



November 16, 2018

Mr. Michael Vendetti  
Bonnet Shores Fire District  
130 Bonnet Shores Road  
Narragansett, Rhode Island

**Subject: Bonnet Shores Project Summary  
Flooding Mitigation Recommendations**

Dear Mr. Vendetti,

The Bonnet Shores Fire District (BSFD) retained the services of Environmental Strategies and Management, Inc. (ES&M) to administer the RIDEM Narragansett Bay Watershed Restoration Fund grant awarded on July 2, 2018. The project covered by the grant was focused primarily on the dredging of Wesquage Pond. However, as a component of the grant administration process, ES&M conducted an evaluation of the flooding and water quality issues in the area. This letter provides a summary of the evaluation and includes recommendations to improve the water quality of Wesquage Pond and to mitigate the flooding along the Bonnet Point Road causeway. The evaluation consisted of field observation and elevation survey, local and state file and document review, knowledgeable party interview, and hydraulic modeling and analysis.

#### Background

The Wesquage pond is a tidal pond connected to Narragansett Bay by a natural breach way and is fed from a 400 acre watershed area to the north of the pond via overland wetlands and streams as well as piped surface runoff from developed areas. Wesquage Pond consists of two distinct basins. The large basin (east side) is approximately 58 acres in size and the small basin (west side) is approximately 13 acres. The pond is approximately 4 feet deep.

The (2) ponds are connected via (2) equalizer culverts located on Bonnet Point Road which are made up of concrete head walls with two (2) 18" dia. concrete pipes. The pond outlet control structure is a concrete box culvert 36" deep x 60" wide which discharges to Bonnet Shores beach.

#### File / Document Review & Interviews

ES&M personnel conducted a review of CRMC and Town of Narragansett files and discussed the project with BSFD members, water quality representatives (BSFD and URI), the local maintenance contractor, and Town representative (Planning and DPW) to determine the history of previous water quality and flood mitigation efforts, the location storm water management systems within the watershed, and pending civil improvements in the area. The following documents were reviewed; CRMC maintenance permit, Allagash Trail & Bonnet Point Road Stormwater collection system (1986), Proposed Precast Concrete Culvert on bonnet point Road (1986), CRMC Bonnet

Shores Causeway Roadway Improvements (1992), Spring Brook Road Bio-retention Basin Plan (2016), Bonnet Shores Beach Club Wastewater Collection System (2017), and Bonnet Shores Causeway Pedestrian Walkway (2017).

### Field Survey Information

ES&M personnel conducted several visits to the area between August and November 2018 during varied weather and beach head conditions. (see attached photos)

An elevation survey was conducted on August 6, 2018. The roadway elevation at the two (2) equalizer culverts are 3.35+/- and 3.50 +/- . The pond elevation during field survey on August 6, 2018 was 2.75 +/- . A field survey of the sand deposit area located at the beginning of the outlet channel was conducted and found to be approximately 30,000 sf area of accumulated sand with elevation varying from 3.16 to 2.79.

The outlet channel from the Pond to the culvert is approximately 15' wide x 250 feet long and approximately 3 feet deep. The elevation of the channel bottom is 1.23 along the delta, and 1.23 at the Bonnet Point Road concrete box culvert. The channel bottom elevation varies between 1.99 and 0.59. The concrete roadway culvert invert elevation is -0.16 at the pond side and -0.45 at the beach side. The outlet channel appeared to be reduced by approximately 24" of sand accumulation on the beach side outlet channel. The outlet channel from the culvert to the beach is approximately 350' long with varying widths. The elevation of the channel bottom immediately to the south of the box culvert is 1.77, and the channel was completely blocked with sand throughout the non-vegetated section of the beach (elevation greater than 3.00). Refer to Figures 1, 2 & 3 for elevation details.

### Hydraulic Analysis

ES&M performed a hydraulic analysis of the pond under current conditions with the culvert outlet channel filled with 24" of sand. The contributing watershed area was 400 acres. The pond elevation was set at 2.75 (at the time of the field survey), the roadway elevation used was a low of 3.13, and we assumed the pond will provide 4" of storage capacity (elevation 3.08). The model indicates the roadway will flood during a 5 year storm (4.1 inches of rainfall during a 24 hour period).

