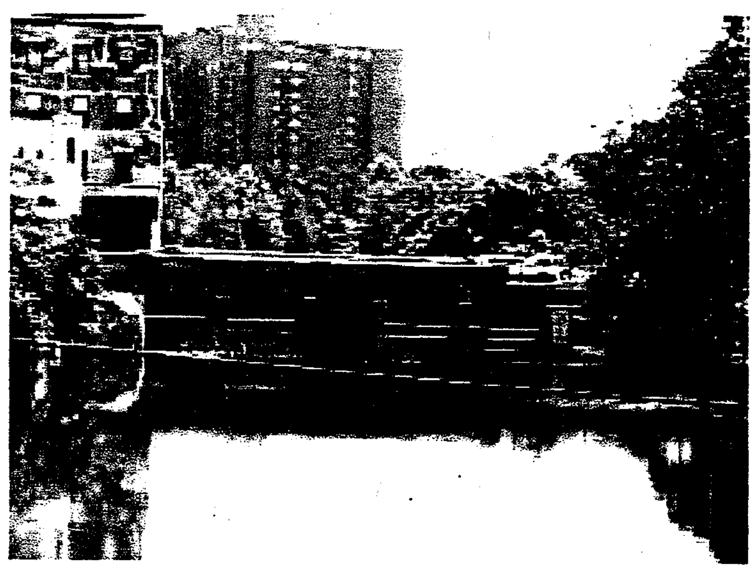
Appendix E: Commonwealth of Massachusetts Department of Conservation and Recreation Flooding Report with Comments by Stephen Kaiser

Metropolitan District Commission

Mystic River Hydrologic and Hydraulic Study Report

MDC Contract No. P83-1250-S2A

January 31, 2003



Executive Summary

General

This report on a hydrologic and hydraulic study of the Mystic River watershed is one component of a Metropolitan District Commission (MDC) project to plan rehabilitation or replacement of the Upper Mystic Lake Dam. This report assesses flooding and identifies flood reduction measures along the Mystic River and its Alewife Brook tributary. It updates numerous previous studies, and follows the occurrence of three recent major floods in the area in October 1996, June 1998, and March 2001.

Numerous studies have been conducted since the early 1900s examining the hydrology of the Mystic River Basin. Some of these have examined the complete watershed, while others have focused on areas with chronic flooding or water quality problems such as Alewife Brook or the Aberjona River. This study follows and makes use of the analysis and findings of the recently completed Aberjona River Flood Study (CDM, 1999) The recommendations from that study are contained in Appendix E. The focus of the study described in this report is on the Mystic River watershed from the Mystic Lakes, including the Upper Mystic Lake Dam, downstream to the Wellington Bridge above the confluence with the Malden River and the downstream limit of the freshwater basin at Amelia Earhart Dam.

Analysis

For this study, all prior studies and the currently available drawings and mapping were collected and reviewed to obtain the necessary data for the analysis. An updated computer model of the Mystic River basin study area was constructed and used to assess hydraulic conditions at the dam along the downstream waterways. The widely used and accepted Storm Water Management Model (SWMM) was used in this analysis. SWMM is a dynamic continuous simulation rainfall-runoff model designed for urban areas. SWMM was developed for the United States Environmental Protection Agency (USEPA) from 1969-1971 by researchers at University of Florida, CDM, and Metcalf and Eddy, Inc. The model has been expanded, refined, and verified many times since by consulting engineers and a variety of academic institutions.

A large storm in October, 1996 caused heavy rainfall in the area and very high flows over a two to three day period. An actual time history of the Aberjona River discharges during this storm was available for the USGS gaging station located just upstream of the Upper Mystic Lake. A number of high-water elevations were also recorded during this event. This storm was selected and consistently used as the basis for our modeling in both the Aberjona and Mystic River hydrologic and hydrology studies because it occurred relatively recently, is well-remembered, caused significant flood damage and has the best available data for it.

