City of Gardner - *Executive Department*
Mayor Michael J. Nicholson

March 21, 2024

Hon. Elizabeth J. Kazinskas, Council President
And City Councilors
Gardner City Hall, Rm 121
95 Pleasant Street
Garnder, MA 01440

RE: A Communication from the Mayor regarding the emergency repairs made to the Crystal Lake Dike by the Greenwood Pool

Dear Madam President and Councilors,

I am writing to inform you of an emergency repair made at the Crystal Lake Dike that took place on Thursday, March 14, 2024.

While vising the new multi-use path/bike trail that as installed to change the color of the fence lights back to white, it was noted that not only was the water at Crystal Lake the highest it has been in years, but also that several feet of the dike that holds Crystal Lake from flowing into the Greenwood Pool/Monument Park area had eroded away due to the high winds we have been experiencing creating waves in the lake.

The high levels of water are attributed to several different factors. The first being the rain we have experienced, the melting/thawing in the area, but largely in part to the work we have done in improving the City's water system.

As you are likely aware, the City conducted a water main replacement project from 2020 through 2022 in which all of our water mains that were installed between 1860 and the late 1920s were replaced. Additionally, the City contracts with a consultant for $10,000/year to go and inspect our water pipes and hydrants to find any leaks that are occurring so we can make the necessary repairs. At the end of last year, the City received an efficiency report that stated due to all of the above, we saved approximately 96 million gallons of water in 2023 compared to before the repairs were made. Our water treatment plant produces approximately 2 million gallons of water daily for our residents, making this saving an equivalent amount to 48 days' worth of water remaining in Crystal Lake.

To alleviate the flooding concerns with the rain and snow that was predicted in the following weeks, the City's gravity fed hydrant system was opened to release some of the water and lower the level in the lake. These are the black painted hydrants that are fed directly from Crystal Lake and flow by gravity and the pressure of the water in the lake. The Water Department's industrial

City of Gardner - *Executive Department*
Mayor Michael J. Nicholson

pump was also attempted to be used, however, due to a malfunction this was not possible. This piece of equipment is now under repair to avoid this happening in the future.

Furthermore, Crystal Lake from then until the date this correspondence is being written (March 21) is being drained into Pond Brook. This, however, does cause flooding to occur on John Street and Risley Street, since the culvert in that area has failed and is in need of replacement.

However, thanks to all of these measures, the water level in Crystal Lake has subsided to a level that alleviates the concerns of flooding.

Additionally to stabilize the dike, the City install rip-rap stones along the shores of the lake to stabilize the dike.

All of these items were cleared through the City's Conservation Agent, the Department of Conservation and Recreation, the Department of Environmental Protection, and the City's contracted dam inspectors. The City was also notified that due to the minimal size of the dike, it falls outside of the Commonwealth's dam inspection requirements and only under local jurisdiction.

Through this review process, the Administration found a report from the dam inspection conducted on the Crystal Lake Dike in April of 2014, that actually recommended that rip-rap stone be added to stabilize this shore in the event of waving- which is exactly what occurred.

The work has since been completed, the dike/dam stabilized, and the flooding concerns alleviated, however, I am writing to make sure you are aware of this entire situation in the event you receive any questions from our constituents.

Respectfully submitted,

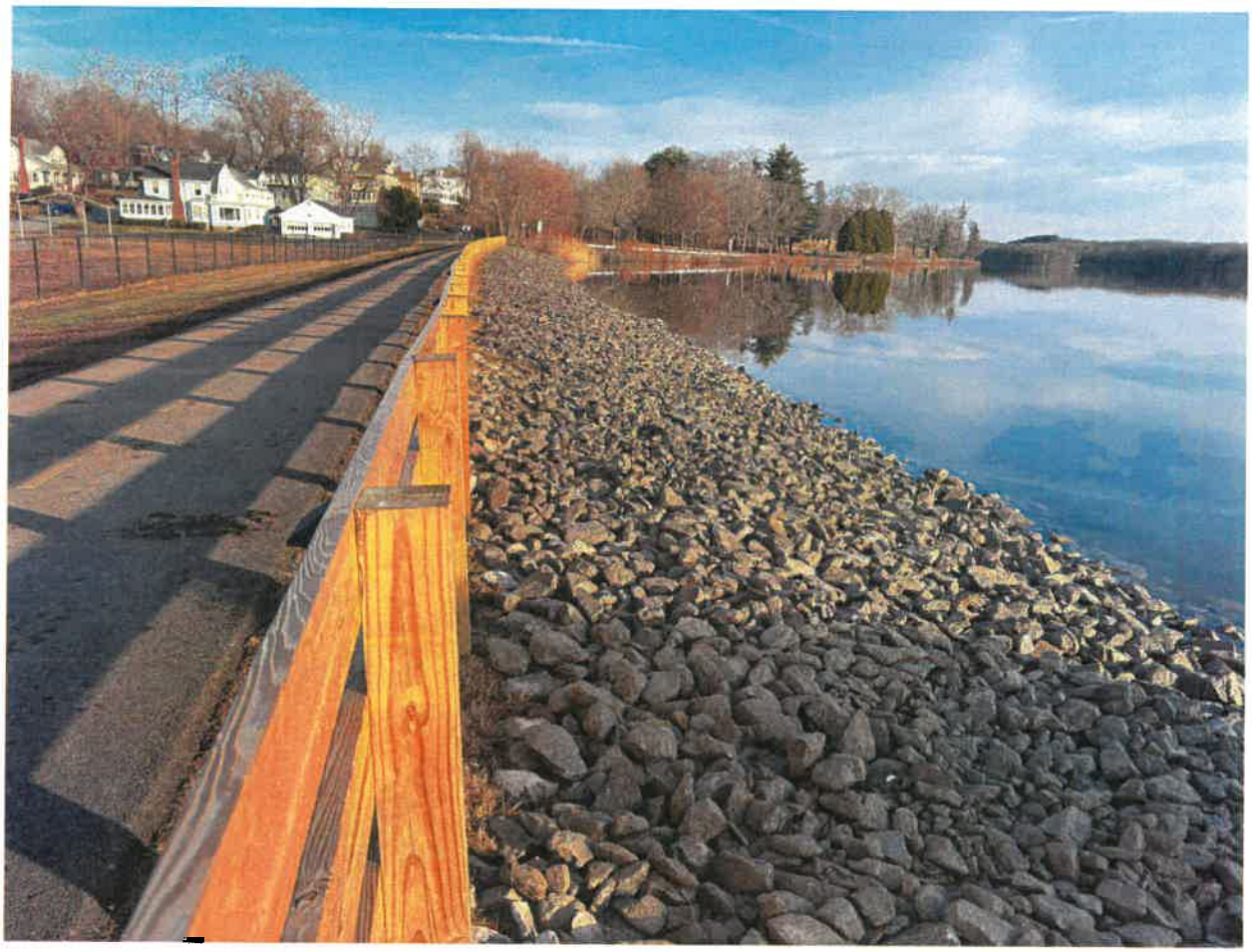
Michael J. Nicholson
Mayor, City of Gardner

Before Repair

Before Repair

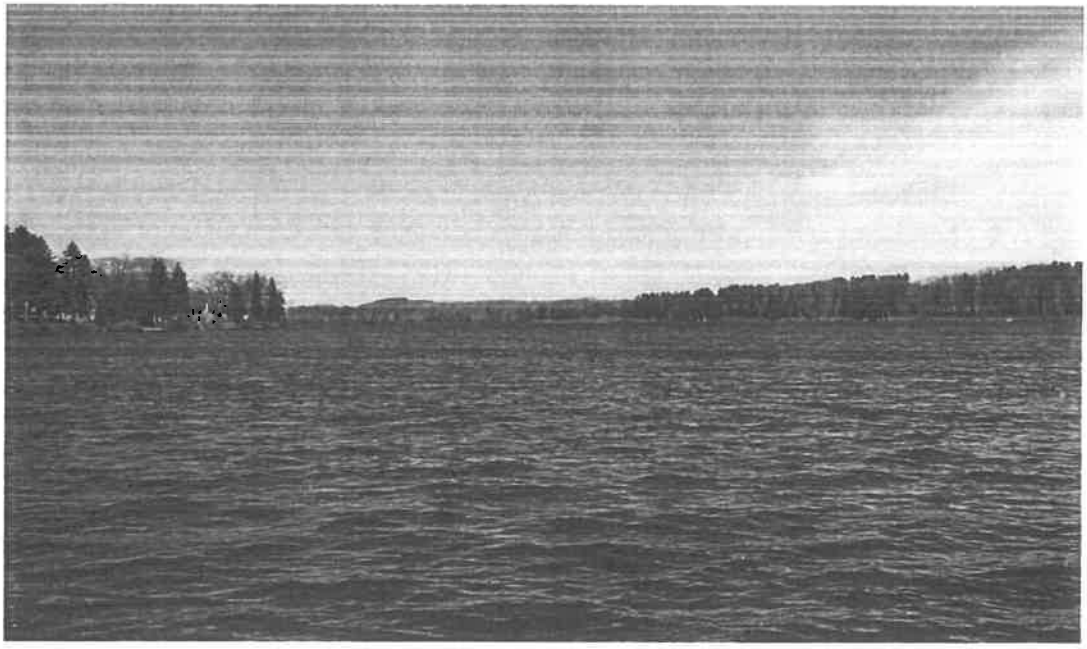
During Repair

After Repair



After Repair

-- Crystal Lake Dike --
Municipally-Owned Dike
PHASE I
INSPECTION/EVALUATION REPORT



Dam Name:	Crystal Lake Dike
State Dam ID#:	3-14-103-21
NID#:	MA01243
Owner:	City of Gardner, MA
Owner Type:	Municipal
City:	Gardner
Consultant	CDR Maguire Inc.
Date of Inspection:	April 8, 2014

CDR MAGUIRE

Executive Summary

This Phase I Inspection/Evaluation Report details the inspection and evaluation of Crystal Lake Dike located in Gardner, Massachusetts. The inspection was conducted on April 8, 2014 by CDR Maguire Inc. of Providence, Rhode Island. Crystal Lake Dike is classified as a Large-size, Class III (Low) hazard potential dam.

