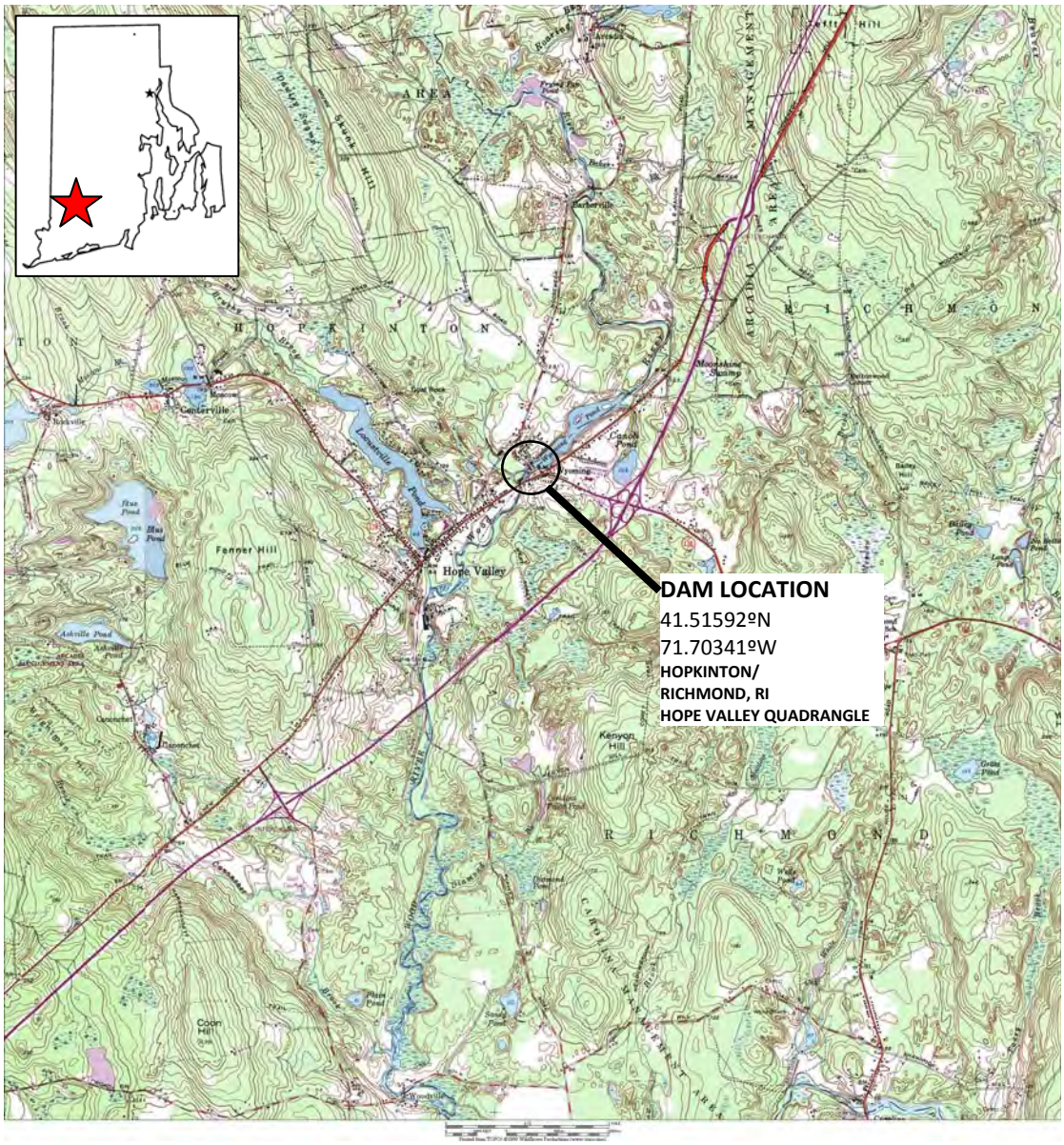
-- WYOMING UPPER DAM --
VISUAL
INSPECTION / EVALUATION REPORT

Dam Name:	***Wyoming Upper Dam***
State Dam ID#:	***216***
Owner:	***RI Department of Fish & Wildlife***
Town:	***Hopkinton/Richmond***
Consultant:	***Pare Corporation***
Date of Inspection:	***June 5, 2014***

PARE
CORPORATION

INSPECTION SUMMARY

Dam Name (No):	Wyoming Upper Dam (216)
Location:	Hopkinton/Richmond
Hazard Classification:	High
Inspector:	David M. Matheson, P.E., Pare Corporation
Inspection Date:	June 5, 2014



When describing the dam, "left" and "right" refer to the respective sides of the dam as viewed when facing downstream (with normal flow of water).

PREFACE

The assessment of the general condition of the dam reported herein was based upon available data and visual inspections. Detailed investigations and analyses involving topographic mapping, subsurface investigations, testing and detailed computational evaluations were beyond the scope of this report unless reported otherwise.

In reviewing this report, it should be realized that the reported condition of the dam was based on observations of field conditions at the time of inspection, along with data available to the inspection team.

