga canadensis*	Eastern Hemlock	facu								<1				
Herbaceous	*Vaccinium corymbosum*	HB Blueberry seedling	facw			<1						<1			
Herbaceous	*Viburnum dentatum*	Northern Arrowwood	fac								<1				
Herbaceous	*Coptis trifolia*	Goldthread	facw			<1			<1						
Herbaceous	*Panicum* spp.	a grass				<1									
Herbaceous	*Impatiens capensis*	Jewelweed	facw						<1						
Non-vascular	*Sphagnum spp.*	sphagnum mosses						<1	1	<1	3	3	5	5	
Non-vascular	*other mosses*			2		1	1	1	2	<1	3	3	2	2	
Liana	*Smilax rotundifolia*	Bull Briar	fac						<1						

FIGURE 14. Data summary for 15m x 15m vegetation study plots established in the three sections of Sharon Great Cedar Swamp.

FIGURE 15. Glossy buckthorn (Frangula alnus) spreads near head of ditch.

FIGURE 16. Glossy buckthorn overtops sweet pepperbush in Section 3.

INVASIVE SPECIES. Along with the loss of AWC and the increasing abundance of upland species within the swamp, several exotic invasives are spreading rapidly. Near the head of the ditch glossy buckthorn is the dominant shrub, both in Section 1 and across the rail line in Section 3. Several amur cork trees, patches of Japanese knotweed, and barberry occur along the ditch and have recently been removed. Garlic mustard is spreading north along the ditch from near Wolomolopoag Road. All of these will require control as they can have permanent impact on the AWC community. Carolyn Danforth, Peter Fletcher, and Madison Meister have assisted with invasives control.

FIGURE 17. Japanese knotweed (Fallopia japonica) takes hold along the ditch bank

FIGURE 18. Barberry (Berberis thunbergii) on the ditch berm.

FIGURE 19. Amur corktree (Phellodendron amurense), a likely invasive, grows on the ditch berm.

FIGURE 20. Garlic mustard (Alliaria petiolata) spreads up from near Wolomolopoag Road.

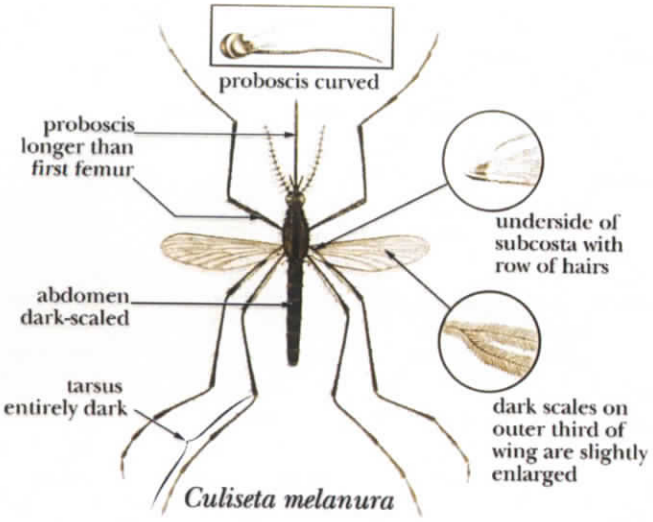


FIGURE 21. Atlantic White Cedar swamps are home to *Culiseta melanura* mosquitoes, the primary vector for Eastern Equine Encephalitis Virus (EEEv). EEEv is a serious but rare disease that has caused outbreaks of human illness periodically throughout Massachusetts as early as 1938. Cedar swamps provide a refuge for the virus to build in the reservoir host population (migratory and local birds) and provides a place for the primary vector, *Cs. melanura*, to feed on these reservoir hosts. Because *Cs. melanura* prefer to feed on birds, the transmission of the disease to humans relies on mosquito species that are less particular in their diet. These bridge vector mosquitoes feed on the infected birds and pass the virus on to humans.

FIGURE 22. Norfolk County often has human cases of EEEv during periods of outbreak because of the Atlantic White Cedar and Red Maple swamps that are located throughout our county that harbor the primary vector. Norfolk County Mosquito Control has trapped and tested mosquitoes for viruses in the Sharon Great Cedar Swamp since 2004. We have found mosquitoes carrying both EEEv and West Nile Virus in traps located around the Sharon Great Cedar Swamp.


Figure 22. Typical crypt monitored for *C. melanura* larvae.