### **CURRENT CONDITION WITH CULVERT OUTLET FILLED WITH 24" SAND**

Storm Event	24 hr Rainfall Amount (inches)	Pond Elevation	Floods Roadway
1 yr	2.8	2.86	N
2 yr	3.3	2.94	N
5 yr	4.1	3.53	Y
10 yr	4.9	5.25	Y
25 yr	6.1	6.45	Y
50 yr	7.2	6.47	Y
100 yr	8.5	7.98	Y

ES&M performed a hydraulic analysis of the pond with the culvert outlet channel cleared. The contributing watershed area was 400 acres. The pond elevation was set at 2.75 (at the time of the field survey), the roadway elevation used was a low of 3.13, and we assumed the pond will provide 4" of storage capacity (elevation 3.08). The model indicates the roadway will flood during a 25 year storm (6.1 inches of rainfall during a 24 hour period).

**PROPOSED CONDITION WITH CULVERT OUTLET CLEARED**

Storm Event	24 hr Rainfall Amount (inches)	Pond Elevation	Floods Roadway
1 yr	2.8	2.76	N
2 yr	3.3	2.81	N
5 yr	4.1	2.93	N
10 yr	4.9	3.08	N
25 yr	6.1	5.27	Y
50 yr	7.2	5.78	Y
100 yr	8.5	7.45	Y

Summary

The Wesquage Pond capacity to manage storm water runoff before flooding the roadway is controlled by the following items:

1. The outlet control structure; box culvert and outflow channel
2. The roadway elevation
3. Development of the existing watershed area, along with contributing storm water runoff.

The dredging and removal of accumulated sand located at the beginning of the outlet channel will clear and allow clear passage toward the box culvert, however sand accumulation of the outlet channel on the beach side reduces the outlet flow from the box culvert, this channel should also be cleared and maintained. We understand during the summer season, the outflow channel on the beach side is not fully cleared.

Recommendations

1. Dredge and remove accumulated sand located at the beginning of the outlet channel to clear passage toward the box culvert. The sand delta varies in elevation from 1.71 to 3.16, we recommend dredging approximate three (3) feet of material down to approximate elevation 0.00.
2. Regular maintenance and clearing of the outflow channels should be conducted. The existing outlet channel should be excavated to approximate elevation 0. The current outlet channel varies between elevation 0.59 to 1.99. The outlet invert is -0.16. This is currently completed under a maintenance assent with CRMC, however we recommend

- the current maintenance contractor excavate the accumulated sand down to elevation 0 to increase the outlet channel capacity.
3. Stabilization of the embankment channels should be implemented to reduce erosion of the embankment and sand accumulation in the channel during storm events.
  4. The Town is currently completing various storm water water quality upgrades which will mitigate the storm water runoff contributing to the pond. This effort from the Town should continue.
  5. Raise the roadway elevation.

The proposed dredging of the Wesquage Pond sand delta forming in the southern area of the pond is only one step to help mitigate flooding of Bonnet Point Road, steps 2 thru 4 should also be implemented in an overall coordinated effort to reduce the roadway flooding. Step 5 would provide the most permanent solution, but would also be the most difficult and expensive to complete. Steps 1 thru 4 do not deal with future sea-level rise, where Step 5 raising of the roadway would provide the best solution to future sea-level rise conditions.

Please call us at 401-728-6860 if you have any questions.

Sincerely,  
*Environmental Strategies & Management, Inc.*



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Mark J. House  
Vice President and Senior Scientist





1) Nov. 27, 2017. Outlet channel (Beach Side)



2) Nov. 27, 2017. Outlet channel (Pond Side)



3) Nov. 27, 2017. Beach Side Channel looking toward road



4) Nov. 27, 2017. Beach outlet





5) August 07, 2018. Outlet channel (Beach Side)



6) August 07, 2018 Concrete box culvert (Pond Side)



7) August 07, 2018 Concrete box culvert (Beach Side).



8) August 07, 2018. Accumulated Sand Delta (Pond)





9) October 16, 2018. Dredge Sampling (Pond)




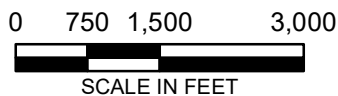
10) October 16, 2018. Outlet Channel (Beach Side)



USGS The National Map: National Boundaries Dataset, National Elevation Dataset, Geographic Names Information System, National Hydrography Dataset, National Land Cover Database, National Structures Dataset, and National Transportation Dataset; U.S. Census Bureau - TIGER/Line; HERE Road Data; Data Refreshed July, 2017.