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

J. Matthew Bellisle, P.E.
PARE CORPORATION
Senior Vice President

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1.0 DESCRIPTION OF PROJECT

1.1 General

1.1.1 Authority

The RIDEM Office of Compliance and Inspection has retained Pare Corporation of Foxboro, Massachusetts and Lincoln, Rhode Island to perform a visual inspection and to develop a report of conditions for the Wyoming Upper Dam along the Wood River in Hopkinton and Richmond, Rhode Island. This inspection and report were completed in accordance with current Rhode Island laws.

RIDEM will develop an overall condition rating based upon the data presented herein. It is understood that this rating will consider operational and structural deficiencies and will be presented under separate cover.

1.1.2 Purpose of Work

The purpose of this investigation was to inspect and evaluate the present condition of the dam and appurtenant structures in accordance with current dam safety regulations to provide information that will assist in both prioritizing dam repair needs and planning/conducting maintenance and operation.

The investigation was divided into three parts: 1) obtain and review reports, investigations, and data pertaining to the dam and appurtenant structures available within the Rhode Island Department of Environmental Management files; 2) perform a visual inspection of the site; and; 3) prepare and submit a final report presenting the evaluation of the structure, including recommendations and remedial actions.

1.1.3 Definitions

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

1.2 Description of Project

1.2.1 Location

The Wyoming Upper Dam is located in the Town(s) of Hopkinton/Richmond. The dam is located approximately 2.2 miles northwest of the center of Richmond. The dam impounds water along the Wood River to form Wyoming Pond. The dam is located at the southwestern end of the impoundment near coordinates 41.51592ºN/71.70341ºW. Please refer to the inspection summary for a locus plan depicting the area of the dam and its immediate surroundings.

The dam is accessible from a RI Dept. of Fish & Wildlife parking lot on the left abutment of the dam. To reach the dam from I-95, take exit 3B for RI-138 West. Follow 138 West/Main Street for

approximately 0.5 miles turn right onto Bridge Street. Roughly 250 feet after turning onto Bridge Street the parking area will be on the right before crossing the river downstream of the dam.

1.2.2 Owner/Caretaker

The dam is owned by RIDEM Fish and Wildlife, which also has responsibility for the operations and maintenance of the structure. The Owner's contact, Ms. Christine Dudley, Deputy Chief – Freshwater Fisheries, can be reached at 401-789-0281.

1.2.3 Purpose of the Dam

The dam currently impounds water for recreational purposes. No other purposes past or present were identified during the preparation of this report. The original date of construction was not available. However, available information suggests that the dam was originally built as a water supply for the mills formally located at each abutment. Records also indicate that the dam was rebuilt in 1962.

1.2.4 Description of the Dam and Appurtenances

The following is based upon information contained within the RIDEM files and observations made during the inspection:

As shown on Figure 1: Site Sketch, The Wyoming Upper Dam is an approximately 310-foot long masonry and earthen dam with a reported maximum structural height of 11-feet. The dam includes three embankment sections divided by the sluiceway and the primary spillway structures.

The embankment at the left end of the dam consists of an approximately 60-foot long (left to right) area of earth fill retained by stone masonry walls along the upstream and right sides. The embankment in this area is approximately 100-feet wide (upstream to downstream).

The center embankment, located between the sluiceway and the spillway, consists of a stone masonry section with earth or rock fill. This section is roughly 15-feet long (left to right) and 30-feet wide (upstream to downstream).

The right embankment is an approximately 70-foot long earthen section located between the right end of the spillway and the right abutment. The upstream side is retained by a variety of stone walls with some sections of slopes. The crest is an earthen surface of variable width. The downstream side includes stone masonry sections, concrete retaining wall sections, and former concrete foundation wall sections of the old mill. The right embankment formerly included a flume to the mill building which was located at the abutment downstream of the dam, but has since been abandoned. Details of the original construction in this area or abandonment procedures were not available.

The spillway structure for the dam consists of an approximately 180-foot long stone masonry gravity section. The spillway consists of three approximately 60-foot long sections with roughly 30º bends between each section. The crest of the spillway is approximately 6-feet wide and is constructed of a sloping concrete apron with a timber weir at the upstream edge. Beyond the apron, the downstream face of the spillway consists of a vertical stone masonry wall.

The sluiceway, located near the left abutment, consists of an approximately 13-foot wide stone masonry wall-lined channel. Flow through the channel area is regulated by two sets of timber flash boards within a steel frame near the upstream end of the sluiceway.

A low level outlet is apparently present within the right third of the spillway section. The outlet apparently consisted of a 3.5-foot wide by 5-foot high rectangular gated conduit through the base of the stone masonry spillway section. The outlet was provided with a gate on the upstream side of the spillway. At this time, the current configuration of the outlet is unknown.

1.2.5 Operations and Maintenance

The RI Department of Fish and Wildlife is the current owner of the dam and is responsible for operations and maintenance at the dam. There is no current operational or maintenance program for this dam.

1.2.6 Hazard Potential Classification

In accordance with current classification procedures under State of Rhode Island dam safety rules and regulations, Wyoming Upper Dam has been classified as a High hazard potential dam by RIDEM.

2.0 INSPECTION

2.1 Visual Inspection

Wyoming Upper Dam was inspected on June 5, 2014. At the time of the inspection, the weather was near 70°F and cloudy. Photographs to document the current conditions at the dam were taken during the inspection and are included at the end of this report. The level of the impoundment appeared to be slightly above normal operating levels. Underwater areas were not inspected as part of the field activity.