The October 20, 1996 Storm was characterized by a long duration of moderately heavy wide-spread rainfall. Approximately 10.1 inches of rain fell over a 41-hour period in the Mystic and Aberjona watershed. The peak 24-hour rainfall of 8.4 inches has an estimated recurrence interval of approximately 100-years, making it among the largest recorded storms in this area.

The peak Aberjona River flow of 1,150 cfs at the USGS gage on the river was also among the highest recorded for the 58 years of record at this gage. Based on this gaging record, the USGS determined that the return period for the October, 1996 peak flow is approximately 50 years (i.e., a storm of that magnitude is expected to occur once every 50 years on average).

Findings

The findings of this study may be summarized briefly as follows. The findings are further described in Section 6 of the report.

Upper Mystic Lake and Dam

- Analysis of the Upper Mystic Lake shows that the current dam and outlet works configuration does not provide sufficient storage to attenuate large stormwater inflows.
- Investigation of changes in the outlet works that would provide a lower initial lake level at the beginning of a large storm showed that this could be an effective means for maintaining lower flood levels in and around the lake without causing adverse increases in the rate of flow and therefore the potential to increase flooding in areas downstream of the dam.
- The specifics of any such improvements for flood control as well as dam safety are being investigated in Phase II of this project and will be described in subsequent reports.

Mystic River

- Evaluation of the structures and flood profiles along the Mystic River from the Lower Mystic Lake to the Amelia Earhart Dam did not identify any constrictions causing high headloss and excessively elevated flood profiles.
- Reports of very significant headlosses at the Cradock Bridge on Main Street in Medford Center could not be replicated by the hydraulic modeling based on the 1980 design drawings for the demolition of the old Cradock Dam and Locks. As a result divers we sent out to investigate the subsurface conditions found the flow section to be significantly constricted with accumulated subsurface debris.
- The MDC is in the process of having this debris removed to greatly reduce the losses associated with this structure and return this structure to its intended flow capacity.
- The Mystic River was found to have no other significant flow constrictions that warrant improvement.

Alewife Brook

- Evaluation of the structures and flood profiles along the Little River/Alewife Brook tributary from Little Pond to its confluence with the Mystic River identified a narrow, shallow channel with several restrictive bridge crossings as contributing to the recurrent flooding problems that occur along this waterway.

- The most restrictive of these were identified as the old bridges at Broadway and Massachusetts Avenue with bridge opening widths of 12.5 feet and 14 feet respectively compared with opening widths of 30 feet or more for the other structures along the brook.

- However, it was determined that the combined head loss attributable to these bridges is only 0.4 feet, or about 5 inches, for a severe storm such as the one that occurred during October, 1996.

- Widening of the Mass. Ave. and Broadway bridges would be desirable to have a more consistent, unrestrictive flow path along the entire length of Alewife Brook. While this improvement would result in some slight improvement in the severity and frequency of flooding upstream of the bridges along Alewife Brook and the Little River, the costs of reconstructing the bridges would likely exceed the expected economic benefit of their improvement.

- The planning level cost estimates are $2,000,000 for widening the Massachusetts Avenue Bridge, and $1,500,000 for widening the Broadway Bridge.

- Based on these costs, the costs of reconstructing the bridges at Massachusetts Avenue and Broadway would likely exceed the economic benefit achieved and cannot be recommended on a flood-control basis alone.

APPENDIX ***DCR Report of February 2003***

3-page executive summary from DCR report.

Additional SK comments :

The MDC/DCR report of February 2003 as prepared by CDM is a significant improvement over the earlier September 2002 draft. For the 50-year storm of October 1996, the elevation drop from one side of the Mass Ave bridge to the other now becomes 5 inches, which compares with a similar value at Broadway and 7 inches at the Route 2 culvert. The new report used a flood elevation of 7.0 NGVD as the calibration point in 1996, and avoided the admitted flawed and inconsistent measurements of the Army Corps for this storm. The Army Corps reported a 3-foot drop through the Route 2 area of Alewife Brook, and this concept was carried over into the initial CDM report. This error was corrected in the new MDC/DCR edition of January/February 2003.