**LEGEND**

 Approximate 400 Acre Watershed Area



PREPARED BY



Norton, MA 508-226-1800  
Pawtucket, RI 401-728-6860  
Newburyport, MA 617-840-0363  
[www.esm-inc.com](http://www.esm-inc.com)

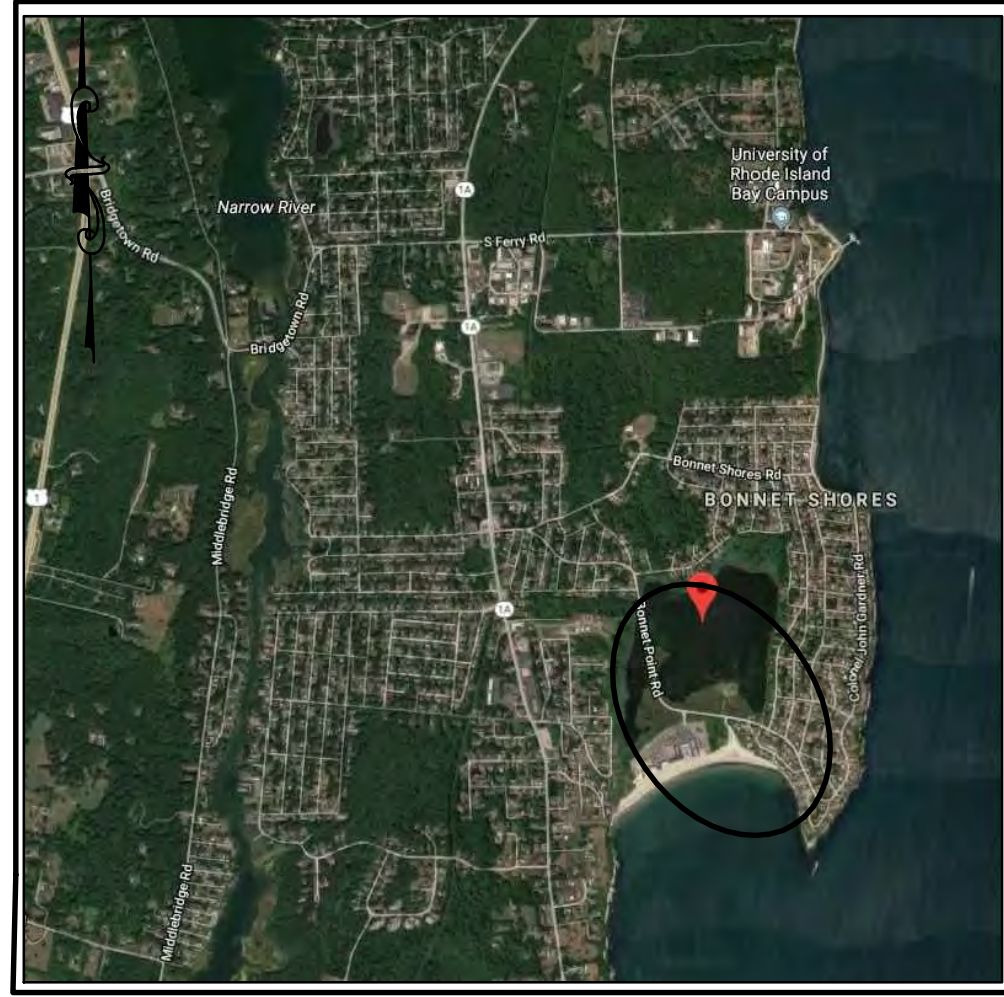
**WATERSHED MAP**

**BSFD  
WESQUAGE POND  
NARRAGANSETT, RI**

DRAWN	CHECKED	PROJ MGR	PROJECT	DATE	FIGURE
CGB	RM	RM	7482	8/16/2018	

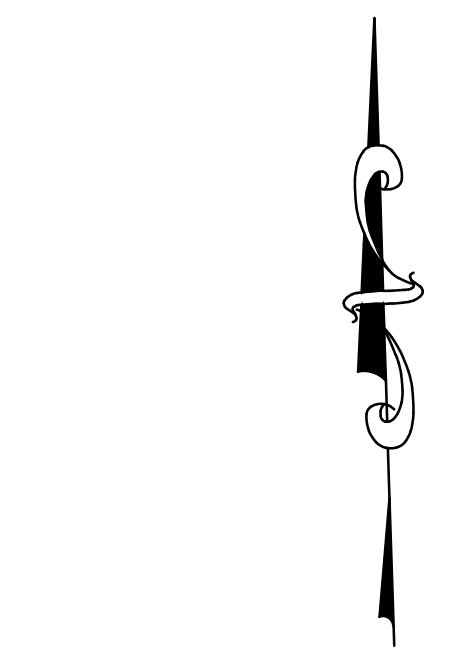
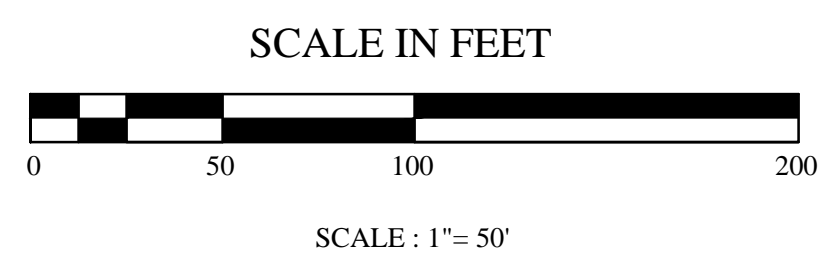
Sources:  
USGS Topographic Map