For reference purposes, a baseline was established along the dam with station 0+00 at the left abutment and Station 3+10 at the right abutment. Observations are reported in relation to their location along the baseline as noted herein.

2.1.1 General Findings

In general, Wyoming Upper Dam was found to have a leaking and inoperable low level outlet; a primary spillway with clear leakage along its right third and an overgrown discharge channel; sinkholes and depressions behind walls at all three embankment sections; masonry walls and structures in need of repointing and resetting; eroded areas along the upstream sides of the left and right embankment sections; and other dam safety deficiencies. The specific concerns are identified in more detail in the sections below:

2.1.2 Dam Embankment

For inspection and reference purposes, the embankment was inspected in three sections: The left embankment (left of the sluiceway), the center embankment (between the sluiceway and spillway), and the right embankment (right of the spillway). The following was noted during the inspection:

Left Embankment

- The stone masonry walls that retain the upstream side, approach channel, and sluiceway discharge channel are in poor condition with missing mortar, missing chinking stones, occasional missing/shifted wall and cap stones, and vegetative growth through the wall joints.
- There are depressions and sink holes (up to 5 inches deep) behind the wall along the approach channel.
- With the exception of a few bare areas along the retaining walls and an eroded area at the transition between the upstream wall and approach channel wall, the crest of the embankment and left abutment contact area is protected with a well maintained grass.
- There is no apparent animal activity.
- This is no apparent leakage along the downstream side of the left embankment section near the sluiceway channel.
- No cracks or signs of unusual movement was observed at the point of contact with the left abutment looks good.

Center Embankment

- The stone surface along the crest has several depressions that are several inches deep with leakage noted at the sluiceway channel side nearest the stop log controls.
- On the downstream side, holes are present behind the backside of the surrounding walls (Photo Nos. 2, 24, and 25) with some voids forming completely through the walls. A complete inspection was not possible in this area due to the thick overgrowth of brush, vines, and weeds, which blocked a complete viewing. Due to the known presence of the voids amongst the obstructing vegetation, clearing for spot checks was not completed due to safety concerns.
- Aged patches of concrete are present to fill the apparent on-going settlement and formation of voids. It does not appear that these repairs have proven effective in addressing this problem as voids are forming below the concrete fill.
- The alignments of the walls that surround the central embankment appear regular.

Right Embankment

- A stone wall retains the right embankment along the spillway's approach channel and wraps around the upstream side for about half the embankment's length before transitioning to an earthen slope which terminates at the right abutment.
    - The stone wall is rotated outward with missing stones throughout the top.
    - Many surface areas behind the walls are depressed or have settled and sloughed downward as a result of the apparent wall rotation.
    - A sinkhole, approximately 6' long x 3' wide by x 1.5' deep, is present behind the downstream left corner of the wall system to the right of the spillway (Photo Nos. 27 and 29).
    - In the area of the sinkhole mentioned above, there is a roughly 0.5 inch wide crack through the top of the wall (Photo No. 29).
- Clear leakage was observed about half-way up the downstream wall and aligns with the above-mentioned sink hole. The leakage is flowing at about 15 GPM.
- Piles of scattered granite blocks are present along the upstream side in the area of the former approach opening to the flume.
- An eroded and/or sloughed area is present along the upstream earthen slope right of the former flume intake.
- A sinkhole, approximately 3' long x 8'wide x 2'deep, is present at the downstream side of the crest behind the concrete section that is covering up the former flume discharge.
- An animal burrow of about 1 inch in diameter is present to the left and slightly downstream of the above mentioned sinkhole at the former flume discharge (Photo No. 31).
- The downstream wall is comprised of mortared stone masonry with a concrete wall section likely installed when the flume was abandoned.
    - The downstream wall appears to be fully intact. However, bulged areas with open joints are typical across the full length (Photo No. 33).
    - The concrete section appears to have good alignment. However, the left and right edges are cracked (Photos Nos. 35 and 36) with a void below each (Photo No. 37). No leakage was observed.
    - There are wet areas along the base of the wall between the concrete section and the spillway with no detectable flow; however, thick vegetative cover in front of the wall prevented a complete inspection.
- The point of contact with the right abutment looks good.

2.1.3 Appurtenant Structures

Primary Spillway

- As indicated on the photo taken by RIDEM personnel (Photo No. 10), several clusters of thin leakage streams are present along the spillway's downstream face along its right-most third.
    - The leakage appears to be concentrated along the mid-height of the wall.
    - During the time of the inspection, access to this area to look for signs of sediment transport downstream of the spillway and/or soil loss and/or undermining along the approach was limited due to its location within the submerged flow areas.
    - The leakage appears to be running clear at roughly 5-10 GPM per location with no iron oxide staining noted along each exit point.
- The stone masonry across the full downstream face has many open joints that are in need of repointing and chinking.
- The flow pattern over the control section is uneven, which may be indicative of missing and/or displaced weir stones.
- The approach channel is clear of debris.
- The discharge channel between the spillway and the downstream bridge is continuing to become overgrown with brush, small trees, and other vegetation that will likely impact the dam's discharge capacity.
- The spillway's right and left stone masonry training walls have poor jointing with occasional shifted stones.
- The approach apron and discharge areas were underwater at this time. Therefore these areas could not be inspected.

