City of New Bedford, MA

Turner Pond Dam

State Dam ID# 6-3-201-____

NID ID#: MA01152

November 2014

Operations and Maintenance Plan

CDM Smith

Prepared By:

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Title: Senior Geotechnical Engineer

Company: CDM Smith Inc.

Date Last Revised: November 2014

Location of Dam Operations and Maintenance Plan:

City of New Bedford
Department of Public Infrastructure
1105 Shawmut Avenue
New Bedford, MA 02746

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Section 1
Introduction

1.1 Purpose

This Operation and Maintenance (O&M) Plan provides relevant engineering data and guidelines for the proper operation, care, and maintenance of the Turner Pond Dam (Dam) located in the City of New Bedford, Massachusetts and Town of Dartmouth, Massachusetts. This O&M Plan has been prepared in accordance with the requirements of the Department of Conservation and Recreation (DCR), Office of Dam Safety (ODS). This manual was prepared for the City of New Bedford, Department of Public Infrastructure (DPI), as owner of the Dam. The goals of the O&M program are to help ensure safe operation of and extend the life of the Dam, protect the environment and owner's investment, and meet legal and social obligations. This document should be periodically reviewed and updated as necessary to ensure accuracy of all Dam information and Damtender/Dam owner contact information.

1.2 Dam Description

The Turner Pond Dam is located within the City of New Bedford and Town of Dartmouth in Bristol County, Massachusetts, northwest of the New Bedford Regional Airport. The Dam impounds Turner Pond, on the southern edge of Acushnet Cedar Swamp, which comprises the main headwater of the Paskamansett River. A Locus Plan and Site Sketch are included in Appendix A. The crest of the Dam supports a two lane, asphalt, public roadway, Old Plainville Road in New Bedford and Old Fall River Road in Dartmouth. Per the November 2013 inspection conducted by CDM Smith, Turner Pond Dam can be considered a large size structure in accordance with DCR ODS classification, under Commonwealth of Massachusetts dam safety rules and regulations stated in 302 CMR 10.00 as amended by Chapter 330 of the Acts of 2002. Appendix C includes 302 CMR 10.00.

1.3 Dam Caretaker/Owner

The current Dam Owner is the City of New Bedford Department of Public Infrastructure. The Dam was previously owned by the Massachusetts Department of Conservation and Recreation. Ownership of the Dam was transferred from the DCR to the City of New Bedford. The reason for the transfer in ownership and date on which the ownership transferred is unknown. The September 2006 report by Pare documented DCR as the Dam's owner, however a Dam Registration Form (DRF) was completed by the City of New Bedford in February 2006. Acceptance of the DRF was received from the DCR ODS in October 2009. According to the Dam Registration Certificate the Dam is located on DCR property.

A Dam caretaker should be assigned to be in charge of implementation of the O&M plan as directed herein. This person shall be responsible for ensuring that all scheduled inspections and maintenance are carried out in a timely fashion and properly documented and retained as a record. Currently, Mr. Charles F. Kennedy of the Department of Public Infrastructure, 1105 Shawmut Avenue, assumes this responsibility (508) 509-6929.

1.4 DCR Hazard Potential Classification

The crest of Turner Pond Dam supports Old Fall River Road and Old Plainville Road. Two overhead electric utility lines run along the crest of the Dam and based on placards posted on the utility poles, there may also be gas and fiber optic lines that run through the embankment of the Dam.

Downstream of the Dam is a low lying flat area that encompasses the Apponagansett Swamp and Paskamanset River. The Apponagansett Swamp covers an area of over 1,000 acres and extends south from Turner Pond Dam to the Smith Mills section of North Dartmouth near Route 6. There are several nature trails and utility easements for Algonquin Gas Company and the City of New Bedford located within the Apponagansett Swamp. The New Bedford Regional Airport is located about 1.5 miles southeast of Turner Pond Dam. The airports runway is elevated above the surrounding area, out of the flood plain. Route 195 is located about 2 miles downstream of the Dam where there is a culvert that passes under the highway embankment. A few residences are located downstream on upland ridges out of the low area.

Failure of Turner Pond Dam may damage and close Old Fall River Road/ Old Plainville Road, damage and/or interrupt various utility services (i.e. electric, gas, fiber optic, etc.), and/or cause minimal property damage to others. Loss of life would not be expected from failure of this Dam.

In accordance with DCR classification procedures, under Commonwealth of Massachusetts dam safety rules and regulations stated in 302 CMR 10.00 as amended by Chapter 330 of the Acts of 2002 , Turner Pond Dam is classified as a significant hazard potential dam.

Section 2

Dam Data

Dam Name: Turner Pond Dam

Dam State Identification Number: 6-3-201-____

NID Number: MA01152

Dam Hazard Classification: Significant

Date of Last Hazard Classification Verification: November 4, 2014

Dam Location: New Bedford, MA and Dartmouth, MA

Latitude: N 41° 40' 43.5" Longitude: W 70° 58' 37.4"

Dam Type: Earthen Embankment w/ Concrete Spillway and Side Discharge Channel

Year of Original Construction: Unknown (Box Culvert constructed in 1949)

Year of Last Construction Activity: Unknown

Name of last Engineer and Builder: Unknown

Dam Use(s): Conservation and Recreation

Dam Owner(s) Name: City of New Bedford, Massachusetts, Department of Public Infrastructure (DPI) (previously owned by Massachusetts Department of Conservation and Recreation [DCR])

Dam Owner(s) Mailing Address: 1105 Shawmut Avenue, New Bedford, MA 02746

Dam Owner(s) Telephone Number: 508-979-1556

Dam Owner(s) Facsimile Number: 508-961-3054

Dam Owner(s) E-Mail: ronaldl@newbedford-ma.gov

Impoundment Name: Turner Pond

River Name: Paskamanset River

Associated wetlands and other natural resources of special concern: Acushnet Cedar Swamp State Reservation (upstream of end of Turner Pond); Flora B. Pierce Nature Trail and Apponagansett Swamp (downstream of Turner Pond Dam)

Dam Structural Height: 14.3 feet

Dam Hydraulic Height: 7.9 feet

Dam Crest Length: 493 feet

Dam Crest Width: 35 feet

Normal Pool Elevation: 67.0 feet (set by stoplogs)

Maximum Pool Elevation: 70.4 feet

Normal Pool Surface Area: 86.6 acres

Maximum Pool Surface Area: 1136.6 acres

Maximum Impoundment Volume (at top of Dam, El. 70.4): 2426 acre-feet

Normal Impoundment Volume (at normal pool elevation, El. 67.0): 346 acre-feet

All Towns/Cities within downstream inundation zone: New Bedford, MA and Dartmouth, MA

Spillway Design Flood: 500 year storm

Auxiliary/ Emergency Spillway Elevation: 67.0 feet

Primary Spillway Type: Uncontrolled Ogee Weir

Auxiliary Spillway Type: Sharp Crested Weir with Flashboards

(Datum used: National Geodetic Vertical Datum of 1929 [NGVD29]

Section 3

Dam Operation and Maintenance

Primary person responsible for Dam Operations: Ronald Labelle, Commissioner, City of New Bedford, Department of Public Infrastructure: (508) 979-1556

3.1 Glossary of Terms

A full glossary of terms can be found in Appendix D Common Dam Safety Definitions.

3.2 Operation

Proper operational procedures are extremely important in maintaining a safe structure. The Dam is being operated by the City of New Bedford, Department of Public Infrastructure. The operation of the Dam includes observing and maintaining lake levels; maintaining, raising, and lowering stop logs; and keeping records. Special operational procedures will be followed during an emergency (see Section 3.2.2 Emergency Conditions).

3.2.1 Operational Procedures and Maintaining Pond Levels

The Turner Pond Dam inspection schedule is defined in this Plan. Flow conditions should be routinely monitored weekly and day by day when high flow conditions exist.

- **Mechanical/Electrical Equipment –** No mechanical/electrical equipment is present at the Dam.
- **Stoplog Bays –** The only movable, non-permanent portions of the Dam requiring operation are two (2) 73-inch-wide stoplog bays with timber stoplogs. Stoplogs may be added or removed from the stoplog bays to lower or raise the water level of the impounded Turner Pond. The stoplogs currently in place are constructed of 4-inch by 4-inch lumber with metal eyebolts for hoisting. Hoisting stoplogs is a two-man lift and is best achieved using two manhole cover picks or similar-type equipment. Any stoplogs that fit within the bay and adequately retain water may be used if future replacement is required. Refer to Section 3.2.2 Safe Draw-Down Plan for further guidance on pond draw-down.
- **Measuring Pond Levels** – The surface elevation of the pond may be measured from the Stoplog Bay Platform. The upper surface of the Stoplog Bay Platform has a known elevation of 62.79 feet. By subtracting distance to water surface from 62.79 feet, a water surface elevation is given. This is the recommended method of measurement for monitoring pond water levels at the Dam. This may be accomplished with a measuring tape or similar measuring device. If desired, DPI may drive a stake or rod and mark accordingly off of the Stoplog Bay Platform for ease of reading.
- **Record Keeping** – Operation of the Turner Pond Dam will include keeping accurate records of Operations and Maintenance performed on the Dam. All records will be maintained by the City of New Bedford, Department of Public Infrastructure, at 1105 Shawmut Avenue, New Bedford MA 02746. Records to be retained include:

- *Inspection Reports*: Completed Inspection Checklists (completed by Dam owner/caretaker) and Phase I Inspection/Evaluation Reports and Dam Safety Inspection Checklists (completed by Phase I Dam Inspection Consultant) shall be kept on file for the City's and DCR's reference (either hard copies or scanned electronic copies).
- *Observations*: All observations shall be recorded. Of particular importance is the periodic observation of existing seepage to detect any changes. Photographs shall be taken for recording observations and changes.
- *Maintenance*: Written records of maintenance and major repairs shall be kept.
- *Rainfall and pool levels*: A record of the date, hour, and maximum elevation of extreme high water events and the associated rainfall should be recorded.
- *Drawdown*: A record shall be kept of the amount, rate, and reason for pool level drawdown.
- *As-Built Conditions:* A set of Project Record Drawings shall be maintained by the Dam Owner.

3.2.2 Safe Draw-Down Plan

The purpose of this section is to discuss the method for drawing Turner Pond down under emergency and non-emergency conditions.

- **Emergency Conditions (such as "Flood") –** The Turner Pond Dam does not have an automated flood monitoring system. The Department of Public Infrastructure staff shall monitor weekly, monthly and seasonal weather conditions to help identify potential floodwater conditions. Flood conditions are characterized by significant increases in depth over relatively short periods of time. High water levels or increasing floodwater levels can be monitored by measuring distance to water surface from the top surface of the Stoplog Bay Platform which has a known elevation of 62.79 feet. Pond level increases in excess of 2 inches per hour require a careful evaluation. If such a situation is observed, a qualified City Representative shall monitor the situation closely and, if necessary to prevent overtopping the crest, instruct the operations staff to begin pond draw-down. In addition, the City Representative shall implement, as appropriate, the procedures specified in the Emergency Action Plan (EAP).
- **Non-emergency Condtions (such as "Repair") –** During non-emergency conditions, if necessary, the lake shall be drawn down at a rate not to exceed 2 feet per day. In addition, the City Representative will advise downstream residents of large and/or prolonged discharges.
- **Riparian Rights –** Care should be taken when releasing water to protect the rights of downstream property owners. The system of riparian rights has been established through the courts, and permits each riparian owner to make a "reasonable" use of the water, having regard to the same rights existing for the other downstream riparian owners. The City could be legally responsible if a sudden release of water caused damages downstream. Similarly, any draw-down should take into consideration the effects, environmental or otherwise, of a decreased water level in the upstream pond.

