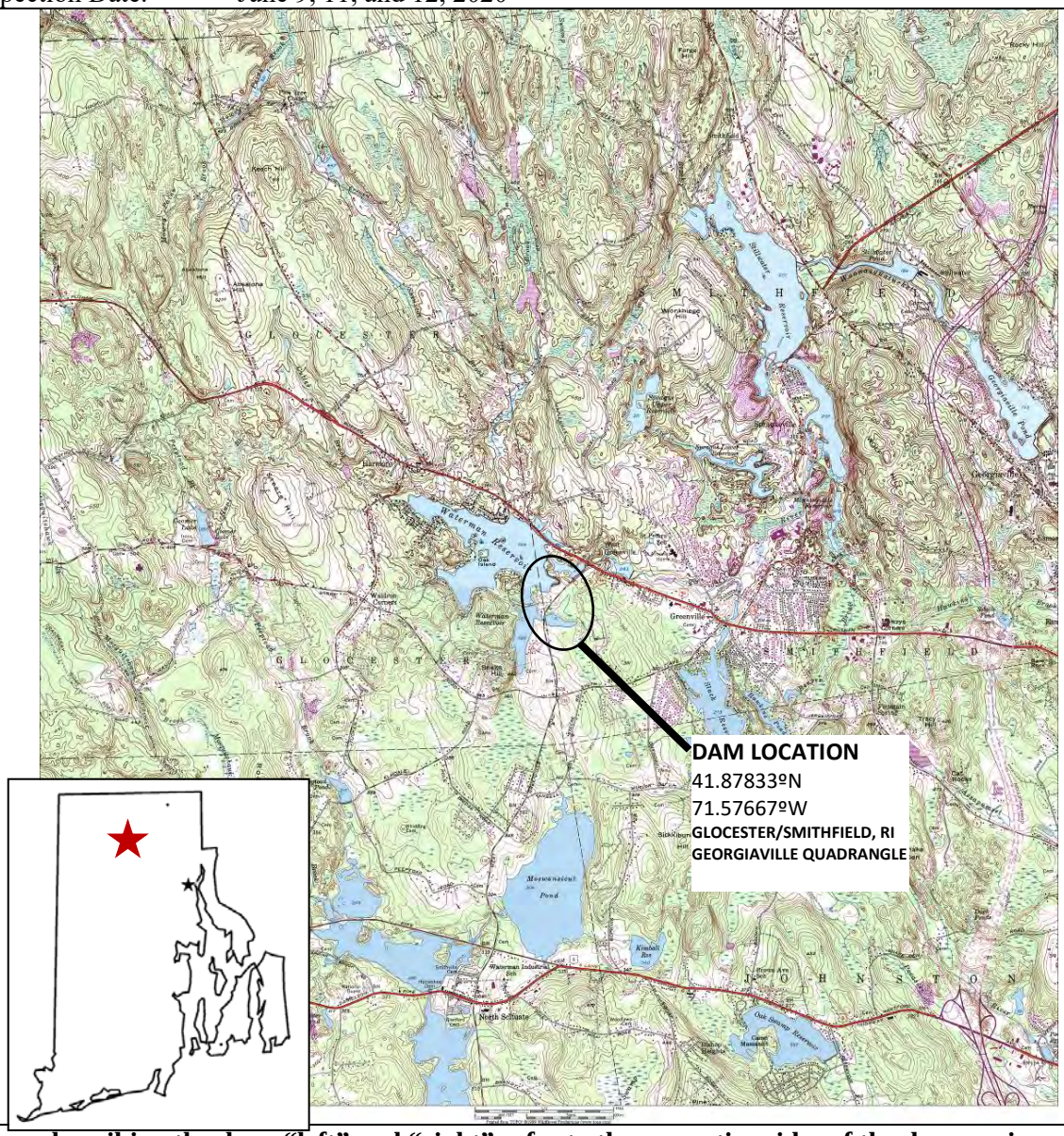
-- WATERMAN LAKE DAM --
VISUAL
INSPECTION / EVALUATION REPORT

Dam Name:	***Waterman Lake Dam***
State Dam ID#:	***111***
Owner:	***Citizens for the Preservation of Waterman Lake, Inc.***
Town:	***Glocester/Smithfield***
Consultant:	***Pare Corporation***
Date of Inspection:	***June 9, 11, and 12, 2020***

PARE CORPORATION

INSPECTION SUMMARY

Dam Name (No):	Waterman Lake Dam (111)
Location:	Glocester / Smithfield
Hazard Classification:	High
Inspector:	Brian Dutra
Inspection Date:	June 9, 11, and 12, 2020



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 develop a report of conditions for the Waterman Lake Dam along the Stillwater River in Glocester/Smithfield, Rhode Island. This inspection and report were performed 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 Waterman Lake Dam and dike system is located in the Towns of Glocester and Smithfield, approximately 3.25 miles west of the I-295/US-44 intersection, and impounds water along Stillwater River to form Waterman Lake. The dam and dikes are located at the eastern end of the impoundment area near coordinates 41.87833ºN/71.57667ºW. A locus plan showing the area of the dam and its immediate surroundings is provided in the inspection summary.

To reach the dam from I-295, take exit 12B (formerly exit 7B) to merge onto US-44 West/Putnam Pike toward Smithfield. After roughly 3.5 miles, turn left into The Lakes Condominium Complex at 720 Putnam Pike. Enter the complex through the main entranceway off of Putnam Pike and go to the back (south) of the parking area against the tree line approximately 300 feet ahead. The

dam is roughly 350 feet away, to the right (west) through the tree cover. Access along the length of the dam is also possible along West Greenville Road and Pine Ledge Road.

1.2.2 Owner/Caretaker

The dam is currently owned and operated by the Citizens for the Preservation of Waterman Lake, Inc. (CPWL). Within the CPWL is the dam maintenance committee which takes responsibility for maintenance and operations at the dam. Mr. Philip Viall, a member of that committee and treasurer of the CPWL can be reached at 401-225-6131. Mr. Mark Favreau is chair of that committee and organizes most of the maintenance activities that are performed at the dam. Both Mr. Viall and Mr. Favreau were present during the inspection. Information provided by them has been incorporated into this report.

1.2.3 Purpose of the Dam

The dam was originally constructed in 1837 to provide supplemental water supply for the Stillwater Reservoir that was used actively for industrial purposes by the former owner of both dams, the Woonasquatucket Reservoir Company. The dam is no longer used for that purpose and currently impounds water for recreational activities.

1.2.4 Description of the Dam and Appurtenances

The following is paraphrased from information contained within the 1977 ACOE Phase I Inspection Report and updated to reflect additional observations and current local terminology:

The Waterman Lake Dam is an old, long, earthen structure impounding a relatively shallow regulating reservoir used formerly for industrial water supply and currently used for recreation. The entire structure consists of a main dam with an outlet structure (located at the left end of the system), an earthen dike (referred to as Booker's Dam), short concrete flood walls in the area of the Marina between Bookers Dam and Pine Ledge Road, an earthen dike with a concrete core wall located between the Marina and West Greenville Road, and an earthen dam with a concrete core wall and an overflow spillway structure located right of West Greenville Road.

MAIN DAM

The main dam is approximately 19 feet high at its highest point at the gatehouse and 430 feet long abutting into high ground at each end. The dam is basically an earthen embankment section that formerly included a dry masonry wall along the upstream slope but now appears to consist of a slope with dumped stone slope protection. The upstream slope is an approximately 2H:1V slope with 3 to 6-inch diameter stone protection. The crest elevation is estimated at El. 334± MSL, is approximately 10 feet wide, and consists of a grassed surface. The downstream side is variable. From 30 feet right of the outlet structure to the left abutment, the downstream side consists of a short grassed slope supported by a dry set stone masonry wall with areas of the wall buttressed with 3 to 6-inch diameter stone. Right of this wall, the downstream side is a 1H:1V grassed slope leading to a grassed toe that transitions to a mildly sloped wooded area that leads to the downstream channel.

An outlet structure, located at about the midpoint of the main dam, consists of a 4-foot wide by 6-foot high stone masonry culvert with gunite facing that extends through the dam. A stone masonry gatehouse structure is located at the upstream of this culvert that houses two timber gates that were formerly used as the primary closure for this culvert. The gates are no longer used as the primary

means of operations and are typically left in the open position; however, they are operable if they needed to be used. Upstream of the gatehouse is a rectangular concrete channel formed by 1.5-foot thick concrete walls and an apparent concrete floor that extends 10 feet upstream. The upstream end of the structure is open to the impoundment and is equipped with removable steel plates (each approximated at 12 inches high by ½ an inch thick set within steel channels within two vertical steel I-beams that are permanently affixed to the upstream end of the walls of the structure. The plates serve as the primary means of closure/operations of the outlet structure and can be added by hand and removed by use of a steel chain and pully system that is supported by the I-beams. A trash rack is present upstream of the steel plates that appears to be welded to the upstream face of the I-beams. The culvert daylights through an apparent concrete retaining wall along the downstream side of the dam. Downstream of the wall, the downstream channel is formed by granite block wing walls with a gunite facing and a gunite faced channel floor. The floor transitions to a natural downstream channel approximately 15 feet downstream of the downstream end of the culvert.