In general, Crystal Lake Dike was found to be in **fair** condition with the following deficiencies worth noting. Potential problems for the dam include:

- Erosion along the upstream slope with missing rip rap.
- Minor brush growth within the upstream riprap slope protection.

CDR Maguire recommends the following actions be taken to address the deficiencies found at the dam during inspection.

- Clear trees, brush and roots from the dam's upstream embankments.
- Repair and maintain the upstream embankment slope with the addition of additional rip rap.

The vegetation removal should be performed under the direction of a professional engineer with experience in dam design.

Dam Evaluation Summary Detail Sheet

1. NID ID:	MA 001243	4. Inspection Date:	April 8, 2014
2. Dam Name:	Crystal Lake Dike	5. Last Insp. Date:	April 16, 2004
3. Dam Location:	GARDNER, MA	6. Next Inspection:	April 8, 2024
7. Inspector:	Robert P. Sims		
8. Consultant:	CDR Maguire		
9. Hazard Code:	Low	9a. Is Hazard Code Change Requested?:	No
10. Insp. Frequency:	10 Years	11. Overall Physical Condition of Dam:	FAIR
12. Spillway Capacity (% SDF)	0-50% of the SDF or Unknown		

E1. Design Methodology:	2	E7. Low-Level Discharge Capacity:	3
E2. Level of Maintenance:	2	E8. Low-Level Outlet Physical Condition:	3
E3. Emergency Action Plan:	2	E9. Spillway Design Flood Capacity:	5
E4. Embankment Seepage:	5	E10. Overall Physical Condition of the Dam:	3
E5. Embankment Condition:	4	E11. Estimated Repair Cost:	$33,500
E6. Concrete Condition:	N/A		

Evaluation Description

E1: DESIGN METHODOLOGY
1. Unknown Design – no design records available
2. No design or post-design analyses
3. No analyses, but dam features appear suitable
4. Design or post design analysis show dam meets most criteria
5. State of the art design – design records available & dam meets all criteria

E2: LEVEL OF MAINTENANCE
1. Dam in disrepair, no evidence of maintenance, no O&M manual
2. Dam in poor level of upkeep, very little maintenance, no O&M manual
3. Dam in fair level of upkeep, some maintenance and standard procedures
4. Adequate level of maintenance and standard procedures
5. Dam well maintained, detailed maintenance plan that is executed

E3: EMERGENCY ACTION PLAN
1. No plan or idea of what to do in the event of an emergency
2. Some idea but no written plan
3. No formal plan but well thought out
4. Available written plan that needs updating
5. Detailed, updated written plan available and filed with MADCR, annual training

E4: SEEPAGE (Embankments, Foundations, & Abutments)
1. Severe piping and/or seepage with no monitoring
2. Evidence of monitored piping and seepage
3. No piping but uncontrolled seepage
4. Minor seepage or high volumes of seepage with filtered collection
5. No seepage or minor seepage with filtered collection

E5: EMBANKMENT CONDITION (See Note 1)
1. Severe erosion and/or large trees
2. Significant erosion or significant woody vegetation
3. Brush and exposed embankment soils, or moderate erosion
4. Unmaintained grass, rodent activity and maintainable erosion
5. Well maintained healthy uniform grass cover

E6: CONCRETE CONDITION (See Note 2)
1. Major cracks, misalignment, discontinuities causing leaks, seepage or stability concerns
2. Cracks with misalignment inclusive of transverse cracks with no misalignment but with potential for significant structural degradation
3. Significant longitudinal cracking and minor transverse cracking
4. Spalling and minor surface cracking
5. No apparent deficiencies

E7: LOW-LEVEL OUTLET DISCHARGE CAPACITY
1. No low level outlet, no provisions (e.g. pumps, siphons) for emptying pond
2. No operable outlet, plans for emptying pond, but no equipment
3. Outlet with insufficient drawdown capacity, pumping equipment available
4. Operable gate with sufficient drawdown capacity
5. Operable gate with capacity greater than necessary

E8: LOW-LEVEL OUTLET PHYSICAL CONDITION
1. Outlet inoperative needs replacement, non-existent or inaccessible
2. Outlet inoperative needs repair
3. Outlet operable but needs repair
4. Outlet operable but needs maintenance
5. Outlet and operator operable and well maintained

E9: SPILLWAY DESIGN FLOOD CAPACITY
1. 0 - 50% of the SDF or unknown
2. 50-90% of the SDF
3. 90 - 100% of the SDF
4. >100% of the SDF with actions required by caretaker (e.g. open outlet)
5. >100% of the SDF with no actions required by caretaker

E10: OVERALL PHYSICAL CONDITION OF DAM
1. UNSAFE – Major structural, operational, and maintenance deficiencies exist under normal operating conditions
2. POOR - Significant structural, operation and maintenance deficiencies are clearly recognized under normal loading conditions
3. FAIR - Significant operational and maintenance deficiencies, no structural deficiencies. Potential deficiencies exist under unusual loading conditions that may realistically occur. Can be used when uncertainties exist as to critical parameters
4. SATISFACTORY - Minor operational and maintenance deficiencies. Infrequent hydrologic events would probably result in deficiencies.
5. GOOD - No existing or potential deficiencies recognized. Safe performance is expected under all loading including SDF

E11: ESTIMATED REPAIR COST
Estimation of the total cost to address all identified structural, operational, maintenance deficiencies. Cost shall be developed utilizing standard estimating guides and procedures

Changes/Deviations to Database Information since Last Inspection

Preface

The purpose of this report is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing and detailed computational evaluations are beyond the scope of this report.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection, along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected the under normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Authorized/Licensed Professional's Signature

Robert P. Sims, P.E.
Massachusetts License No. 35130

Project Manager
CDR Maguire Inc.

Crystal Lake Dike - Inspection/Evaluation Report

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Section 1

1.0 DESCRIPTION OF PROJECT

1.1 General

1.1.1 Authority

The City of Gardner, Massachusetts, has retained CDR Maguire Inc. to perform visual inspections and develop reports updating the conditions of a number of dams owned and operated by the City of Gardner and provide recommendations for remediation, as necessary.

1.1.2 Purpose of Work

The purpose of this investigation was to inspect and evaluate the present condition of the Crystal Lake Dike, appurtenant structures and downstream channel area. The dike was inspected in accordance with Army Corps of Engineers' Phase I requirements, the Massachusetts Department of Conservation and Recreation (DCR)1, and requirements set forth in the Code of Massachusetts Regulations (302 CMR 10.00 Dam Safety Rules and Regulations). The scope of work for the Phase I evaluations was divided into four parts: 1) obtain and review all available reports, investigations, and data previously submitted to the DCR, owner, or U.S. Army Corps of Engineers pertaining to each dike and appurtenant structures; 2) perform a visual inspection of each site and completion of the standard dam inspection checklist; 3) evaluate the status and need for an emergency action plan for the site; and 4) prepare and submit a final report presenting the evaluation of each retention structure, including recommendations and remedial action.

1.1.3 Definitions

To provide the reader with a better understanding of the report, definitions of commonly used terms associated with dams are provided in Appendix E. Many of these terms may be included in this report. The terms are presented under common categories associated with dams which include: 1) orientation; 2) dam components; 3) size classification; 4) hazard classification; and 5) miscellaneous.

1.2 Description of Project

1.2.1 Location

Crystal Lake Dike is an earth embankment dike located along the southwest rim of Crystal Lake in Gardner, Massachusetts. Access to the dike is located off of Graham Street as shown in Figure 1. Appendix A contains a sketch of the dike, and Appendix B contains photographs taken at the dike site.