3.3 Inspection

3.2.1 General

There is an urgent and continuing need for dam safety. Dams and lakes are important components of the national infrastructure, but the public risk in the case of a failure is great. Although there are many who are concerned about dam safety, legal and moral responsibility essentially rests with the dam owner. The dam owner can directly influence the safety of a dam. Owners can and should develop their own safety program which includes such important elements as inspection, monitoring and maintaining the structure, emergency action planning and operation. Such a program is directly related to the dam structure and its immediate environment and depends on the dam owner's knowledge of the dam and how it works.

An effective inspection program is essential to identify problems and to provide for safe maintenance of a dam. The inspection program should involve three (3) types of inspections: (1) periodic technical inspections, (2) periodic, formal maintenance inspections, and (3) informal observations by project personnel as they operate the dam. Technical inspections involve specialists familiar with the design and construction of dams and include assessments of structure safety. Formal, maintenance inspections are performed more frequently than technical inspections in order to detect, at an early stage, any detrimental developments in the Dam; they involve assessment of operational capability as well as structural stability. The third type of inspection is actually a continuing effort by project personnel performed in the course of their normal duties. A summary of required inspections is provided in Table 1.

Table 1. Summary of Recommended Inspection Schedule

Inspection Type	Frequency	Items to Inspect/Monitor	Personnel
Informal	As needed	Seepage/wet areas/pool level	Damtender/Owner[1]
Formal Maintenance	Every 3 months and as needed, before and after major events (storm, earthquake, etc.)	Seepage/ wet areas/ pool level/ slides/ cracks/ rodent activity/ vegetation/ concrete surfaces/ vandalism/ slope protection/riprap and embankment erosion/ condition of vegetative cover/ stoplog bays/ outlet training walls	Damtender/Owner
Technical	Every 5 years	Dam Safety Inspection[2] (in accordance with 302 CMR 10.07)	Professional Engineer

Notes:

1. City of New Bedford, Department of Public Infrastructure
2. A Dam Safety Inspection was conducted by CDM Smith in November 2013.

Visual inspections performed on a regular basis are one of the most economical means a dam owner can use to help assure the safety and long life of a dam. Visual inspections are a straight forward method that can be used by any properly trained person to make a reasonably accurate assessment of a dam's condition. The inspection involves careful examination of the surface and all parts of the structure, and its adjacent environment. An inspection should be organized and systematic. Following a consistent sequence lessens the chance of an important condition being overlooked. Reporting inspection results in the same sequence is recommended to help ensure consistent records. An accurate and detailed description of conditions observed during each inspection will enable meaningful comparison of conditions observed at different times. All measurements and observed details required to get an accurate picture of a dam's current condition and possible problems, should be recorded. This information has three elements:

- Location – The location of any questionable area or condition must be accurately described so the area or condition can be evaluated for changes over time or re-examined by experts. Photographs can be helpful in this regard.
- Extent of the Area – The length, width, and depth or height of any suspected problem areas should be determined.
- Descriptive Detail – A brief yet detailed description of any anomalous condition should be given. Some items to include are:
  - Quantity of seepage from point and area sources
  - Color and quantity of sediment in the water
  - Length, displacement and depth of cracks
  - Extent of moist, wet, or saturated areas
  - Adequacy of protective cover
  - Adequacy of surface drainage
  - Steepness or configuration of slopes
  - Apparent deterioration rate
  - Changes in conditions

A dated report should be filled out for each inspection, and should be filed along with any photographs taken (which should also be dated). In addition to inspection observations, monitoring measurements and weather conditions (especially recent rains, extended dry spells and snow cover) should also be systematically recorded and included in the inspection record. Immediately following an inspection, observations should be compared with previous records to see if there are any trends that may indicate developing problems. If a questionable change or trend is noted, a dam owner should consult a professional engineer in dam safety. Quick reaction to questionable conditions will help ensure the safety and long life of a dam and possibly prevent costly repairs.

There are at least four special times when an inspection is recommended regardless of the regular schedule.

- Prior to a predicted major rainstorm or heavy snow melt: check the spillway, outlet channel, and riprap; look for seepage throughout
- During or after a severe rainstorm or heavy snow melt: check the spillway, outlet channel, riprap, and crest and downstream slope of the earth Dam; look for seepage throughout
- During or following a severe windstorm: check riprap performance during storm (if possible) and again after the storm has subsided; note any downed trees or debris in or around the Dam area and, if necessary, schedule removal of debris and trees
- Following an earthquake in the area; make a complete inspection of the Dam and appurtenant structures immediately after the event
- If any unusual conditions are observed during an inspection, the Owner shall contact a qualified engineer to further evaluate the nature and/or criticality of the observed condition

3.2.2 Specific Inspection Schedule

As discussed above and summarized in Table , there are three types of recommended and/or required inspections. Each is discussed in further detail below.

3.2.2.1 Informal Observations

Informal observations are completed by project personnel in the course of their normal duties and may be as simple as pulling over to quickly look over the Dam when driving near the Dam. These are the quickest, most frequent, and least comprehensive type of inspection. Informal observations do not necessarily need to be recorded unless an issue of concern is encountered. Informal observations may spur a more in depth, formal maintenance inspection if determined necessary.

3.2.2.2 Formal Maintenance Inspection

Formal Maintenance Inspections are designed to be completed with minimal resources and personnel training and can be completed fairly quickly. It is recommended that these be completed every three (3) months and before and/or after significant events as needed. A significant event may include such events as rain, ice, snow, or wind storms, earthquakes, snow/ice melt, or automobile accidents along the Dam-supported public roadway. Formal Maintenance Inspections should be completed by a designee appointed by the Damtender/Dam owner (DPI). Pictures can be very helpful in documenting areas of concern. The following items should be recorded on the Formal Maintenance Inspection Checklist:

- Inspector name and title
- Date and time of inspection
- Elapsed time since last inspection
- Weather conditions and temperature at time of inspection
- Reason for inspection (regularly scheduled or significant event, and event details).
- Any additional relevant notes

Items to check during a Formal Maintenance Inspection include the following:

- Check for seepage throughout the Dam. Areas where seepage may commonly occur include along the spillway, box culvert, or toe of the earthen embankment slope. This is generally indicated by wet areas above the current water surface, water/mineral staining, and/or ice build-up (icicles) during colder weather. Record location and severity of any seepage found.
- Check pool level from the Stoplog Bay Platform using the methods described in Section 3.2.1 of this manual. Record pool level, change since last reading, and date and time of reading.
- Check stoplog bay and stoplogs for any indication of deterioration of stoplogs or missing stoplogs. The stoplogs should be exercised at least annually to ensure free movement within the stoplog bay. The procedures for safe draw-down, discussed in Section 3.2.2 of this manual, should be followed.
- Look over upstream and downstream earth embankment slopes for any indications of movement of the embankment slope. This may be indicated by the existence of a scarp near the upper portion of the slope or hummocky, slumping soil near the base of the slope. Any indications should be noted.
- All concrete surfaces should be checked for cracking and general wear. Record the location and extent (length and width) of all cracks.
- Any indications of unwanted animal activity should be noted. This is indicated mainly by animal burrows in the embankment slope or damming of the spillway or discharge channel. Record location of all indications found.
- Check for vegetation in the Dam area. Vegetation on the embankment slope should be neatly trimmed and without bare spots. The entire Dam area should be free of trees and brush and the spillway and outlet channel should be free of aquatic plants. Check for dead or leaning trees. Record the type and location of any unwanted vegetation found.
- Check entire Dam area for indications of tampering or vandalism. This may include graffiti, removed or broken stoplogs, etc. Record location and extent of any vandalism.
- Check for debris in the Dam area. This may include sediment buildup upstream of the stoplog bay, trash in the spillway, culvert or outlet channel, or trash along the roadway.
- Inspect the roadway supported by the crest of the Dam (Old Plainville Road/Old Fall River Road) for any cracking, depressions, potholes, or similar opportunities for water to permeate into and erode the Dam earth embankment. Check the verticality of utility poles and condition of the guardrail. Note any deficiencies on the inspection checklist.
- Check the upstream and downstream embankment slopes for signs of erosion. Examples of erosion include rills running downslope or a scarp caused by scour of the slope, generally due to wave action.
- Check the condition of all rip rap material along the Dam spillway and earth embankment slope. Note the location and condition of any deficiencies.
- Check the verticality and overall condition of the spillway and discharge channel training walls. Record any deficiencies. Note any stones fallen into the discharge channel from the discharge channel stone training walls.

A Formal Maintenance Inspection Checklist is included in Appendix B. This form should be completely filled out during Formal Maintenance Inspections and a copy maintained by the Damtender/Dam owner (DPI).

3.2.2.3 Required Technical Inspection

Massachusetts General Law (M.G.L.) c. 253 s. 46 states that every dam shall be inspected by the commissioner according to a schedule established by regulation. The schedule for dam inspection is listed in C.M.R. 10.07. As a Significant hazard classification dam, Turner Pond Dam is required to undergo a technical Dam Safety Inspection conducted by a registered professional engineer every five (5) years.

3.3 Maintenance

3.3.1 General

Dam maintenance includes both routine preventive maintenance and repair of problems as they are identified through routine inspections or otherwise. Preventive maintenance includes work performed to maintain the Dam and lake in good working condition as to prevent more harmful conditions from developing. This includes such tasks as mowing grass, repair of erosion rills, and removal of burrowing animals from the site. Maintenance that involves the repair of problems identified during inspections should also be planned out, listing the same details as needed for preventive maintenance.

Dam repairs should be scheduled based on severity of the problem, available resources, and weather conditions. For example, if a severe settlement problem is identified on the crest of the Dam, it should have a high priority since further degradation could lead to dam breaching. The cause of major maintenance items, such as excessive settlement, should be identified by a qualified dam safety professional.

3.3.2 Maintenance Activities

Typical routine maintenance tasks that should be performed on the Dam include the following. The maintenance activities required will be identified through periodic inspection:

3.3.2.1 Maintenance of Vegetative Cover

A vegetative cover of grass or similar low vegetation should be maintained on the upstream and downstream embankment slopes. Maintaining a vegetative cover will minimize erosion of the slope. A sturdy sod, free of weeds and brush, is generally most effective. It is important that the vegetative cover be kept to a manageable level through periodic trimming. This will enable easier inspection of the embankment slope and prevent plant life from overtaking and deteriorating the condition of the Dam. Trimming of the vegetative cover should be conducted three (3) times per year. Any erosion rills in the embankment slope should be filled with compacted soil and reseeded.

3.3.2.2 Removal of Brush and Trees

Any large trees or brush should be completely removed from the Dam area. Large brush and trees can inhibit line of sight to parts of the Dam and roots can grow deep into the Dam embankment and/or concrete training walls. This may lead to cracking of concrete portions of the Dam. In addition, if trees growing on the embankment are felled for any reason (i.e. windstorm, icestorm, automobile collision, etc.), the associated root balls may pull out from the Dam and/or begin to rot, leading to void spaces in the Dam embankment. Brush and tree removal should be conducted three (3) times each year.

3.3.2.3 Removal of Litter and Other Debris

Any litter or other debris in and around the Dam area should be removed and disposed of. In addition to being unsightly, debris can clog the spillway, discharge channels, and stoplog bays. Locations where debris may commonly be found include along the roadway on the Dam crest, in the side channel or culvert, along the embankment slope, and behind the stoplog bays. The stoplog bays may also gather a build-up of sediment on the upstream side and should be regularly cleared.