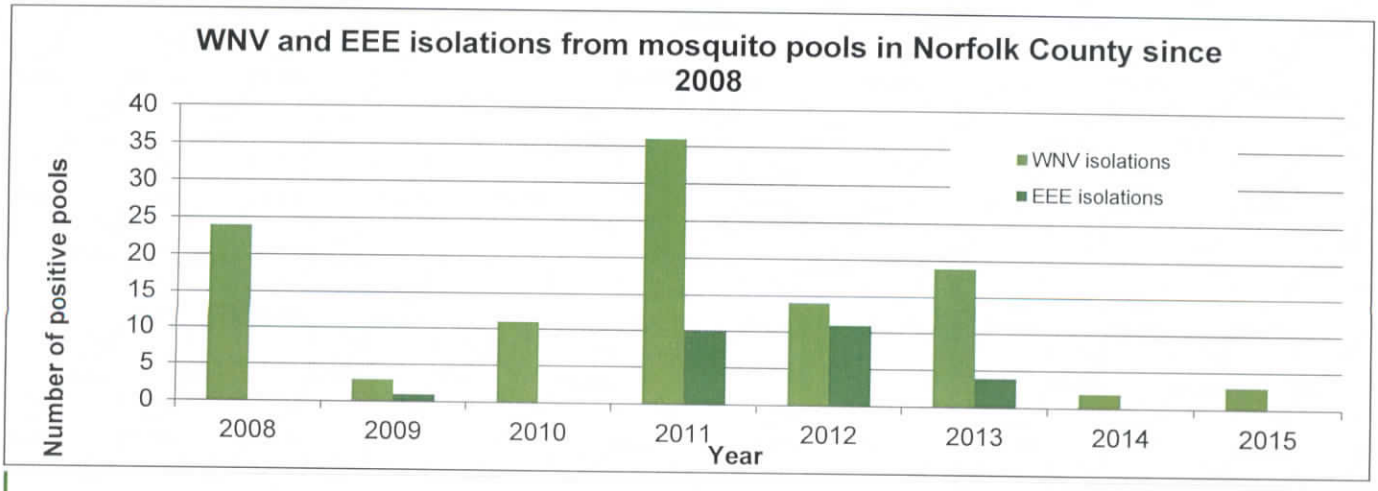


FIGURE 23. Pools of mosquitoes that tested positive for West Nile and Eastern Equine Encephalitis since 2008. The most recent Massachusetts outbreak of EEEv in humans occurred in 2010-2013. Though there has never been a human or horse case of EEEv in residents of Sharon, there have been cases in residents from surrounding towns and during the most recent EEEv active season, Sharon mosquitoes accounted for more than half of the total mosquito pools that tested positive for EEEv in Norfolk County.

FIGURE 24. Pools of mosquitoes that tested positive for WNV and EEEv in Sharon since 2006. Note that the 2011 isolations make up more than half of the total number of positive isolates for the county. Sharon is a big source of EEEv for Norfolk County.

Trap Date	Trap Site	Genus	Species	Virus
2006	Sharon DPW	Culex	pipiens/restuans complex	WNV
2011	Garden Street	Culiseta	melanura	EEE
2011	Garden Street	Culiseta	melanura	EEE
2011	Garden Street	Culiseta	melanura	EEE
2011	Garden Street	Ochlerotatus	canadensis	EEE
2011	Garden Street	Ochlerotatus	canadensis	EEE
2011	Garden Street	Culiseta	melanura	WNV
2012	Garden Street	Culiseta	melanura	WNV
2012	Garden Street	Culiseta	melanura	EEE
2013	Garden Street	Culex	pipiens/restuans complex	WNV

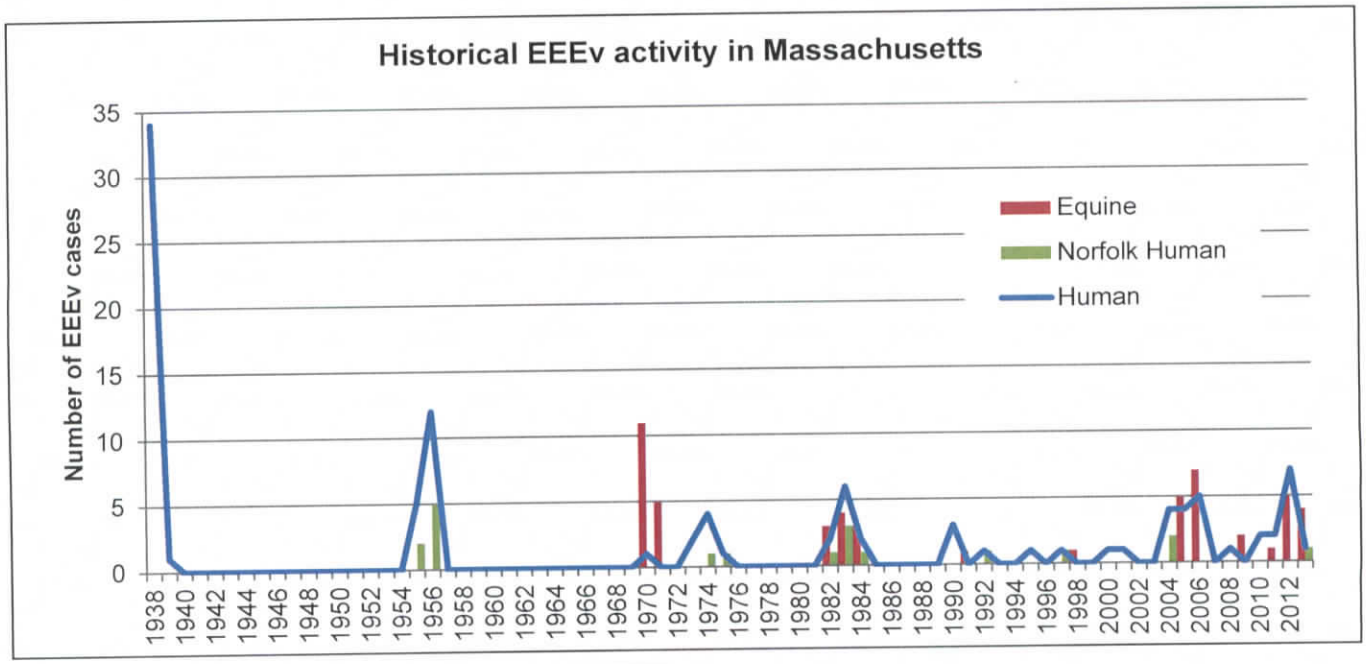


FIGURE 25. EEEv cases in humans throughout MA (in blue) and in Norfolk County (in green) as well as horse cases throughout the state. Note that Norfolk County consistently has human cases during each EEEv human outbreak. EEEv is very active in Norfolk County because of the Atlantic White Cedar and Red Maple swamps that are located throughout our county that harbor the primary vector.