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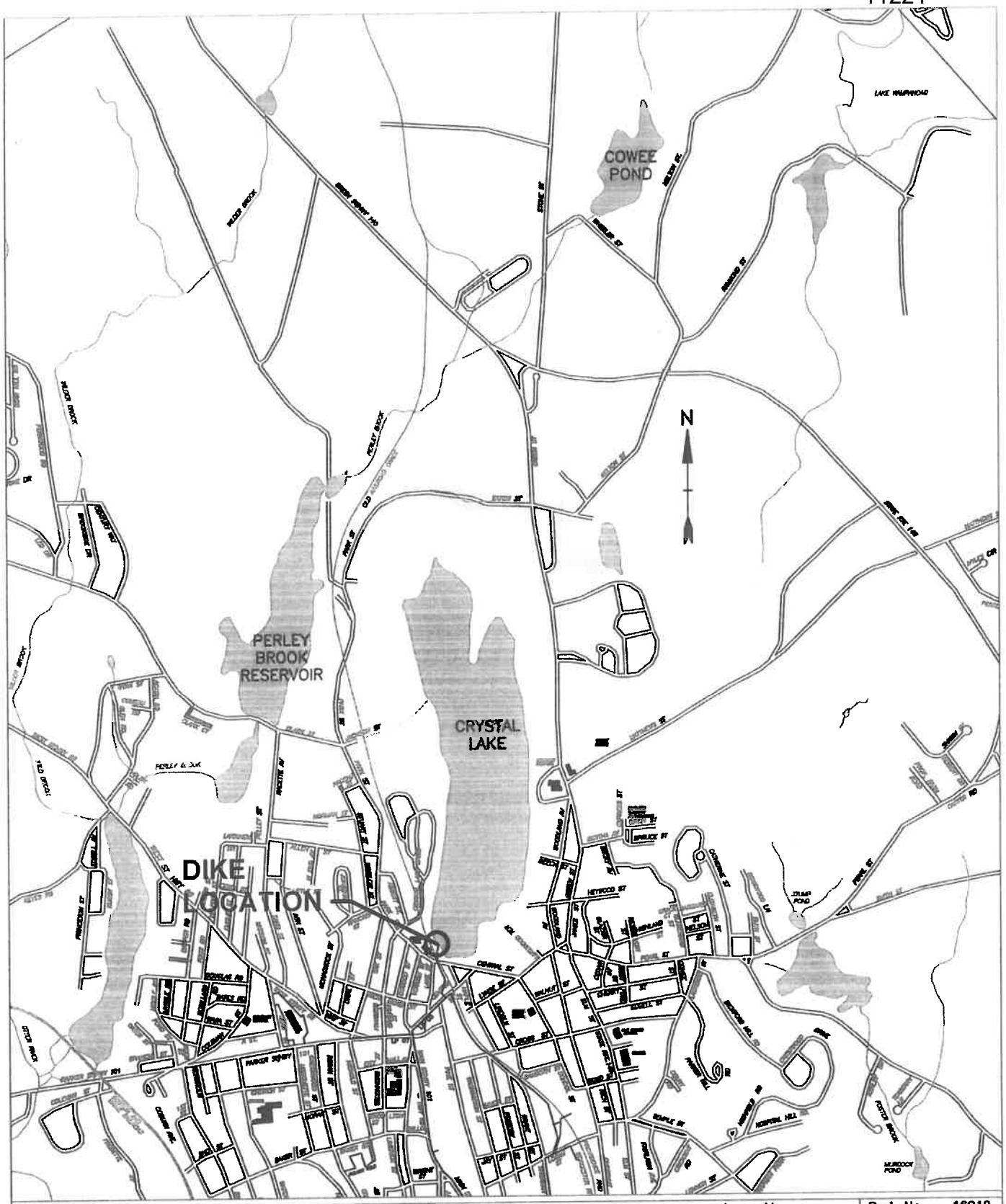
[1]The Department of Conservation and Recreation Office of Dam Safety was formerly known as the Department of Environmental Management Office of Dam Safety.



Maguire Group Inc.
Architects/Engineers/Planners
225 Foxborough Boulevard
Foxborough, MA 02035

City of Gardner, Massachusetts
Crystal Lake Dike
Inspection and Evaluation

LOCATION MAP
SCALE: 1"=2,000'

Proj. No. 16919
Figure No. 1

1.2.2 Owner

The dike is owned by the City of Gardner:

Gardner Water Department
City Hall
Gardner, MA 01440
Mr. Dane Arnold
Tel: 978-632-7661

1.2.3 Operator

United Water is currently under contract with the City for operating the dike.

1.2.4 Purpose of Dike

The reservoir impounded by the dike is part of the water supply system for the City of Gardner.

1.2.5 Description of Dike and Appurtenances

Crystal Lake Dike is a 5-foot high and 370-foot long earth embankment with an abandoned railroad track located along its crest. The crest and downstream area of the dike are grass covered. The right abutment of the dike is at Graham Street and the left abutment blends into natural ground at a point about 250 feet north of Park Street. The dike's crest has a slight downward slope from Graham Street to Park Street.

1.2.6 Operation and Maintenance

No formal operational procedures and maintenance programs were established for this dike.

1.2.7 DEM Size Classification

Storage volume for Crystal Lake Dike is approximately 1450 acre-feet at maximum storage as calculated by Louis Berger & Associates Inc. in 1980. The dike height is approximately 5 feet as measured from the dike crest to the lowest point of the downstream slope. In accordance with the size classification set forth under Code of Massachusetts Regulations 302 CMR Dam Safety Rules and Regulations, Crystal Lake Dike is a **Large**-size dam.

1.2.8 DEM Hazard Classification

Crystal Lake Dike is located upstream of a topographical depression which contains a large municipal swimming pool. Failure of the dike would inundate the depression at the downstream toe of the dike but is not likely to cause loss of life. A minimal amount of property damage would be expected in the event of a dike breach. In accordance with the hazard classification set forth under Code of Massachusetts Regulations 302 CMR Dam Safety Rules and Regulations, Crystal Lake Dike is a **Class III (Low)** hazard dam.

1.3 Engineering Data

The following sections are based on available design and construction information obtained from the City of Gardner and previous inspection reports. The accuracy of this information (dimensions, elevations, etc.) was not verified as it was outside the specified scope of work.

1.3.1 Drainage Area

The drainage area of Crystal Lake Dike is approximately 0.95 square miles.

1.3.2 Reservoir

1.3.2.1 Length (feet)

Length of normal pool	5,700 ±
Width of normal pool	1,350 ±
Length of pool at top of dike	Unknown
Width of pool at top of dike	Unknown

1.3.2.2 Storage (Acre-Feet)

Normal pool	2,290
Top of dike	Unknown
Spillway design flood	Not Applicable (N/A)

1.3.2.3 Surface (Acres)

Normal pool	151
Top of dike	Unknown
Spillway design flood	N/A

1.3.3 Discharges at Dike Site

There is no spillway at the dike for discharging water. However, there is an intake structure for a fire suppression system that is not currently used. In addition, there are two 20-inch pipes that discharge to the drainage system. The gate valves on the ends of the two pipes are currently closed.

1.3.4 Additional Elevations (Feet)

Top of dike	1,103 ±NAVD88
Spillway design flood pool	N/A
Design surcharge	N/A
Normal pool	1,097.12 NAVD88
Spillway crest, gated	N/A
Spillway crest, ungated	N/A
Full flood control pool	Unknown
Low level outlet invert	Unknown

Upstream portal diversion tunnel	N/A
Downstream water at toe of dike	N/A

1.3.5 Main Spillway

Type	N/A
Length of weir	N/A
Crest elevation (gated)	N/A
Crest elevation (ungated)	N/A
Upstream channel	N/A
Downstream channel	N/A

1.3.6 Construction Records

No construction records for this structure were available at the time of inspection.

1.3.7 Operating Records

No operating records for this structure were available at the time of inspection.

Section 2

2.0 VISUAL INSPECTION

Crystal Lake Dike was inspected on April 8, 2014. At the time of inspection, the reservoir level was approximately 5 feet below the crest of the dike. The Field Inspection Checklist is included in Appendix C.

2.1 General Findings

In general the overall condition of the dike was considered poor. Deficiencies to the upstream slope include significant erosion which is undermining the abandoned railroad tracks, missing riprap, granite blocks falling into the lake, and light-to-moderate vegetation. The crest of the dike has tire ruts throughout, light-to-moderate vegetation, and a moderate depression.

2.1.1 Dike

An abandoned railroad track runs the length of the crest of Crystal Lake Dike (see Photos). Also on the crest and next to the railroad tracks there is a grassed pathway which provides vehicular access along the dike. Tire ruts were observed along the pathway and vary in depth from 8-18 inches. There is light tree growth along the crest with tree diameter sizes ranging from 1 to 3 inches.

The upstream slope of the dike has missing riprap, and, in some locations, granite blocks along the crest have fallen into the lake. The loss of slope protection has led to significant erosion to the point that some railroad ties on the crest of the dike have become undermined. There is moderate vegetation along the upstream slope consisting of brush and trees ranging in size from 1 to 3 inches in diameter. The left and right embankment-to-abutment contact is good. There is moderate vegetation at the left and right abutment.

The downstream slope of the dike is grassed and appears to be well maintained by the City. The downstream slope transitions to a depression downstream of the dike. No seepage or wet areas were observed along the downstream slope or toe of the dike. No unusual movement or erosion was observed.