BOOKERS DAM

A 1,500-foot long earthen dike (referred to as Bookers Dam) is located 300 ft right of the main dam. The upstream side of the dike consists of a 1.2H:1V slope generally covered by grass vegetation from the crest to approximately 2 feet above normal pool where it than transitions to stone slope protection. There are areas where the portion of the slope along the waterline is supported by a short 2 to 3-foot tall stone wall before transitions to the stone slope protection. The crest elevation is estimated at El. 334± MSL, is approximately 10 feet wide, and consists of a grassed surface. The downstream side is variable. From the left end of the dike to near the first bend in the dike (approximately 200 feet from the left end) the downstream side consists of a short grassed slope supported by a dry set stone masonry wall. Right of the wall, the downstream side consists of a 1H:1V grassed slope transitioning to a 10-foot long grassed toe transitioning to an excavated trapezoidal earthen drainage/seepage swale. The swale along the embankment section located between the downstream wall supported section and the private access drive (200 to 750 feet from the left abutment) is typically dry and only sees seepage flows during elevated pool levels. The swale along the right half of the embankment (750 feet to 1,500 feet from the left abutment) routinely sees iron oxide stained flows, most likely related to seepage through the dam. This swale extends from 50 feet right of the right abutment pitching left to where it crosses under the private access driveway.

MARINA DAM

Concrete flood walls are present above the normal pool elevation in the area of a Marina between the Bookers Dam dike and the Pine Ledge to West Greenville dike. The flood walls include 12-inch thick concrete walls, with a section of the wall integrated into a building at the Marina. The approximate length of this section of the system is 330 feet and the exposed height of the walls is generally less than 3 feet. The tops of the walls are presumably at the level of the top of the dam system El. 334 ± MSL.

PINE LEDGE ROAD TO WEST GREENVILLE ROAD DAM

Two earthen dike sections are located left and right of Pine Ledge Road, the embankment left of the road is approximately 250 feet long and the embankment right of the road is approximately 550 feet long. The dike embankment left of Pine Ledge Road consists of a 1.5H:1V upstream slope with 3 to 6-inch diameter stone slope protection along the entire length of the slope, a 1-foot wide concrete core wall along the crest, and a 2H:1V grassed downstream slope leading to an excavated trapezoidal earthen drainage/seepage swale along the toe of slope. The swale routinely sees iron oxide stained

flows, most likely related to seepage through the dam. The swale pitches from left to right and flows underneath Pine Ledge Road via an 18-inch diameter RCP culvert where it ties into the swale of the dike embankment right of Pine Ledge Hill Road. The dike embankment right of Pine Ledge Road consists of a 1H:1V upstream slope, a 1-foot wide concrete core wall along the crest, and a 1.5H:1V downstream slope leading to an excavated trapezoidal earthen drainage/seepage swale along the toe of slope. The vegetation along the upstream and downstream slopes as well as the downstream area generally consists of hay type growth (mixture of grass, weeds, and brush). The swale routinely sees iron oxide stained flows, most likely related to seepage through the dam. The swale generally pitches from either end of the dike towards the center where a combined channel extends in the downstream direction, eventually flowing underneath West Greenville Road via a culvert.

SPILLWAY SECTION

A 1,375-foot long embankment section is located at the right end of the dam system, right of West Greenville Road. The dam section includes and earthen embankment with a 1.5H:1V upstream slope with 3 to 6-inch stone slope protection, a 1-foot wide concrete core wall along the crest, and a 2H:1V grassed downstream slope that transitions to a grassed downstream toe. In two areas, an excavated trapezoidal earthen drainage/seepage swale is present downstream of the toe of the slope.

Located at about mid-embankment is the overflow spillway structure for the dam system. The spillway consists of a 201-foot long by 3-foot high rectangular overflow channel with a granite block weir that is buttressed on the upstream side by a concrete weir along the centerline of the channel. Concrete capped stone masonry training walls are located at either end of the spillway channel. The approach is the mild slope of the impoundment bottom, approximated at 6 to 8 inches below the level of the weir. The discharge area consists of a mildly sloped channel with 3 to 6-inch diameter riprap along the surface that transitions to a natural channel through the wooded downstream area.

1.2.5 Operations and Maintenance

The CPWL dam maintenance committed takes responsibility for operations and maintenance at the dam, including undertaking routine maintenance of vegetation along the length of the dam, completing routine inspections, implementing dam improvement programs as budgets permit, completing other maintenance as required, and adding/removing steel plates from the outlet structure at the main dam as pool levels and anticipated storm events warrant. Pond levels are measured and recorded daily and are available on the CPWL's website (www.cpwl.org).

1.2.6 Hazard Potential Classification

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

2.0 INSPECTION

2.1 Visual Inspection

Waterman Lake Dam was inspected on June 9, 11, and 12, 2020. At the time of the inspection, the weather was near 75°F and clear, 75°F and rain, 75°F and clear, to the respected dates above. Please refer to the sections below for what date each section was inspected. Photographs to document the current condition of the dam were taken during the inspection and are attached to this report. The level of the impoundment was measured at approximately 4 inches below the spillway crest on each day of inspection. Underwater areas were not inspected as part of the field activity.

2.1.1 General Findings

The following presents the observations made during the inspection:

1. Seepage along most of the dam and dike embankment sections within the dam system.
2. Numerous significant animal burrows throughout the dam and dike system.
3. Areas of irregularity along the embankments including areas of steep slope, areas of scarping and erosion along the unprotected portions of the upstream slope (most notably at one isolated section of the Bookers Dam and along the portion of the dike embankment right of Pine Ledge Road).
4. Areas of deterioration along the concrete corewalls of the dam embankment sections right of Bookers Dam.
5. Isolated areas of unwanted vegetation throughout the dam and dike system.
6. Isolated areas of poor grass growth throughout the dam and dike system.
7. Possible instability of the right third of the downstream stone masonry wall at the Bookers Dam embankment.
8. Additional dam safety concerns and maintenance deficiencies as noted herein.
9. Reported, possible scour hole within the downstream channel of the main dam. *Not observed during this inspection.*

2.1.2 Main Dam

The Main Dam was inspected on June 9, 2020. The following was noted along embankment of the Main Dam:

Upstream Side

- No apparent deficiencies were noted along the riprap.
- Minor accumulation of pine needles and other debris were present on the riprap along the waterline and extending up the slope approximately 2 feet.
- Maintained weeds and small brush were noted in isolated areas.

Crest

- The grass was generally well developed.
- The crest was rounded with vertical irregularities throughout, but generally appeared okay.

- A 30-inch diameter tree was located near the left abutment and near STA 4+30.

Downstream Side

- The following was noted along the downstream wall that spans from the left abutment to near 30 feet right of the outlet culvert:
    - There were no apparent areas of movement or soil migration through the wall.
    - The wall right of the outlet was buttressed with 3 to 6-inch diameter stone and was generally clear of unwanted vegetation.
    - An area of seepage was previously observed along a 3 to 5-foot long section of the toe of the buttress stone with clear flow approximated at 10-20 gpm. During this inspection, the tailwater (approximately 6 inches higher than reported during the previous inspection) inhibited confirmation of this observation. No signs of flow were observed during this inspection. Minor scarping up to 6 inches was located along this area at the waterline.
    - The toe of the wall and downstream area left of the outlet structure was generally clear up to 10 feet downstream of the toe of the wall, with isolated areas of vine and brush growth along the wall. Downstream of the toe of the wall appeared to be a buttressed section with 6-inch minus riprap that appeared to pitch from the toe of the wall to a low point about 10 feet downstream of the wall. Areas beyond 10 to 20 feet of the toe of the wall were overgrown with thick brush, weeds, and wetland vegetation Debris from clearing was also scattered across the surface of the buttressed section. A section of this area (starting 70 feet left of the left abutment and extending to within 30 feet of the outlet channel) was saturated with areas of standing water and wetland vegetative growth which may be related to seepage through the embankment.
    - Several piles of branches were present along the toe of the wall and buttressed section, the caretaker indicating that they were the result of recent maintenance activities and there are plans for the debris to be removed.

- The short section of slope between the crest and the top of the downstream wall had irregularities and areas of bare soil throughout. A collapsed animal burrow, approximately 16 inches in diameter and 4 inches deep, was noted near STA 1+30 and was located at the mid-slope above the downstream wall.
- Maintained knotweed vegetation was present along the slope and wall within 30 feet of the left abutment.
- The slope right of the stone wall section consisted of vertical irregularities, and bare soils throughout.
    - A tailwater was present along the toe of the slope right of the outlet section.
    - Several 5-inch diameter trees are observed within 10 feet of the toe of the slope between STA 2+00 and 3+00.
    - A 24-inch diameter stump was noted near the toe of the slope near STA 2+10.
    - 50 feet downstream of the toe, and near the right abutment of the mild wooded slope of the downstream area, several areas (3±) of seepage were noted, each approximated between 1-3 GPM, some with iron oxide staining and one with a possible accumulation of sand downstream of the seepage area. More areas that were noted in the previous inspection report may be present during lower tailwater conditions, but were not observed during this inspection.

