HYDRAULICS AND HYDROLOGY REPORT

CEDAR LAKE DAM AT NORTH STREET

WOLCOTT, CONNECTICUT

HRP #WOL2015.CE

DRAFT FOR REVIEW

Prepared for:

Town of Wolcott
Town Hall
10 Kenea Avenue
Wolcott, CT 06716

Prepared by: ______________________
Diane Tran, E.I.T.
HRP Associates, Inc.

Checked by: ______________________
Gwen Williamson, P.E.
HRP Associates, Inc.

Approved by: ______________________
Thomas R. Battles, P.E
HRP Associates, Inc.

Prepared by:

HRP *Associates, Inc.*
Engineering & Geology
197 Scott Swamp Road
Farmington, CT 06032
Telephone: (860) 674-9570

August 19, 2014

HYDRAULICS AND HYDROLOGY REPORT

CEDAR LAKE DAM AT NORTH STREET

TOWN OF WOLCOTT

WOL2015.CE

TABLE OF CONTENTS

1.0 EXECUTIVE SUMMARY-DESIGN

Location

- Town: Wolcott
- Road(s): North Street
- Location Relative to Highway Landmark: 1,700 west of North Street and Wolcott Road (Route 69) intersection
- Lake: Cedar Lake
- Stream: Upper Channel of Mad River

Design Flood

- Hydrologic Procedure used for Design: HEC-HMS
- Drainage Area: 0.91 sq. mi.

Existing Structure

Dam:

- Type: 315 ft earthen dam with low and high flow outlets
- Minimum Retaining Wall Elevation: 893 ft

Low Flow Outlet Structure:

- 12" PVC Culvert
  - Inverts: 882.96 ft (upstream) 877.45 ft (downstream)
  - Length: 49 ft long at 13% slope
  - Controlled by gate in Dam House

High Flow Outlet Structure:

- Weir:
  - Low flow weir: horizontal weir, Elevation 888.69, 1.85 ft wide
  - High flow weir: semicircular weir, Elevation 890.70, 12.3 ft
- Box culvert: 40" wide by 46" high
  - Inverts: 884.74 ft (upstream) 883.82 ft (downstream)
  - Length: 35 ft long at 2.6% slope
- Hydraulic Control: Inlet (Weir) Control

Proposed Structure

High Flow Outlet Structure:

- Weir:
  - Alternative 1 – Modify the low flow weir from 2 ft to 5 ft
- Box culvert:
  - Replace Box Culvert with 36" diameter PVC pipe

Hydrology

Method: HEC-HMS 4.0

Peak Flows

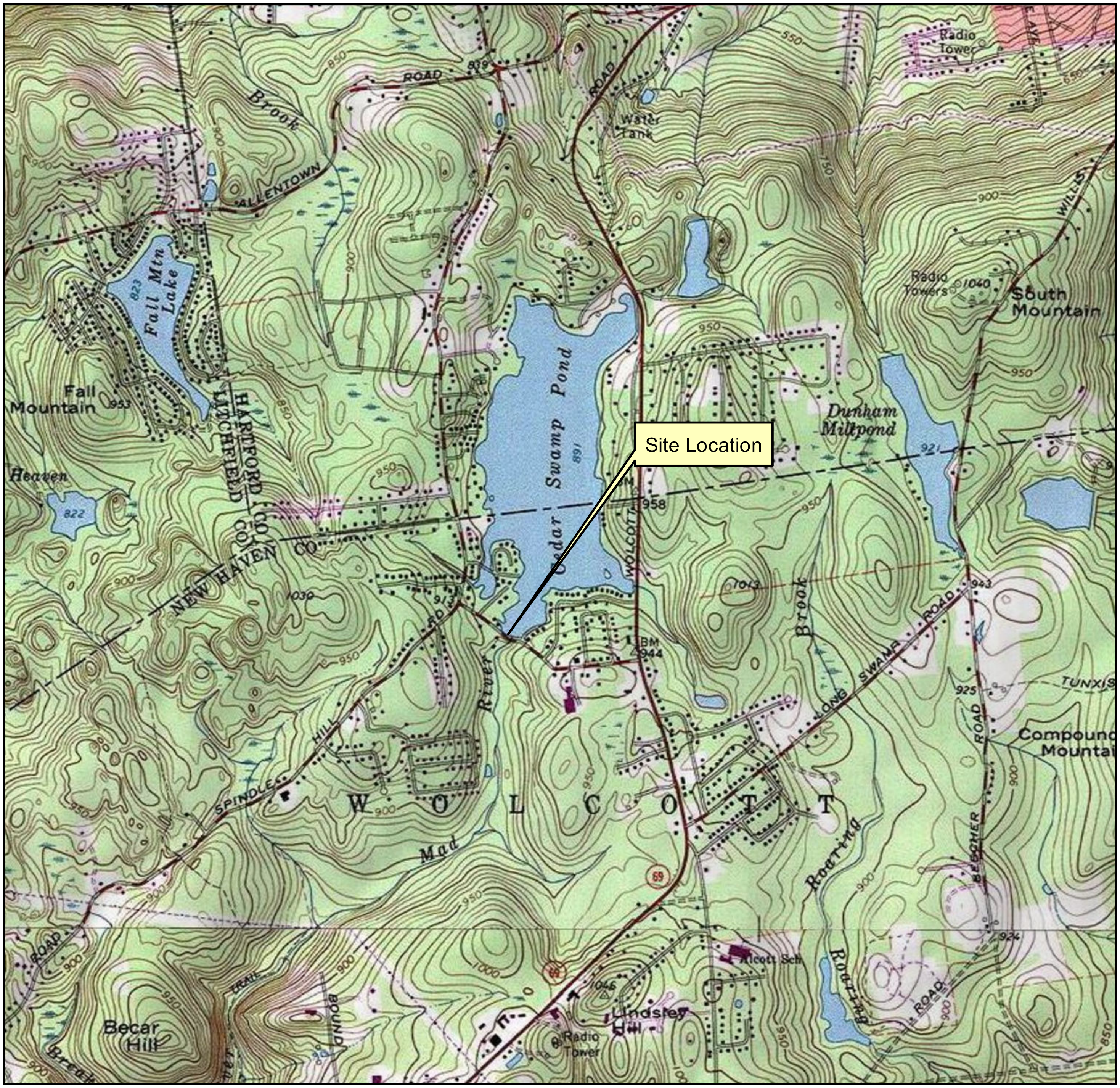
Method Used	Drainage Area (sq. mi.)	Discharge Rate (cfs)					
		2-year	10-year	25-year	50-year	100-year	500-year
HEC-HMS	0.91	0.1	106	360	539	751	1080