Low Level Outlet

- Remnants of the gate control mounts can be seen protruding out of the water within the approach channel. No controls are in place nor is there a means for accessing this area.
- The outlet opening located at the base of the spillway appears to be constructed of stacked stone and appears to have a good alignment.
- Water is flowing out of the discharge opening at about 30 GPM.
- The discharge area is the spillway's downstream channel.
- Due to its position within and below the flow areas, no further inspection of the low level outlet could be completed.

Sluiceway

- With water flowing over the stop logs, an inspection was limited for leakage through boards or around stop log frame sections.
- Underwater areas along the approach, stop log control invert, downstream channel bottom, and channel wall sections were not inspected.
- The discharge channel’s left and right walls support the left and center embankments, respectively. As such, notes on their conditions are provided above under the appropriate inspection sections above within this report.

2.1.4 Downstream Area

Downstream of the spillway, the bottom of the discharge channel strewn with several boulders and/or rock outcrops that passes beneath Bridge Street via two bridges that have been replaced in 2011. Downstream of the bridges, the downstream area appears to be generally flat and wooded.

2.1.5 Reservoir Area

The dam is located at the southwestern end of the impoundment area. The impoundment area is a long (approximately 4,000-feet) and narrow (generally less than 400-feet) water body. Although narrow, the impoundment is relatively open upstream of the dam providing a long fetch that allow waves to build up in height by the time it reaches the dam.

The perimeter of the impoundment is generally undeveloped and wooded with some residential development and roadways beyond the vegetated shoreline.

2.2 Caretaker Interview

The RI Dept. of Fish & Wildlife, Owner of the facility, is responsible for maintenance and operations at the dam. No Owner's representative was available at the time of the inspection. Therefore, no caretaker interview was conducted.

Prior to the time of the inspection, the undersigned communicated with the following:

- Ms. Christine A. Dudley, Deputy Chief – Freshwater Fisheries
- Mr. Andres Aveledo, Conversation Engineer – Planning and Development

Information from Ms. Dudley and Mr. Aveledo was incorporated into this report.

2.3 Operation and Maintenance Procedures

No formal operations and maintenance manual was available at the time of the inspection nor is one known to exist.

2.3.1 Operational Procedures

The low level outlet was designed with a gated control system. At the time of the inspection, the control system was no longer in place with flows discharging from the discharge opening at the base of the spillway. It is unclear whether the gate has been removed, is partially opened, and/or is compromised.

2.3.2 Maintenance of Dam and Operating Facilities

Aside from maintenance to control vegetation with the grass areas on the left abutment, it does not appear that any maintenance is completed.

3.0 ASSESSMENTS AND RECOMMENDATIONS

3.1 Assessments

In general, Wyoming Upper Dam was found to have

1. A leaking and inoperable low level outlet;
2. A primary spillway with clear-flowing leakage along its right third and an overgrown discharge channel;
3. Sinkholes and depressions behind walls at all three embankments;
4. Masonry walls and structures in need of repointing and resetting;
5. Eroded areas along the upstream sides of the left and right embankments.

The previous inspection was completed by PARE on November 29, 2011. Based upon a comparison of reported conditions and photographs, the Wyoming Upper Dam remains in a similar condition with continued deterioration of the stone masonry components and ongoing formation of depressions and sinkholes behind walls.

Previously Identified Deficiency/Recommendation	***Resolution or Current Condition***
Fill the sinkholes right of the spillway with compacted engineered fill. Monitor for continue settlement.	Apparently not completed,
Repoint stone masonry joints along the upstream face and side of the center embankment	
Complete a stability evaluation of the dam sections	
Complete an underwater inspection to assess the condition of walls, gates, stop logs, and other structures that are normally below water	
Complete an inspection of the downstream face of the spillway	
Monitor the seepage through the base of the wall right of the spillway and beneath the concrete wall at the apparent former flume location	
Repoint stone masonry along the right side of the left embankment section upstream of the sluiceway	
Seal leakage around the stop log slots at the sluiceway	
Modify the existing controls at the sluiceway to provide an operable outlet structure	
Rehabilitate the upstream side of the dam right of the spillway	
Clear brush and other vegetation from the area of all stone masonry walls	
Develop a formalized Operations and Maintenance Manual	

The following recommendations and remedial measures generally describe the recommended approaches to address current deficiencies at the dam. Prior to undertaking recommended maintenance, repairs, or remedial measures, the applicability of environmental permits needs to be determined for activities that may occur within resource areas under the jurisdiction of RIDEM or other regulatory agencies.

3.2 Recommendations

The following present additional studies, routine and recurrent operations and maintenance activities, and repairs recommended for addressing deficiencies noted during the inspection and the completion of this report. The recommendations provided below should be implemented in accordance with general dam safety practice. Further, if left unaddressed, many of the conditions identified above will continue to deteriorate and could compromise the future safety of the dam and appurtenant structures.

Since the last inspection, deterioration has continued. However, it does not appear that new deficiencies have developed. PARE's recommendations from the 2011 report remain valid.

1. Fill the two sinkholes right of the spillway and the depressions behind wall sections at the left and right embankments with compacted engineered fill. Monitor for continued settlement.

2. To help reduce leakage through the embankment sections, clear vegetation from, re-chink, and repoint stone masonry joints along the following areas:

    a. Walls that support the three embankments (both above and below the normal pool level)
    b. Along the right channel wall at the sluiceway's discharge, and
    c. Along the downstream face of the spillway.