3.3.2.4 Roadway Improvements

Improvements to the roadway should be made as needed to ensure proper runoff along the public roadway supported by the Dam crest. This may include regrading the road, filling potholes or depressions, and sealing any cracks in the asphalt. By ensuring proper runoff, opportunities for permeation of water into the Dam, and subsequent erosion of the earth embankment, are minimized. In addition, if needed, improvements should be made to utility poles and guardrails along the roadway.

3.3.2.5 Removal of Burrowing Animals

Rodents such as the groundhog (woodchuck), muskrat, and beaver are attracted to dams and reservoirs, and can be quite dangerous to the structural integrity and proper performance of the embankment and spillway. Animal burrows weaken the embankment and can serve as pathways for seepage. Beavers may plug the spillway and raise the pool level. Animal control is essential in preserving a well-maintained dam and all animal burrows in the Dam area should be promptly filled with compacted fill.

3.3.2.6 Exercising of Stoplogs

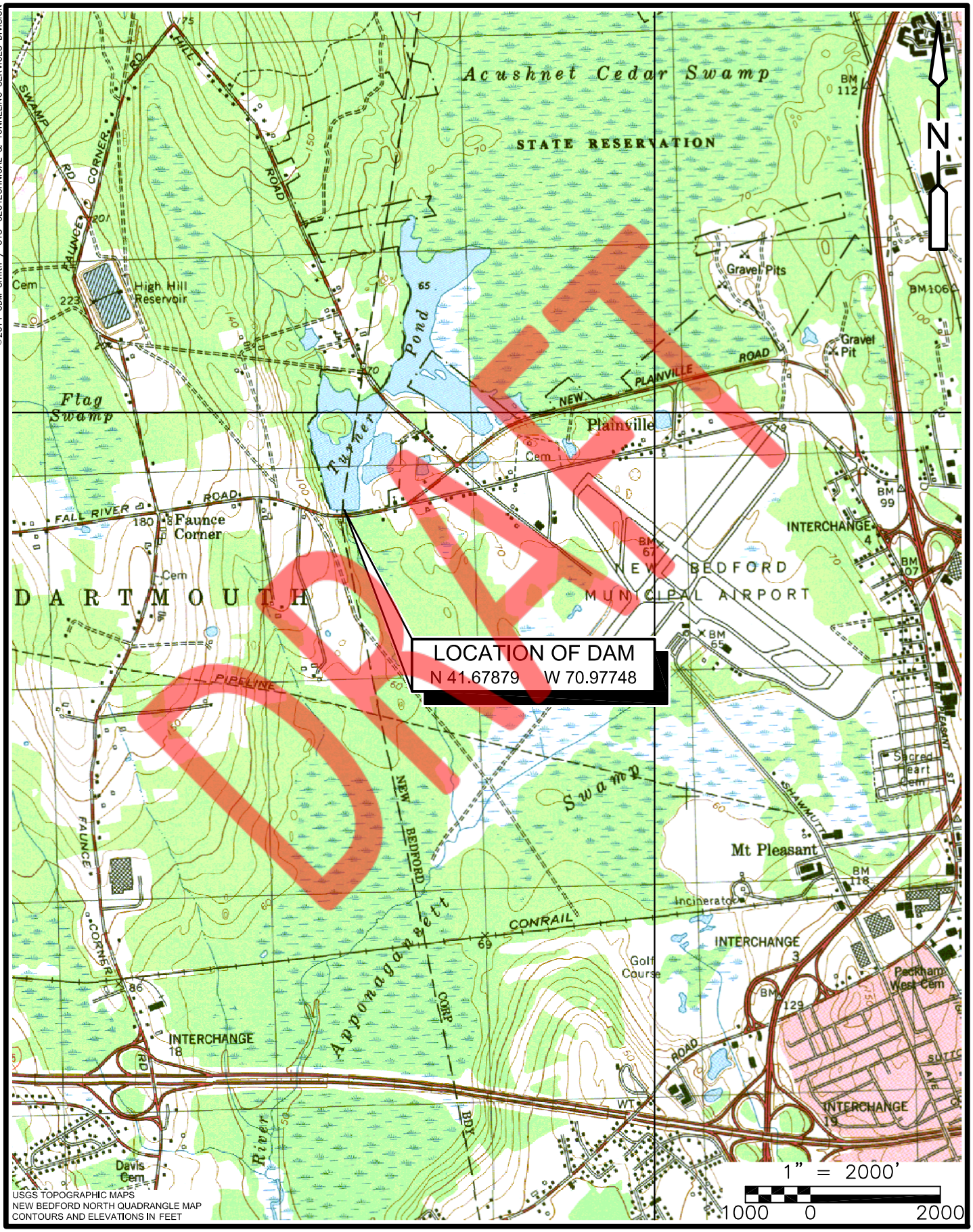
The stoplogs should be periodically exercised (remove and replace) to maintain functionality and ensure free movement within the stoplog bays. When removed, the stoplogs should be cleaned of any algae, moss, or similar build-up to inhibit decay. Refer to Sections 3.2.1 and 3.2.2 of this document for further information on operational procedures and safe draw-down practices while removing stoplogs.

3.3.2.7 Masonry Repair, Sealing Cracks, Concrete Repair

Any joints or cracks in the concrete portions of the Dam (spillway structure, box culvert, etc.) should be sealed with a waterproof type sealant. This could consist of an expansion joint-type sealant for gaps between concrete sections or a cement grout for repair of cracks. Any stones that have fallen from the discharge channel training walls should be removed from the channel and placed back on the wall.

Appendix A

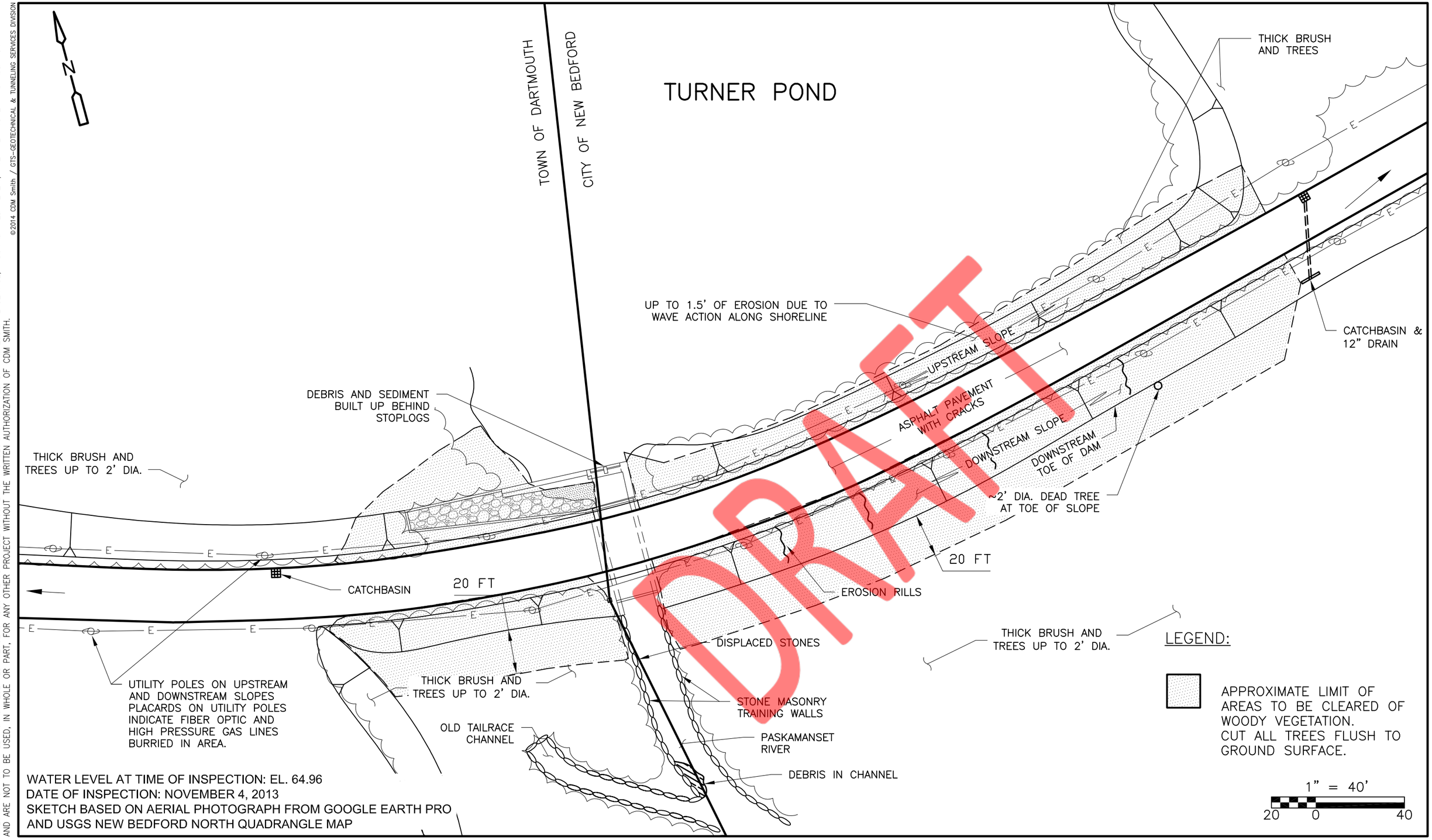
Locus Plan and Site Sketch



CDM Smith

DEPARTMENT OF PUBLIC INFRASTRUCTURE
TURNER POND DAM
STATE DAM ID NO.: 63-201 NID ID NO.: MA 01152

LOCUS PLAN
FIGURE A1
NOVEMBER 2014



WATER LEVEL AT TIME OF INSPECTION: EL. 64.96
DATE OF INSPECTION: NOVEMBER 4, 2013
SKETCH BASED ON AERIAL PHOTOGRAPH FROM GOOGLE EARTH PRO AND USGS NEW BEDFORD NORTH QUADRANGLE MAP

CDM Smith

CITY OF NEW BEDFORD, MASSACHUSETTS
TURNER POND DAM
STATE DAM ID NO.: 36-3-201- NID ID NO.: MA01152

SITE SKETCH
FIGURE A2
NOVEMBER 2014

Appendix B

Formal Maintenance Inspection Checklist

City of New Bedford, Department of Public Infrastructure
Formal Maintenance Inspection Checklist
Turner Pond Dam
NID#: MA01152
Old Plainville Road, New Bedford, MA

Inspector Name: _____
Inspector Title: _____
Date/Time of Inspection: _____
Elapsed Time Since Last Inspection: _____
Weather Conditions: _____
Temperature: _____
Reason for Inspection: _____
Pool Elevation: _____
Change in Pool Elevation Since Last Reading: _____
Additional Notes: _____

Checklist Item	Checked? (Yes/No)	Additional Notes	Photos
Seepage/Wet Areas			
Stoplog Bay			
Indications of Slope Movement			
- Upstream Slope			
- Downstream Slope			
Concrete Surfaces/Cracks			

Checklist Item	Checked? (Yes/No)	Additional Notes	Photos
Animal Activity			
Vegetation			
Vandalism			
Debris			
Roadway			
- asphalt cracking			
- depressions/potholes			
- utility pole verticality			
- guardrail			
Erosion			
Rip Rap			
Training Walls			
- Spillway			
- Discharge Channel			

Appendix C

302 CMR 10

302 CMR 10.00: DAM SAFETY

Section

10.01: Authority and Purpose

(1) 302 CMR 10.00 is promulgated pursuant to the authority granted the Department of Environmental Management (DEM) in M.G.L. c. 253, § 44.

(2) The purpose of 302 CMR 10.00 is to provide regulatory guidelines for the safety of dams by establishing reasonable standards and to create a public record for reviewing the performance of a dam.