Hydraulics

Model Used: HEC-HMS 4.0

Conclusions and Recommendations

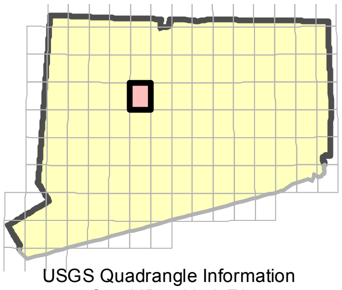
The existing dam has to pass the 500-year flood event with one foot of dam freeboard. Five alternatives were analyzed. The recommended option is Alternative 1, which proposes: (1) replacement of the existing box culvert with a 36” diameter PVC pipe, (2) modification to the low flow weir from 2 feet to 5 feet, and (3) drawdown of the lake to the current weir elevation of 888.7 prior to a significant storm event. The outlet structure is inlet (weir) controlled so the recommended plan can pass the 500-year storm with 1 foot of freeboard.



0 1,000 2,000 4,000 6,000 8,000 Feet

1 inch = 2,000 feet

N



USGS Quadrangle Information
Quad ID: 41072-F8
Name: Bristol, Connecticut
Date Rev: 1982
Date Pub: 1985
Map Edit: 1

Site Location
Cedar Lake Dam
Wolcott, Connecticut
Scale 1" = 2,000'

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www.hrpassociates.com

Path: J:\WWOLCT - TOWN OF WOLCOTT\CEDAR LAKE DAM\WOL2008CE\GIS\Site Location.mxd

2.0 INTRODUCTION

Cedar Lake Dam is located on North Street in Wolcott, Connecticut. Cedar Lake Dam is designated by the CT DEEP as Dam No. 16603. The dam is located on the southern end of the Cedar Lake in New Haven County approximately ¼ of a mile west of Route 69. The dam impounds Cedar Lake which is privately owned and maintained by the Cedar Lake Association (CLA). North Street which runs along the top of the dam is owned and maintained by the Town of Wolcott.

Cedar Lake is located both in the Town of Bristol (Hartford County) and Town of Wolcott (New Haven County). Cedar Lake is approximately 4000 feet long and 1500 feet wide with a surface area of 135 acres. The watershed area is approximately 582 acres consistently mainly of residential areas and some undeveloped areas north of the lake. The dam for Cedar Lake is approximately 350 feet long running in a northwest to the southeast direction with a semicircular geometry. The dam consists of concrete and earthen materials with two outlets. Photographs of the dam are included as Appendix A.

The dam has a low flow outlet which is also serves the drawdown location for the dam prior to the winter. The low flow outlet is located in the middle of the dam and consists of a 12-inch PVC culvert with a slope of 13%. The flow from the culvert is controlled by a gate mechanism located at the intake structure in the gate house. The high flow outlet consists of a double weir with an observation grated steel platform located on top. The double weir consists of contracted horizontal weir and a semicircular weir. The horizontal weir has a height of 1.5 feet and length of 1.5 feet. The semicircular weir has a radius of feet. The horizontal weir elevation can be adjusted by the addition of weir plate. Water flowing over the weirs drops into a concrete pit where it is conveyed by concrete box culvert to the base of the dam embankment. The concrete box culvert is with a slope of 2.7%. Both outlets (low flow and high flow) discharge to rip rap swales located at the base of the dam embankment. The dam embankment at each discharge location has gabion baskets to prevent erosion. The water from the low flow and high flow outlets flow into rip rap swales for approximately 50 feet then into a rip rap channel which is the headwaters of the Mad River.

A Town of Wolcott Road, North Street, runs along the top of the dam. The two laned divided road is approximately 22 feet wide with guardrails on each side. The lake is immediately behind a 3-foot concrete retaining on the north side. On the south side, immediately after the guardrail, the embankment (containing a shallow layer of rip rap) slopes down at 1.0V: 1.5V for approximately 15 feet until it meets the wetland associated with the headwaters of the Mad River.

HRP was tasked with performing a hydrologic study, evaluating the hydraulic capacity of the existing dam outflows, and determining a solution to pass a 500-year storm event while maintaining a 1 foot dam freeboard.

3.0 HYDROLOGY ANALYSIS

3.1 Watershed Properties

The measured drainage area of Cedar Lake is 0.91 square miles. The entire drainage area is contained within New Haven County. Parts of the watershed are wooded and undeveloped, while other parts are developed for residential land usage. The watershed curve number of 76 was calculated using a weighted average of the land use within the watershed and the corresponding soil properties found in the NRCS custom soil report (Appendix B). These calculations can be found as Appendix C.

Cedar Lake is located in the middle southern part of the watershed and provides storage for the watershed. The time of concentration was developed using sheet flow, shallow concentrated flow, and lake flow. The calculated time of concentration was 1.5 hours (Appendix D).

3.2 Peak Flow Methods

3.2.1 HEC-HMS

The peak flood flows were also calculated for Cedar Lake Dam using Hydrologic Engineering Center's hydrologic modeling system (HEC-HMS). HEC-HMS is designed to model the precipitation-runoff processes of a watershed system by separating the hydrologic cycle into pieces and constructing boundaries around them.

A model of the watershed and components were developed in HEC-HMS to determine peak discharges for the 2-, 10-, 25-, 50-, 100- and 500-year floods. The sub-basins were modeled using the SCS Curve Number method to represent infiltration in the watershed, the SCS Unit Hydrograph to represent surface runoff, and Recession to represent subsurface processes. Simple Canopy and Simple Surface methods were used to represent initial storage. The 24-hour duration precipitation values were taken from the CT DOT Drainage Manual for the New Haven County and inputted into the model.