2.1.2 Appurtenant Structures

Two twin 20-inch pipes were observed entering the right portion of the upstream slope. Both pipes have visible gate valves. There also is a circular intake structure approximately 35 feet off shore. Access to it was not possible on the day of inspection. The status of any piping systems associated with it is unknown.

2.1.3 Downstream Area

The area downstream of the dike is a topographical depression which contains a large municipal swimming pool.

2.1.4 Reservoir Area

The slopes of Crystal Lake are forested and appear to be stable.

2.2 Caretaker Interview

On April 8, 2014, Mr. Dane Arnold from the Department of Public Works was interviewed via telephone. He indicated that there are no existing drawings or construction records for the dike, no existing Emergency Action Plan, and no operating records. Crystal Lake has no natural outlet and the level of the lake is controlled by an intake structure located on the southeast rim of the lake. This intake structure connects to a gravity fire suppression system. The two twin 20-inch pipes on the right of the dike are reportedly connected to the local drainage system and used to control water levels in the lake. However, the gate valve controls have not been exercised in years.

2.3 Operation and Maintenance Procedures

Owner Bob Hankinson informed me that there is no formal operation and maintenance procedures for the dam.

2.4 Emergency Warning System

No Emergency Action Plan has been assembled for Crystal Lake Dike.

2.5 Hydrologic/Hydraulic Data

Crystal Lake Dike is a Large size, Class III (Low) hazard dam. In accordance with Massachusetts Law, the spillway design flood (SDF) for existing dams falling under this classification is based on the 100-year storm event.

The hydraulic/hydrologic analyses performed by Louis Berger & Associates, Inc. in the 1980 inspection report are included in Appendix D of this report. However, no hydraulic data is available for the Dike.

2.6 Structural Stability/Overtopping Potential

2.6.1 Structural Stability

Although no stability analyses of the dike were performed, observation of the existing conditions and dike geometry indicate that the dike is stable at the present time. The high level of erosion on the upstream slope presents a significant hazard to the stability of the dike. If left unattended it could lead to failure of the dike. It should be noted that dike stability depends on numerous and constantly changing internal and external conditions. It is incorrect to assume that the present condition of the dike will be representative of the condition of the dike in the future.

2.6.2 Overtopping Potential

The hydraulic/hydrologic analyses performed by Louis Berger & Associates, Inc. in the 1980 inspection report indicates that the pool elevation must be maintained 6 feet below the low point on the dike to prevent overtopping by a storm of probable maximum precipitation (PMP) magnitude for a 6-hour duration. Computations are included in Appendix D.

Section 3

3.0 OPERATION AND MAINTENANCE PROCEDURES

3.1 Assessments

The visual inspection of Crystal Lake Dike revealed evidence of impending instability and so the dike is considered to be in fair condition. The following deficiencies need attention to improve the dike's condition.

1. Significant erosion along portions of the upstream slope where slope protection is missing or has fallen into the lake.
2. Tire ruts across the crest of the dike.
3. Light-to-moderate vegetation on the crest, upstream slope, and left and right embankment-to-abutment contacts.

3.2 Studies and Analyses

The following studies and analyses should be completed to evaluate concerns and/or comply with current regulations:

- Develop an Operations and Maintenance Manual. This manual should include procedures for maintaining the level of the impoundment including seasonal adjustments. Additionally, the manual should include periodic inspection schedules and operational and maintenance procedures required to ensure satisfactory operations for prolonged life of the dam.

- Develop of an Emergency Action Plan. A list of downstream residences and businesses should be complied and included in the Emergency Action Plan as well as an inundation zone in the event of a dam breach.

3.3 Recommendations

It is recommended that the owner undertake the remedial measures outlined below.

1. The eroded areas on the upstream slope must be backfilled with granular fill and compacted to design grade. Riprap slope protection should be added to deter further erosion.
2. All brush on the slopes, crest, and left and right abutments of the dike should be removed. Excavations should be properly filled and compacted to insure the integrity of the embankment.
3. Institute a program of annual inspection by personnel from the Department of Public Works or its contract operator. The owner should also provide surveillance of the dike during intense rainfall.
4. A dike failure analysis should be computed to assess the downstream damage and impact.
5. Develop an Emergency Action Plan that will include an effective preplanned warning system; action to be taken at other reservoirs; locations of emergency

equipment, material and manpower; authorities to be contacted; potential areas that require warning and/or evacuation; and reservoir dewatering procedures, if necessary.

3.4 Operational Procedures

The City of Gardner has contracted with United Water for operating the dike. United Water personnel visit the dike once daily to record the water level elevation. During this daily activity, the dike is visually inspected for abnormal conditions. Anything unusual is reported to the Department of Public Works. Other than a daily inspection and water level reading, there are no known documented operating procedures for the dike.

3.5 Maintenance of Dike and Operating Facilities

The downstream slope appears to be maintained and kept free of brush and tree growth. The upstream slope, crest, and left and right abutments do not appear to be maintained and have light-to-moderate tree and brush growth.

3.6 Emergency Warning System

In 2002, the City had a Surface Water Protection Plan prepared and a portion of this document addresses the City's Emergency Response Plan relative to water supply sources. However, no Emergency Action Plan specific to this dike was available for review.

3.7 Opinion of Probable Costs

The following conceptual opinions of probable construction costs have been developed for the recommendations and remedial measures noted above. The costs shown here are based on a limited investigation and are provided for general information only. This should not be considered an engineer's estimate, as actual construction costs may be somewhat less or considerably more than indicated.

Studies and Analyses	Cost
1. Operations and Maintenance Manual	$5,000
2. Emergency Action Plan	$10,000
Total	**$15,000**

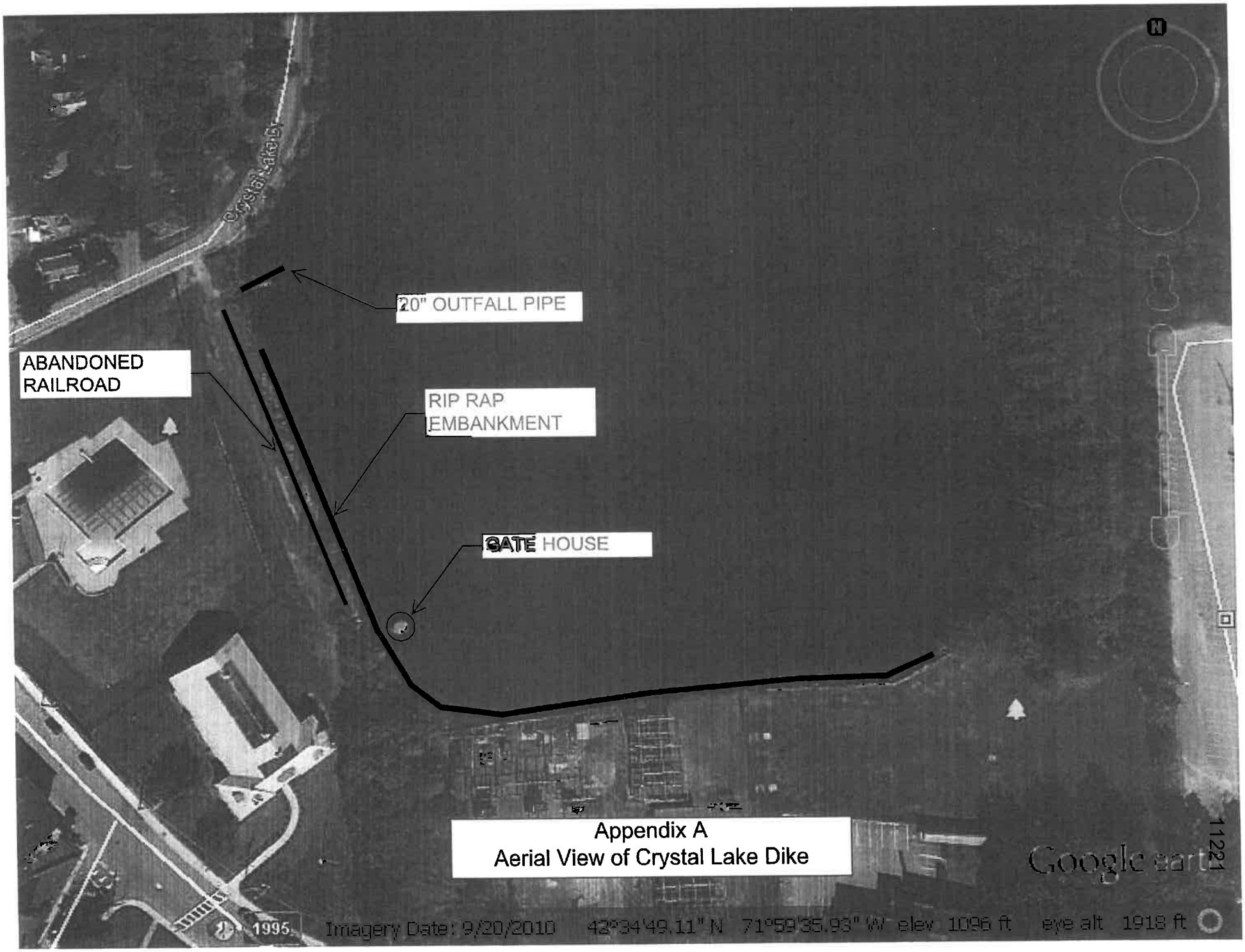
Yearly Recommendations	Cost
1. Removal of Vegetation	$5,000
Total	**$5,000**

Recommendations, Maintenance and Minor Repairs	Cost
1. Replace rip rap along upstream bank	$10,000
Total	**$10,000**

Remedial Measures	Cost
1. Annual Inspection by Municipal Ground Department	$1,000
2. Recording Water Levels	$2,500
Total	**$3,500**

Appendices

Appendix A – Plan of Dike



Appendix A
Aerial View of Crystal Lake Dike

Appendix B - Photographs

Photo B1: View of the dike crest looking towards the right abutment.