10.02: Application

302 CMR 10.00 *et seq*. shall apply to the registration of dams, safety inspections, owner responsibilities, applications for review and approval of plans for the construction, alteration, modification, repair, enlargement, and removal of dams, quality assurance of construction, acceptance of construction, notification of intent to construct, and emergency action plans. 302 CMR 10.00 shall apply to any dam, as defined herein, constructed, altered or used to store and/or divert water in Massachusetts. Certain structures herein defined are exempt from 302 CMR 10.00.

10.03: Definitions

In addition to M.G.L. c. 253, § 44 as used in 302 CMR 10.00, the following terms shall have the following meanings:

(1) Undefined Terms. As used in 302 CMR 10.00 any term not defined in accordance with 302 CMR 10.03 shall have the meaning given to the term by any statutes, regulations, executive orders or policy directives governing the subject matter of the term. Examples include terms pertaining to:

(a) wetlands, which is defined by the Wetlands Protection Act, M.G.L. c. 131, § 40, and its implementing regulations, 310 CMR 10.00, and 33 USC 1341 and 314 CMR 9.00 regarding Water Quality Certification, as well as other statutes, regulations, executive orders, or policy directives that govern wetlands issues; and

(b) roadways or traffic, which is defined by the Massachusetts Highway Department's Highway Access Policy (adopted September 17, 1991), its Standard Operating Procedure for Review of State Highway Access permits (adopted September 17, 1991), and the Guidelines for EIR/EIS Traffic Impact Assessment (1989, as amended) by the Executive Office of Transportation and Construction and the Executive Office of Environmental Affairs, as well as other statutes, regulations, executive orders or policy directives that govern roadway and traffic issues.

10.03: continued

(2) Defined Terms. As used in 302 CMR 10.00, the following terms shall have the following meanings:

Abutment means 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. Right and left abutments are those on respective sides of an observer looking downstream.

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

Applicant means any person making application for a dam safety permit.

Appurtenant Works means structures, either in dams or separate therefrom, including, but not 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.

Artificial Impoundment means as applied to dam safety, a reservoir created by a dam.

As- builts means plans, drawings and all other descriptive and factual information that depict how a dam was actually constructed or repaired. As-builts are required to be submitted to the Commissioner at dam completion.

Authority means M.G.L. c. 253, §§ 44 through 48.

Axis of Dam means a plane or curved surface, arbitrarily chosen by a designer, appearing as a line in a plan or cross section to which the horizontal dimensions of the dam can be referred.

Baffle Block means a block, usually of concrete, constructed in a channel or stilling basin to dissipate the energy of water flowing at high velocity.

Base Width (Base Thickness) means the maximum width or thickness of a dam measured horizontally between upstream and downstream faces and normal to the axis of the dam but excluding projections for outlets, etc.

Beaver Dams means dams that are constructed by beavers and that are not subject to 302 CMR 10.00. Control of beaver population and removal of beaver dams is regulated by M.G.L. c. 131, 321 CMR 2.00: *Miscellaneous Regulations Relating to Fisheries and Wildlife*, and also by the Local Boards of Health and Conservation Commissions.

Berm means a horizontal step or bench in the sloping profile of an embankment dam.

Boil means a disturbance in the surface layer of soil caused by water escaping under pressure from behind a water retaining structure such as dam or a dike. The boil may be accompanied by deposition of soil particles (usually sand) in the form of a ring (miniature volcano) around the area where the water escapes.

Certificate of Completion means a document signed and stamped by a registered professional engineer with contractor's signature and supporting as-builts, upon completion of the work, attesting that the work has been performed in accordance with the permit conditions.

Certificate of Compliance means when a dam has been deemed safe, evaluated, constructed, repaired, altered or removed to the satisfaction of the Commissioner under a properly issued permit, the Commissioner shall issue a certificate of compliance, on a form prescribed by the Commissioner, to the owner approving the dam but subject to terms and conditions, if any. Such certificate shall be recorded by the owner in the registry of deeds in the county where the dam lies.

10.03: continued

Certificate of Non-compliance means a certificate of non-compliance issued by the Commissioner determines that the dam or appurtenant features are unsafe. Such certificate shall be recorded by the Commissioner in the registry of deeds in the county where the dam lies.

Certificate of Registration means a form to be provided by the Commissioner to be completed by the owner and filed with the Department.

Cofferdam means a temporary structure enclosing all or part of a construction area so that construction can proceed in a dry area. A "diversion cofferdam" diverts a river into a pipe, channel or tunnel.

Commissioner means the Commissioner of the Department of Conservation and Recreation or his authorized designee.

Conduit means a closed channel for conveying discharge through or under a dam.

Crib Dam means a gravity dam built up of boxes, cribs crossed timbers, or gabions and filled with earth or rock.

Culvert means a drain or waterway built transversely under a road, railway, or embankment, usually consisting of a pipe or covered channel of box section. A gallery or waterway constructed through any type of dam, which is normally dry but is used occasionally for discharging water, hence the terms "scour culvert", "drawoff culvert", and "spillway culvert". A roadway or railway culvert shall not be considered a dam if its invert is at the natural bed of the water course, it has adequate discharge capacity, and it does not impound water under normal circumstances. A culvert with installed man made water control device which impounds, release or diverts water may be designated by the Commissioner as a dam.

Cutoff Wall means an impervious construction or material which reduces seepage or prevents it from passing through foundation material.

Dam means any artificial barrier, including appurtenant works, which impounds or diverts water, and which:

(a) is 25 feet or more in height from the natural bed of the stream or watercourse measured at the downstream toe of the barrier, or from the lowest elevation of the outside limit of the barrier, if it is not across a stream channel or watercourse, to the maximum water storage elevation; or

(b) has an impounding capacity at maximum water storage elevation of 50 acre feet or more. Any other artificial barrier, including appurtenant works, the breaching of which could endanger property or safety, may be designated by the Commissioner as a dam, and shall be subject to M.G.L. c. 253, §§ 44 through 48.

The word "dam" shall not mean any of the following:

(c) any appurtenant works which temporarily impounds or diverts water used on land in agricultural use as defined pursuant to M.G.L. c. 131, § 40;

(d) any barrier or appurtenant works which has a size classification of small or low hazard potential classification that is used on land in agricultural use as defined in M.G.L. c. 131, § 40; and

(e) any barrier which is not in excess of six feet in height, regardless of storage capacity, or which has a storage capacity at maximum water storage elevation not in excess of 15 acre feet, regardless of height. The Commissioner shall make such determination by taking into consideration factors such as height, type of structure, condition of structure, volume of the impoundment, extent of development downstream, and other factors deemed appropriate by the Commissioner.

Dam Breach means an eroded opening through a dam which drains the impoundment. A controlled breach is a design and constructed opening. An uncontrolled breach is an unintentional opening which allows uncontrolled discharge from the impoundment,

Dam Break Analysis means a determination of a flood hydrograph resulting from a dam breach.

10.03: continued

Dam Certificate of Registration means a certificate to be issued by the Commissioner to the dam owner.

Dam Failure means an uncontrolled release of impounded water from a dam.

Dam Inspection Form or Format means a form or forms prescribed by the Commissioner containing information relative to the present condition, safety and adequacy of the dam and such other information as the Commissioner may require by regulation, signed by a registered professional engineer and filed with the Department.

Dams Not Regulated by M.G.L. c. 253, §§ 44 through 48 means dams constructed by beavers, created by ice, debris etc. and any other non man-made structures.

Dam Registration Form means a form or forms to be provided by the Commissioner to be prepared by the owner and filed with Commissioner containing the name of the owner, the location and the dimensions of the dam and such other information as the Commissioner may require by regulation.

Dam Safety Engineer means a person who is employed by the department who meets the requirements established by the Department of Personnel Administration

Database means electronic database of detailed information about dams. The database is owned, compiled, maintained and distributed by the Commissioner. Requests for database information are subject to M.G.L. c. 4, § 7, clause twenty-sixth (n) (Public Records) until suspended.

DEP means the Department of Environmental Protection

Department means the Department of Conservation and Recreation (DCR), as established in M.G.L. c. 21 § 1.

Drainage Area means the area which drains to a particular point on a river or stream.

Drawdown means the lowering of water surface level due to loss of water from a reservoir.

Embankment means the fill material, usually earth or rock, placed with sloping sides which provide a permanent barrier which impounds water.

Emergency Condition means unsafe dams with highest risk of failure, requiring immediate attention and a predetermined plan of action to reduce the highest level of risk, for the protection of public safety.

Emergency Action Plan means 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.

Engineer/Design Engineer. *See* Registered Professional Engineer.

Factor of Safety means as applied to dam safety, the ratio of the forces or moments resisting mass movement to the forces or moments tending to produce mass movement.

Fees means as applied to dam safety, the cost of services listed under 302 CMR 10.15 and provided by the Department

Flashboards means a length of timber, concrete, or steel placed on the crest of a spillway to raise the retention water level but that may be quickly removed in the event of a flood either by a tripping device or by a deliberately designed failure of the flashboard or its supports.

Flow Net means graphical representation of families of streamlines and equipotential lines, used in groundwater studies to determine quantities, rate, and directions of flow.

10.03: continued

Freeboard means the vertical distance between a stated water level and the top of a dam. Net Freeboard, Dry freeboard, Flood Freeboard or Residual Freeboard is the vertical distance between the estimated maximum water level and the top of a dam.

Gravity Dam means a dam constructed of concrete and/or masonry that relies on its weight for stability.

Great Pond means a pond containing in its natural state more than ten acres of land, as defined in the Waterways regulations at 310 CMR 9.02.

Great Pond/Enlarged means as applied to dam safety, any change in or addition to an existing Great Pond which raises or may raise the water storage elevation, of the water impounded by a Great Pond, by construction of a dam.

Hazard Potential Classification means the rating for a dam based on the potential consequences of failure. The rating is based on potential for loss of life and damage to property that failure of that dam could cause downstream of the dam. The hazard potential classification for a dam also is based on the incremental adverse consequences of failure, and has no relationship to the current structural integrity, operational status, flood routing capability, or safety condition of the dam or its appurtenances.

Height of Dam means the vertical distance from the lowest elevation of the dam crest to the lowest point of natural ground, including any stream channel, along the downstream toe of the dam.

Hydraulic and Hydrologic (H&H) Analyses means the analytical process of computing the change in a flood wave as it passes through a reservoir or a channel.

Hydraulic Height means the height to which water rises behind a dam and the difference between the lowest point in the original streambed at the axis of the dam and the maximum controllable water surface.

Hydrograph/Flood means a graphical representation of the flood discharge with respect to time for a particular point on a stream or river.

Inspections

(a) Additional Required Inspection means an additional inspection by a registered professional engineer of the dam, in accordance with the inspection frequency established by the Commissioner, to detect apparent signs and changes of deterioration in material, developing weaknesses or unsafe hydraulic and/or structural behavior or any other deficiencies of the dam structure or function since the initial Phase I or poor/unsatisfactory condition was determined. The additional inspection report shall follow a form as established by the Commissioner.

(b) Follow-up Inspection means an inspection when it is desirable to obtain supplemental data and/or to observe or monitor a dam under particular conditions (i.e. wet season, dry season, foliage, etc.)

(c) Phase I Formal Inspection means the visual inspection of the dam, in accordance with the inspection frequency established by the Commissioner, by a registered professional civil engineer to evaluate or reevaluate the safety and integrity of the dam and appurtenant structures to determine if the structure meets current design criteria. Formal inspection includes field observations to detect any signs of deterioration in material, developing weaknesses or unsafe hydraulic and/or structural behavior and a review of the records on project design, construction and performance. The final formal inspection report shall follow a form or format as established by the Commissioner and shall be filed with the Office of Dam Safety. All formal field inspections shall be performed during good weather conditions.