**LOCATION MAP**

- Legend:**
- SUBJECT PROPERTY LINE
  - - - - - EXISTING COUNTOUR
  - - - - - ABUTTER PROPERTY LINE
  - - - - - EXISTING TREELINE
  - - - - - SURVEYED WETLAND EDGE
  - ▲ EXISTING WETLAND FLAG
  - █ 50' PERIMETER WETLAND
  - █ 100' PERIMETER WETLAND
  - EXISTING UTILITY POLE
  - ☆ SURVEYED WETLAND EDGE
  - EXISTING BOUND
  - IRON PIN
  - DRILL HOLE
  - - - - - ZONING SETBACK
  - PROPOSED PAVEMENT
  - PROPOSED GRADE
  - - - - - PROPERTY SETBACK
  - × FENCE LINE



SAND ACCUMULATION AREA (30,000 SF)

EXISTING OFFFALL CHANNEL FROM WESQUAGE POND

EXISTING 3'X6' CONCRETE CULVERT

EXISTING OFFFALL CHANNEL TO NARRAGANSETT BAY

**SITE PLAN**  
SCALE: 1" = 50'


**ES&M**  
 Norton, MA 508-226-1800  
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 www.esm-inc.com

PREPARED FOR:  
 BSFD - BWRP / FLOOD MITIGATION  
 BONNET SHORES FIRE DISTRICT  
 130 BONNET SHORES ROAD  
 NARRAGANSETT, RI 02882

DRAFT  
 FOR REVIEW

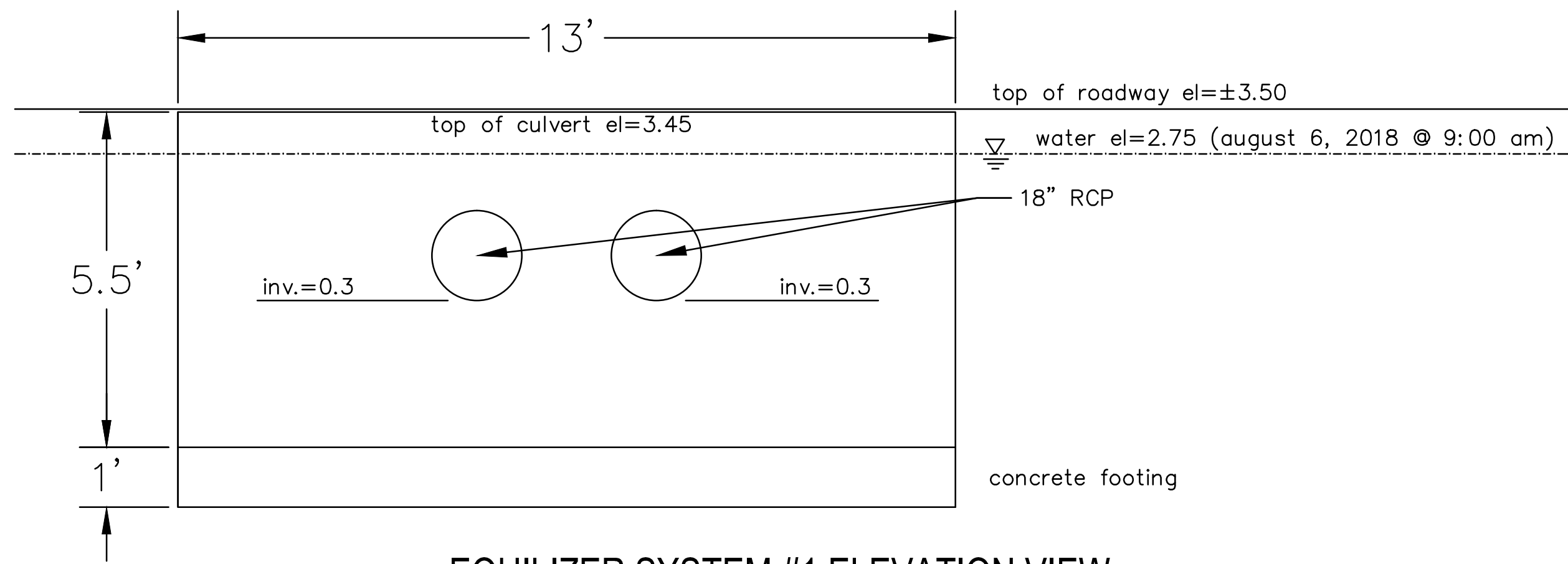
SHEET TITLE:  
 OVERALL SITE PLAN  
 WESQUAGE POND BREACHWAY  
 NARRAGANSETT, RI