The new report is generally consistent with the 1981 flood study for Alewife, also prepared by CDM. However, the recent analysis considers only a 50-year storm and does not preview any other storms or flood measurements. Replacement of bridges on Alewife Brook could not need cost-benefit criteria for funding. As a result, the report recommends no structural proposals to decrease upstream flooding or increase downstream flooding.

Appendix F: Alewife Rainfall and Flooding Summary by Stephen Kaiser

ALEWIFE RAINFALL AND FLOODING SUMMARY

TABLE 1 Flood measurements near Route 2 and Mass Avenue

RAINFALL	October 1996	June 1998	March 2001	April 2004
at Logan Airport	(National Weather Service)			
Rain in one day	6.1 inches	5.7 inches	2.6 inches	4.3 inches
Rain in 2 days	7.9 inches	6.8 inches	3.0 inches	5.6 inches
Prior rain	2.3 inches 11 days before	1/2 inch 10 days before	frozen ground and melting snow	very dry

FLOOD LEVELS Upstream of Route 2 / Near ADL All elevations in feet, NGVD

Measured by	1996	1998	2001	2004
by Army Corps	8.9 feet	-	-	-
DCR Measure	-	-	-	-
CDM Computer Model	7.0 feet	5.9 feet (uncalibrated)	4.8 feet (uncalibrated)	-
by MWRA or DEP	-	-	-	-
by ARLINGTON	6.9 feet (Mugar)	-	-	-
by BELMONT	st flood was 1955 Hurricane = 6.9 feet)			-
by CAMBRIDGE	-	-	-	-
by S. Kaiser by Sunnyside neighbors	7.0 feet (15 inches)	6.5 feet (10 inches)	6.4 feet (10 inches)	5.4 feet in basements

FLOOD LEVELS Upstream of Mass Avenue All elevations in feet, NGVD

Measured by	1996	1998	2001	2004
by Army Corps	5.65 feet	-	-	-
DCR Measure	-	-	-	-
CDM Computer Model	6.3 feet	4.1 feet (uncalibrated)	3.6 feet (uncalibrated)	-
by MWRA or DEP	-	-	-	-
by ARLINGTON	-	-	-	-
by BELMONT	-	-	-	-
by CAMBRIDGE	-	-	5.3 feet	-
by S. Kaiser by Sunnyside neighbors	6.6 feet (15 inches)	6.3 feet (10 inches)	6.0 feet (10 inches)	5.0 feet in basements
by Lafayette neighbors	-	7.2, 7.6 feet	-	-
Flood Rating by FEMA Criteria	50-year event	25-year event	25-year event	5 to 10 year event

FLOOD IMPACTS	1996	1998	2001	2004
Route 2 Closed	2 lanes	2 lanes	4 lanes	1 lane
Parkway Closed	4 lanes	4 lanes	4 lanes	none
Basements Flooded	Yes	Yes	Yes	Yes
Number of Basements flooded	unknown	unknown	unknown	unknown

Appendix G: Potential Flood Storage Enhancements: Alewife Reservation prepared by The Bioengineering Group on behalf of the Department of Conservation and Recreation

DRAFT
Potential Flood Storage Enhancements
Alewife Reservation & Alewife Brook
Prepared by The Bioengineering Group, Inc.
January 2004