    Water control and diversion may be required to complete this work.

3. If the above work does not adequately reduce and control the leakage, additional studies may be required to develop other options. The studies may include underwater inspections, dye tests, subsurface investigations, and flow monitoring. Repair options may include injected grout subsealing and/or filtered drains.

4. Clear the discharge channel of all vegetation from flow areas between the spillway and Bridge Street. This does not include removing vegetation from the whole island in the middle of the channel, but does include trimming back vegetation to the edges of the original flow areas.

5. Complete a stability evaluation of the dam sections. The stability analyses should consider the spillway sections, upstream and downstream stone masonry wall sections, and the stone and/or earthen fill of the embankment sections. The completion of a subsurface investigation inclusive of probing will likely be required to determine the soil properties of the in-situ embankment fill and to better understand the geometry of the walls.

6. Complete an underwater inspection to assess the condition of walls, gates, stop logs, and other structures that are normally below water. The inspection should also include the apparent low level outlet structure, the spillway approach, and the downstream channel to evaluate the potential for scouring and undermining at the toe of the spillway.

7. Complete an inspection of the downstream face of the spillway under low flow conditions to assess the spillway for indications of problematic leakage or stone loss. Develop and implement a repair program to address deficiencies.

8. Monitor the seepage through the base of the wall right of the spillway and beneath the concrete wall at the apparent former flume location (not seen during the current inspection), and the seepage at the base of the right downstream wall between the former flume and the spillway.

9. Evaluate the abandonment procedures utilized at the flume. Complete additional evaluations to determine if repairs are necessary to cut-off the flow or properly abandon the former flume structure.

10. Seal leakage around the stop log slots at the sluiceway.

11. Modify the existing controls at the sluiceway to provide an operable outlet structure. This could include removing and installing new stop logs fitted with steel lifting eyes to allow the stop logs to be installed and removed manually with one or two pole-mounted hooks.

12. Trap and remove burrowing animals and promptly fill the resulting holes with compacted structural fill.

13. Rehabilitate the right embankment's upstream side. The rehabilitation program should include reconstruction of the upstream wall, replacement of apparently dumped fill in the apparent former flume approach, and regrading the upstream slope right of the former flume followed by the installation of a rip rap erosion control system to protect the slope from wave action.

14. A formalized Operations and Maintenance Manual should be developed for this structure. This manual should include procedures for maintaining the level of the impoundment, including adjusting the level of the impoundment in anticipation of rain events to provide additional free board as necessary. Additionally, the manual should include periodic inspection schedules and operational and maintenance procedures required to ensure satisfactory operation and minimize deterioration of the facility. The manual should also provide record keeping procedures for ongoing inspection and monitoring of noted deficiencies. The manual should include a schedule for regular maintenance activities to be completed to control and prevent the growth of unwanted vegetation.

15. Implement a program of regular inspection and monitoring of the dam. As the dam is currently classified as a High hazard potential dam, the completion of a formal visual inspection by a RI registered professional engineer familiar with dam engineering is required every 2 years.

3.3 Alternatives

The following alternatives are presented based upon a conceptual review of the concerns. Additional studies and or considerations may indicate that some or all of the options presented below are not suitable for the conditions specific to this dam and dam site. In addition to the general activities, appropriate environmental permits will be required to complete many of the alternatives presented below.

Dam Removal/Breaching: Alternative to implementing any of the repairs noted above, breaching of the dam is a viable alternative for addressing safety and stability concerns at the dam. While this

alternative will address the safety concerns at the dam, it will result in the loss of the recreational and environmental resource and reduce potential flood control capacity provided by the dam and impoundment. Additionally, while removal will result in elimination of yearly operating and maintenance expenses, permitting activities and construction costs associated with dam removal may exceed those of rehabilitation continued and operations and maintenance.

Lower the Dam: Complete modifications to the dam to reduce the dam height, thereby reducing the maximum height and volume of water that may be impounded by the dam. Evaluate the impact of the lowered dam upon the hazard potential. While this alternative may result in reducing the hazard potential, recommendations listed above remain valid and should be implemented in accordance to general dam safety practice. Additionally, permitting activities and construction costs associated with reducing the dam height may exceed those of the above recommended approaches. ***Considering the dam is primarily constructed of stone masonry, reducing the height of this dam may not be feasible***

COMMON DAM SAFETY DEFINITIONS

For a comprehensive list of dam engineering terminology and definitions refer to State of Rhode Island Rules and Regulations for Dam Safety, or other reference published by FERC, Dept. of the Interior Bureau of Reclamation, or FEMA.

Orientation

Upstream – Shall mean the side of the dam that borders the impoundment.
Downstream – Shall mean the high side of the dam, the side opposite the upstream side.
Right – Shall mean the area to the right when looking in the downstream direction.
Left – Shall mean the area to the left when looking in the downstream direction.

Dam Components

Dam – means any barrier made by humans, including appurtenant works, that impounds or diverts water.
Embankment – means the fill material, including but not limited to rock or earth, placed to provide 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 – means any ancillary feature of a dam including such structures as dikes, training walls, spillways, either in the dam or separate there from, low level outlet works, and water conduits such as tunnels, channels, pipelines or penstocks, either through the dam or its abutments.
Spillway – means a structure, a low area in natural grade or any part of the dam which has been designed or relied upon to allow normal flow or major flood flow to pass over or through while being discharged from a reservoir.