2.1.3 Bookers Dam

The following was noted along the dike embankment of Bookers Dam. Deficiencies reference a baseline with STA 0+00 at the right abutment.

Upstream Side

- The alignment of the slope was irregular in areas.
- In general, the 12-inch diameter riprap along the lower section of the slope appeared okay.
    - Areas of near vertical slope were observed between STA 0+00 and 0+30 between the mid-slope of the embankment to near the water line.
    - Missing or buried riprap was noted between STA 4+50 and 7+60.
    - The riprap between STA 8+75 and 10+35 appeared to have been repaired. The slope in this area is covered with 6-inch diameter trap-rock.
- A section of bare grass slope was located from 9+36 to 10+00.
- Animal burrows were observed throughout the upstream slope. Major animal burrows were noted below.
    - STA 6+10 – 24-inch diameter 12-inch deep collapsed animal burrow
    - STA 12+50 – Three, 3-inch diameter animal burrows approximately 6 inches deep,
    - STA 12+60 – 6-inch diameter by 12-inch deep animal burrow
- The upstream slope left of STA 14+75 had numerous 2-inch diameter roots extending from top of the slope to the downstream side of the crest. The roots appeared to be rotting and were loose when kicked.

Crest

- The grass was well maintained and generally well developed.
- The crest was rounded and had minor vertical irregularities throughout.
- The crest widens to near 10 feet at STA 10+00.
- Roots up to 2 inches in diameter were observed along the surface of the crest. The roots appeared to be rotting and were loose when kicked.

Downstream Side

- The following was noted between the right abutment and STA 7+50.
    - Numerous significant animal burrows were noted along the slope. Some were measured at 10-inch diameter and up to 48 inches deep. Fresh spoils were located outside of the animal burrows. Gophers were actively observed on the dam slopes and entering the burrows during the time of the inspection. Please refer to the following locations for significant animal burrows:
        - STA 0+60 – 8-inch diameter animal burrow (active), mid-slope
        - STA 2+99 – Several collapsed animal burrows up to 12 inches in diameter and approximately 6 to 8 inches deep.
        - STA 3+16 – 6-inch diameter animal burrow (active), mid-slope
        - STA 3+85 – 12-inch diameter animal burrow (active), toe of slope
        - STA 3+90 – 12-inch diameter animal burrow (active), mid-slope
        - STA 4+40 – Two (2) 10-inch diameter animal burrows (active), mid-slope
        - STA 7+60 – 10-inch diameter animal burrow (active), mid-slope

  - Two stumps up to 8 inches in diameter were located near STA 4+00 at the mid-height of the downstream slope. A 30-inch diameter and 8-inch deep depression was located upslope of the stump.
  - The following was noted along the drainage/seepage swale that extends along the downstream area of the embankment approximately 10 feet downstream of the downstream toe:
    - STA 0+45 to 0+55 - Low flow seepage, approximately 12 inches above the toe of the slope above the seepage channel.
    - STA 0+85 to 0+95 – Low-flow seepage, approximately 18 inches above the toe of the slope above the seepage channel.
    - STA 1+36 to 1+44 – Low-flow seepage, approximately 1-foot above the toe of the slope above the seepage channel.
    - STA 6+90 – Approximately ½ gpm of seepage was noted at the toe of the slope along the seepage channel with orange staining.
- The following was noted left of the private access drive between STA 7+50 and 12+50.
  - The drainage/seepage swale within the downstream area between STA 7+50 and 12+50 of was mostly dry with isolated areas of saturated sections with no flow. This reportedly does see seepage flows during higher pool levels.
  - Piles of fill were located between STA 10+00 to 12+00 along an access road along the downstream embankment that varies from the toe of the embankment near 7+50 to 3 feet below the crest at 12+30. The owner indicated these piles were stockpiled in preparation should an emergency situation developed along the dam.
  - Construction and concrete debris were located along the toe of the dam between STA 12+85 and 12+60. The owner indicated this had been dumped in recent years and that the CPWL may be installing a locked gate to prevent unwanted dumping.
  - Some knotweed growth was present along the slope in the areas of the bend in the embankment near the private access drive.
- The following was noted along the portion of the downstream side that was supported by the stone masonry downstream wall (left most 200 feet of the dike).
  - The grassed slope leading from the crest to the top of the wall had several areas of bare grass and significant animal burrows noted below. Please note animal burrows with fresh spoils were not probed due to the likelihood that an animal was present. .
    - 12+50 to 13+00 – Loose soil along the surface with animal burrows (turtle) throughout ranging between 8 to 18 inches in diameter and 4 to 8 inches deep.
    - 13+30 to 13+35 – Three 8-inch diameter animal burrows with fresh spoils.
    - 14+23 – 6-inch diameter animal burrow 40 inches deep.
    - 14+20 – 6-inch diameter animal burrow 30 inches deep.
  - Trees and stumps were observed behind the wall at the following locations:
    - 13+75 to 14+20 – 8-inch diameter trees at approximately 10 feet on center.
    - 13+90 – Two (2) tree stumps 6-inch diameter.
    - 14+37 – 6-inch diameter pine tree.
  - The right two thirds of the wall appeared okay with no apparent evidence of movement.
  - The left third of the wall had some areas of potential stone movement and larger joints between the stones (a possible result of missing stones).
  - Trees were present within 10 feet of the toe of the wall along the left third of the wall.
    - A large 40-inch diameter tree was located at the base of the stone wall near STA 14+60.

  - The ground surface along the toe of the wall was saturated with wetland vegetation from STA 12+95 to 14+00. Several areas (4 to 6) of seepage flow (approximated between 0.5 and 1 GPM) were observed along the base of the wall at the tallest section of the wall.
  - An apparent seepage channel extends downstream of the wetland vegetation through the wooded downstream area, eventually flowing underneath the private access drive via a culvert.
- The swale pitched from the right end (located 50 feet left of the right abutment) to the left end where it was conveyed under the private access drive via a culvert
  - The flow rate at the downstream (left) end of the swale was approximated at 50-GPM. Flow appeared clear with some level of iron oxide staining.
  - The flow rate appeared similar (50 GPM) at the first bend in the upstream direction as well as towards the start (right end) of the swale.
  - With the exception of some areas of wetland and weed growth, the swale appears to be clear of debris.

2.1.4 Marina

The following was noted along the flood walls at the Marina:

- The concrete walls had deficiencies noted throughout including through cracks, hairline cracks, surface scour, and general weathering; however, in general, the walls appeared stable.
  - The walls right of the access driveway appeared to be integrated into the foundation of the facility garage.
- A break in the walls (approximately 12 feet wide) exists at two access driveways to the Marina. The break to the right may need to be sandbagged during elevated pool levels; the driveway to the left appeared to be near the height of the top of the wall.
- The transition to the left end of the Pine Ledge Road dike embankment was overgrown with dense trees and brush.

2.1.5 Marina to West Greenville Road Dike

The following was noted along the dike embankment between the Marina and Pine Ledge Road and the dike embankment between Pine Ledge Road and West Greenville Road.

The following was noted left of Pine Ledge Road. Deficiencies reference a baseline in the left direction with STA 0+00 at Pine Ledge Road.

- The riprap along the upstream slope was in good condition. Dense brush growth was present within the riprap at both the left and right ends of the embankment.
- The top of the concrete core wall was exposed with numerous deficiencies observed included cracks and spalled sections.
- The downstream slope had significant vertical irregularities including depressions and bulges up to 6 feet in diameter and 24 inches in variability.
  - Isolated areas of animal burrows up to 6 inches in diameter and 12 inches deep (4 total) were present along the downstream side of the embankment.
- Stockpiled grass clippings were present at the toe and near the left end of the embankment.
- The drainage/seepage swale was generally clear of debris right of the stockpiled grass clippings and was observed to be flowing with iron oxide stained flow. Flow was approximated at 3 GPM at the right end of the swale just upstream of the culvert crossing that

conveys the seepage flow under Pine Ledge Road. Wetland vegetation growth was observed throughout the seepage channel.
- A 12-inch diameter, 9-inch deep depression was observed at the toe of the slope at the seepage channel near STA 1+10.
- Vehicle rutting, approximately 4 inches wide and 3 inches deep was apparent between STA 1+00 and 1+30.