Photo B2: View of the dike crest looking towards the right abutment.

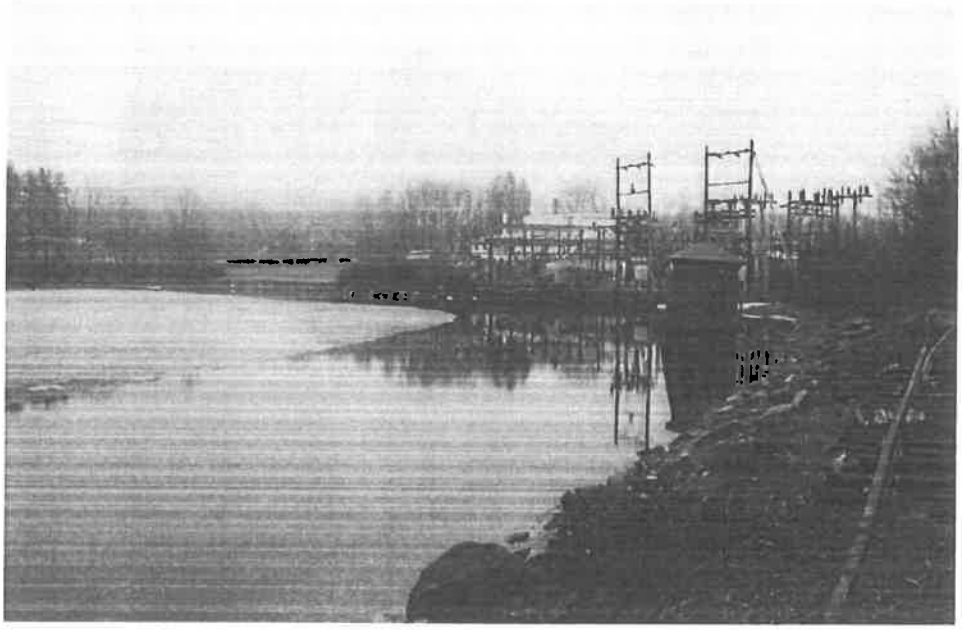


Photo B3: View of the dike upstream slope from right abutment.

Photo B4: View of the dike upstream slope protection.

Photo B5: Abandoned Gate house

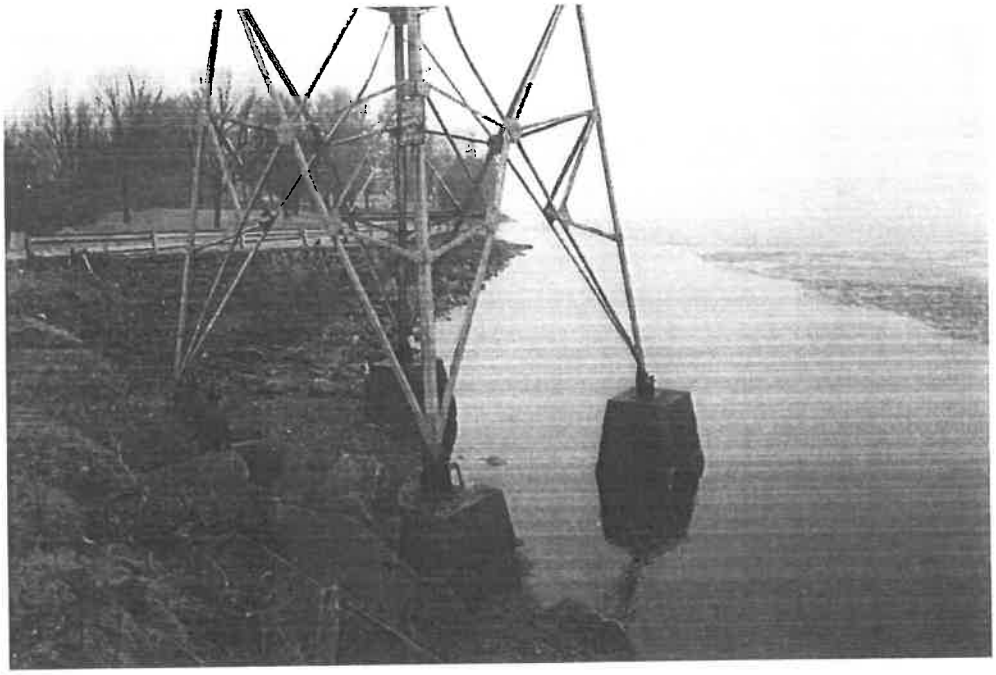


Photo B6: Electric Transmission Tower near the right Abutment

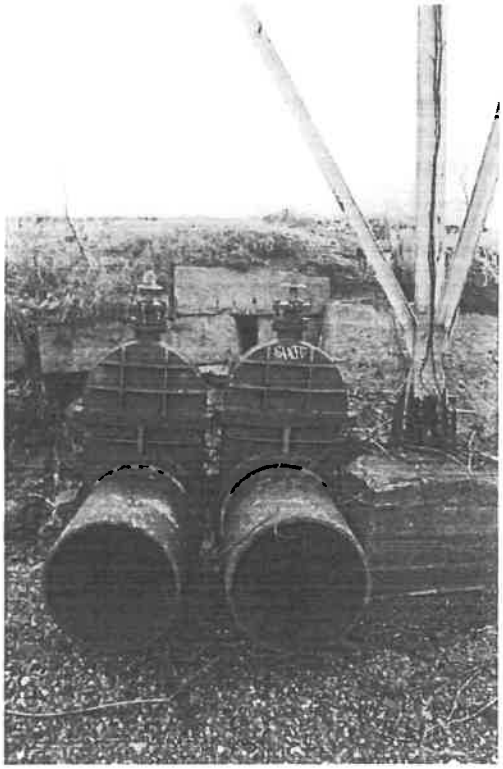


Photo B7: View of the twin 20-inch pipe entering the dike near the right abutment

Photo B8: View from the right abutment of the dike.