3.2.2 FEMA

The site was investigated for available hydrology data. There were no nearby USGS flow gages. A FEMA Flood Insurance Study (FIS) for the New Haven County in Connecticut, effective date December 17, 2010, revised October 16, 2013 is available and was reviewed. The study contains peak discharges for a point on the Mad River at the Scoville Reservoir. The drainage area at this point contains the drainage area of Cedar Lake Dam. Peak discharges for the 10-, 50-, 100-, and 500-year floods were calculated using the empirically developed USGS 1975 Floodflow formulas.

The flows at Scoville Reservoir was used to calculate the proportioned flows based on drainage area for Cedar Lake Dam. The drainage area at the Scoville Reservoir is 5.5 sq. mi. and the drainage area of the Cedar Lake Dam is 0.91 sq. mi. This was used for comparison purposes. Since the flows were for a different discharge point, taking a ratio may not be representative of the actual flows.

3.2.3 Others

StreamStats was used to compute the flows but is not a viable option since it does not meet the minimum drainage area requirement. Hydraflow Hydrographs was also used to model the drainage area. The model uses SCS Method, which is the same method used in HEC-HMS for the loss and transform method. However, HEC-HMS allows other features of the watershed to be represented that cannot be represented in Hydraflow Hydrographs.

3.3 Recommended Peak Flows

The recommended peak flows for the hydraulic analysis are the values calculated by HEC-HMS. This application more accurately depicts the characteristics of the watershed resulting in more conservative and accurate peak flow numbers.

The calculated peak flows from the two methods are shown in Table 1, below. The recommended flows to be used for the hydraulic analysis are the HEC-HMS flows (Appendix E).

Table 1 – Peak Flood Flow Comparisons

Method Used	Drainage Area (sq. mi.)	Discharge Rate (cfs)					
		2-yr	10-yr	25-yr	50-yr	100-yr	500-yr
StreamStats	0.91	73	157	202	246	284	434
HEC-HMS	0.91	19	125	378	557	770	1107
Hydraflow Hydrographs	0.91	249	538	647	777	927	--
FEMA Flood Insurance Study (Scoville Reservoir)	5.5		450		980	1375	1980
FEMA Flood Insurance Study (Cedar Lake based on Drainage Area Ratio)	0.91	--	74	--	162	228	328

The 500-year storm for HEC-HMS is based on a ratio of the FEMA flood storms since the CT DOT Drainage Manual does not provide precipitation data for the 500-year storm.

4.0 HYDRAULIC ANALYSIS

A hydraulic analysis was performed on the existing conditions and the proposed conditions to verify that the proposed conditions would be adequate to pass the 500-year flood with 1 foot of freeboard.

4.1 Pond Storage

The elevation storage numbers used in the HEC-HMS model were derived from GIS topographical information and storage information from the National Inventory of Dams (NID). The NID recorded that the maximum storage is 594 ac-ft and the dam is 12 ft in height. A summary of these numbers are listed in Table 2.

Table 2 – Cedar Lake Elevation-Storage

Elevation (ft)	***Storage (ac-ft)***
893.0 (top of dam)	594.0
892.0	544.5
891.0	495.0
890.0	445.5
889.0	396.0
888.0	346.5
887.0	297.0
886.0	247.5
885.0	198.0
884.0	148.5
883.0	99.0
882.0	49.5
881.0 (bottom of pond)	0

4.2 Normal Water Level Elevation

The normal flow water level elevation is based on water level measurements from previous dam inspections. The normal flow elevation was 3.5” over weir crest or elevation 890.99 feet per September 29, 2011 (Condition Assessment and Repair Evaluations, Cedar Lake Dam, January 2012, Prepared for Cedar Lake Owners Association, Prepared by Karl F. Acimovic, P.E.).

4.3 High Flow Outlet Flows

Flows at various pond elevations were computed using weir equations for the horizontal weir and semicircular weir structure and pipe capacity equations for the box culvert. Table 3 shows the discharge flow at various pond elevations. The capacity of the existing box culvert is 212 cfs. The existing high flow outlet structure is weir controlled.

Table 3 – High Flow Outlet Elevation-Discharge Table

Elevation (ft)	*Discharge (cfs)*
888.7 (El.of Horizontal Weir)	0
889.0	0.98
889.5	4.03
890.0	7.85
890.5	11.98
890.7 (El. of Semicircular Weir)	13.66
891.0	21.64
891.5	44.07
892.0	73.34
892.5	107.68
893.0	146.09

4.4 Analysis of the Existing Dam Outlet Capacities

The existing dam and its high flow outlet structure can pass the 100-year flood with 0.3 feet of freeboard. The analysis assumes that the pond elevation is at normal conditions (890.99).

The dam cannot pass the 500-year flood, under normal conditions. The top of the dam and roadway would be overtopped.

The HEC-HMS output for the existing condition is included as Appendix F.

4.5 Proposed Structures

The proposed conditions were evaluated by routing the 500-year storm event flow through the proposed high flow outlet structure(s) to see which could pass the storm with 1 foot of freeboard. Due to the condition of the existing box culvert, all alternatives include replacing it with a 36" diameter circular PVC pipe. The proposed pipe would be placed in the box culvert and the void spaces would be filled in. The capacity of the proposed 36" diameter circular PVC pipe is 140 cfs.

A few options were analyzed and are summarized in the following sections. The HEC-HMS outputs and Elevation-Discharge rating curves for the proposed alternatives are included as Appendix F.

Alternatives 1 and 2 involve modifications to existing high flow outlet structure. Alternatives 3, 4, and 5 involve construction of an additional high flow outlet structure.

Alternatives 1, 2, and 3 require the drawdown of the lake before a storm event to the elevation of the low flow weir (elev. 888.7). It will take 3 days to draw the lake down from normal conditions (890.99) to the necessary elevation (888.7). Alternative 4 and 5 can pass the 500-year storm event without drawing down the lake prior to the event.