10.03: continued

(d) Phase II Detailed Inspection means all studies, investigations and analyses appropriate to evaluate the structural safety and hydraulic capacity of a dam or reservoir and appurtenant works. This inspection may include, but is not limited to, structural stability analyses, detailed hydrologic/hydraulic assessment, dam breach analyses, subsurface investigation, soil and materials testing, foundation explorations, conclusions, conceptual alternatives, cost estimate and recommendations. This inspection shall be performed by a registered professional civil engineer.

(e) VIF (Verification In Field) Inspection means an inspection for jurisdictional determination, and/or to obtain supplemental data, and/or for any other reason(s) deemed appropriate by the Commissioner.

(f) Visual Inspection means a visual but technical evaluation that must be performed of the physical conditions which affect performance of the structure and may include an analysis of the dam's ability to pass flood waters and must be performed by a registered professional civil engineer or dam safety engineer.

Instrumentation means an arrangement of devices installed into or near dams (*i.e.* piezometers, inclinometers, strain gages, measurement points, *etc.*) which provide for measurements that can be used to evaluate the structural behavior and performance parameters of the structure.

Inundation Map means a map delineating the area that would be flooded by a particular flood event or dam failure.

Liability means legal liability associated with the ownership, operation, maintenance, repair and failure of a dam.

Lien means a notice for the payment by the owner to the Commonwealth of the costs and expenses incurred by the Commonwealth for any actions taken in accordance with M.G.L. c. 253, § 47 and shall be effective upon mailing to the owner at the address shown in the Certificate of Registration and recorded at the Registry of Deeds in the county where the dam lies.

Low Level Outlet (Bottom Outlet) means an opening at a low level in a reservoir generally used for emptying the reservoir or scouring sediment and sometimes for irrigation.

Materially Alter means any change to a dam or reservoir which affects the physical parameters and/or safety of the dam or reservoir which may include, but is not limited to changing the height of a dam, increasing the normal pool or spillway elevation or changing the elevation or physical dimensions of an emergency spillway.

Maximum Impoundment Elevation means the maximum elevation of water surface which can be contained by the dam without overtopping the embankment section.

Maximum Water Storage Elevation means the reservoir elevation level reached during the spillway design flood.

Normal Water Level means for a reservoir with a fixed overflow sill the lowest crest level of that sill. For a reservoir whose outflow is controlled wholly or partially by movable gates, siphon or other means, it is the maximum level to which water may rise under normal operating conditions, exclusive of any provision for flood surcharge.

One-hundred-year Storm Event means the storm which is estimated to have a 1% chance, or one chance in 100 of being equaled or exceeded in one year, or one chance in 100 hundred years of being equaled.

Operation and Maintenance Manual (O&MM) means a document identifying routine maintenance and operational procedures under routine and storm conditions.

Order means a written document prepared and issued by the Commissioner which mandates specific actions to be accomplished by a dam owner within a specified time frame. Failure to comply with an order shall make the owner subject to fines as provided for in 302 CMR 10.15.

10.03: continued

Orientation:

(a) Upstream means the side of the dam that borders the reservoir.
(b) Downstream means the high side of the dam, the side opposite the upstream side.
(c) Right means the area to the right when the viewer is looking downstream.
(d) Left means the area to the left when the viewer is looking downstream.

Owner means the person or persons, including any individual, firm, partnership, association, syndicate, company, trust corporation, municipality, agency, political or administrative subdivision of the commonwealth or any other legal entity of any kind holding legal title to a dam, but excluding the United States, its agencies or any person who operates a dam owned by the United States.

Permit or Chapter 253 Dam Safety Permit means a written approval, pursuant to M.G.L. c. 253, §§ 44 through 48, to construct, repair, alter, breach or remove a dam. The technical aspect of the Permit must be reviewed and approved by a Dam Safety Engineer.

Phreatic Surface means the free surface of groundwater at atmospheric pressure.

Piezometer means as applied to dam safety, an instrument used for measuring water pressure within soil, rock or concrete.

Piping means the progressive development of internal erosion by seepage, appearing downstream as a hole or seam discharging water that contains soil particles..

Poor Condition means dams with major structural, operational, maintenance and flood routing capability deficiencies. Also unsafe-nonemergency dams.

Probable Maximum Flood (PMF) means the most severe flood that is considered reasonably possible at a site as a result of the most severe combination of critical meteorological and hydrologic conditions possible in the region.

Registered Professional Engineer means a civil engineer licensed and registered in the Commonwealth of Massachusetts with experience in dam safety inspections and engineering. Individuals licensed and registered in another state, but not in Massachusetts must be approved by the Commissioner.

Removal means the destruction or breaching of a dam to the extent that no water can be impounded by the dam.

Repairs means any work done at a dam which affects the integrity of the dam. This includes but is not limited to, work requiring excavation into the embankment fill or foundation of a dam or work requiring removal or replacement of major structural components of a dam.

Reservoir means the area which contains or will contain the body of water impounded by a dam.

Riprap means is a layer of large uncoursed stones, broken rock, or pre-cast blocks placed in random fashion on the upstream slope of an embankment dam, on a reservoir shore, or on the sides of a channel as a protection against wave and ice action. Very large rip-rap is sometimes referred to as armoring.

Risk means a measure of the likelihood and severity of adverse consequences. In dam safety applications, life-safety risk is expressed in units of loss-of-lives per year; economic, societal and environmental risks are expressed in units of dollars per year. The risk may be associated with an individual failure mode or it may be total risk, representing the cumulative risk associated with all failure modes

Risk Assessment means as applied to dam safety, the process of identifying the likelihood and consequences of dam failure to provide the basis for informed decisions on a course of action.

10.03: continued

Roll Dams means low head dams usually run of the river overflow weir or spill way structures that produce vertical water surface drops of one to 15 feet and change river flows from super-critical to sub-critical.

Run-of-the-river-dam means a dam situated on a river or stream whose spillway length and width of impoundment is nearly equal to the width of the original river or stream bank to bank.

Safety Evaluation means as applied to dam safety, the process of determining the ability of a dam and its appurtenances to pass a given flood.

Seepage means the interstitial movement of water that may take place through a dam, its foundation, or its abutments.

Siphon/Inverted means a conduit or culvert to permit water to pass under an intersecting roadway, stream or other obstruction.

Spillway means a structure over or through which flood flows are discharged. If the flow is controlled by gates, it is a controlled spillway; if the elevation of the spillway crest is the only control, it is an uncontrolled spillway.

Spillway/Auxiliary (Emergency Spillway) means a secondary spillway designed to operate only during exceptionally large floods.

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

Stoplogs means large logs or timbers or steel beams placed on top of each other with their ends held in guides on each side of a channel or conduit to control water level in reservoir.

Tailwater Level means as applied to dam safety, the level of water in the discharge channel immediately downstream of the dam.

Toe of Dam means the junction of the downstream face of a dam with the ground surface, also referred to as downstream toe. For an embankment dam, the junction of the upstream face with ground surface is called the upstream toe.

Unsafe Dam means a dam whose condition, as determined by the Commissioner, is such that a high risk of failure exists. Among the deficiencies which would result in this determination are: excessive seepage or piping, significant erosion problems, inadequate spillway capacity and/or condition of outlet(s), and serious structural deficiencies, including movement of the structure or major cracking.

Uplift means as applied to dam safety, the upward pressure in the pores of a material(interstitial pressure) or on the base of a structure.

Water Storage Elevation means the maximum elevation without encroaching on the approved freeboard at maximum design flood.

Weir means a low dam or wall built across a stream to raise the upstream water level. Termed fixed-crest weir when uncontrolled. A structure built across a stream or channel for the purpose of measuring flow. Types of weir include broadcrested weir, sharp-crested weir, ogee weir, and V-notched weir.

10.04: Exclusions

Dams owned and operated by the United States, its agencies or any person who operates a dam owned by the United States are excluded from the provisions in 302 CMR 10.00, together with dams and reservoirs licensed and subject to inspection by the Federal Energy Regulatory Commission (FERC) provided that a copy of all FERC approved periodic inspection reports are provided to the Department. All other dams are subject to 302 CMR10.00 unless exempted in writing by the Commissioner, M.G.L. c. 253, §§ 44 through 48, or 302 CMR 10.00. Examples of exempt dams could be temporary drainage detention ponds, surface impoundments (other than water) for industrial or commercial wastes which are regulated by other agencies or storage tanks.

10.05: Registration

(1) General. The purpose of registration is to establish a public record of the dam.

(2) The owner of any dam subject to 302 CMR 10.00 shall cause to be filed with the Commissioner, within 30 days following notice by him, on a form prescribed by him, a Dam Registration Form containing the name of the owner, the location and dimensions of such dam and such other information as the Commissioner may reasonably require.

(3) A registration form shall not be deemed received by the Commissioner until all information required by statute or 302 CMR 10.00 is furnished.

(4) In the event that the owner fails to file the dam registration form in the time prescribed, the Commissioner may notify the owner of such failure and offer a 30 day grace period after which a Certificate of Non-compliance will be issued and recorded at the Registry of Deeds in the county where the dam lies, with all costs of recording, and interest thereon, to be assessed against the owner.

(5) Upon receipt and approval of the Dam Registration Form, a Certificate of Registration will be issued to each owner. Within 14 days of receipt such Certificate of Registration must be recorded by the owner at the Registry of Deeds in the county where the dam lies, and a copy of the recorded Certificate filed with the Commissioner within ten days of recording.

(6) The owner shall notify the Commissioner by registered or certified mail, of the proposed transfer of legal title of such dam 30 days prior to any such transfer. Upon receipt of such notice, a new Certificate of Registration will be issued. Such Certificate shall contain any outstanding obligations of the registered owner under M.G.L. c. 253, §§ 44 through 50.

10.06: Size and Hazard Classification

(1) General. Dams shall be classified for purposes of establishing inspection schedules and adherence to design criteria, in accordance with their potential for damage to life or property in the area downstream from the dam in the event of failure of the dam or appurtenant facilities. This determination shall be made by the Commissioner and noted on the owner's Certificate of Registration. It may be necessary to periodically reclassify dams as additional information becomes available and/or conditions change. The criteria established in 302 CMR 10.06(2) through (4) shall be used by the Commissioner to determine the size and hazard potential classification based upon the extent of development downstream from the dam, taking into consideration factors such as height, type of structure and volume of impoundment, pursuant to M.G.L. c. 253.

(2) Size Classification. The classification for size based on the height of the dam and storage capacity shall be in accordance with the Size Classification Table. The height of the dam is established as described in 302 CMR 10.06 with respect to maximum water storage elevation. The storage capacity of the dam is the volume of water contained in the impoundment at maximum water storage elevation measured as defined in 302 CMR 10.06(2). Size class may be determined by either storage or height, whichever gives the larger size classification.

10.06: continued

SIZE CLASSIFICATION TABLE

Category	Storage (acre-feet)	Height (feet)
Non-jurisdictional	Not in excess of 15 regardless of height	Not in excess of six regardless of storage capacity
Small	≥ 15 and <50	≥6 and <15
Intermediate	≥50 and <1000	≥ 15 and <40
Large	≥1000	≥40
For dams not in excess of 25 feet in height or having maximum impounding capacity not in excess of 50 acre-feet, the Commissioner shall make jurisdictional determination by taking into consideration factors or combination of factors such as height, type of structure, volume of the impoundment, extent of downstream development, and other factors deemed appropriate by the Commissioner.		

(3) Hazard Potential Classification. The classification for potential hazard shall be in accordance with the Hazard Potential Classification Table in 302 CMR 10.06(3). The hazards pertain to potential loss of human life or property damage in the event of failure of the dam or appurtenant works. Development of the area downstream from the dam that would be affected by its failure shall be considered in determining the classification. Dams will be subject to reclassification if the Commissioner determines the hazard has changed.