Parcel	Proposed Action	TBG Method for Estimating Existing FSV	In 100-yr Floodplain (8.28' NGVD)	Existing								Potential		Potential Gain in FSV (ac-ft)***
				Min. El.	Max. El.	Avg. El.*	Area** (sf)	Area** (acres)	FSV*** (CY)	FSV*** (ac-ft)	Avg. El.	FSV*** (ac-ft)		
Former MDC Ice Rink	Excavate, berm, and install flood gates, maximize upland habitat with inundation-tolerant plants	DTM for existing	No	4.4	12.5	8.4	187,974	4.3	4,269	2.6	5.0	17.3		14.6
Belmont Uplands	New development with slight increase in FSV	take directly from developer's plan and numbers	partially	~1	~21	NA	NA	15.6	NA	NA	NA	NA		0.5
Little River b/w Perch Pond & Rt. 2 Access Rd. Bridge	Dredge an avg. of ~ 1.0', restoring natural channel profile	rough estimate based on average dredging depth of 1.0' over river area	NA	less than 0.0'			213,108	4.9	NA	TBD	TBD	TBD		4.9
Cambridge Stormwater Wetland	Excavate and install stormwater wetland basin and compensatory wetlands	take directly from project plans and numbers	partially	2	13	NA	NA	3.0	NA	51.5	1.0	58.7		7.2
Acorn Office Park	Remove existing buildings along riverfront portion, convert to conservation easement	rough estimate based on calculated area and elevations from plan	Yes	4	7.5	5.5	174,000	4.0	NA	9.5	5.5	14.0		4.5
ADL Parking Lot	Acquire, then create wetland for habitat, education, and flood control	DTM for existing	Yes	2.7	13	2.8	265,000	6.1	61,248	38.0	2.0	42.6		4.6
Cattail Marsh	Acquire outer areas, restore wetland, enhance for flood control by excavating to GW; potential USACE involvement	rough estimate based on calculated area and elevations from plan	Yes	1.4	2.8	2.2	133,000	3.1	NA	20.8	1.5	22.9		2.1
Dilboy Field parking lot	Excavate down to gain flood storage, connect to Little River	DTM for existing	partially	6.8	10.5	8.0	78,824	1.8	2,812	1.7	6.0	5.4		3.7
Blair Pond	Dredge to remove accumulated soft sediments (to > 10' depth, est. 15,000 CY); potential USACE involvement	based on the 1999 Blair Pond Master Plan estimate of 15,000 CY soft sediment volume	Yes	between -5.0' & +10' contours			57,000	1.3	NA	Unknown	Unk.	Unk.		9.3
Mugar Parcel	Acquire & then utilize as upland preserve?	Not enough info	partially	between 5' and 15' contours			775,000	17.8	NA	TBD	TBD	TBD		TBD
Sum All Parcels										**124.1**		**160.8**		**51**

NOTES:
All elevations in ft NGVD
*Avg. Elev. = Average elevation for area based on observing 1-ft contours
**Area: Area of region as delineated in AutoCAD plan; ownership of some areas not resolved, some areas need to be acquired by MDC for this area to be possible.
*** FSV: Flood Storage Volume to 9.0'
TBD: To be determined

Appendix H: Commonwealth of Massachusetts Department of Environmental Protection and Department of Public Health, *Flooding and Sewage Backups: Home Care Guide*

Appendix

Massachusetts Department of Environmental Protection
Massachusetts Department of Public Health

Flooding and Sewage Back-ups: Home Care Guide

- Introduction
- Prevention/Preparation
- Cleaning Up:
    - Interior Cleanup
    - Exterior Cleanup
- Links

Background/Introduction

This document has been jointly prepared by the Massachusetts Department of Public Health Division of Community Sanitation (DPH), and the Massachusetts Department of Environmental Protection (DEP) and is intended to provide guidance to the general public relative to managing pathogen risks from direct contact with floodwaters and/or sewage backups.

> ***It is important to note that during and following flooding events, dangerous and even life-threatening hazards may exist, and the public is strongly urged to contact local and state emergency management officials for instructions on the procedures or actions necessary to safely avoid injury during these conditions.***

This document *is not* intended to directly address these public safety issues (such as risks from accidental electrocution from flooded basements or downed power lines). Additional information on the public safety hazards associated with floodwaters can be found at the Massachusetts Department of Public Health, Red Cross and Federal Emergency Management Agency and Massachusetts Emergency Management Agency websites.

Pathogens are disease-causing agents, which can be in the form of bacteria, viruses, mold spores, or protozoans, and which are normally present in large numbers in sewage wastes. The nature and extent of potential pathogen risks of sewer backups and floodwaters will depend in large part on the potential contaminants expected to be in the waters. In general, the greater the extent of the sewage component, the more likely the potential for adverse impacts, and the more important the proper cleanup of the materials that have come into direct contact with the contaminated waters. The severity of the health threat therefore depends on the source of the water and the extent of