Conclusively, Alternative I is the most cost-effective option and it maintains the purpose of the dam/lake. The requirement to draw down the lake prior to a major storm event is manageable and a better option compared to the alternatives due to the high construction costs associated with an additional high flow outlet structure.

4.5.1 Alternative I

This plan includes modifying the low flow weir from 2 feet to 5 feet. The modified high flow outlet structure will consist of a 5' low flow weir at elevation 888.7 and a 9.15' high flow weir at elevation 890.7.

High Flow Outlet Structure	***Existing***	***Proposed***
Low Flow Weir	*1.85' horizontal weir (Elev. 888.7)*	*5' horizontal weir (Elev. 888.7)*
High Flow Weir	*12.3' semicircular weir (Elev. 890.7)*	*9.15' semicircular weir (Elev. 890.7)*
Culvert	*Box Culvert*	*36" PVC Pipe*

The proposed dam could pass the 500-year flood with 1 foot of freeboard. This alternative requires that the lake be drawn down from the normal conditions surface elevation in advance of any major storm events.

4.5.2 Alternative II

This plan includes modifying the entire high flow, semicircular weir in elevation from 890.7 to 888.7 ft to match the elevation of the low flow weir.

High Flow Outlet Structure	***Existing***	***Proposed***
Low Flow Weir	*1.85' horizontal weir (Elev. 888.7)*	*14.15' horizontal/ semicircular weir (Elev. 888.7)*
High Flow Weir	*12.3' semicircular weir (Elev. 890.7)*	*No high flow weir*
Culvert	*Box Culvert*	*36" PVC Pipe*

The proposed dam could pass the 500-year flood with 1.3 feet of freeboard. This alternative requires that the lake be drawn down from the normal conditions surface elevation in advance of any major storm events.

At elevation 891.5, the structure becomes culvert control rather than weir controlled. It was analyzed and found that increasing the pipe capacity will still not allow the dam to pass the 500-year storm (with a foot of freeboard), without first drawing down the pond. Therefore, there is no benefit in increasing the low flow weir greater than 5 feet in weir length, as described in Alternative I.

4.5.3 Alternative III

This plan is to construct another high flow outlet structure with the same dimensions and configuration and at the same elevations as the existing structure. The dam would be equipped with two high flow outlet structures: the existing one and a proposed one. Both the existing and proposed outlets will have 36" diameter PVC pipe.

The proposed dam can pass the 500-year flood with 1.1 feet of freeboard. This alternative requires that the lake be drawn down from the normal conditions surface elevation in advance of any major storm events. The cost associated with constructing another high flow outlet structure makes this plan undesirable.

4.5.4 Alternative IV

This plan is similar to Alternative III, except the proposed outlet structure will have the weir construction of Alternative II. The proposed outlet structure will have no high flow weir. The entire weir will be 14.15' in length and at elevation 888.7.

The proposed outlet, in combination with the existing outlet, can pass the 500-year flood with 1 foot of freeboard. No drawdown of the lake prior to a major storm event is needed. However, the benefit of not having to draw down the lake does not outweigh the cost associated with construction of an additional outlet structure.

4.5.5 Alternative V

This plan includes the modification of the existing high flow outlet structure as described in Alternative I, in addition to constructing another high flow outlet structure with the same dimensions and configuration.

The modified existing structure and the proposed structure, can pass the 500-year flood with 1.1 foot of freeboard, under normal conditions. This will NOT require the lake to be drawn down before a major storm event. However, as with Alternative V, the construction cost would make this alternative an undesirable option.