Hazard Classification

High Hazard – means a dam where failure or misoperation will result in probable loss of human life.
Significant Hazard – means a dam where failure or misoperation results in no probable loss of human life but can cause major economic loss, disruption of lifeline facilities or impact other concerns detrimental to the public's health, safety or welfare. Examples of major economic loss include but are not limited to washout of a state or federal highway, washout of two or more municipal roads, loss of vehicular access to residences, (e.g. a dead end road whereby emergency personnel could no longer access residences beyond the washout area) or damage to a few structures.
Low Hazard – means a dam where failure or misoperation results in no probable loss of human life and low economic losses.

General

EAP – Emergency Action Plan – Shall mean a predetermined (and properly documented) 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 failure.
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. One million U.S. gallons = 3.068 acre feet.

Height of Dam– means the vertical distance from the elevation of the uppermost surface of a dam to the lowest point of natural ground, including any stream channel, along the downstream toe of the dam.
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.
Maximum Water Storage Elevation – means the maximum elevation of water surface which can be contained by the dam without overtopping the embankment section.
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.
Maximum Storage Capacity – The volume of water contained in the impoundment at maximum water storage elevation.
Normal Storage Capacity – The volume of water contained in the impoundment at normal water storage elevation.

Condition Rating

Unsafe – Means the condition of a regulated dam, as determined by the Director, is such that an unreasonable risk of failure exists that will result in a probable loss of human life or major economic loss. Among the conditions that would result in this determination are: excessive vegetation that does not allow the Director to perform a complete visual inspection of a dam, excessive seepage or piping, significant erosion problems, inadequate spillway capacity, inadequate capacity and/or condition of control structure(s) or serious structural deficiencies, including movement of the structure or major cracking.*
Poor – A component that has deteriorated beyond a maintenance issue and requires repair.; the component no longer functions as it was originally intended.
Fair – Means a component that requires maintenance
Good – Meeting minimum guidelines where no irregularities are observed and the component appears to be maintained properly.

* Structural deficiencies include but are not limited to the following:

- Excessive uncontrolled seepage (e.g., upwelling of water, evidence of fines movement, flowing water, erosion, etc.)
- Missing riprap with resulting erosion of slope
- Sinkholes, particularly behind retaining walls and above outlet pipes, possibly indicating loss of soil due to piping, rather than animal burrows
- Excessive vegetation and tree growth, particularly if it obscures features of the dam and the dam cannot be fully inspected
- Deterioration of concrete structures (e.g., exposed rebar, tilted walls, large cracks with or without seepage, excessive spalling, etc.)
- Inoperable outlets (gates and valves that have not been operated for many years or are broken)

REFERENCES AND RESOURCES

The following reports were located during the file review completed at RIDEM Offices in Providence, Rhode Island:

1. "Visual Inspection/Evaluation Report", Pare Corporation, Foxboro Massachusetts, November 29, 2011.
2. "Dam Inspection Report", Department of Environmental Management, September 26, 1988.
3. "Dam Inspection Report", Department of Environmental Management, February 27, 1984.
4. "Dam Inspection Report", Department of Environmental Management, July 27, 1983.
5. "Dam Inspection Report", Department of Environmental Management, September 8, 1983.
6. "Dam Inspection Report", Department of Natural Resources, March 21, 1978.
7. Plans: "Proposed Repairs to Dam in Wyoming, RI", Division of Fish & Game, September 11, 1961.
8. "Resume of Correspondences", A.C. Caccia, Engineer, November 9, 1950.
9. "Special Inspection Report", Division of Harbors and Rivers, July 28, 1946.
10. "Special Inspection Report", Division of Harbors and Rivers, June 14, 1945.
11. "Plan "216 – Wyoming Upper", Division of Harbors and Rivers, October 7, 1940.
12. "Dam Inspection Report", Office of Compliance and Inspection, February 17, 2000.

The following were referenced during the completion of the visual inspection and preparation of this report and the development of the recommendations presented herein:

1. "Design of Small Dams", United States Department of the Interior Bureau of Reclamation, 1987.
2. "ER 110-2-106 - Recommended Guidelines for Safety Inspection of Dams", Department of the Army, September 26, 1979.
3. "Guidelines for Reporting the Performance of Dams" National Performance of Dams Program, August 1994.

The following provides an abbreviated list of resources for dam owners to locate additional information pertaining to dam safety, regulations, maintenance, operations, and other information relevant to the ownership responsibilities associated with their dam.

1. RIDEM Office of Compliance and Inspection Website: http://www.dem.ri.gov/programs/benviron/compinsp/
2. "Dam Owner's Guide To Plant Impact On Earthen Dams" *FEMA L-263,September 2005.*
3. "Technical Manual for Dam Owners: Impacts of Plants on Earthen Dams" *FEMA 534, September 2005.*
4. "Dam Safety: An Owners Guidance Manual" *FEMA 145,December 1986.*
5. Association of Dam Safety Officials – Website: www.asdso.org/
6. "Dam Ownership – Responsibility and Liability", ASDSO.