The following was noted right of Pine Ledge Road: Deficiencies reference a baseline from left to right with STA 0+00 at Pine Ledge Road.
- The upstream slope was irregular with areas of the top of the slope lower than the crest, exposing more of the top of the concrete core wall. The exposed height of the wall varied between 8 and 18 inches.
    - Scarping was noted along the top of the slope up to 12 inches deep along a 6-foot wide area near STA 0+30.
    - Trees and stumps were observed at the following locations:
        - STA 1+48 - 18-inch diameter stump at the toe of the slope.
        - STA 3+00 – 12-inch diameter stump at the toe of the slope.
        - STA 3+20 – Two 12-inch diameter stumps at the toe of the slope.
        - STA 3+30 to 3+45 – Five (5) stumps up to 12 inches in diameter along the toe of the slope.
        - STA 4+00 – 20-inch diameter tree at top of slope
        - STA 4+05 – 12-inch diameter tree at toe of slope
        - STA 4+20 – 24-inch diameter tree at toe of slope
        - STA 4+95 – 30-inch diameter tree at top of slope
    - A 30-inch diameter depression was noted near the top of the slope at STA 1+89 and was approximately 8 inches deep.
    - An animal burrow, along the upstream side of the concrete core wall near STA 3+13, was approximately 12 inches in diameter and 45 inches deep. Apparent turtle nests were noted along the top of the slope between STA 3+40 and 3+50.
- The concrete core wall appeared to be in fair condition with isolated portions of the wall with severe spalls and cracks. Some spalls extended along the surface from the upstream side of the wall to the downstream side.
- The downstream slope was irregular with several significant animal burrows observed.
    - Several areas of the bottom 2 feet of the slope were saturated. No apparent flow was observed in these areas.
    - Animals burrows were typically up to 8 inches in diameter and 12 inches deep. Significant animal burrows are noted below:
        - STA 0+50 – 8-inch diameter animal burrow, near the top of the slope (active)
        - STA 1+00 – 6-inch diameter animal burrow 24 inches deep, mid slope.
        - STA 1+60 – 6-inch diameter animal burrow 24 inches deep, mid slope.
    - A portion along the top of the downstream slope was approximately 27 inches lower at 4+00. The portion extends from near STA 3+95 to 4+15 and appeared to be a result of erosion. The bottom of the concrete core wall extension was exposed in this area with apparent large aggregate located beneath.
- The following was noted along the drainage/seepage swale:
    - The apparent headwall to the seepage channel culvert beneath Pine Ledge Road appeared to be crushed with a 3-inch wide cracked and spalled section along the top of the headwall.
    - Iron oxide stained flow was typical throughout the swale.

- The flow rate within the left half of the swale that flowed from left to right was approximated at 10-15 GPM at the location of the slight bend in the embankment.
- The flow rate within the right half of the swale that flows from right to left was approximated at 10-15 GPM at the location of the merged channel that extended in the downstream direction.
- The swale was generally clear of debris with the exception of a pile of cut branches that were present along the toe of the embankment and within the seepage channel between STA 2+65 and 2+85 STA 3+10 and STA 3+50 and between.

2.1.6 Spillway Section

The following was noted along the dam embankment located right of West Greenville Road. Deficiencies reference a baseline from STA 0+00 at the right abutment.

- The riprap along the upstream slope appeared to be in good condition. Maintained brush and weed vegetative growth were present throughout.
  - The upstream slope between STA 13+20 and the left end of the dam appeared to be unprotected.
- The condition of the corewall varied from fair to poor with sections of severe deterioration including spalled sections, through cracks, and general weathering. The wall section between STA 1+50 and STA 2+30 was deteriorated with the top 1.5 inches spalled across the entire width of the wall.
  - A 42-inch wide and 8-inch deep spall was noted near STA 9+00.
- The downstream slope was well maintained and generally had good grass coverage.
  - Several areas (3-4) of the level section between the slope and the drainage/seepage swale within 250 feet from the right abutment were saturated.
  - The toe of the embankment was soft between STA 2+50 and 1+70 with low flow saturated soils and orange staining. Apparent tire ruts were observed along this section of the embankment.
  - The drainage/seepage swale located at the left third of the dam was saturated throughout with several areas of ponded water (Some with iron oxide staining). No flow was observed.

2.1.7 Appurtenant Structures

Spillway

- The approach appeared clear with some isolated areas of minor grass and weed growth.
- The concrete upstream edge of the weir appeared to be in good condition.
- The stones along the downstream face of the wall appeared to be vertically irregular, but no apparent signs of movement were noted.
- In general, the discharge apron appeared to be in good condition. Light weed growth was present along the discharge channel.
- There were several areas of ponded water within the downstream channel within 10 to 15 feet of the spillway weir. It was unclear if these areas were the result of seepage under the weir.
  - Approximately 2gpm leakage was observed at the toe of the riprap discharge area 30 feet right of the left spillway channel wall. No whirlpools or other indications of a leakage source were observed upstream of the spillway.

- The left and right training walls had deterioration along the concrete facing throughout but generally appeared stable.
    - The concrete core wall right of the spillway had a 1-inch wide through crack approximately 4 feet from the right spillway channel wall.
    - Erosion up to 6 inches was noted along the downstream ends of both spillway walls.
- The downstream side of the spillway was reportedly re-armored with 6-inch blast rock. The riprap was generally in fair condition; however, it was becoming overgrown with seasonal vines and other vegetation.

Outlet Structure at Main Dam

- Both gates were operated at the outlet structure within the gate house, for the range of motion through which each gate was operated, operation was smooth. Both gates currently remain in the open position and the water levels are controlled by the removal/addition of the steel plates at the upstream end of the intake structure.
    - Chain pulleys were observed adjacent to the spillway structure to remove steel plates at the intake structure, as necessary.
- Flow over the steel plates limited the inspection of the floor of the intake structure and outlet conduit.
- One hairline crack was noted on the interior of the right wall of the intake structure.
- Apparent saturated areas of concrete without flow were observed along the upstream face of the headwall for the conduit. Isolated areas of efflorescence were observed in the saturated areas. These areas were, mainly limited along the edges of the wall with the exception of one saturated area approximately 2 feet from the top of the conduit at the center of the wall.
- Saturated areas were typical within the gunite faced conduit through the dam. No leakage was observed. The conduit was only inspected from the downstream end, as this area would require a diver/confined spaced entry for a thorough inspection.
    - Saturated areas extended from the veiling of the conduit to the base of the conduit and was limited to the upstream half, aside from minor isolated saturated areas near 6 inches in diameter along the downstream half of the conduit.
    - Water flow over the spillway limited an inspection of the floor and the bottom of the left and right walls.
- Debris was observed upstream of the trash rack, which reportedly was routinely removed during inspections.
- Minor hairline cracks were noted on the gunite facing of the downstream wall and downstream wing walls.
- A ¼-inch void was observed along the top of the downstream steel thimble beneath the gunite facing. No leakage was observed in this area.
- The natural channel floor at the downstream end of the gunite faced portion of the channel floor appears deep and may be a result of scour.
    - A previously reported scour hole was observed in this area, but viewing the hole was inhibited due to tailwater conditions.

2.1.8 Downstream Area

The area downstream of the main dam consists of a downstream pool within a primarily undeveloped wooded area (with the exception of the assisted living community located on the elevated left bank of the area) between Route 44 and West Greenville Road. A culvert conveys flow under West Greenville Road (at RI03424 Greenville Mill Pond Dam) then under Route 44. Flow continues

through an unregulated dam structure located just upstream of the Stillwater Antique Center (likely a former industrial building), around the building, and into the impoundment and through the Knight Mill Pond Dam (RI04323). From there flow continues through the Stillwater Mill Pond Dam (RI04322), under Austin Ave, under Deerfield Road, under Route 5, through Granite Mill Pond Dam (RI04318), under Mountaindale Road, and into the Stillwater Reservoir (Stump Pond)

The area downstream of Booker Dam generally consists of undeveloped woodlands along the left portion of the dike embankment with the exception of a private driveway of a residential property and consists of an open field along the right half that extends to West Greenville Road.

The area downstream of the Pine Ledge Road dike embankment generally consists of open fields with the exception of a residential property along West Greenville Road at the right end of the dike.

The downstream area of the dam embankment right of West Greenville Road generally consists of undeveloped woodlands with residential development located on the elevated banks of downstream channel of the spillway. The channel of the spillway eventually extends under West Greenville Road where it empties into the Greenville Mill Pond downstream of the main dam.

2.1.9 Reservoir Area

The dam is located along the easterly side of the irregularly shaped impoundment, which stretches roughly 4,400 feet southwest to northeast and 7,500 feet northwest to southeast. The perimeter of the impoundment is generally wooded, mixed with residential development, Putnam Pike (US-44) to the north, Snake Hill Road to the south, and Sawmill Road to the west.

The primary inlets to the reservoir appear to be the Nine Foot Brook, which empties into the portion of the reservoir located north of Route 44, the Center Brook and another unnamed stream that empties into the tip of the northwest corner of the reservoir, and an unnamed stream that empties into the tip of southwestern corner of the reservoir. The impoundment extends under several roadways including under Route 44, under Pine Ledge Road via an approximately 20-foot wide bridge culvert, and under West Greenville Road via an approximately 17-foot wide bridge culvert.