FIGURES

EXISTING CONDITIONS SURVEY

NORTH STREET AT CEDAR LAKE DAM
WOLCOTT, CONNECTICUT

REVISIONS

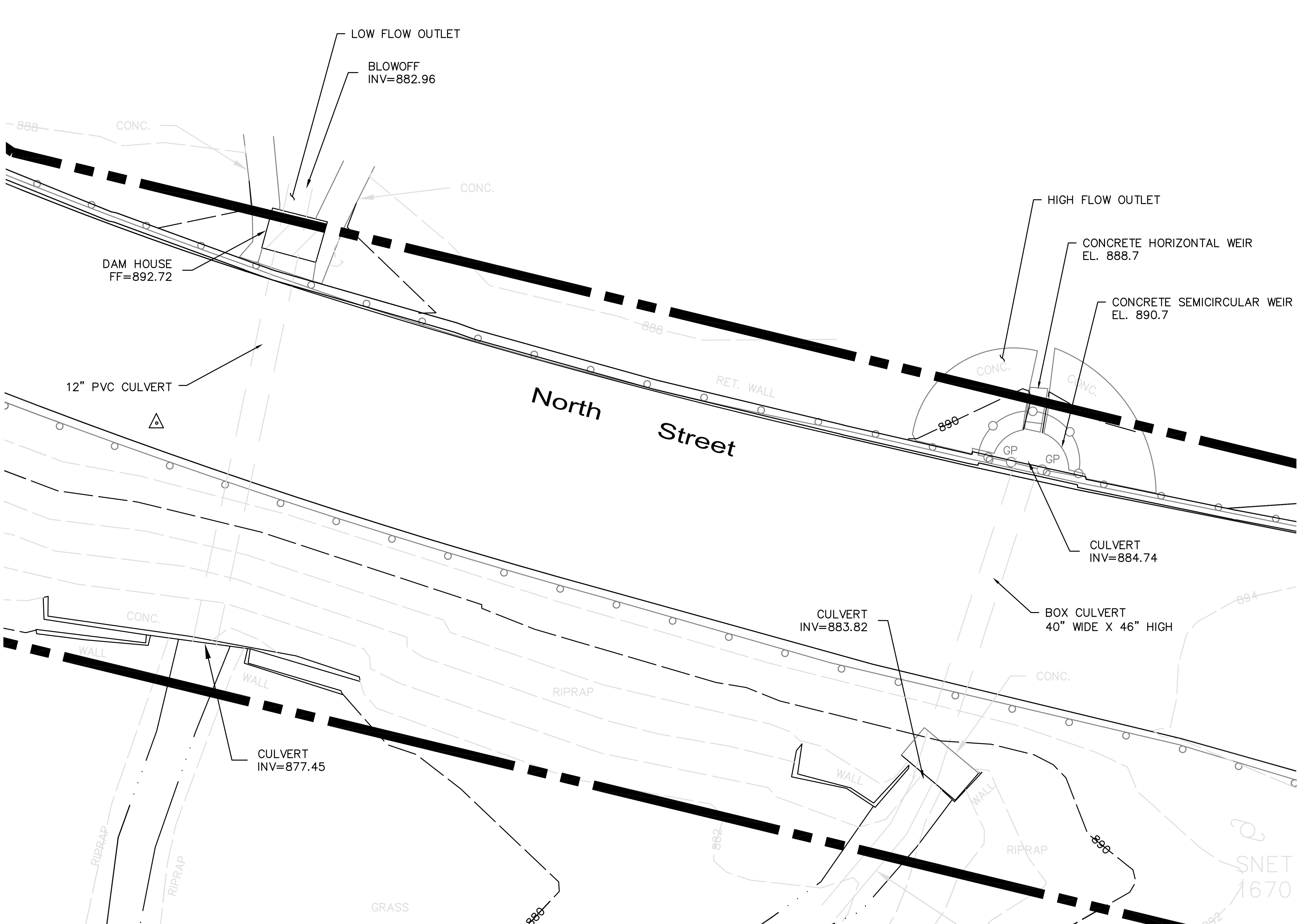
NO.	DATE	DESCRIPTION

HRP Associates, Inc.
Environmental/Civil Engineering & Hydrogeology
Creating the Right Solutions Together
Connecticut, New York, Pennsylvania, South Carolina
197 Scott Swamp Road
Farmington, Connecticut 06032
Ph:(860)674-9570 Fax:(860)674-9624
www.hrpassociates.com

FMS/DFH SURVEYED	FMS APPROVED	1" = 20' SCALE
FMS DRAWN	JULY 13, 2012 DATE	1 of 1 SHEET NO.
FMS CHECKED	WOL2008.CE PROJECT NO.	

J:\W\WOLCT - TOWN OF WOLCOTT\CEDAR LAKE DAM\WOL2008CE\CAD\TopoSurvey-CedarLake.dwg, Existing Conditions, 3/7/2013 2:12:06 PM, ARCH expand D (36.00 x 24.00 Inches), 1:1

DRAWING NAME: J:\W\WOLCT - TOWN OF WOLCOTT\CEDAY LAKE DAM\WOL2015CE\CAD\C0.2 Survey - Outlets.dwg LAYOUT: High Flow Outlet PLOT DATE: Aug 19, 2014 - 10:48am OPERATOR: DOT



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NORTH

0 5' 10'

REVISIONS	
NO.	DATE

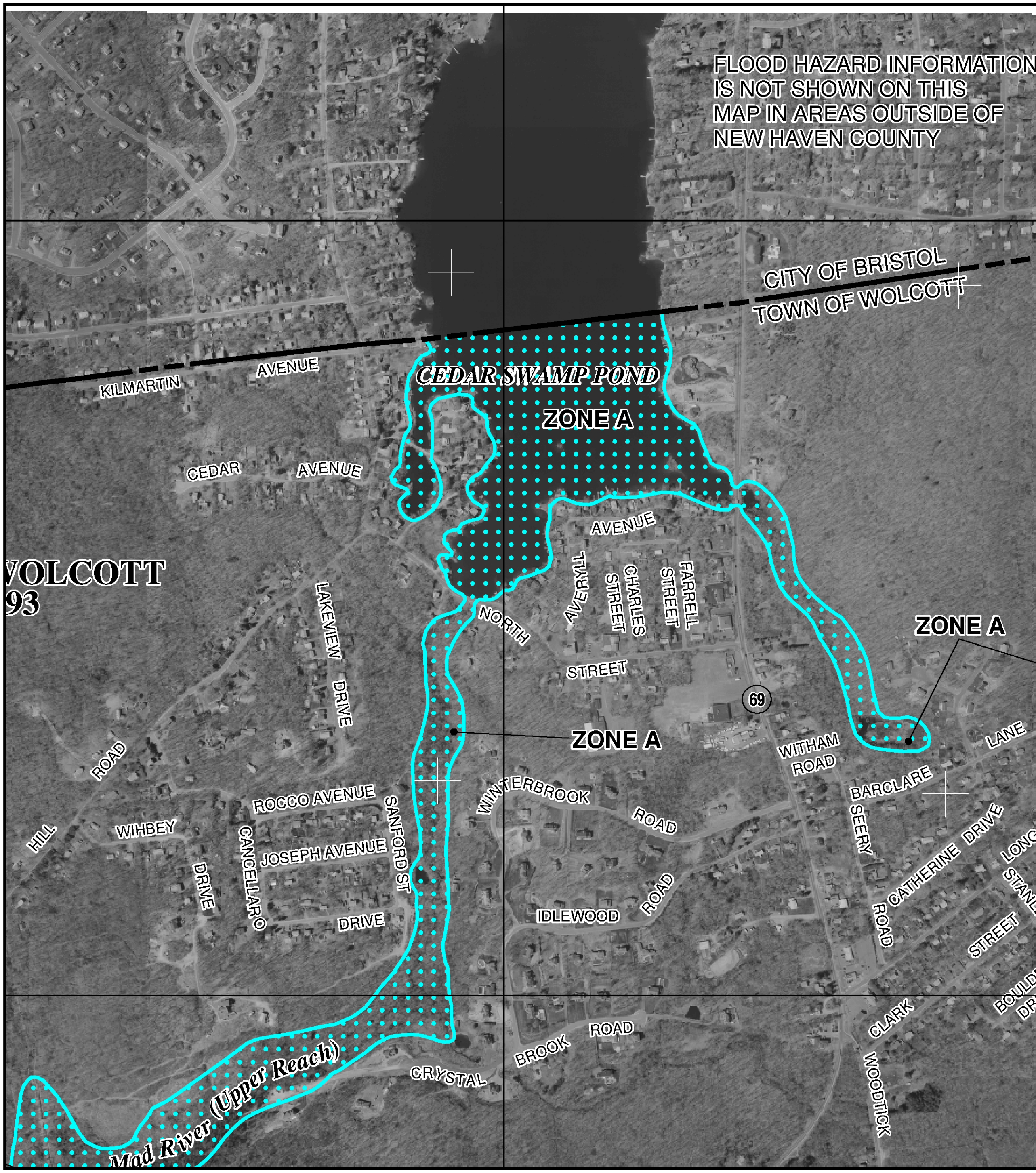
DESIGNED BY: DT
DRAWN BY: DT
REVIEWED BY: TRB