VISUAL DAM INSPECTION LIMITATIONS

Visual Inspection

1. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigations and analyses involving topographic mapping, subsurface investigations, testing and detailed computational evaluations are beyond the scope of this report.

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

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

Use of Report

4. The applicability of environmental permits needs to be determined prior to undertaking maintenance activities that may occur within resource areas under the jurisdiction of any regulatory agency.

5. This report has been prepared for the exclusive use of the RIDEM for specific application to the referenced dam site in accordance with generally accepted engineering practices. No other warranty, expressed or implied, is made.

6. This report has been prepared for this project by PARE. This report is for preliminary evaluation purposes only and is not necessarily sufficient to support design of repairs or recommendations or to prepare an accurate bid.

Photo No. 1: Overview of the primary spillway from the left. Note the sunken areas of stone along the left training wall (See Photo No. 2).

Photo No. 2: Sunken stone areas along the top of the primary spillway's left training wall as pointed out in Photo No. 1.

Photo No. 3: The control section at the primary spillway as viewed from the left.

Photo No. 4: Overview of the approach to the primary spillway as viewed from the left.

Photo No. 5: The discharge channel as viewed from left of the primary spillway. Note the overgrowth within the channel.

Photo No. 6: Downstream face of the primary spillway as viewed from the bridge over the downstream channel looking left.

Photo No. 7: Downstream face of the primary spillway as viewed from the left side of the downstream channel looking right.

Photo No. 8: Downstream face of the primary spillway as viewed from the right side of the downstream channel looking left.

Photo No. 9: Right downstream face of the primary spillway as viewed from the bridge over the downstream channel. Note the leakage at its connection with the right embankment.

Photo No. 10: This photo location is similar to Photo No. 9, except during low flow conditions (taken at the end of June 2014 by RIDEM). Note the leakage areas along the downstream spillway face. Arrow points to the leakage shown in Photo No. 9. Also note the flow through the low level outlet discharge.

Photo No. 11: The area downstream of the right embankment as viewed from the bridge over the downstream channel looking right. Note the overgrowth in the downstream area.

Photo No. 12: A closer view of the leakage shown in Photo No. 9. Photo taken from the downstream toe of the right embankment.

Photo No. 13: The control section at the primary spillway as viewed from the right. Note the location of the former low level outlet controls.

Photo No. 14: Overview of the wall at the left side of the spillway approach, which also supports the left embankment. Photo taken from the sluiceway looking upstream. Note the numerous sinkholes behind the wall and the erosion along its upstream side.

Photo No. 15: Close-up of the erosion circled in Photo No. 14.

Photo No. 16: Overview of the sluiceway as viewed from upstream.

Photo No. 17: Overview of the sluiceway's approach area and view into the impoundment as viewed from the sluiceway.

Photo No. 18: Stop log controls at the sluiceway as viewed from the left. Note the poor jointing along the channel's right wall.

Photo No. 19: Stop log controls at the sluiceway as viewed from the right. The channels' left wall joints are in a similar condition to that noted along the right wall (Photo No. 18).

Photo No. 20: The sluiceway's left downstream channel wall as viewed from its control section. Note the poorly defined joints and unwanted vegetation growth through the joints.

Photo No. 21: The sluiceway's right downstream channel wall as viewed from its control section.

Photo No. 22: The sluiceway's downstream channel as viewed from its control section.

Photo No. 23: Overview of the sluiceway's stepped discharge area as viewed from downstream.

Photo No. 24: Back side of the sluiceway's right channel wall looking upstream. Note the location of the observed undermining.

Photo No. 25: A view into the undermined wall section pointed out in Photo No. 24. Though not distinguishable from this photo, the discharge channel can be viewed through this hole.

Photo No. 26: The upstream side of the right embankment as viewed from the crest near the embankment center. Note the eroded and/or sloughed area.

Photo No. 27: Overview of the crest of the right embankment as viewed from near the right abutment looking left. Note the depressions behind the abandoned flume discharge and near the spillway.

Photo No. 28: Close-up of the depression behind the flume's discharge headwall as pointed out in Photo No. 27. Photo is looking to the left.

Photo No. 29: Close-up of the depression behind the spillway's right training wall as pointed out in Photo No. 27. Photo is looking to the left.

Photo No. 30: Overview of the right abutment.

Photo No. 31: Animal burrow near the center of the right embankment.

Photo No. 32: Overview of the downstream wall supporting the right embankment as viewed from the right looking left.

Photo No. 33: The downstream wall supporting the right embankment. Note the joints typically in poor condition with missing chinking stones and the apparently shifted wall stones.

Photo No. 34: Typical seepage along the bottom of the right embankment's downstream wall between the abandoned flume and the primary spillway.