Project No.	7482
Designed By:	RGM
Drawn By:	EMD
Checked By:	RCA
Date:	AUGUST 2018
Scale:	AS SHOWN



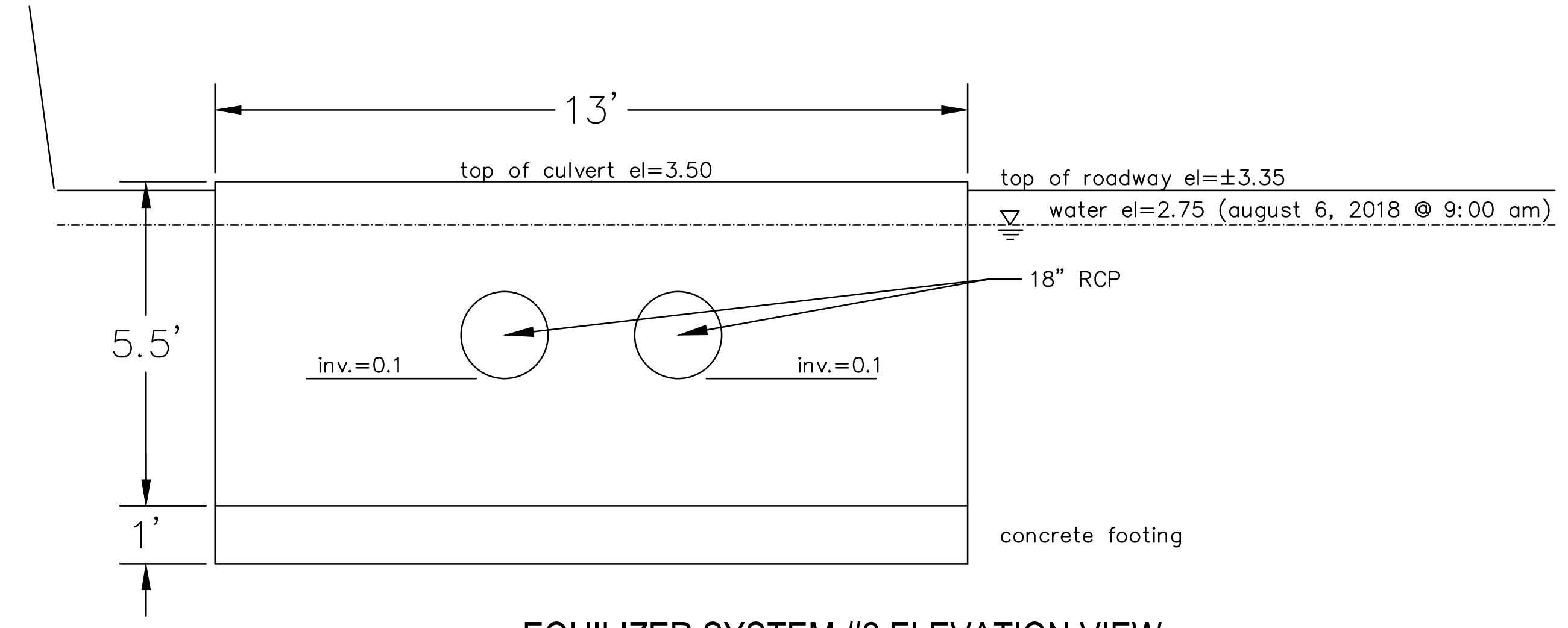






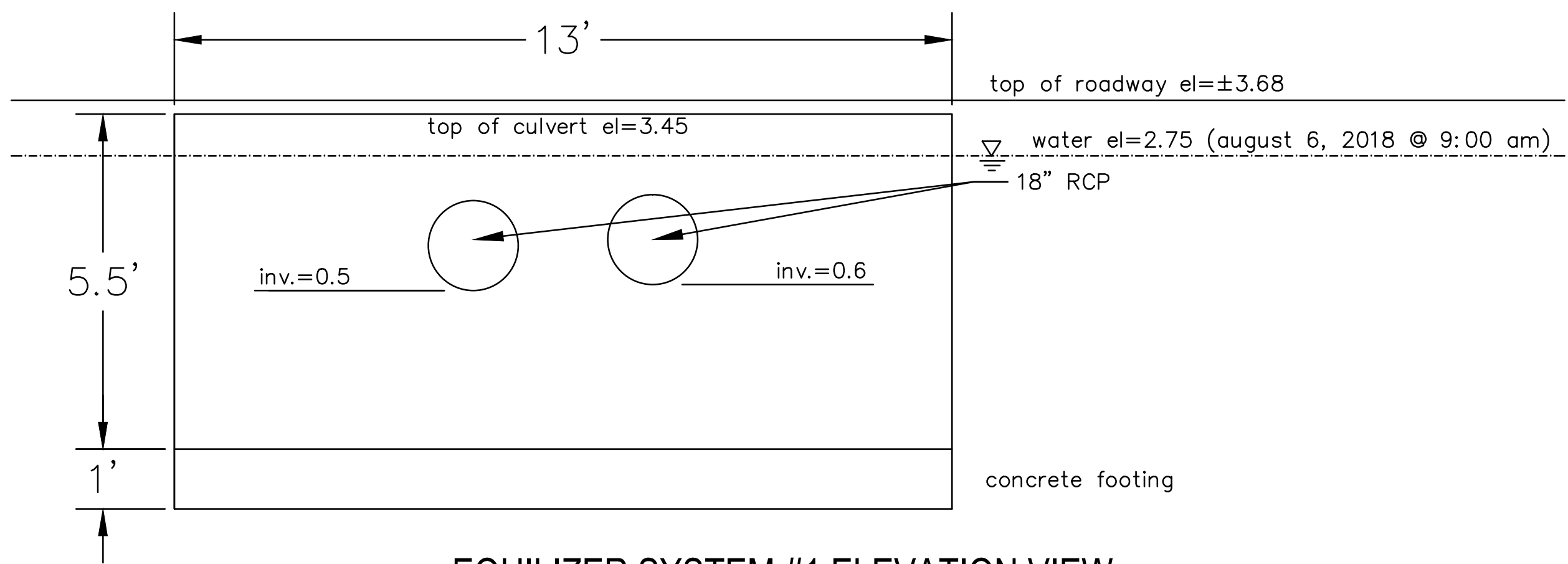