ISSUE DATE: 8/19/2014
PROJECT NUMBER: WOL2015.CE
SHEET SIZE: 11"x17"

LOW AND HIGH FLOW OUTLETS

NORTH STREET
AT CEDAR LAKE DAM
WOLCOTT, CONNECTICUT

SHEET NO.
2



ational Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 1000'

500 0 1000 2000 FEET

METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0040H

FIRM

FLOOD INSURANCE RATE MAP

NEW HAVEN COUNTY, CONNECTICUT

(ALL JURISDICTIONS)

PANEL 40 OF 635

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
WOLCOTT, TOWN OF	090093	0040	H

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER 09009C0040H

EFFECTIVE DATE DECEMBER 17, 2010

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

APPENDICES

APPENDIX A

PHOTOGRAPHS

Photographic Log

Cedar Lake Dam

Photo 1: North Street

Photo 2: Upstream side of Cedar Lake Dam

Photographic Log

Cedar Lake Dam

Photo 3: High Flow Outlet

Photo 4: Horizontal & Semicircular Weir of High Flow Outlet

Photographic Log

Cedar Lake Dam

Photo 5: Box Culvert of High Flow Outlet

Photo 6: Low Flow Outlet

Photographic Log

Cedar Lake Dam

Photo 7: Gate Control for Low Flow Outlet

Photo 8: Dam House

Photographic Log

Cedar Lake Dam

Photo 9: Retaining Wall on upstream side of Dam

Photo 10: Downstream side of Dam/Road Embankment

<u>**Photographic Log**</u>

Cedar Lake Dam

Photo 11: Outflow of Box Culvert (High Flow Outlet)

Photo 12: Box Culvert of High Flow Outlet

<u>**Photographic Log**</u>

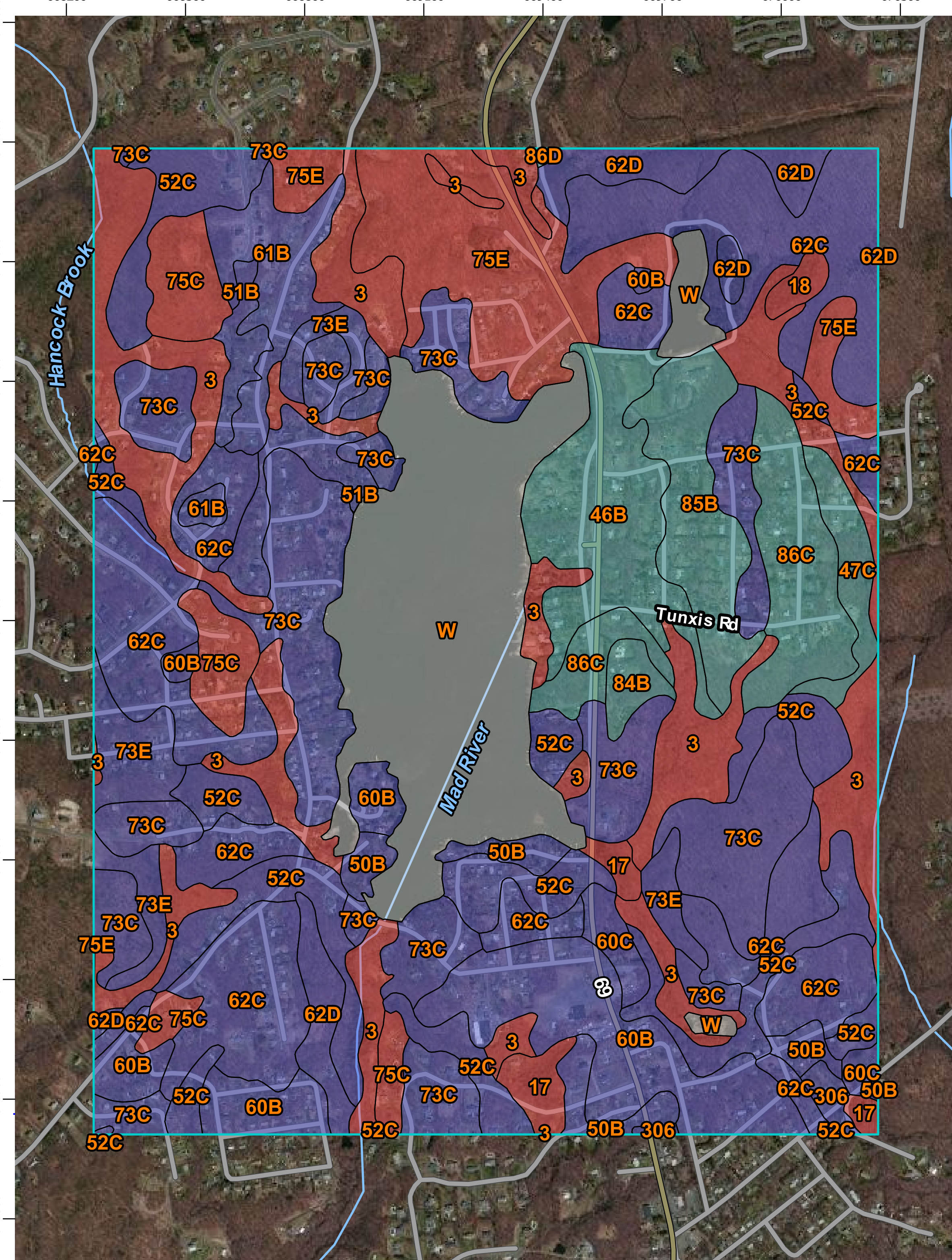
Cedar Lake Dam

Photo 13: Outflow of Low Flow Outlet

Photo 14: Outflow of Low Flow Outlet

APPENDIX B

NRCS SOIL REPORT



Map Scale: 1:15,300 if printed on A portrait (8.5" x 11") sheet.