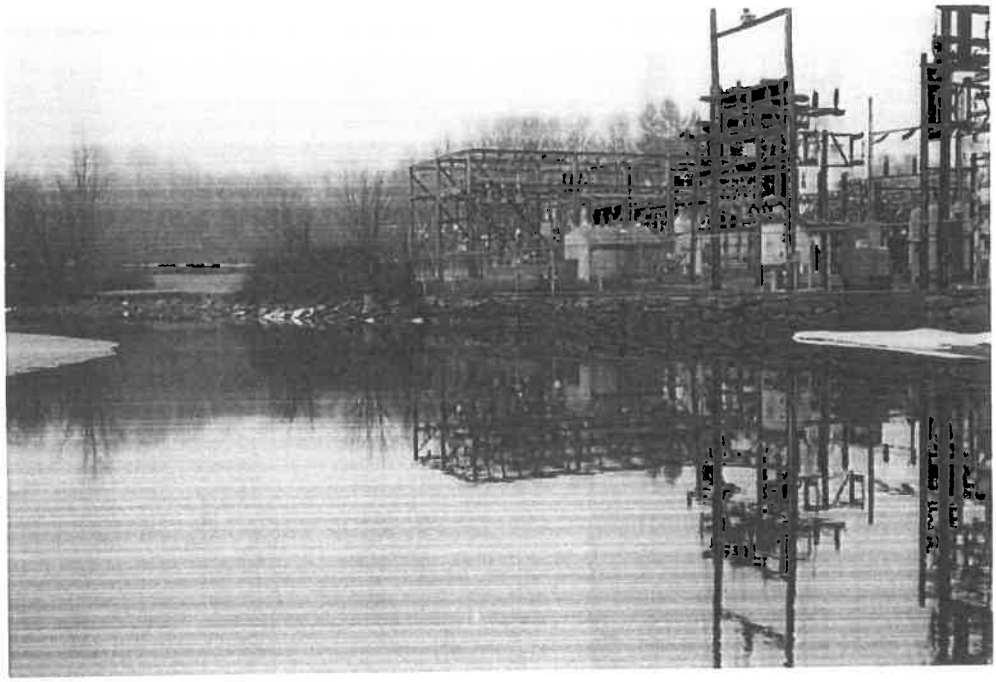


Photo B9: View of the upstream face of the dike

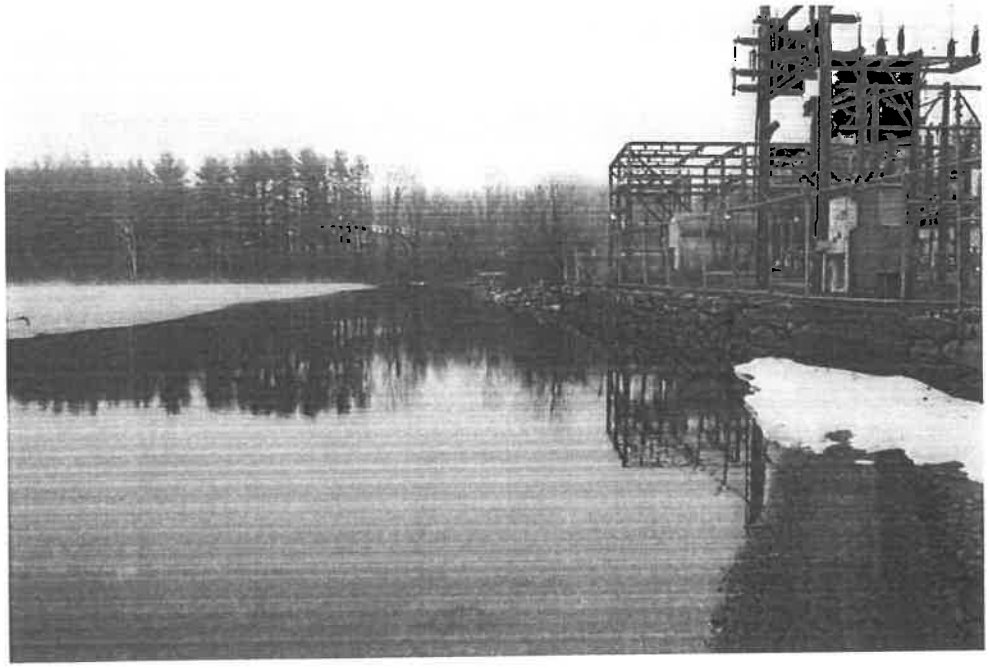


Photo B10: View of the upstream face of the dike

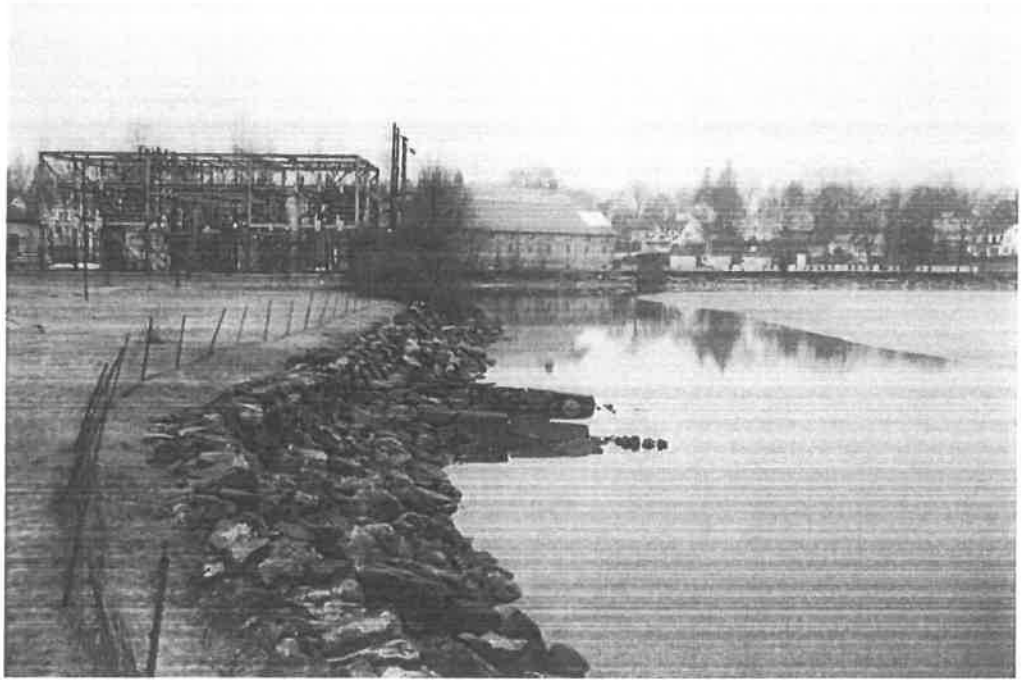


Photo B11: View of the upstream face from the left abutment

Photo B12: View of the left abutment

Appendix C – Inspection Checklist

DAM SAFETY INSPECTION CHECKLIST

NAME OF DAM: Crystal Lake Dike
STATE ID #: 3-14-103-21

REGISTERED: ☑ YES ☐ NO
NID ID #: MA 001243

STATE SIZE CLASSIFICATION: Large
STATE HAZARD CLASSIFICATION: Low
CHANGE IN HAZARD CLASSIFICATION REQUESTED?: No

DAM LOCATION INFORMATION

CITY/TOWN: GARDNER
COUNTY: Worcester

DAM LOCATION: Graham Street
(street address if known)
ALTERNATE DAM NAME: N/A

USGS QUAD.: Gardner 19C
LAT.: 42.57979397N
LONG.: 71.9933738W

DRAINAGE BASIN: Connecticut
RIVER: Off Stream

IMPOUNDMENT NAME(S): Crystal Lake

GENERAL DAM INFORMATION

TYPE OF DAM: Earth Filled
OVERALL LENGTH (FT): 370

PURPOSE OF DAM: Water Supply
NORMAL POOL STORAGE (ACRE-FT): 1160

YEAR BUILT: 1900
MAXIMUM POOL STORAGE (ACRE-FT): 1,450

STRUCTURAL HEIGHT (FT): 5
EL. NORMAL POOL (FT): 1097.0

HYDRAULIC HEIGHT (FT): 5
EL. MAXIMUM POOL (FT): 1102.0

FOR INTERNAL MADCR USE ONLY

FOLLOW-UP INSPECTION REQUIRED: ☐ YES ☐ NO
CONDITIONAL LETTER: ☐ YES ☐ NO

11221

NAME OF DAM: Crystal Lake Dike | STATE ID #: 3-14-103-21

INSPECTION DATE: April 8, 2014 | NID ID #: MA 001243

INSPECTION SUMMARY

DATE OF INSPECTION: April 8, 2014 | DATE OF PREVIOUS INSPECTION: April 16, 2004

TEMPERATURE/WEATHER: Overcast, 40 Degrees | ARMY CORPS PHASE I: ☑ YES ☐ NO | If YES, date November 1980

CONSULTANT: CDR Maguire | PREVIOUS DCR PHASE I: ☑ YES ☐ NO | If YES, date 9-Jul-04

BENCHMARK/DATUM:

OVERALL PHYSICAL CONDITION OF DAM: FAIR | DATE OF LAST REHABILITATION: Unknown

SPILLWAY CAPACITY: 0-50% of the SDF or Unknown

EL. POOL DURING INSP.: 1,025.16 | EL. TAILWATER DURING INSP.: 985

PERSONS PRESENT AT INSPECTION

NAME	TITLE/POSITION	REPRESENTING
Robert P. Sims	Project Manager	CDR Maguire, Inc.

EVALUATION INFORMATION

	Click on box to select E-code		Click on box to select E-code
E1) TYPE OF DESIGN	2	E8) LOW-LEVEL OUTLET CONDITION	3
E2) LEVEL OF MAINTENANCE	2	E9) SPILLWAY DESIGN FLOOD CAPACITY	1
E3) EMERGENCY ACTION PLAN	2	E10) OVERALL PHYSICAL CONDITION	3
E4) EMBANKMENT SEEPAGE	5	E11) ESTIMATED REPAIR COST	$33,500
E5) EMBANKMENT CONDITION	4	ROADWAY OVER CREST	NO
E6) CONCRETE CONDITION	N/A	BRIDGE NEAR DAM	NO
E7) LOW-LEVEL OUTLET CAPACITY	3		

NAME OF INSPECTING ENGINEER: Robert P. Sims | SIGNATURE:

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NAME OF DAM: Crystal Lake Dike

STATE ID #: 3-14-103-21

INSPECTION DATE: April 8, 2014

NID ID #: MA 001243

OWNER:		CARETAKER:	
ORGANIZATION	Gardner Water Department	ORGANIZATION	Gardner Engineering Dept.
NAME/TITLE	Dane Arnold	NAME/TITLE	Robert Hankinson
STREET	416 West Broadway	STREET	City Hall, 95 Pleasant St. Rm. 226
TOWN, STATE, ZIP	Gardner, MA 01440	TOWN, STATE, ZIP	Gardner, MA 01440
PHONE	978-632-7661	PHONE	978-630-4010
EMERGENCY PH. #		EMERGENCY PH. #	
FAX	978-630-4029	FAX	978-630-4894
EMAIL	darnold@gardner-ma.gov	EMAIL	rhankinson@gardner-ma.gov
OWNER TYPE	Municipality or Political subdivision		