**EQUILIZER SYSTEM #1 ELEVATION VIEW  
(LARGE POND SIDE)**

SCALE: 1/2"=1'



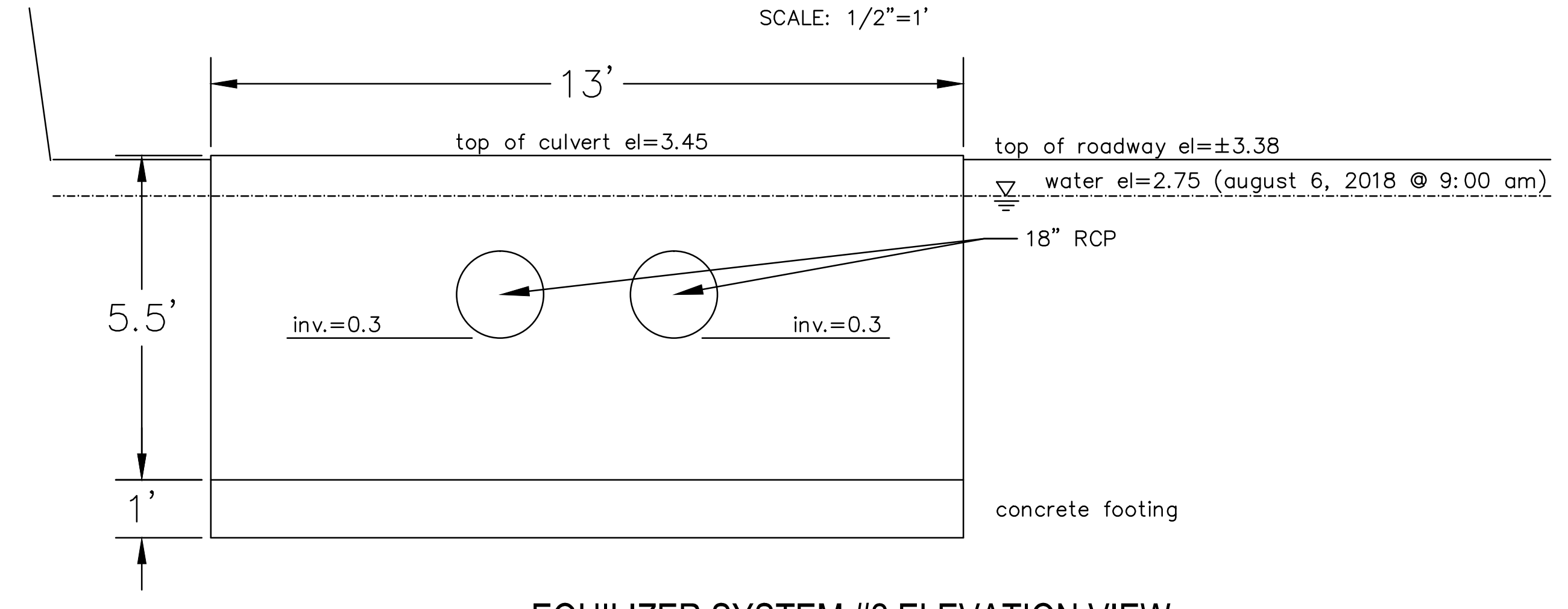
**EQUILIZER SYSTEM #2 ELEVATION VIEW  
(LARGE POND SIDE)**