Meters: 0, 200, 400, 800, 1200

Feet: 0, 500, 1000, 2000, 3000

N

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:12,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: State of Connecticut
Survey Area Data: Version 11, Nov 19, 2013

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Mar 28, 2011—Oct 9, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — State of Connecticut (CT600)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
3	Ridgebury, Leicester, and Whitman soils, extremely stony	D	140.2	11.6%
17	Timakwa and Natchaug soils	D	11.4	0.9%
18	Catden and Freetown soils	D	3.6	0.3%
46B	Woodbridge fine sandy loam, 2 to 8 percent slopes, very stony	C	48.6	4.0%
47C	Woodbridge fine sandy loam, 2 to 15 percent slopes, extremely stony	C	12.1	1.0%
50B	Sutton fine sandy loam, 3 to 8 percent slopes	B	18.2	1.5%
51B	Sutton fine sandy loam, 2 to 8 percent slopes, very stony	B	19.1	1.6%
52C	Sutton fine sandy loam, 2 to 15 percent slopes, extremely stony	B	103.2	8.5%
60B	Canton and Charlton soils, 3 to 8 percent slopes	B	73.6	6.1%
60C	Canton and Charlton soils, 8 to 15 percent slopes	B	8.8	0.7%
61B	Canton and Charlton soils, 3 to 8 percent slopes, very stony	B	27.1	2.2%
62C	Canton and Charlton soils, 3 to 15 percent slopes, extremely stony	B	183.0	15.1%
62D	Canton and Charlton soils, 15 to 35 percent slopes, extremely stony	B	28.4	2.3%
73C	Charlton-Chatfield complex, 3 to 15 percent slopes, very rocky	B	166.1	13.7%
73E	Charlton-Chatfield complex, 15 to 45 percent slopes, very rocky	B	31.6	2.6%

Hydrologic Soil Group— Summary by Map Unit — State of Connecticut (CT600)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
75C	Hollis-Chatfield-Rock outcrop complex, 3 to 15 percent slopes	D	32.1	2.7%
75E	Hollis-Chatfield-Rock outcrop complex, 15 to 45 percent slopes	D	74.3	6.1%
84B	Paxton and Montauk fine sandy loams, 3 to 8 percent slopes	C	6.2	0.5%
85B	Paxton and Montauk fine sandy loams, 3 to 8 percent slopes, very stony	C	33.8	2.8%
86C	Paxton and Montauk fine sandy loams, 3 to 15 percent slopes, extremely stony	C	41.6	3.4%
86D	Paxton and Montauk fine sandy loams, 15 to 35 percent slopes, extremely stony	C	0.4	0.0%
306	Udorthents-Urban land complex	B	3.8	0.3%
W	Water		144.5	11.9%
Totals for Area of Interest			**1,211.7**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Higher

APPENDIX C

RUNOFF CURVE NUMBER CALCULATIONS

Existing Watershed - A1

Project: **Cedar Lake Dam**	BY: **DT**	Date: **07/29/2014**
Location: **North Street, Wolcott, CT**	BY:	Date:

1. Runoff Curve Number (Existing Conditions)

Soil name and hydrologic group	Cover Description	CN Table 2-2	CN Table 2-3	CN Table 2-4	Area* (Acres)	Product of C x Area
Rating B	Woods (Good Condition)	58			169.23	9815.1
Rating B	Open Space (Good Condition)	61			76.22	4649.2
Rating B	Open Space (Poor Condition)	79			14.49	1145.0
Rating C	Woods (Good Condition)	72			41.34	2976.3
Rating C	Open Space (Good Condition)	74			23.65	1750.3
Rating C	Open Space (Poor Condition)	86			11.48	987.1
Rating D	Woods (Good Condition)	79			79.52	6281.9
Rating D	Open Space (Good Condition)	80			6.95	555.8
Rating D	Open Space (Poor Condition)	89			1.07	94.9
	Impervious	98			31.90	3126.7
	Water Body	100			126.26	12626.3
					Totals: 582.10	44008.6

Table 2-2, 2-3 & Figure 2-4: Urban Hydrology for Small Watersheds TR-55

Square Miles: 0.910

CN (weighted)= $\frac{\text{Total Product}}{\text{Total Area}}$ = **Use C:** 76

2. Runoff

Frequency . . . . yr	2	5	10	25	50	100
New Haven County Rainfall, P (24 Hour). . . . . .in	3.30	4.20	5.00	5.60	6.30	7.10
S	3	3	3	3	3	3
Runoff, Q. . . . . In	1.20	1.86	2.50	3.00	3.60	4.30
Volume of Runoff: (cu-ft)	2,531,651	3,936,876	5,284,924	6,339,900	7,607,052	9,092,760

$$Q=\frac{(P-0.2S)^2}{(P+0.8S)}$$

$$S=\frac{1000}{CN}\ -10.00$$

* For the purposes of a high-level overview of the existing conditions, areas were approximated as accurately as possible. See supplementary table for further details.

APPENDIX D

TIME OF CONCENTRATION CALCULATIONS

TIME OF CONCENTRATION COMPUTATIONS - CEDAR LAKE DAM

Project: Cedar Lake Dam
Wolcott, CT

Calculations By: DT
Date: 7/30/2014

Project Notes:
The following Tc calculations are based upon preliminary data.