HAZARD POTENTIAL CLASSIFICATION TABLE

High Hazard (Class I):	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	Dams located where failure may cause loss of life and damage home(s), industrial or commercial facilities, secondary highway(s) or railroad(s) or cause interruption of 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.

(4) Dams in Series.

(a) If an upstream dam has the capability to create failure in a downstream dam because of its failure flood wave, it shall have the same or higher hazard classification as the downstream dam. If the failure flood wave of the upstream dam will not cause failure of the downstream dam, the upstream dam may have a different hazard potential classification from the downstream dam.

(b) The classification of each dam shall be reviewed during each subsequent periodic inspection.

(c) Potential damage to habitable structures will be considered minor when habitable structures are not within the direct path of the probable flood wave produced upon failure of a dam or where such structures will experience:

1. no more than 2.0 feet incremental rise of flood water above the lowest ground elevation adjacent to the outside foundation walls; or
2. no more than 2.0 feet incremental rise of flood water above the lowest habitable floor elevation of the structure; the lower of the two elevations governing.

(5) Failure Damage. The extent of potential damage resulting from a dam breach may justify designating damage as either major or minor. Such a designation may be made after a detailed analysis has established the relative impact of the probable dam breach and has considered the following factors:

10.06: continued

(a) the conditions prior to and after a dam breach;
(b) the extent to which access has been affected, both before and after a dam breach; and
(c) the extent of damage.

(6) Hazard Reconsideration. An owner may at any time request the Commissioner to reconsider the hazard determination. The owner's request must be filed by a registered professional civil engineer, specifying the findings and analyses with which the owner disagrees. The Commissioner will issue a written decision to the owner and the registered professional civil engineer within 30 days of receipt of a request for hazard reconsideration, and such decision shall be final and binding upon the parties.

10.07: Inspection Schedule

(1) Upon the failure of an owner to file a dam inspection report within the time prescribed, the Commissioner or his designee, in accordance with M.G.L. c. 253, § 47 may enter upon the property on which the Department's jurisdictional dam(s) and appurtenant works lie at any time to conduct any kind of dam safety evaluation(s) and/or action(s) as required, and/or to obtain the requisite information.

(2) The owner shall periodically inspect all dams in accordance with the following schedule. These time periods are the maximum time between inspections, more frequent inspections may be performed at the discretion of the Commissioner.

FORMAL INSPECTION FREQUENCY

Hazard Potential	Inspection Frequency
Low	ten years
Significant	five years
High	two years

ADDITIONAL INSPECTION FREQUENCY

High and Significant Hazard potential dams whose condition are determined to be poor and/or emergency by formal inspection must be inspected and reported on at least every six months by a registered professional engineer employed by the owner until the dam safety repairs are completed and the dam is found to be in satisfactory condition.

Any dam determined to be in an unsafe condition must be monitored at frequencies assuring the safety of the public.

Updates on the condition of the dam shall be provided by a registered professional engineer to the Office of Dam Safety and local emergency management officials until the dam is made safe.

(3) Inspections scheduled according to the time period set forth above, may be modified, at the discretion of the Commissioner, in special cases where it is desirable to observe a dam under particular conditions (*i.e.* wet season, dry season, foliage, *etc.*).

(4) The Commissioner may require scheduled inspections on a more frequent basis if particular conditions exist which require more frequent monitoring.

10.07: continued

(5) When the Commissioner reschedules the inspection of a particular dam for any reason cited in 302 CMR 10.07, the date of that inspection may become the starting date from which the date of the next regularly scheduled periodic inspection will be computed.

(6) The owner shall employ the services of a registered professional engineer experienced in the design, construction and inspection of dams, to inspect the owner's dam according to the inspection schedules determined by the Commissioner and on forms prescribed by the Commissioner.

(7) The owner shall furnish a copy of each completed inspection report in a format determined by the Commissioner within 30 days of the date of the inspection to the Commissioner.

(8) The inspection report shall be sealed by a registered professional engineer, as described herein.

(9) The owner must submit a statement of his or her intent to implement such recommendations of the registered professional engineer, if required.

(10) Upon review and approval of submitted inspection report, the Commissioner will determine compliance and appropriate procedure(s) in accordance with 302 CMR 10.08.

10.08: Compliance with Inspection Results

(1) The Commissioner shall determine whether the dam and appurtenant features meet accepted dam safety standards. If the Commissioner determines that the dam does not meet these standards and a threat to life and/or property exists, he shall issue a Certificate of Non-compliance. Certificates shall be recorded by the Commissioner with the Registry of Deeds for the county where the dam lies.

(2) A Certificate of Non-compliance shall be issued if the Commissioner determines that the dam or appurtenant features are unsafe, as defined under 302 CMR 10.06.

(3) If the Commissioner issues a Certificate of Non-compliance, after receiving the owner's inspection form, or at any other time, the Commissioner may order the owner of the dam to: cause a detailed inspection of the dam by a registered professional engineer, including such tests as the Commissioner may require or recommend to determine the course of action necessary to bring the dam into compliance and a time schedule by which the work shall be accomplished; or take whatever action is necessary to reduce the safety risk, as determined by the Commissioner.

(4) Notice of such aforementioned orders shall be served upon the owner(s) by registered or certified mail, return receipt requested, and recorded by the Commissioner in the Registry of Deeds in the county where the dam lies.

(5) When the dam meets minimum dam safety standards, or has been corrected or removed pursuant to an order by the Commissioner, the Commissioner shall issue a Certificate of Compliance to the owner.

(6) The Commissioner has the authority, pursuant to M.G.L. c. 253, § 47, and in accordance with the Memorandum of Understanding Between the DEP and the DCR relative to lake water level drawdowns/dam repair projects to determine the maximum allowable water elevation for reservoirs and impoundments where dams have been determined to be unsafe. In determining the maximum allowable water elevation, the Commissioner may consider the recommendations of a registered professional engineer representing the owner, if the owner has retained one. The owner shall not store water in excess of the stated elevation so determined by the Commissioner.

10.08: continued

(7) When the spillway capacity of the existing dam does not meet stated criteria a relative impact analysis may be required to be performed by the owner. This analysis will address such factors as: downstream impact area; capacity and/or condition of outlet work(s); overtopping potential; operation plans; consideration of incremental impacts of possible failure; and emergency action plans. Upon review and approval by the Commissioner a reduction in the standard design flood may be allowed to such dam.

10.09: Dam Construction, Repair, Alteration, Breach or Removal Permit

(1) General Application. Any person(s) who proposes to construct, repair, materially alter, breach or remove a dam, pursuant to M.G.L. c. 253, must file with the Commissioner a permit application to determine whether or not a Chapter 253 Dam Safety Permit is required. Routine maintenance-related work does not require a Chapter 253 Dam Safety Permit. Approved permits issued by the Commissioner do not relieve the applicant from required compliance with M.G.L. c. 131, § 40, and, where applicable, M.G.L. c. 131, §§ 5C and 19. Applications shall be sent by certified mail, return receipt requested. All permit applications must comply with DCR's standard design and construction criteria (*see* 302 CMR 10. 14). If the Commissioner determines that the proposed dam falls within the jurisdiction of 302 CMR 10.00, the owner must complete the construction, repair, alteration, breach or removal permit application as follows:

(a) Preliminary Report. The Permit application for any dam shall include a preliminary report. (Filing of the preliminary report prior to filing the final report, early in the site investigation and design schedule, is encouraged to assure the state's concurrence with the hazard classification, site investigation, and design concept.) The preliminary report shall be filed with the permit application and shall include, but not be limited to, the following information:

1. completion of all required information on the application;
2. maps showing the location of the proposed structure that include the county, location of state roads, access to site, and outline of the reservoir (aerial photographs or U.S. Geological Survey may be used);
3. preliminary drawings or sketches that include cross sections, plans and profiles of the dam, propose pool levels, and type of all spillways;
4. preliminary design criteria and basis for selection including a description of the size, ground cover conditions, and extent of development of the watershed, drainage area, spillway design storm, geology and geotechnical engineering assumptions for the foundation and embankment materials, and type of materials used in the principal spillway(s); and
5. book and page number of location of the dam as recorded in the Registry of Deeds with the name of the Registry.

(b) Final Design Report. Approval or denial of a permit to construct, repair, alter, breach or remove a dam will be issued within 60 days from the time the final design report and permit application is received. The final design report shall include, but may not be limited to, the following information:

1. a report of the investigation of the foundation soils or bedrock and the borrow materials, including the location of borrow areas, that are to be used to construct or repair the dam;
2. analysis and/or criteria to indicate that the dam will be stable during construction and filling and under all conditions of reservoir operations;
3. computations indicating that the dam is safe against overtopping during occurrence of the inflow design flood and wave action; wave action need not be considered when the design flood is based on the probable maximum precipitation (PMP);

10.09: continued

4. criteria, design data or references to indicate that seepage flow through the embankment, foundation, and abutments will be controlled to limit internal erosion and sloughing in the area where the seepage occurs;
5. calculations and assumptions relative to design of the spillway(s);
6. provisions to protect the upstream slope, crest, and downstream slope of earth embankments and abutments from erosion due to wind and rain;
7. other design data, assumptions and analysis data pertinent to individual dams and site conditions;
8. a proposed construction schedule;
9. a proposed filling schedule for the reservoir;
10. a maintenance and operation plan; and
11. for all new high and significant hazard potential dams, an emergency action plan to be implemented in the event of a dam failure.

The preliminary report and the final design report may be submitted as one document.

(2) Construction Documents. Two sets of plans and specifications must be submitted along with the Final Design Report. The documents shall be detailed engineering design drawings and specifications and that include the following at a minimum:

(a) sheet one showing the name of the project; name of owner; hazard classification of the dam; designated access to the project; and location with respect to highways, roads, streams, and any dam(s) that would affect or be affected by the proposed structure;
(b) maps showing the drainage area and outline of the reservoir and the ownership of properties covered by the reservoir or flood pools;
(c) geologic investigation, cross section, profiles, logs of borings, location of borrow areas, drawing of principal and emergency spillways, drawn in sufficient detail to clearly indicate the extent and complexity of the work performed;
(d) the technical provisions, as may be required, to describe the method of construction and quality control for the project; and
(e) special provisions, as may be required, to describe technical provisions needed to ensure that the dam is installed according to the approved plans and specifications.

(3) Notification. The Commissioner shall notify the applicant in writing within 60 days following the receipt of the completed application if the application is approved or disapproved. If the application is disapproved an explanation will be provided.

(4) Permit. Approval of construction, drawdown, repair, alteration, brief or removal of a dam will be contained in a Chapter 253 Permit to be issued by the Commissioner. A permit may be subject to written general stipulations and/or written specific stipulations deemed necessary by the Commissioner. No construction shall be performed until the permit is issued and recorded in the Registry of Deeds for the county within which the dam lies. The permit shall be valid for the construction schedule specified in the approved final design report and application. Construction must commence within two years after the permit is issued. If construction does not commence within two years after the permit is issued, the permit shall expire and a new application shall be submitted unless prior to the permit expiration date, upon written application and for good cause shown, the Commissioner extends the time for commencing construction.

(5) Recording a Chapter 253 Permit. A permit to construct, drawdown, repair, alter, breach or remove a dam shall be recorded at the Registry of Deeds in the county where the dam lies. Recording must be done prior to the commencement of construction and a copy of the recorded permit filed with the Commissioner.