SCALE: 1/2"=1'



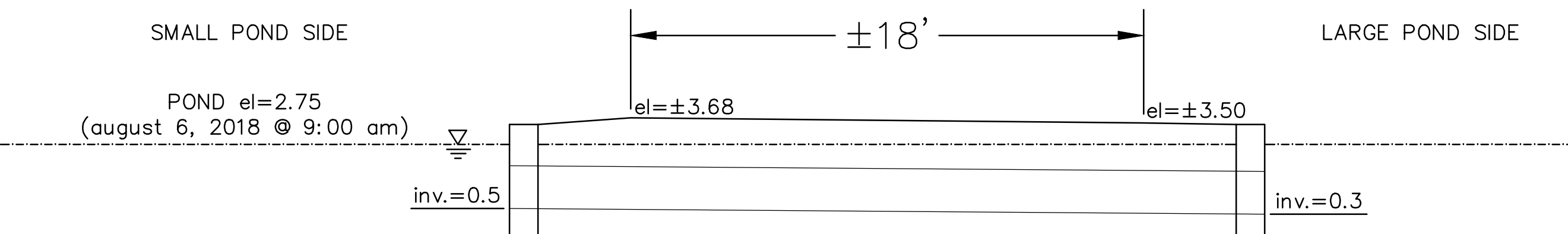
**EQUILIZER SYSTEM #1 ELEVATION VIEW  
(SMALL BEACH SIDE)**

SCALE: 1/2"=1'



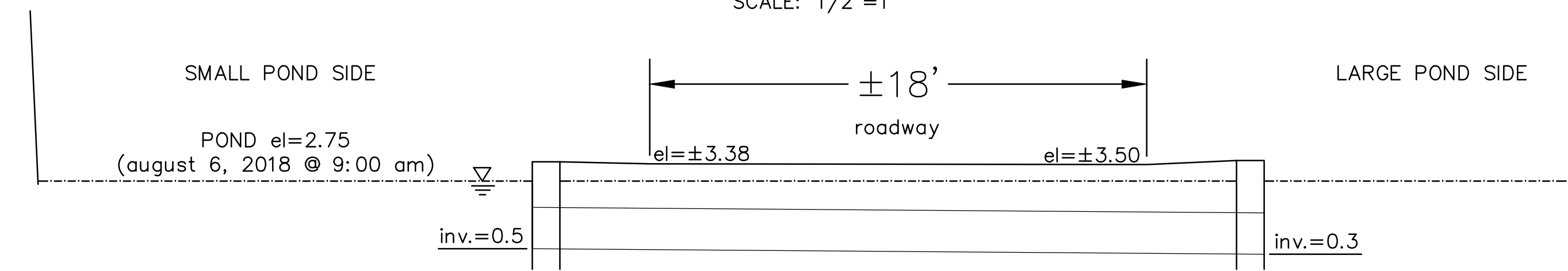
**EQUILIZER SYSTEM #2 ELEVATION VIEW  
(SMALL BEACH SIDE)**

SCALE: 1/2"=1'