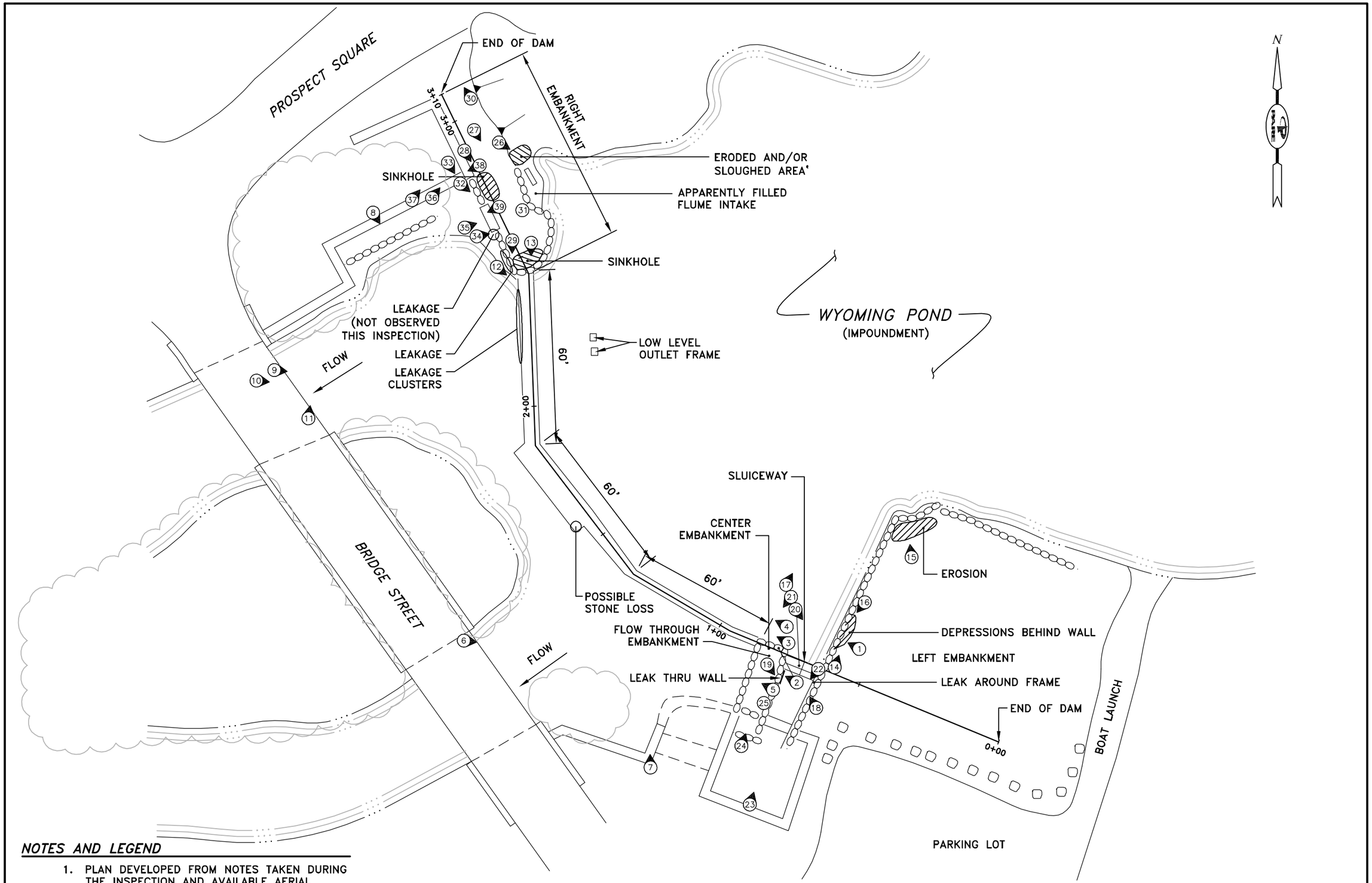
Photo No. 35: Left side of the flume's abandoned discharge. Note the spalled areas of concrete.

Photo No. 36: Right side of the flume's abandoned discharge. Note the spalled areas of concrete.

Photo No. 37: A void along the base of the right side of the abandoned flume's discharge. A similar void is present at the base of the left side of flume's discharge as well.

Photo No. 38: View of the downstream area as seen from the crest of the right embankment. Note the heavy overgrowth. Arrow indicates edge of discharge channel.

Photo No. 39: The discharge channel as viewed from right of the primary spillway. Note the overgrowth within the center of the channel.



NOTES AND LEGEND

1. PLAN DEVELOPED FROM NOTES TAKEN DURING THE INSPECTION AND AVAILABLE AERIAL IMAGERY. INFORMATION IS PROVIDED FOR REFERENCE PURPOSES ONLY.

◀# DENOTES APPROXIMATE LOCATION AND DIRECTION OF PHOTOGRAPH.

SITE SKETCH

SCALE: 1"=30'±

PARE
PARE CORPORATION
ENGINEERS - SCIENTISTS - PLANNERS
10 LINCOLN ROAD, SUITE 103
FOXBORO, MA 02035
508-543-1755

SCALE ADJUSTMENT GUIDE
0" 1"
BAR IS ONE INCH ON ORIGINAL DRAWING.

WYOMING UPPER DAM

RI DAM No. 216

HOPKINTON/RICHMOND, RHODE ISLAND

OWNER: RIDEM FISH & WILDLIFE

REVISIONS:

PROJECT NO:	11130.03
DATE:	JULY 2014
SCALE:	AS NOTED
DESIGNED BY:	DMM/ARO
CHECKED BY:	DMM
DRAWN BY:	LMC
APPROVED BY:	JMB

SITE SKETCH

FIGURE NO.: 1

Z:\JOBS\11 Jobs\11130.03 Addendum 4 37 Dam Inspections\Inspections\Inspection Round 5\216 Wyoming Upper\dwgs\Fig 1 – Site Sketch.dwg