Given the irregularity of the impoundment shape, the Main Dam and Bookers Dam are the only embankment section with significant effective fetch and as such are the only sections that experiences significant wave action.

2.2 Caretaker Interview

Mr. Philip Viall, a member of the dam maintenance committee and Treasurer of the CPWL and Mr. Jeff D'Antuano, President of the CPWL, were present during the inspection. Information provided by Mr. Viall and Mr. D'Antuano has been incorporated within this report.

2.3 Operation and Maintenance Procedures

There was no formal operations and maintenance manual for the dam available at the time of the inspection.

2.3.1 Operational Procedures

The steel plates at the outlet structure at the main dam are routinely removed/added based upon pond levels and anticipated storm events.

2.3.2 Maintenance of Dam and Operating Facilities

Routine maintenance is completed at the dam to control vegetation along most portions of the dam. The caretaker also routinely completes inspections to check the condition of the dam. In general, the caretaker was knowledgeable of current conditions at the dam.

3.0 ASSESSMENTS AND RECOMMENDATIONS

3.1 Assessments

The Waterman Lake Dam was found to have the following deficiencies:

1. Seepage along most of the dam and dike embankment sections of the dam system.
2. Numerous, significant animal burrows throughout the dam and dike system.
3. Areas of irregularity along the embankments including areas of steep slope, areas of scarping and erosion along the unprotected portions of the upstream slope (most notably at one isolated section of the Bookers Dam and along the portion of the dike embankment right of Pine Ledge Road).
4. Areas of deterioration along the concrete corewalls of the dam embankment sections right of Bookers Dam.
5. Isolated areas of unwanted vegetation throughout the dam and dike system.
6. Isolated areas of poor grass growth throughout the dam and dike system.
7. Possible instability of the right third of the downstream stone masonry wall at the Bookers Dam embankment.
8. Reported, possible scour hole within the downstream channel of the main dam. *Not observed during this inspection.*
9. Additional dam safety concerns and maintenance deficiencies as noted herein.

The last inspection of the dam system was completed by Pare in 2018. Based upon a comparison to reported conditions, the condition of the structures appear similar; however, the owner has cleared additional areas of the embankments making them more accessible during the current inspection.

Previously Identified Deficiency/Recommendation	***Resolution or Current Condition***
Continue the current dam improvements clearing program	Most of the areas identified have been cleared since the previous inspection; some areas remain Ongoing routine maintenance
Remove burrowing animals and fill/regrade burrows throughout the dam embankment sections.	Animal burrows still problematic
Continue to maintain swales clear of debris. Install weirs to allow for routine measuring and monitoring	No change
Evaluate the seepage	No apparent change
Monitor seepage at right end of right downstream wing wall at outlet structure	This area was not observed during this inspection; however, seepage flow was observed a short distance right and downstream of this location
Develop a formalized O&M Manual	No apparent change
Perform an H&H to assess the dam's ability in accommodating various storm events	No apparent change
Continue to implement the routine monitoring and inspections of the dam. Complete formal inspections once every two years	Ongoing

The following recommendations and remedial measures generally describe the recommended approach 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 that are recommended to address 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.

1. **Develop a program to further monitor and evaluate the seepage observed along the dam and dike embankment sections within the dam system**. Areas of seepage include from left to right:
    a. Main Dam: the saturated toe of the downstream wall left of the outlet structure, the seepage flow at the toe of the riprap buttress right of the outlet structure, the saturated toe of the slope at the right end of the dam, the seepage flow within the wooded downstream area at the right end of the dam.
    b. Bookers Dam: the toe of the downstream wall, the seepage flow within the drainage/seepage swales, the saturated toe at the right end of the dike.
    c. Dike Embankments Left and Right of Pine Ledge Road: the seepage flow within the drainage/seepage swales, the saturated toe in areas.
    d. Dam Embankment Right of West Greenville Road: the saturated areas within the drainage/seepage swales, the saturated areas of the downstream toe near the right end of the dam, the areas of ponded water within the spillway downstream channel.

    For all areas, implement the following:

    i. Continue to maintain the vegetation in these areas to provide access. Continue to remove debris from the seepage areas to allow for free flow conditions.
    ii. Continue to monitor the areas of seepage. Check for increases in flow rate and/or flow clarity. Document the monitoring program. The installation of weirs along the drainage/seepage swales would likely aid in the consistency of the flow rate measurements.
    iii. Perform seepage and stability evaluations of the dam sections. While the dam sections appear stable and the seepage observed at the dam has reportedly not changed very much since the dam's original construction in 1837, the evaluations are recommended due to the irregular embankment sections, steady seepage observed at most dam sections, and the little to no information available as to the composition of the embankment and foundation at each of the dam/dike sections.
    iv. Pending the results of the seepage and stability evaluations, modifications to the dam system may be required to address any seepage or stability concerns identified.

2. **Address the presence of animal burrows throughout the dam and dike embankment system:**
    a. Trap and remove burrowing animals.
    b. Excavate the area around the burrows to remove soil weakened by the burrow.
    c. Fill burrows with fill material suitable for use on a dam embankment in compacted lifts.
    d. Remove spoils from the active burrows, regrade the area to a uniform section, and establish grass cover.

3. **Address the areas of irregularity along the embankments** including the following:
    a. Regrade areas of the embankments that were steep/irregular including some areas portions of the upstream slope of the Bookers Dam including the 50-foot long area that has experienced some erosion/washout, the downstream slope of the dike embankment left of Pine Ledge Road, and the upstream and downstream slope of the dike embankment right of Pine Ledge Road including providing scarping protection along the waterline on the upstream slope, and addressing areas of missing riprap throughout the dam and dike embankment system.

4. **Complete a concrete repair program at the dam to address the areas of concrete deficiencies along the corewalls and other concrete elements.** The program may range from surficial crack to patch repairs.

5. **Clear/maintain the isolated areas of remaining unwanted vegetation** including along the toe of the downstream wall left of the outlet structure at the Main Dam, along the toe of the downstream wall at the Bookers Dam, at the left and right end of the dike embankment left of Pine Ledge Road, and at the right end of the dike embankment right of Pine Ledge Road. For tree type vegetation, grub root systems, fill resulting holes with suitable material, and establish adequate surface coverage.

    Note that areas of knotweed were noted on the structures. Knotweed is a fast growing, resilient, and invasive plant, due in part to its ability to sprout from the root. Ridding the dam of this plant will include a significant personnel effort and pesticide application or a significant earthwork operation to dig up root balls and replace overgrown portions of the embankment. Once vegetation is removed establish grass growth and monitor for returned growth.

6. **Develop a healthy stand of grass throughout the dam and dike embankment sections**.

7. **Further evaluate the potential scour hole developing within the natural channel of the outlet structure at the main dam**. If required, provide scour protection at this area.

8. **Address the potential instability/movement of the right third of the downstream wall at the Bookers Dam dike embankment.** Chink large joints of the wall. Monitor the wall for movement. Consider rebuilding and/or buttressing this section of the wall.

9. 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 during the wetter months. 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 areas of potential movement, seepage, and deterioration.

    The manual should include schedule for regular maintenance activities to be continued to control and prevent growth of unwanted vegetation.

10. Review/update available hydrologic and hydraulic (H&H) analyses to evaluate the capacity of the structure to accommodate various storm events that would be typical for the watershed. It

is recommended that the analyses consider flows associated with the 100-year through the one half probable maximum flood (1/2 PMF) storm events. The analysis should account for the routed inflow that utilizes the full storage capacity within the impoundment and drainage area. A structure that cannot discharge the inflow associated with normal storm events will be overtopped in an uncontrolled manner that could damage the structure and threaten downstream areas. The analysis should consider the affects that the Pine Ledge Road culvert and the West Greenville Road culvert has on the hydraulic capacity of the dam system (specifically the spillway).

11. 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 recommended 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 and operations and maintenance. Due to the extensive recreational use of this impoundment, this alternative is likely not practical or 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. "Dam Inspection/ Evaluation Report", Pare Corporation, June 11, 2018.
2. Entries "Yearly Report of Commissioners of Dams and Reservoirs", 1883, 1885, 1908, 1913, 1916, 1919, 1921, 1927, 1929.
3. "Plan for Strengthening Retaining Wall at Draw Off Gate – Waterman Reservoir", 1884.
4. "Survey of State Dams" Division of Harbors and Rivers, July 15, 1940 (with plan)
5. "Special Inspection Report, Waterman's Reservoir, Dam No.111", Rhode Department of Public Works Division of Harbors and Rivers, November 1, 1946.
6. "Dam Inspection Report" Department of Natural Resources, December 15, 1977.
7. "Phase I Inspection Report – National Dam Inspection Program", ACOE, December 1977.
8. "Visual Inspection Checklist, Waterman", State of Rhode Island and Providence Plantations Department of Environmental Management, September 87, 1978.
9. "Dam Inspection Report, Waterman Lake Dam", State of Rhode Island and Providence Plantations Department of Environmental Management, May 29, 1985.
10. "Special Inspection Report, Waterman Lake Dam No.111," September 27, 1995.
11. "Special Inspection Report, Waterman Lake Dam No.111," May 21, 1996.
12. Letter – re: Main Gate Repairs (with gate drawings), CPWL, 1996.
13. "Dam Inspection Report", RIDEM, March 30, 2000.
14. "2010 Flood Status Report on Dams", RIDEM, March 31, 2010.
15. "Visual Inspection/Evaluation Report", Pare Corporation, August 2, 2012.