PRIMARY SPILLWAY TYPE: None

SPILLWAY LENGTH (FT): N/A

SPILLWAY CAPACITY (CFS): 0

AUXILIARY SPILLWAY TYPE: NONE

AUX. SPILLWAY CAPACITY (CFS): NONE

NUMBER OF OUTLETS: 0

OUTLET(S) CAPACITY (CFS): NONE

TYPE OF OUTLETS: N/A

TOTAL DISCHARGE CAPACITY (CFS): 0

DRAINAGE AREA (SQ MI): 4224 ACRES

SPILLWAY DESIGN FLOOD (PERIOD/CFS): 0

HAS DAM BEEN BREACHED OR OVERTOPPED: ☐ YES ☑ NO IF YES, PROVIDE DATE(S):

FISH LADDER (LIST TYPE IF PRESENT): NONE

DOES CREST SUPPORT PUBLIC ROAD? ☐ YES ☑ NO IF YES, ROAD NAME:

PUBLIC BRIDGE WITHIN 50' OF DAM? ☐ YES ☑ NO IF YES, ROAD/BRIDGE NAME:

MHD BRIDGE NO. (IF APPLICABLE

11221

NAME OF DAM: Crystal Lake Dike STATE ID #: 3-14-103-21

INSPECTION DATE: April 8, 2014 NID ID #: MA 001243

EMBANKMENT (CREST)

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
CREST	1. SURFACE TYPE	Earth		X	
	2. SURFACE CRACKING	None Observed		X	
	3. SINKHOLES, ANIMAL BURROWS	Minor		X	X
	4. VERTICAL ALIGNMENT (DEPRESSIONS	None Observed		X	
	5. HORIZONTAL ALIGNMENT	Good		X	
	6. RUTS AND/OR PUDDLES	Minor		X	X
	7. VEGETATION (PRESENCE/CONDITION)	Minor		X	X
	8. ABUTMENT CONTACT	Good		X	

ADDITIONAL COMMENTS:

11221

NAME OF DAM: Crystal Lake Dike STATE ID #: 3-14-103-21

INSPECTION DATE: April 8, 2014 NID ID #: MA 001243

EMBANKMENT (D/S SLOPE)

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
D/S SLOPE	1. WET AREAS (NO FLOW)	None Observed	X		
	2. SEEPAGE	None Observed	X		
	3. SLIDE, SLOUGH, SCARP	None Observed	X		
	4. EMB.-ABUTMENT CONTACT	Good	X		
	5. SINKHOLE/ANIMAL BURROWS	None Observed	X		
	6. EROSION	None Observed	X		
	7. UNUSUAL MOVEMENT	None Observed	X		
	8. VEGETATION (PRESENCE/CONDITION)	Mostly maintained grassy surface. Light vegetation.		X	

ADDITIONAL COMMENTS:

11221

NAME OF DAM: Crystal Lake Dike STATE ID #: 3-14-103-21

INSPECTION DATE: April 8, 2014 NID ID #: MA 001243

EMBANKMENT (U/S SLOPE)

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
U/S SLOPE	1. SLIDE, SLOUGH, SCARP	NONE OBSERVED	X		
	2. SLOPE PROTECTION TYPE AND COND.	Riprap missing in places			X
	3. SINKHOLE/ANIMAL BURROWS	None Observed			X
	4. EMB.-ABUTMENT CONTACT	Good	X		
	5. EROSION	So,e during high water conditions			X
	6. UNUSUAL MOVEMENT	None Observed	X		
	7. VEGETATION (PRESENCE/CONDITION)	Light vegetation between Riprap Stone but well maintained by City.		X	

ADDITIONAL COMMENTS:

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NAME OF DAM: Crystal Lake Dike STATE ID #: 3-14-103-21

INSPECTION DATE: April 8, 2014 NID ID #: MA 001243

INSTRUMENTATION

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
INSTR.	1. PIEZOMETERS	None Observed	X		
	2. OBSERVATION WELLS	None Observed	X		
	3. STAFF GAGE AND RECORDER	None Observed	X		
	4. WEIRS	None Observed	X		
	5. INCLINOMETERS	None Observed	X		
	6. SURVEY MONUMENTS	None Observed	X		
	7. DRAINS	None Observed	X		
	8. FREQUENCY OF READINGS	Daily readings taken at Water Plant		X	
	9. LOCATION OF READINGS	None Observed	X		

ADDITIONAL COMMENTS:

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NAME OF DAM: Crystal Lake Dike STATE ID #: 3-14-103-21

INSPECTION DATE: April 8, 2014 NID ID #: MA 001243

DOWNSTREAM MASONRY WALLS

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
D/S WALLS	1. WALL TYPE	N/A	X		
	2. WALL ALIGNMENT	N/A	X		
	3. WALL CONDITION	N/A	X		
	4. HEIGHT: TOP OF WALL TO MUDLINE	min: N/A max: N/A avg: N/A	X		
	5. SEEPAGE OR LEAKAGE	N/A	X		
	6. ABUTMENT CONTACT	Good		X	
	7. EROSION/SINKHOLES BEHIND WALL	N/A	X		
	8. ANIMAL BURROWS	N/A	X		
	9. UNUSUAL MOVEMENT	N/A	X		
	10. WET AREAS AT TOE OF WALL	N/A	X		

ADDITIONAL COMMENTS:

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NAME OF DAM: Crystal Lake Dike STATE ID #: 3-14-103-21

INSPECTION DATE: April 8, 2014 NID ID #: MA 001243

UPSTREAM MASONRY WALLS

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
U/S WALLS	1. WALL TYPE	Masonry		X	
	2. WALL ALIGNMENT	Good		X	
	3. WALL CONDITION	Good		X	
	4. HEIGHT: TOP OF WALL TO MUDLINE	min: 1 max: 6 avg: 2		X	
	5. ABUTMENT CONTACT	N/A	X		
	6. EROSION/SINKHOLES BEHIND WALL	N/A	X		
	7. ANIMAL BURROWS	N/A	X		
	8. UNUSUAL MOVEMENT	N/A	X		

ADDITIONAL COMMENTS:

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NAME OF DAM: Crystal Lake Dike STATE ID #: 3-14-103-21

INSPECTION DATE: April 8, 2014 NID ID #: MA 001243

DOWNSTREAM AREA

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
D/S AREA	1. ABUTMENT LEAKAGE	NONE OBSERVED	X		
	2. FOUNDATION SEEPAGE	NONE OBSERVED	X		
	3. SLIDE, SLOUGH, SCARP	NONE OBSERVED	X		
	4. WEIRS	N/A	X		
	5. DRAINAGE SYSTEM	DRAINS TO SWIMMING POOL	X		
	6. INSTRUMENTATION	N/A	X		
	7. VEGETATION	Good		X	
	8. ACCESSIBILITY	Restricted by Power Company	X		
	9. DOWNSTREAM HAZARD DESCRIPTION	Low Hazard			
	10. DATE OF LAST EAP UPDATE	EAP performed in February 2008.			

ADDITIONAL COMMENTS:

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NAME OF DAM: Crystal Lake Dike STATE ID #: 3-14-103-21

INSPECTION DATE: April 8, 2014 NID ID #: MA 001243

MISCELLANEOUS

AREA INSPECTED	CONDITION	OBSERVATIONS		
MISC.	1. RESERVOIR DEPTH (AVG)	UNKNOWN		
	2. RESERVOIR SHORELINE	Heavily Vegetated/Forested		
	3. RESERVOIR SLOPES	Gentle Slopes to Edge of Reservoir		
	4. ACCESS ROADS	Graham Street		
	5. SECURITY DEVICES	Bollards and gates near substation		
	6. VANDALISM OR TRESPASS	☐ YES	☑ NO	WHAT:
	7. AVAILABILITY OF PLANS	☐ YES	☑ NO	DATE:
	8. AVAILABILITY OF DESIGN CALCS	☐ YES	☑ NO	DATE:
	9. AVAILABILITY OF EAP/LAST UPDATE	☐ YES	☑ NO	DATE:
	10. AVAILABILITY OF O&M MANUAL	☐ YES	☑ NO	DATE:
	11. CARETAKER/OWNER AVAILABLE	☑ YES	☐ NO	DATE: April 8, 2014
	12. CONFINED SPACE ENTRY REQUIRED	☐ YES	☑ NO	PURPOSE:

ADDITIONAL COMMENTS:

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NAME OF DAM: Crystal Lake Dike STATE ID #: 3-14-103-21

INSPECTION DATE: April 8, 2014 NID ID #: MA 001243

PRIMARY SPILLWAY

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
SPILLWAY	SPILLWAY TYPE	N/A	X		
	WEIR TYPE	N/A	X		
	SPILLWAY CONDITION	N/A	X		
	TRAINING WALLS	N/A	X		
	SPILLWAY CONTROLS AND CONDITION	N/A	X		
	UNUSUAL MOVEMENT	N/A	X		
	APPROACH AREA	N/A	X		
	DISCHARGE AREA	N/A	X		
	DEBRIS	N/A	X		
	WATER LEVEL AT TIME OF INSPECTION	N/A	X		