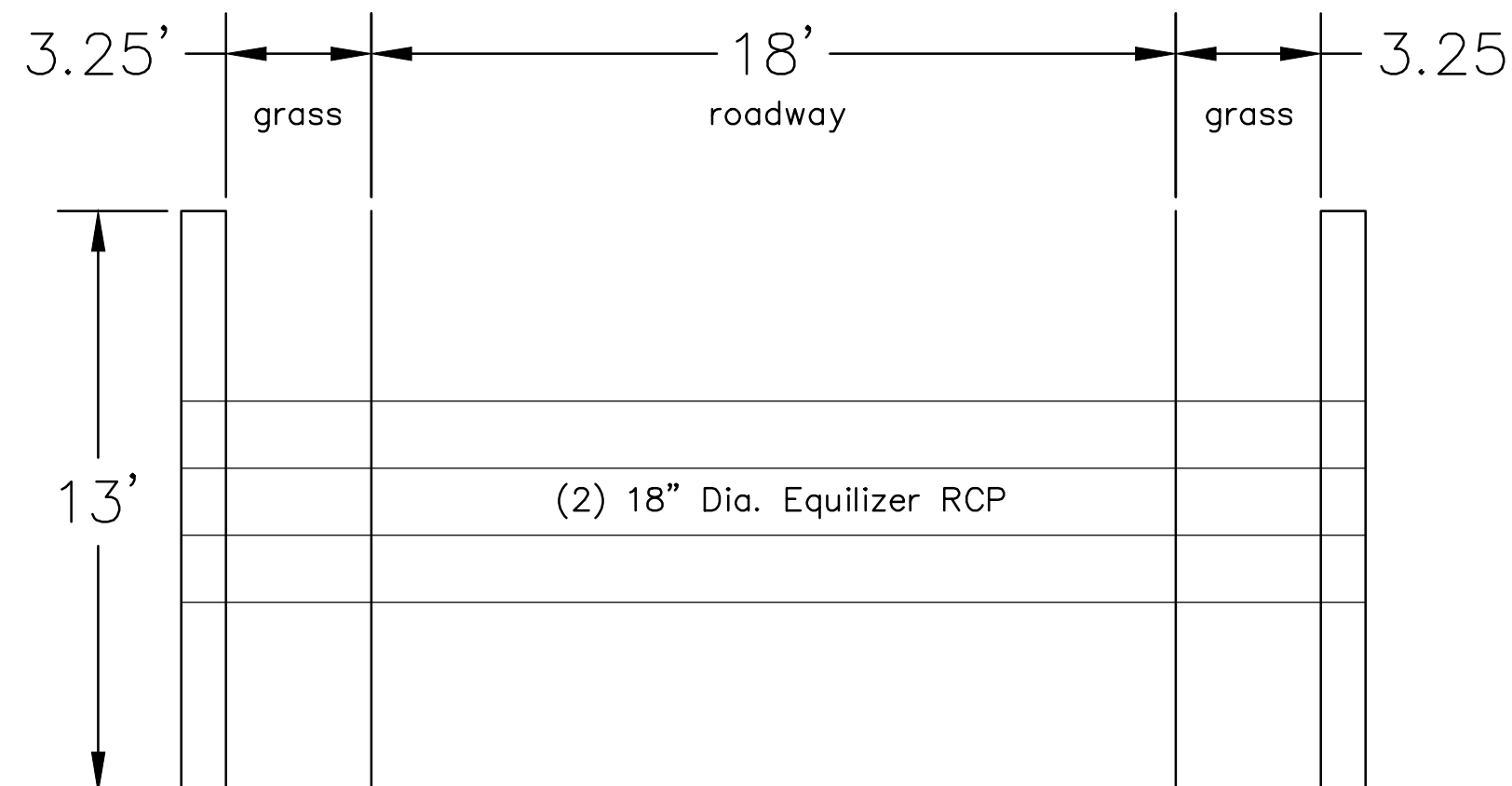
**EQUILIZER SYSTEM #1  
SECTION VIEW**

SCALE: 1/2"=1'



**EQUILIZER SYSTEM #2  
SECTION VIEW**

SCALE: 1/2"=1'



**EQUILIZER SYSTEM PLAN VIEW TYP.**

SCALE: 1/2"=1'



PREPARED FOR:  
BSFD - BWRP / FLOOD MITIGATION  
BONNET SHORES FIRE DISTRICT  
130 BONNET SHORES ROAD  
NARRAGANSETT, RI 02882

DRAFT  
FOR REVIEW

SHEET TITLE:  
EXISTING EQUILIZER PIPE  
DETAILS  
WESQUAGE POND BREACHWAY  
NARRAGANSETT, RI

Project No. 7482  
Designed By: RGM  
Drawn By: EMD  
Checked By: RCA  
Date: AUGUST 2018  
Scale: AS SHOWN