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

Photo No. 1: Main Dam - Upstream side of the dam from near the left abutment looking right.

Photo No. 2: Main Dam - Upstream side of the dam from near the gatehouse looking left.

Photo No. 3: Main Dam - Upstream slope from the right abutment looking left.

Photo No. 4: Main Dam – Crest at the left abutment. Note the 30-inch diameter tree at the downstream side of the crest. .

Photo No. 5: Main Dam - Crest from left abutment looking right.

Photo No. 6: Main Dam – Crest from right of the low-level outlet looking right.

Photo No. 7: Main Dam - Downstream side of the crest from left of the low-level outlet looking right.

Photo No. 8: Main Dam - Area downstream of the downstream wall from near the left abutment looking right.

Photo No. 9: Main Dam - Area downstream of the downstream wall from near STA 1+30 looking right.

Photo No. 10: Main Dam - Downstream wall and area right of the low-level outlet wall.

Photo No. 11: Main Dam - Downstream side of the embankment right of the outlet structure. Note the location of the previously reported seepage.

Photo No. 12: Main Dam - Downstream side of the embankment from near the right abutment looking left.

Photo No. 13: Main Dam - Seepage at the toe of the wooded slope 100 feet downstream and right of the outlet structure (arrow).

Photo No. 14: Main Dam - Upstream end of the outlet structure.

Photo No. 15: Main Dam - Upstream end of the intake to the outlet structure.

Photo No. 16: Main Dam - View of the upstream end of the outlet conduit. Note the hairline crack with efflorescence on the interior of the right wall of the intake structure and the saturated areas along the conduit upstream headwall.

Photo No. 17: Main Dam - Gate controls within the interior of the outlet structure.

Photo No. 18: Main Dam - Interior of the outlet conduit as viewed from the downstream end looking upstream. Note the saturated wall and ceiling areas along the upstream portion of the conduit.

Photo No. 19: Main Dam - Overview of the discharge end of the conduit and the outlet left downstream channel wall.

Photo No. 20: Main Dam - The outlet right downstream channel wall.

Photo No. 21: Main Dam - Overview of the impoundment.

Photo No. 22: Main Dam - Overview of the downstream channel from the low-level outlet.

Photo No. 23: Bookers Dam - Overview of the upstream side of the dam from the right abutment looking left.

Photo No. 24: Bookers Dam - Upstream slope from near STA 3+00 looking left.

Photo No. 25: Bookers Dam - Upstream slope and crest from near STA 9+00 looking left. Note area of damaged slope and stored material along the downstream toe of the slope.

Photo No. 26: Bookers Dam - Upstream slope from near the right abutment looking right. Note the irregular alignment of the slope.

Photo No. 27: Bookers Dam - Crest from near the right abutment looking left.

Photo No. 28: Bookers Dam - Crest from near STA 12+00 looking right.

Photo No. 29: Bookers Dam - Crest from near the left abutment looking right.

Photo No. 30: Bookers Dam - Downstream slope from near the right abutment looking left.

Photo No. 31: Bookers Dam - Downstream embankment from near STA 2+50 looking right. Note seepage areas along the toe of the slope.

Photo No. 32: Bookers Dam - Typical active animal borrow near 4+00 along the downstream side of the embankment. Note the fresh gravelly-sand spoils along the underside of the borrow.

Photo No. 33: Bookers Dam - Downstream slope from near STA 6+00 looking left. Note the seepage channel along the downstream end of the embankment.

Photo No. 34: Bookers Dam - Downstream slope from near STA 9+50 looking left. Note stored material along the mid-slope.

Photo No. 35: Bookers Dam – Concrete debris dumped along the downstream slope near STA 12+00.

Photo No. 36: Bookers Dam - Downstream slope and stone masonry wall from STA 12+00 looking left.

Photo No. 37: Bookers Dam – Seepage along the base of the downstream stone masonry wall near STA 13+25.

Photo No. 38: Bookers Dam - Downstream stone masonry wall viewed from near the left abutment looking right.

Photo No. 39: Marina Dam – View of the upstream side of the floodwalls at the Marina looking left.

Photo No. 40: Marina Dam – Overview of the marina walls looking right towards pine ledge road. Note materials stored along and on top of the flood walls.

Photo No. 41: Marina Dam – View of the floodwalls at the Marina from the upstream side looking downstream. Note the area of the access road through the floodwalls is lower than the floodwalls.

Photo No. 42: Marina Dam – Overview of the floodwalls left of the storage building.

Photo No. 43: Marina Dam – Downstream area of the marina dam

Photo No. 44: Pine Ledge Road to West Greenville Road Dam – Upstream side of the dike from Pine Ledge Road looking left.

Photo No. 45: Pine Ledge Road to West Greenville Road Dam – Crest and downstream slope of the embankment left of Pine Ledge Road. Note the vertical irregularities along the downstream slope.

Photo No. 46: Pine Ledge Road to West Greenville Road Dam – Accumulated clippings and vegetation along the toe of the embankment left of Pine Ledge Road near the left abutment.

Photo No. 47: Pine Ledge Road to West Greenville Road Dam – Upstream side of the embankment from pine ledge road looking right.

Photo No. 48: Pine Ledge Road to West Greenville Road Dam – Crest, concrete corewall, and upstream slope of the embankment right of Pine Ledge Road from near STA 1+30 looking left.

Photo No. 49: Pine Ledge Road to West Greenville Road Dam – Tree stumps along the upstream slope near STA 3+25.

Photo No. 50: Pine Ledge Road to West Greenville Road Dam – Crest, concrete corewall, and upstream slope of the embankment right of Pine Ledge Road from near the right abutment looking left. Note the 30-inch tree located at the right abutment and the two trees in the background of the photo near STA 4+00.

Photo No. 51: Pine Ledge Road to West Greenville Road Dam – Overview of the downstream slope from near STA 0+10 looking right. Note the orange stained seepage channel along the toe of the embankment.

Photo No. 52: Pine Ledge Road to West Greenville Road Dam – Downstream slope from near STA 3+50 looking left.

Photo No. 53: Pine Ledge Road to West Greenville Road Dam – Overview of the downstream slope from near STA 3+75 looking right. Note the eroded area of the downstream slope near STA 4+00 exposing the corewall.

Photo No. 54: Spillway Section – Upstream slope from the right embankment looking left.

Photo No. 55: Spillway Section – Upstream slope and crest from near STA 2+50 looking right.

Photo No. 56: Spillway Section – Upstream slope and crest from near STA 2+50 looking left.

Photo No. 57: Spillway Section – Spalled and cracked concrete near STA 9+00.

Photo No. 58: Spillway Section – Upstream slope and crest from near the left abutment looking right.

Photo No. 59: Spillway Section – Downstream slope from near STA 2+50 looking right. The locations of the saturated areas are evidenced by tall grass at the toe of the slope.

Photo No. 60: Spillway Section – Tire rutting with seepage near STA 1+70 along the toe of the slope.

Photo No. 61 Spillway Section - Downstream slope from left of the spillway looking left.

Photo No. 62: Spillway Section – Downstream slope from near the left abutment looking right. Note through cracks along the corewall.