ADDITIONAL COMMENTS:

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NAME OF DAM: Crystal Lake Dike STATE ID #: 3-14-103-21

INSPECTION DATE: April 8, 2014 NID ID #: MA 001243

AUXILIARY SPILLWAY

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
SPILLWAY	SPILLWAY TYPE	N/A			
	WEIR TYPE	N/A			
	SPILLWAY CONDITION	N/A			
	TRAINING WALLS	N/A			
	SPILLWAY CONTROLS AND CONDITION	N/A			
	UNUSUAL MOVEMENT	N/A			
	APPROACH AREA	N/A			
	DISCHARGE AREA	N/A			
	DEBRIS	N/A			
	WATER LEVEL AT TIME OF INSPECTION	N/A			

ADDITIONAL COMMENTS:

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NAME OF DAM: Crystal Lake Dike STATE ID #: 3-14-103-21

INSPECTION DATE: April 8, 2014 NID ID #: MA 001243

OUTLET WORKS

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
OUTLET WORKS	TYPE	Two 20-inch pipes to swimming pool		X	
	INTAKE STRUCTURE	N/A	X		
	TRASHRACK	N/A	X		
	PRIMARY CLOSURE	Gate Valve	X		
	SECONDARY CLOSURE	NONE OBSERVED	X		
	CONDUIT	Two 20-inch pipes to swimming pool		X	
	OUTLET STRUCTURE/HEADWALL	NONE OBSERVED	X		
	EROSION ALONG TOE OF DAM	NONE OBSERVED	X		
	SEEPAGE/LEAKAGE	NONE OBSERVED	X		
	DEBRIS/BLOCKAGE	NONE OBSERVED	X		
	UNUSUAL MOVEMENT	NONE OBSERVED	X		
	DOWNSTREAM AREA	N/A	X		
	MISCELLANEOUS				

ADDITIONAL COMMENTS:

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NAME OF DAM: Crystal Lake Dike STATE ID #: 3-14-103-21

INSPECTION DATE: April 8, 2014 NID ID #: MA 001243

CONCRETE/MASONRY DAMS

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
GENERAL	TYPE	N/A			
	AVAILABILITY OF PLANS	N/A			
	AVAILABILITY OF DESIGN CALCS	N/A			
	PIEZOMETERS	N/A			
	OBSERVATION WELLS	N/A			
	INCLINOMETERS	N/A			
	SEEPAGE GALLERY	N/A			
	UNUSUAL MOVEMENT	N/A			

ADDITIONAL COMMENTS:

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NAME OF DAM: Crystal Lake Dike STATE ID #: 3-14-103-21

INSPECTION DATE: April 8, 2014 NID ID #: MA 001243

CONCRETE/MASONRY DAMS (CREST)

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
CREST	TYPE	N/A			
	SURFACE CONDITIONS	N/A			
	CONDITIONS OF JOINTS	N/A			
	UNUSUAL MOVEMENT	N/A			
	HORIZONTAL ALIGNMENT	N/A			
	VERTICAL ALIGNMENT	N/A			

ADDITIONAL COMMENTS:

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NAME OF DAM: Crystal Lake Dike STATE ID #: 3-14-103-21

INSPECTION DATE: April 8, 2014 NID ID #: MA 001243

CONCRETE/MASONRY DAMS (DOWNSTREAM FACE)

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
D/S FACE	TYPE	N/A			
	SURFACE CONDITIONS	N/A			
	CONDITIONS OF JOINTS	N/A			
	UNUSUAL MOVEMENT	N/A			
	ABUTMENT CONTACT	N/A			
	LEAKAGE	N/A			

ADDITIONAL COMMENTS:

11221

NAME OF DAM: Crystal Lake Dike STATE ID #: 3-14-103-21

INSPECTION DATE: April 8, 2014 NID ID #: MA 001243

CONCRETE/MASONRY DAMS (UPSTREAM FACE)

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
U/S FACE	TYPE	N/A			
	SURFACE CONDITIONS	N/A			
	CONDITIONS OF JOINTS	N/A			
	UNUSUAL MOVEMENT	N/A			
	ABUTMENT CONTACTS	N/A			

ADDITIONAL COMMENTS:

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Appendix D – Hydrologic Data and Computations

Appendix E – Definitions

COMMON DAM SAFETY DEFINITIONS

For a comprehensive list of dam engineering terminology and definitions refer to 302 CMR10.00 Dam Safety, or other reference published by FERC, Dept. of the Interior Bureau of Reclamation, or FEMA. Please note should discrepancies between definitions exits, those definitions included within 302 CMR 10.00 govern for dams located within the Commonwealth of Massachusetts.

Orientation

Upstream – Shall mean the side of the dam that borders the impoundment.

Downstream – Shall mean the high side of the dam, the side opposite the upstream side.

Right – Shall mean the area to the right when looking in the downstream direction.

Left – Shall mean the area to the left when looking in the downstream direction.

Dam Components

Dam – Shall mean any artificial barrier, including appurtenant works, which impounds or diverts water.

Embankment – Shall mean the fill material, usually earth or rock, placed with sloping sides, such that it forms a permanent barrier that impounds water.

Crest – Shall mean the top of the dam, usually provides a road or path across the dam.

Abutment – Shall mean that part of a valley side against which a dam is constructed. An artificial abutment is sometimes constructed as a concrete gravity section, to take the thrust of an arch dam where there is no suitable natural abutment.

Appurtenant Works – Shall mean structures, either in dams or separate therefrom. including but not be limited to, spillways; reservoirs and their rims; low level outlet works; and water conduits including tunnels, pipelines, or penstocks, either through the dams or their abutments.

Spillway – Shall mean a structure over or through which water flows are discharged. If the flow is controlled by gates or boards, it is a controlled spillway; if the fixed elevation of the spillway crest controls the level of the impoundment, it is an uncontrolled spillway.

Size Classification
(as listed in Commonwealth of Massachusetts, 302 CMR 10.00 *Dam Safety*)

Large – structure with a height greater than 40 feet or a storage capacity greater than 1,000 acre-feet.

Intermediate – structure with a height between 15 and 40 feet or a storage capacity of 50 to 1,000 acre-feet.

Small – structure with a height between 6 and 15 feet and a storage capacity of 15 to 50 acre-feet.

Non-Jurisdictional – structure less than 6 feet in height or having a storage capacity of less than 15 acre-feet.

Hazard Classification
(as listed in Commonwealth of Massachusetts, 302 CMR 10.00 *Dam Safety*)

High Hazard (Class I) – Shall mean dams located where failure will likely cause loss of life and serious damage to home(s), industrial or commercial facilities, important public utilities, main highway(s) or railroad(s).

Significant Hazard (Class II) – Shall mean dams located where failure may cause loss of life and damage to home(s), industrial or commercial facilities, secondary highway(s) or railroad(s), or cause the interruption of the use or service of relatively important facilities.

Low Hazard (Class III) – Dams located where failure may cause minimal property damage to others. Loss of life is not expected.

General

EAP – Emergency Action Plan - Shall mean a predetermined plan of action to be taken to reduce the potential for property damage and/or loss of life in an area affected by an impending dam break.

O&M Manual – Operations and Maintenance Manual; Document identifying routine maintenance and operational procedures under normal and storm conditions.

Normal Pool – Shall mean the elevation of the impoundment during normal operating conditions.

Acre-foot – Shall mean a unit of volumetric measure that would cover one acre to a depth of one foot. It is equal to 43,560 cubic feet. On million U.S. gallons = 3.068 acre feet.

Height of Dam – Shall mean the vertical distance from the lowest portion of the natural ground, including any stream channel, along the downstream toe of the dam to the crest of the dam.

Spillway Design Flood (SDF) – Shall mean the flood used in the design of a dam and its appurtenant works particularly for sizing the spillway and outlet works, and for determining maximum temporary storage and height of dam requirements.

Condition Rating

Unsafe - Major structural, operational, and maintenance deficiencies exist under normal operating conditions.

Poor - Significant structural, operation and maintenance deficiencies are clearly recognized for normal loading conditions.

Fair - Significant operational and maintenance deficiencies, no structural deficiencies. Potential deficiencies exist under unusual loading conditions that may realistically occur. Can be used when uncertainties exist as to critical parameters.

Satisfactory - Minor operational and maintenance deficiencies. Infrequent hydrologic events would probably result in deficiencies.

Good - No existing or potential deficiencies recognized. Safe performance is expected under all loading including SDF.

Appendix F – Previous Inspection Reports

Previous Inspection Reports

1. Crystal Lake Dike Phase I Inspection Report, November 1980 by Department of Army, New England Division, Corps of Engineers, Waltham, Mass. 02154
2. Crystal Lake Dike Phase I Inspection Report, April 2008 by CDR Maguire, Inc. Providence, RI