10.09: continued

(6) Construction/Drawdown Notification. At least 21 days before construction or controlled drawdown is commenced, the owner shall provide notice by certified and/or registered mail to the Commissioner and the local Conservation Commission and to the Commonwealth Division of Fish and Wildlife, Field Headquarters, 1 Rabbit Hill Road, Westborough, MA 01581 attn: Natural Heritage and Endangered Species Section. When repairs are necessary to safeguard life and property, they may be started under the provisions of M.G.L. c. 253, § 47 upon notification by the Commissioner of an emergency condition. The owner shall assign a registered professional engineer to monitor any drawdown for the first four hours after its commencement, observing conditions at least on an hourly basis. Thereafter, the owner or his registered professional engineer shall monitor the drawdown at least once each 24 hours until drawdown has been completed. Emergency drawdowns in accordance with an order issued by the Commissioner excepted, to meet standards established by the Commonwealth Division of Fish and Wildlife drawdown rates should not exceed four cubic feet per second per square mile of drainage area (CFSM), as measured at the outlet structure. During reimpoundment, 0.5 cfsm should be maintained at the outflow.

(7) Entry. During construction the Commissioner or his designee may enter upon the property to inspect during construction without prior notice and may direct any additional testing or actions as required.

(8) Removal of Dams. If it is desirable to remove a dam due to new construction, abandonment or unsafe conditions, the owner shall be required to comply with 302 CMR 10.09 regarding the construction and repair of dams. Upon complete removal of the dam, the Commissioner will issue a Certificate of Approval stating that the removal has been in accordance with the approved plans and specifications, or any approved revisions thereof.

10.10: Revocation, Suspension, or Modifications of Chapter 253 Permits

Chapter 253 Permits may be revoked, suspended, modified or denied by the Commissioner for causes including but not limited to, the following:

(1) violation of any permit condition;

(2) failure to fully disclose all relevant facts or obtaining a permit through misrepresentation;

(3) violation of any provisions of M.G.L. c. 253, or 302 CMR 10.00 *et seq.*;

(4) change or newly discovered condition or circumstance that makes or would make the dam unsafe; or

(5) change of conditions develop that are hazardous to life and/or property.

10.11: Emergency Action Plans

(1) All dams classified or reclassified as high hazard potential shall have an Emergency Action Plan ("EAP"). If the Commissioner requires it, the owner of a non-high hazard potential dam shall also be required to provide an EAP. Approval to construct a new significant hazard potential dam or high hazard potential dam shall be contingent upon the submission of an EAP to the Commissioner. All EAP's are subject to approval by the Commissioner. The EAP shall, at a minimum, contain the following:

(a) the identification of equipment, manpower and material available for implementation of the plan;
(b) a notification procedure for informing the local emergency agencies;
(c) a dam failure inundation map for high hazard potential dams and a topographic map for significant hazard potential dams showing the stream which will be flooded; and
(d) a procedure for warning nearby local residents if failure of the dam is imminent and a listing of addresses and telephone numbers of downstream residents who may be affected by the failure of the dam.

10.11: continued

(2) Prior to submission of an EAP to the Commissioner, the owner shall submit a copy of the proposed EAP to the local and state emergency agencies, and all local emergency coordinators involved in the plan, for review. The owner shall submit with the EAP, recommendations received from said agencies and coordinators, if any.

(3) Annually, the owner shall review the EAP, update it and provide the updated EAP to all involved agencies for review.

(4) EAP'S shall be provided by the owner in both hard copy and electronic format to the Commissioner and the Massachusetts Emergency Management Agency.

10.12: Records

Upon request by the Commissioner, an owner shall make available for inspection and review, all plans, specifications and other such pertinent material relating to the dam. The Commissioner shall return all such material upon completion of his inspection.

10.13: Liability

(1) The owner shall be responsible and liable for damage to property of others or injury to persons, including but not limited to loss of life, resulting from the operation, failure of or misoperation of a dam.

(2) 302 CMR 10.00 shall not relieve from or lessen the responsibility of any person owning, or operating a dam from any damages to persons or property caused by defects, nor shall the Commissioner be held liable by reason of any inspections or permits issued.

10.14: Design and Construction Criteria for New and Existing Dams

(1) General. Design and construction of dams shall comply with 302 CMR 10.14. Design and construction standards that are not included in 302 CMR 10.14, shall conform to design procedures established by: The U.S Army Corps of Engineers, the U.S. Bureau of Reclamation, the U.S. National Resource Conservation Agency and other generally accepted engineering practices and principles. Where specific site conditions may exist which warrant appropriate changes in the following design and construction criteria, the Commissioner shall review and approve the design.

(2) Foundations and Abutments. The foundations and abutments investigation shall consist of borings, test pits, and other subsurface exploration necessary to assess the soil, rock, and groundwater conditions.

(3) Construction Materials. Specifications for construction materials shall establish minimum acceptance criteria so that anticipated design properties are achieved. If the use of on site borrow materials is specified, exploration, testing, and calculations shall be performed to indicate that there are sufficient quantities of material available that meet the design criteria.

(4) Surveys. Surveys shall be made with sufficient accuracy and scale to locate the proposed construction and to define the volume of the storage in the reservoir. The downstream area shall be investigated in order to delineate the area of potential damage in case of failure. Locations of centerlines, and other horizontal and vertical control points, shall be shown on a map of the site.

(5) Hydrologic Investigation. The drainage area shall be determined. Present land use shall be considered in determining the runoff characteristics of the drainage area. All hydrologic assumptions and design calculations shall be included in the report.

10.14: continued

(6) Spillway Design.

(a) The spillway system shall have a capacity to pass a flow resulting from a design storm, as indicated in the following table, unless the applicant provides calculations, designs and plans to show that the design flow can be stored, passed through, or passed over the dam without failure occurring.

SPILLWAY DESIGN FLOOD
DESIGN STORM

Hazard	Size	Existing Dams	New Dams
Low	small intermediate large	50 year 50 year 100 year	100 year 100 year 100 year
Significant	small intermediate large	100 year 100 year 500 year	500 year 500 year ½ PMF
High	small intermediate large	500 year ½ PMF ½ PMF	PMF PMF PMF

(b) Vegetated earth or unlined emergency spillway(s) will be approved when computations indicate that it will pass the design flood without jeopardizing the safety of the structure. The risk of recurring storms, excessive erosion, and inadequate vegetative cover will be considered acceptable in such a spillway when its average frequency of use is predicted to be no more than indicated in the following table.

EMERGENCY SPILLWAY FREQUENCY TABLE

Hazard	Size	Existing Dams	New Dams
Low	small intermediate large	25 years 25 years 25 years	25 years 25 years 25 years
Significant	small intermediate large	25 years 25 years 50 years	50 years 50 years 50 years
High	small intermediate large	50 years 50 years 100 years	100 years 100 years 100 years

(c) The Department recognizes that the relationships between valley slope and width, total reservoir storage, drainage area, and other hydrologic factors have a critical bearing on determining the safe spillway design flood. Rational selection of a safe spillway design flood for specific site conditions based on quantitative and relative impact analysis is acceptable. The spillway should be sized so that the increased downstream damage resulting from an overtopping failure of the dam would not be significant when as compared with the damage caused by the flood in the absence of dam overtopping failure. In lieu of quantitative and relative impact analysis, the preceding table shall be used as spillway design criteria.

(d) Lined Spillways and Channels. The design report shall include design data criteria for open channel, drop, ogee, and chute spillways and other spillway types that include crest structures, walls, channel linings, and miscellaneous details. All masonry or concrete structures shall have joints that are relatively water tight and shall be placed on foundations capable of sustaining applied loads without undue deformation. Provisions must be made for handling leakage from the channel or under seepage from the foundation which might cause saturation of underlying materials or uplift against the undersurfaces.

10.14: continued

(7) Conduits.

(a) A conduit shall be provided to drain each reservoir. Any new and/or existing conduit design shall include the computation of the minimum time required to drain the reservoir.

(b) All pipe conduits shall convey water at the design velocity without damage to the interior surface.

(c) Protection shall be provided to prohibit unsafe seepage along conduits through the dam, abutments, and foundations. The specific design for seepage protection along conduits shall be shown in the drawings and specifications.

(d) Adequate allowances shall be incorporated in the design to compensate for differential settlement and possible elongation of the pipe conduit.

(e) Trash racks shall be installed at the intake of conduits to prevent clogging the conduit.

(f) Pipe Conduit Materials:

1. Pipe conduits shall be designed to support the total external loads in addition to the total internal hydraulic pressure without leakage.

2. Reinforced or Prestressed Concrete Pipe Conduits.

a. All conduits shall be designed and constructed to remain watertight under maximum anticipated hydraulic pressure and maximum probable joint opening, including the effects of joint rotation and extensibility.

b. Provisions for safe movement of the barrel shall be provided at each joint in the barrel and at the junction of the barrel and riser or inlet. Cradles shall be articulated if constructed on a yielding foundation.

c. The owner's engineer shall submit the final design details of the proposed pipe to be used for all significant and high hazard potential dams.

3. Corrugated Metal Pipe Conduits.

a. Corrugated metal pipe shall not be used in any dam, except for special cases where the design engineer can adequately demonstrate satisfactory performance. Any exemption which allows their use must be issued in writing by the Commissioner.

4. Dissipating Devices. All gates, valves, conduits and concrete channel outlets shall be provided with a dissipater designed and constructed to control erosion and prevent damage to the embankment or the downstream outlet or channel.

5. In the case of repair to an existing dam, the owner's engineer may determine that the conduit should not be repaired or replaced and shall submit reasons to support this determination in the application for the Chapter 253 Permit to repair.

(8) Seepage Control.

(a) All dams shall be designed and constructed to prevent the development of instability due to excessive seepage forces, uplift forces, or loss of materials in the embankment, abutments, spillway areas, or foundation. Seepage analyses for design shall identify areas having high internal uplift or exit gradients.

(b) The design shall include an embankment internal drainage system, a zoned embankment, a foundation cut-off, an upstream blanket, a sufficiently wide homogeneous section, or other methods to protect against instability from excessive seepage forces or high hydraulic gradients.

(c) For high hazard potential dams, a flow net analysis shall be made to determine the location of the phreatic surface, flow lines, and equipotential lines within the embankment and its foundation. These analyses may be based on graphical construction, electrical or liquid analogs, soil prototype methods, or other generally accepted methods. The flow net and stability analysis shall be the maximum water storage elevation. Possible fluctuations in tail water elevation shall be included in the analysis. The flow net and seepage analysis shall be included in the final design report.

(d) Piezometers for confirming the location of the phreatic surface assumed for seepage and slope stability analyses shall be considered by the design engineer for low and significant hazard potential dams and shall be required for high hazard potential dams. Where piezometers are required, their design, depths and locations shall be provided in the final design report.

10.14: continued

(9) Structural Stability and Slope Protection.

(a) Design and construction of dams to assure structural stability shall be consistent with accepted engineering practice. The scope and degree of precision that will be required for a specific project will depend on the conditions of the site and the damage potential of the proposed structure. Consideration in design for structural stability shall include, but are not necessarily limited to, the following:

1. The hazard potential of the dam under present downstream conditions and under conditions which would likely develop during the life of the reservoir;
2. foundation bearing capacity, compressibility, and permeability; the extent and reliability of the site investigation; and the predictability of the site and foundation conditions;
3. the reliability of construction materials, such as borrow soils, in terms of sufficient volume to complete construction without unanticipated interruption and in terms of predictability of physical properties such as strength, permeability, and compressibility;
4. durability of construction materials;
5. construction conditions at the site;
6. the degree of quality control to be exercised during construction;
7. pore pressure build-up during construction;
8. the rate of filling the reservoir and the rate of possible reservoir drawdown;
9. tailwater conditions and the impact of drawdown;
10. possible effects of landslides and subsurface solution activity on the structural stability of the dam and spillway structures; and
11. the extent of of the proposed use of piezometers and other devices which will be used to monitor the completed dam and the means of access for inspections.