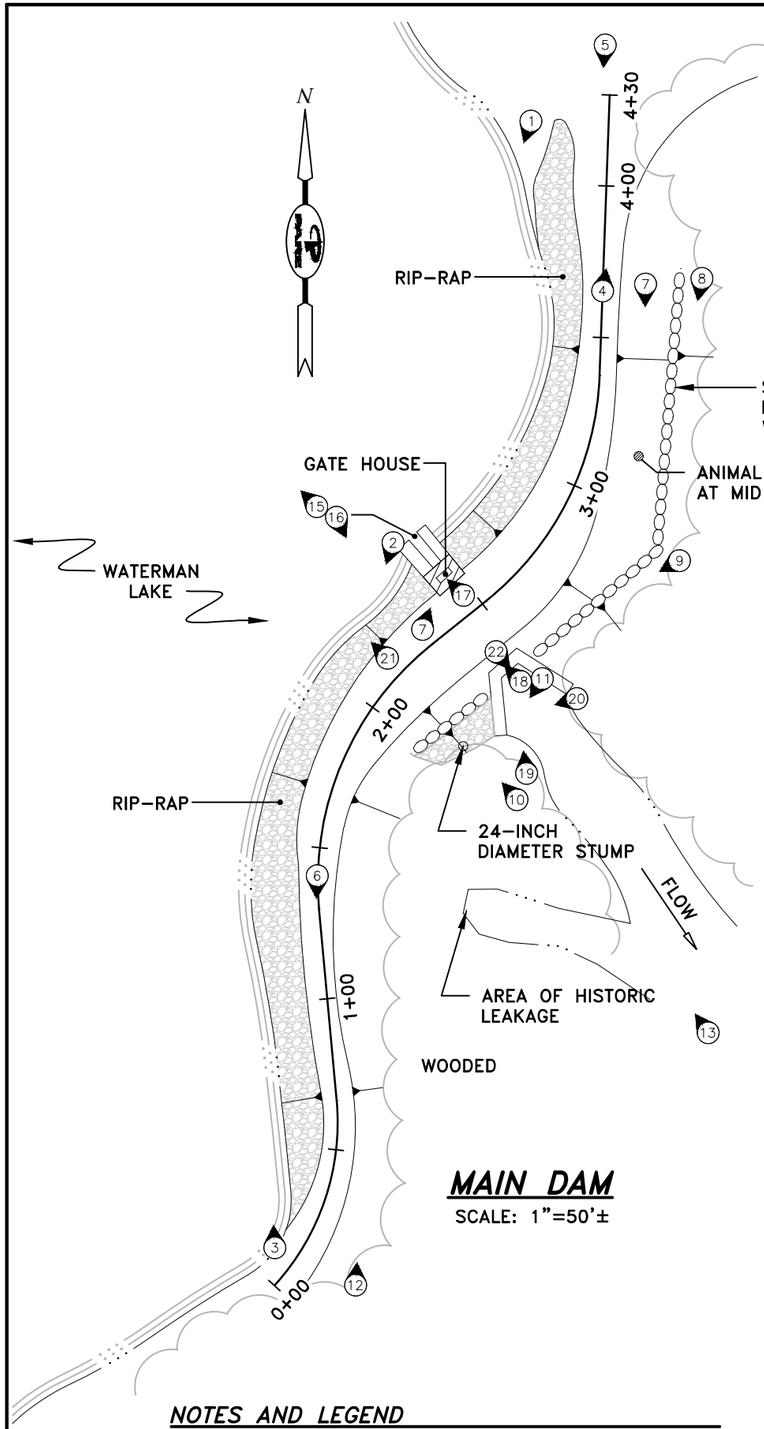
Photo No. 63 Spillway Section – Crest of the spillway section from the spillway left channel wall looking right.

Photo No. 64: Spillway Section – View of the spillway weir and the spillway right channel wall.

Photo No. 65 Spillway Section – View of the spillway weir and the spillway left channel wall.

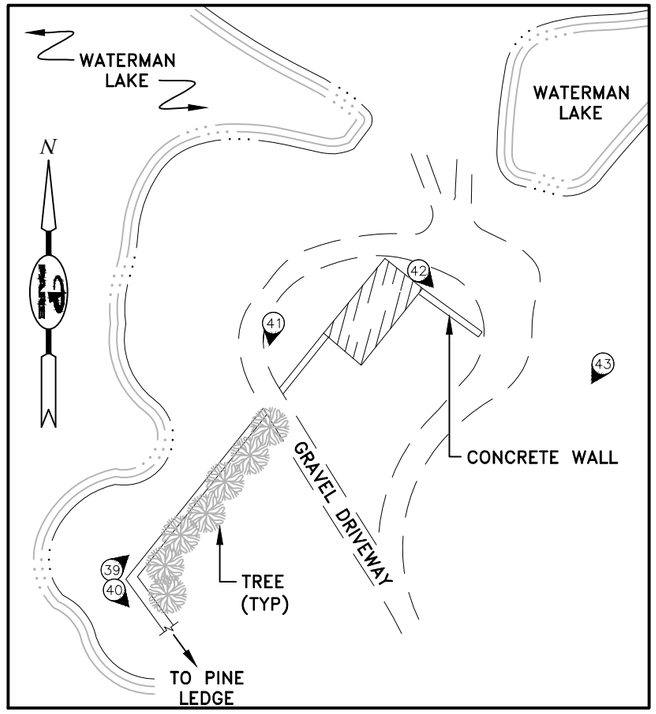
Photo No. 66: Spillway Section – Overview of the impoundment from the left abutment.

Photo No. 67 Spillway Section – Discharge area of the spillway.



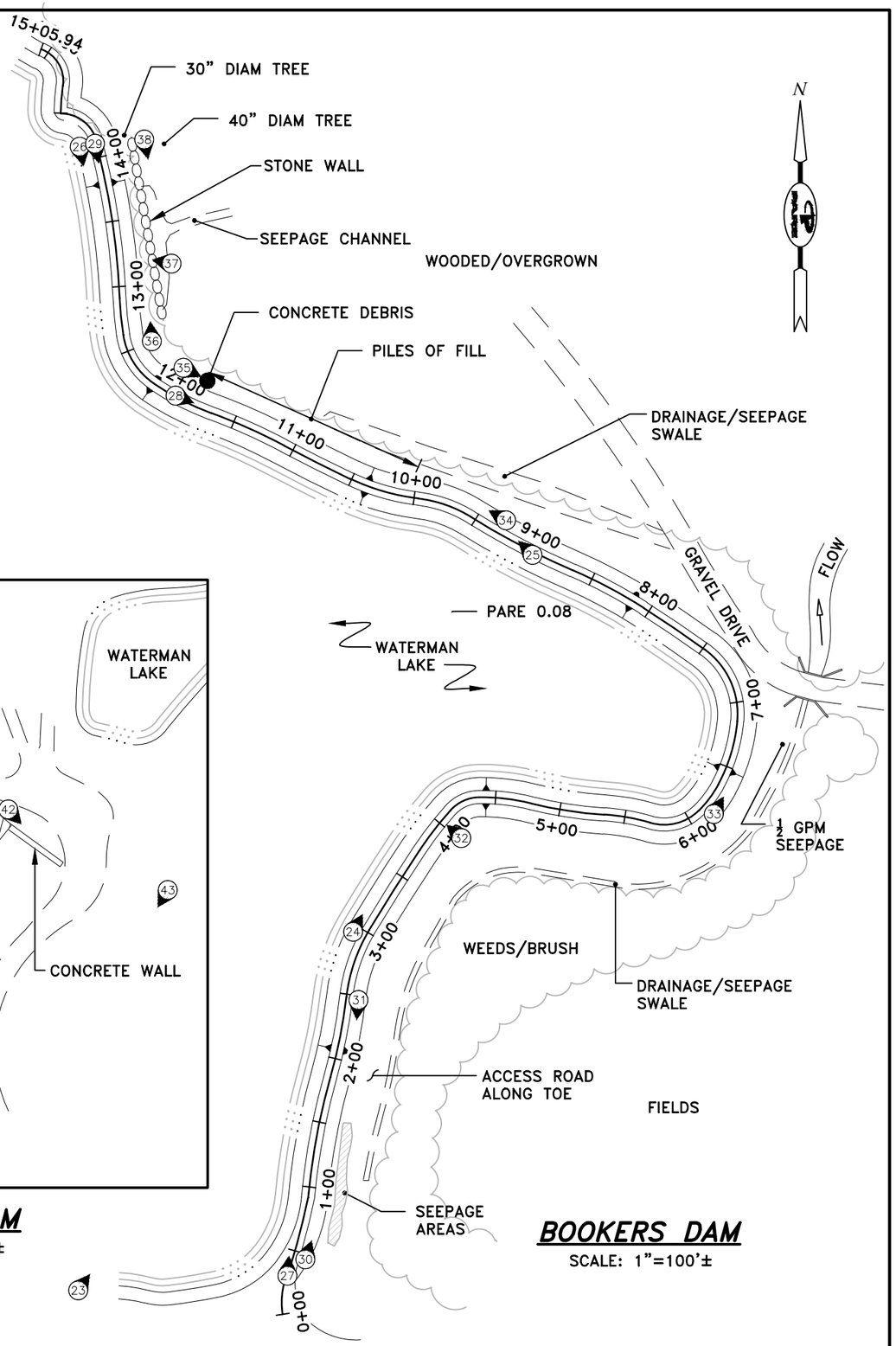
MAIN DAM

SCALE: 1"=50'±



MARINA DAM

SCALE: 1"=100'±



BOOKERS DAM

SCALE: 1"=100'±

NOTES AND LEGEND

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

(#) DENOTES APPROXIMATE LOCATION AND DIRECTION OF PHOTOGRAPH.

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10 LINCOLN ROAD, SUITE 103
FOXBORO, MA 02035
508-543-1755

SCALE ADJUSTMENT GUIDE

0" 1"

BAR IS ONE INCH ON ORIGINAL DRAWING.