(b) Slope stability analysis shall be considered by the design engineer for all embankment dams and are required for high hazard potential dams. Where slope stability analysis is required documentation in the final design report, such analysis shall include the design cross section(s) showing the soil parameters assumed for analysis, the location of the phreatic surface assumed for analysis, stability computations, and the location and computed safety factor(s) for the most critical circle(s) or failure wedge(s).

(c) Minimum factors of safety are listed in the following table. Final accepted factors of safety may depend upon the degree of confidence in the engineering data available. In selecting a minimum acceptable factor of safety, an evaluation should be made on both the degree of conservatism with which assumptions were made in choosing soil strength parameters and pore water pressures, and the influence of the method of analysis which is used.

1. 302 CMR 10.14(8)(c) shall not be applicable to embankments on clay shale foundations, soft sensitive clays, or materials with large strength loss under stresses.
2. For embankments over 50 ft. high on relatively weak foundations, a minimum factor of safety of 1.4 shall be used.

10.14: continued

SLOPE STABILITY ANALYSIS
MINIMUM FACTORS OF SAFETY

Loading Condition	Minimum Factor of Safety Analyzed	Slope to be
End of construction condition	1.3	upstream and downstream
Sudden drawdown from maximum pool	>1.1*	upstream
Sudden drawdown from spillway crest or top of gates	1.2	upstream
Steady seepage with maximum storage pool	1.5	upstream and downstream
Steady seepage with surcharge pool	1.4	downstream
Earthquake (for steady seepage conditions with seismic loading using seismic coefficient method)	>1.0	upstream and downstream

(d) Foundation bearing capacity and sliding base analysis shall be considered for all dams and are required for high hazard dams. Where bearing capacity or sliding base analysis is required, documentation of assumptions, computations, and safety factors shall be included in the final design report.

(e) Resistance of appurtenant structures against flotation uplift shall be provided for all dams. If the structures are anchored by dead weight alone, the buoyant weight shall be used for analysis. If the structures are anchored to soil or rock, the minimum factor of safety for that portion of the resistance provided by soil or rock anchorage shall be 2.0 unless the design engineer provides a thoroughly documented basis for using a lower safety factor.

(f) For concrete, masonry, or other similar dams of relatively narrow cross section, resistance against overturning and sliding under maximum design loading conditions shall be considered; overturning and sliding stability computations shall be required for significant and high hazard dams.

(g) The anticipated reservoir and tailwater drawdown conditions shall be considered in all stability computations and shall be included in the design documents provided in the final design report.

(h) The slopes shall be protected against erosion by wave action, and the crest and downstream slope shall be protected against erosion due to wind and rain. Riprap and other erosion protection shall be provided over the full range in stage between the lowest drawdown elevation and at least two feet above maximum water storage elevation. Exemptions for specific site conditions, slowly rising reservoirs, such as waste storage facilities, may be approved in writing by the Commissioner upon written request by the Applicant.

(i) All significant and high hazard potential dams shall be designed to withstand seismic accelerations of the following intensities: Zone 1 = 0.025 g., Zone 2 = 0.05 g., Zone 3 = 0.15 g. Zones refer to "Geologic Hazard Maps".

(j) Loading Combinations. The following conditions and requirements are suitable in general for gravity dams of intermediate size. Loads which are not indicated such as wave action, or any unusual loadings should be considered where applicable.

*The factor of safety shall not be less than 1.5 when drawdown rate and pore water pressures developed from flow nets are used in the stability analyses and where rapid drawdown is a normal operating condition as with pumped storage reservoir.

10.14: continued

Case I: Usual Loading Combination--Normal Operating Condition The reservoir elevation is at the normal pool, as governed by the crest elevation of an overflow structure or the top of the closed spillway gates, whichever is greater. Normal tailwater is used. If applicable, horizontal silt pressure should be also be considered.

Case II: Unusual Loading Combination--Flood Discharge The projected inflow design flood up to and including the Probable Maximum Flood, if appropriate, that results in reservoir and tailwater elevations that exert the greatest head differential and uplift pressure upon the structure shall be used. However, unusual conditions, such as high tailwater, shall be examined on a case by case basis as it is possible that the worst case loading condition exists under other than extreme floods.

Case IIA: Unusual Loading Combination--Ice Case I loading plus ice pressure, if applicable. Generally ice pressure will not be a factor in the stability analyses, but may affect the operation, or structural integrity of flashboards and spillway gates.

Case III: Extreme Loading Combination--Normal Operating with Earthquake Case I loading except that the inertial force due to the earthquake acceleration of the dam, and the increased hydrostatic forces due to the reservoir reaction on the dam are added.

(k) Stability Criteria. Specific stability criteria for a particular loading combination shall be dependent upon the type of analysis being done (i.e. foundation or concrete analysis), the degree of understanding of the foundation-structure interaction and site geology, and, to some extent, on the method of analysis.

1. For new dams, preliminary analyses shall be based upon more conservative criteria than final designs. As the design process progresses the designer has available more sophisticated, and detailed, foundation information and material testing results. Therefore, when the unknowns associated with the preliminary designs are reduced by the final design stage, lower safety factors may be acceptable.
2. For existing dams, assumptions used in the analysis shall be based upon construction records and the performance of the structures under historical flood loadings. In the absence of available design data and records, site investigations shall be conducted to verify all assumptions.
3. Recommended safety factors shall apply to the calculations of stress and the shear-friction factor of safety within the structure, at the rock/concrete interface and in the foundation. Safety factors shall be determined using the gravity method of analysis.

RECOMMENDED FACTORS OF SAFETY Dams having a high or significant hazard potential.	
Loading Condition	Factor of Safety
Usual Unusual Extreme	3.0 2.0 >1.0

Dams having a low hazard potential.

Loading Condition	Factor of Safety
Usual Unusual Extreme	20 1.25 >1.0

(10) Design Life of a Dam. The selection of materials and equipment to be used in a dam and all of its appurtenant features shall either be based on sufficient quality and durability to function satisfactorily throughout the design life or to provide for safe and economical replacement within the design life span.

10.14: continued

The design life of a dam shall be the period of time the dam can be expected to perform effectively as planned. The design life of a dam shall be determined by the following:

(a) the time required to fill the reservoir with sediment from the contributing watershed;
(b) the durability of appurtenances and materials used to construct the dam; and
(c) the time required to perform the specific function for which the dam was designed.

(11) Additional Design Requirements.

(a) All elements of the dam shall conform to good and generally accepted engineering practice. The safety factors, design standards, and design references that are used shall be included in the final design report.

(b) Monitoring or inspection devices may be required by the Commissioner for use by the inspectors or owners during construction and filling and after completion of construction. The Commissioner may also require that such monitoring or inspection devices, existing or installed by requirement, be read and documented at specified intervals and that copies of such be forwarded to his office.

(12) Construction Schedule. The applicant shall submit a construction schedule that includes:

a) suggested techniques and work force to be used to demonstrate that the dam will be constructed according to the plans and specifications;
(b) an estimated time to complete the construction activities;
(c) techniques to be used to divert the stream flow to prevent interference with construction; and
(d) the extent and method of quality control.

(13) Proposed Changes In Design. The owner shall notify the Commissioner in writing of any proposed changes in design, plans, and specifications that will affect the stability of the dam. Approval shall be in the form of a written addendum to the Chapter 253 Permit and must be obtained prior to installation.

(14) As-built Plans. Two complete sets of as-built plans shall be submitted to the Commissioner within 30 days of completion of the project.

(15) Engineer's Certification. The registered professional civil engineer who has inspected the construction of the dam, shall submit a written statement bearing his/her professional seal that the dam and all appurtenances have been built, repaired, altered, or removed in conformance with the plans, specifications, and drawings approved by the Commissioner and that the dam is in compliance with 302 CMR 10.00. For repairs accomplished, the certification shall be for the repairs only.

(16) Acceptable Design: Procedures and Technical References. The following represent acceptable design procedures and references:

(a) the design procedures, manuals and criteria used by the United States Corps of Engineers;
(b) the procedures, manuals, and criteria used by the United States Soil Conservation Service;
(c) the procedures, manuals, and criteria used by the United States Bureau of Reclamation; and
(d) other procedures that are approved by the Commissioner.

(17) Granting of Final Approval. Unless the Commissioner has reason to believe that the dam, on completion, is unsafe or not in compliance with any applicable requirement, regulation, or law, or of any condition or specification contained within the Permit, upon completion of construction and upon receipt of the engineer's statement, the Commissioner shall grant final approval of the work and shall issue a Certificate of Compliance, subject to such terms as he deems necessary for the protection of life and property.

10.15: Schedule of Fees and Fines

(1) Registration Fees.
(a) The fee for registering a dam with the Office of Dam Safety for the first time is $75.00
(b) The fee for registering with the Office of Dam Safety the transfer of a dam to a new dam owner after a real estate transaction is $50.00

(2) Chapter 253 Application Fee and Permit Fees.
(a) The fee to apply for a Chapter 253 Dam Safety Permit to construct, materially alter, perform major repairs, breach or remove a dam is $50.00.
(b) The fee for review and issuance of a Chapter 253 Dam Safety Permit is based on the size and cost of the proposed project (construction and engineering) as follows:
1. For a dam construction project costing up to $100,000.00 the fee will be $250.00;
2. For a dam construction project costing from $100,000.00 to $500,000.00 the fee will be $500.00;
3. For a dam construction project costing between $500,000.00 and $1,000,000.00 the fee will be $750.00;
4. For any dam project over $1,000,000.00, the fee will be $1,000.00.

(3) Fees for Special Inspections. The fee for a dam safety emergency inspection and inspections of unsafe non-compliance dams performed by the Department, will be up to $1,000.00. Exclusions: The Commonwealth, its agencies, authorities and political sub-divisions, including municipalities, are exempt from the payment of fees.

(4) Fines for Non-compliance with the Following Requirements (but not necessarily limited to):
(a) Failure to register a dam with the Office of Dam Safety and the Registry of Deeds will result in fines up to $500.00.
(b) Failure to notify the Office of Dam Safety of the transfer of a dam from one owner to another will result in fines up to $500.00.
(c) Failure of the owners of "HIGH HAZARD POTENTIAL" dams and newly constructed "SIGNIFICANT HAZARD POTENTIAL" dams to provide up to date EMERGENCY ACTION PLANS to the Office of Dam Safety and the Massachusetts Emergency Management Agency will result in fines up to $500.00.
(d) Failure of the owners to comply with the conditions of a Chapter 253 Dam Safety Permit will result in fines up to $500.00.
(e) Failure of the owners to provide the Office of Dam Safety with an Inspection Report that is in compliance as to content and frequency of inspection as provided for in 302 CMR 10.00 will result in fines up to $500.00.
(f) Failure of an owner to obtain a Chapter 253 Dam Safety Permit prior to performing any dam work such as alteration, breach, removal or substantial repairs will result in fines up to $500.00.

Each violation shall be a separate and distinct offense and, in case of a continuing violation, each day's continuance thereof shall be deemed to be a separate and distinct offense.

10.16: Severability

If any section, subsection, division or subdivision of 302 CMR 10.00 shall be determined to be invalid, such determination shall apply only to the particular section, subsection, division or subdivision, and all other provisions of 302 CMR 10.00 shall remain valid in full force and effect.

REGULATORY AUTHORITY

302 CMR 10.00: M.G.L. c. 253, § 44.

NON-TEXT PAGE

Appendix D

Common Dam Safety 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 exist, 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 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 the dam or separate from the dam, 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 dam or the abutments.

Spillway – Shall mean a structure over or through which water flows are discharged. If gates or boards control the flow, 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 lowest point on 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.