WATERMAN LAKE DAM

RI DAM No. 111

GLOCESTER/SMITHFIELD, RHODE ISLAND

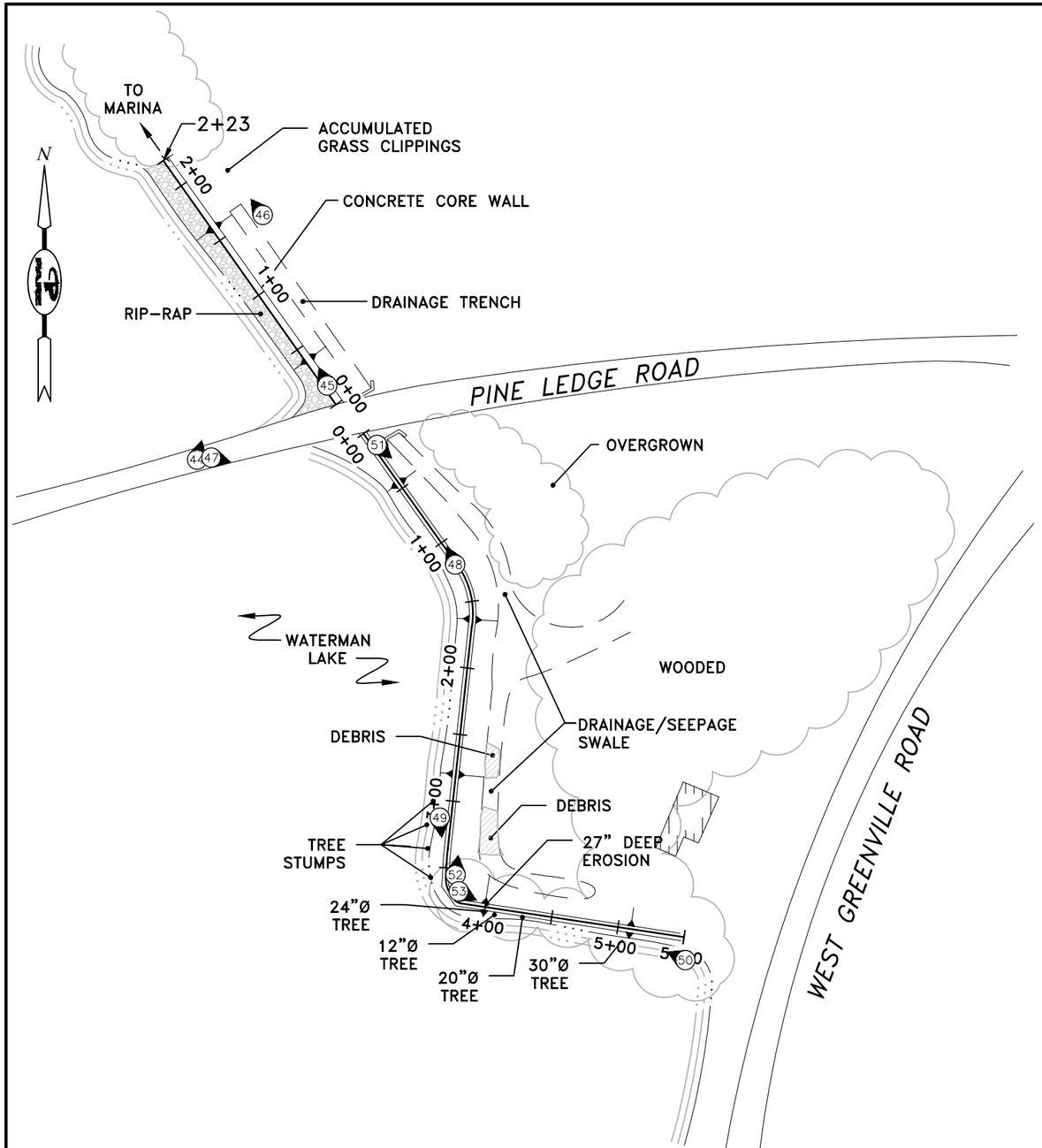
OWNER: CITIZENS FOR THE PRESERVATION OF WATERMAN LAKE, INC.

REVISIONS:

PROJECT NO.:	16178.04/010
DATE:	JUNE 2020
SCALE:	AS NOTED
DESIGNED BY:	BMD
CHECKED BY:	DRC
DRAWN BY:	AWB
APPROVED BY:	JMB

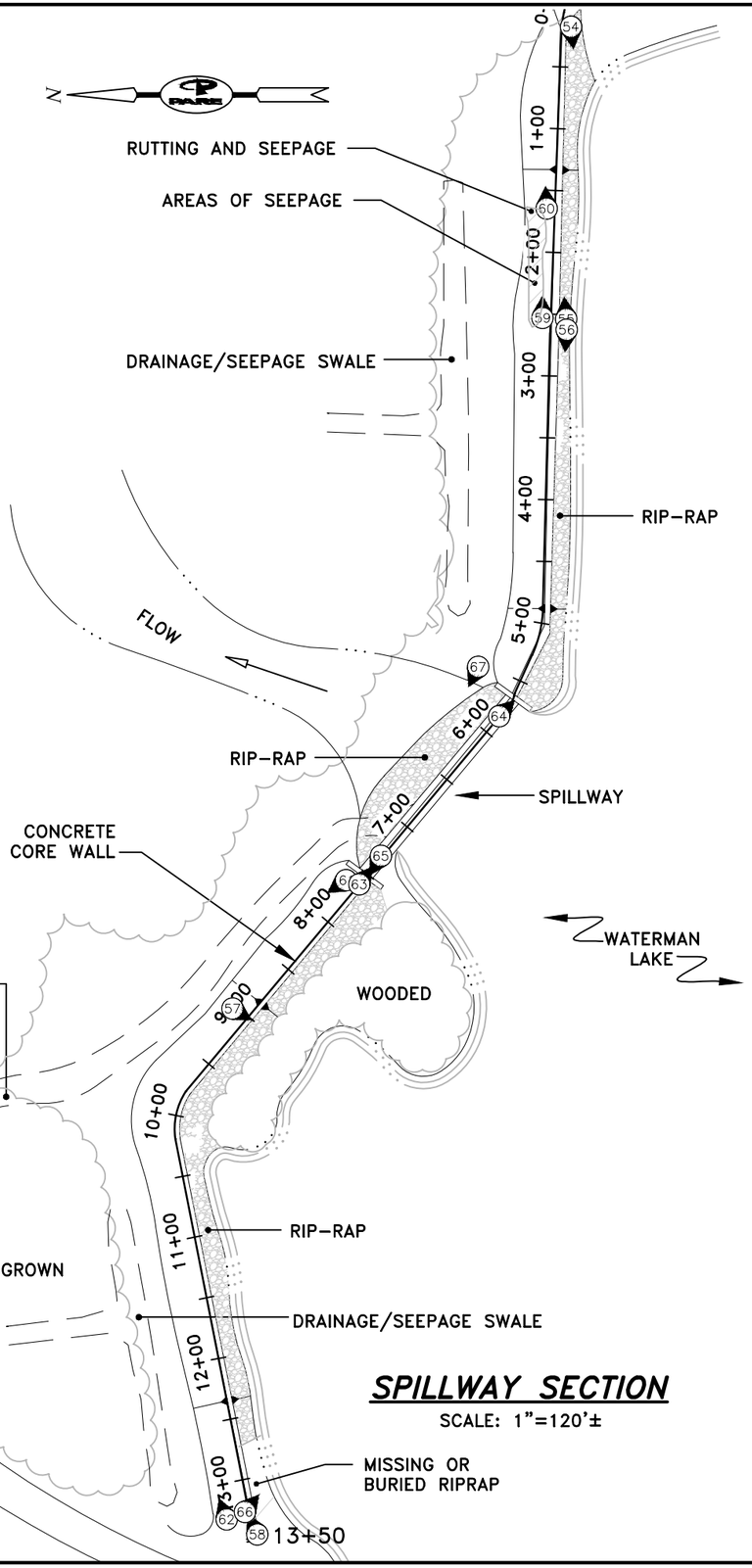
SITE SKETCH MAIN DAM, BOOKERS DAM & MARINA DAM

FIGURE NO.: 1



PINE LEDGE TO GRANVILLE DAM

SCALE: 1"=100'±



SPILLWAY SECTION

SCALE: 1"=120'±

NOTES AND LEGEND

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(#) DENOTES APPROXIMATE LOCATION AND DIRECTION OF PHOTOGRAPH.

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

WATERMAN LAKE DAM

RI DAM No. 111

GLOCESTER/SMITHFIELD, RHODE ISLAND

OWNER: CITIZENS FOR THE PRESERVATION OF WATERMAN LAKE, INC.

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DRAWN BY:	AWB
APPROVED BY:	JMB

SITE SKETCH PINE LEDGE DIKE & SPILLWAY SECTION

FIGURE NO.: 2