Overland Flow: (Maximum 150 FT)

$$T_t = \frac{0.007(nL)^{0.8}}{(P_2)^{0.5} s^{0.4}}$$ (TR-55 Equation 3-3)

T_t=Travel Time (Hr)
n=Manning's Roughness (TR-55 Table 3-1)
L=Flow Length (ft)
s=slope (ft/ft)

P_2= 2 Year,24-hour Ranfall (in) New Haven County = 3.30

Common Manning n Values for Overland flow

Woods	0.400	Light Underbrush
Pavement	0.011	
Lawns	0.410	Bermuda Grass
Dense Grass	0.240	

Shallow Concentrated Flow:

Unpaved: $V=16.1345(s)^{0.5}$
Paved: $V=20.3284(s)^{0.5}$
T_t = L / 60V

(Conn DOT Equations 6.C.4 & 6.C.5)

T_t=Travel Time (min)
V=Velocity (ft/s)
s=slope (ft/ft)

Open Channel\Swale Flow:

$$V = \frac{1.49 r^{\frac{2}{3}} s^{\frac{1}{2}}}{n}$$ (TR-55 Equation 3-4)

T_t = L / 60V

T_t=Travel Time (min)
n=Manning's Roughness
L=Flow Length (ft)
V=Velocity (ft/s)
s=slope (ft/ft)
r= hydraulic radius (a/pw)
a=cross-section area (ft^2)
p_w=wetted perimeter (ft)

Common Manning n Values for Open Channel Flow
2000 ConnDOT Drainage Manual Table 7-1
Natural Streams, type 1.a.4., n= 0.045
Natural Streams, type 1.a.7., n= 0.070

Reservoir/Lake Flow:

$V_w=(gD_m)^{0.5}$ (Conn DOT Equation 6.C.7)

T_t = L / 60V

V_w=wave velocity across the water (ft/s) (8-30 ft/s)
g=32.2 ft/s^2
D_m=mean depth of lake or reservoir (ft)

Minimum allowable T_c = 5.00 min.

		Overland Sheet Flow				Overland Shallow Flow					Open Channel Flow							Reservoir or Lake Flow					Total
Design Point	Basin(s)	n	L (ft)	S (%)	T_o (min)	Paved (Y or N)	L (ft)	S (%)	V (ft/s)	T_1 (min)	n	Area (s.f.)	Wet. Perim. (ft)	S (%)	V(full flow) (ft/s)	L (ft)	Ts (min)	g	D_m (ft)	Vw (ft/s)	L (ft)	Tp (min)	T (min)
A	A1	0.410	300	1.33	61.09	N	833	4.80	3.54	3.93	*Location of an existing stream not field verified. Assuming overland*							32.20	4.50	12.04	2150.00	2.98	
						N	2234	1.34	1.87	19.91	*shallow flow generates a shorter Tc (thus more conservative)*												
				Subtotal	61.09				Subtotal	23.84						Subtotal	0.00				Subtotal	2.98	87.90
																						Total Tc	87.90

APPENDIX E

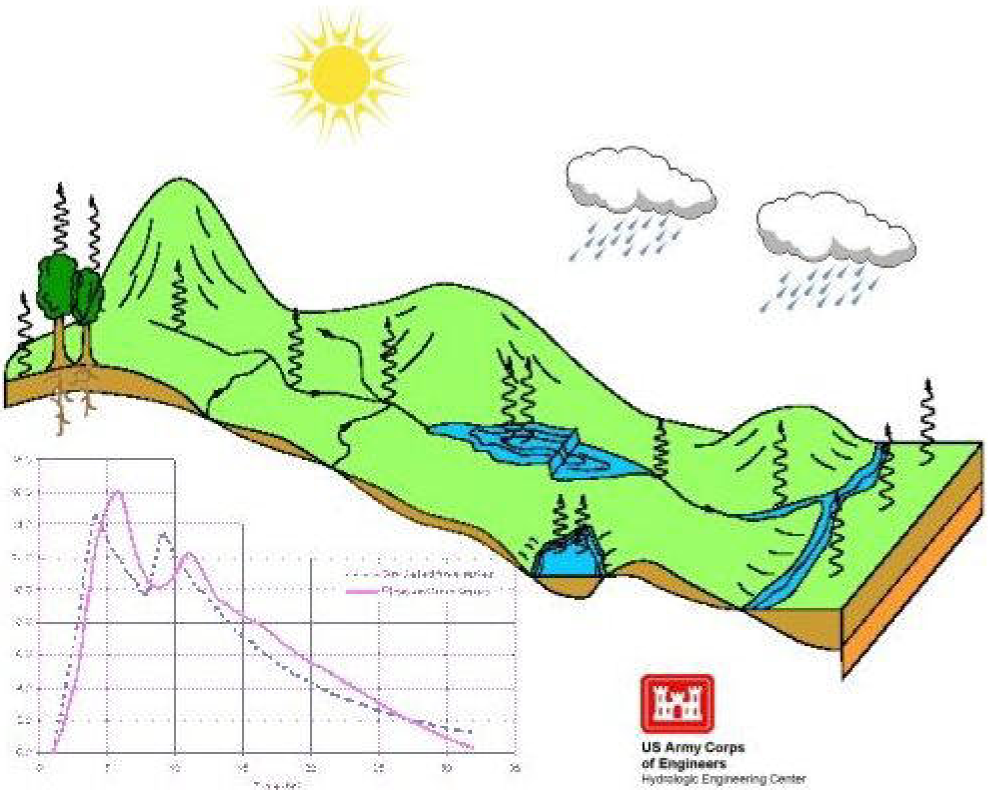
HEC-HMS HYDROLOGIC RESULTS

HEC-HMS Hydrologic Results

Project: Cedar Lake Dam

Wolcott, Connecticut

August 2014



HRP *Associates, Inc.*

ENVIRONMENTAL/CIVIL ENGINEERING & HYDROGEOLOGY

197 Scott Swamp Road

Farmington, CT 06032

(860) 674-9570

HEC-HMS Hydrologic Results

Project: Cedar Lake Dam

Storm Frequency: 2-Year

Project: Cedar Lake Dam CAL   Simulation Run: 2 Year

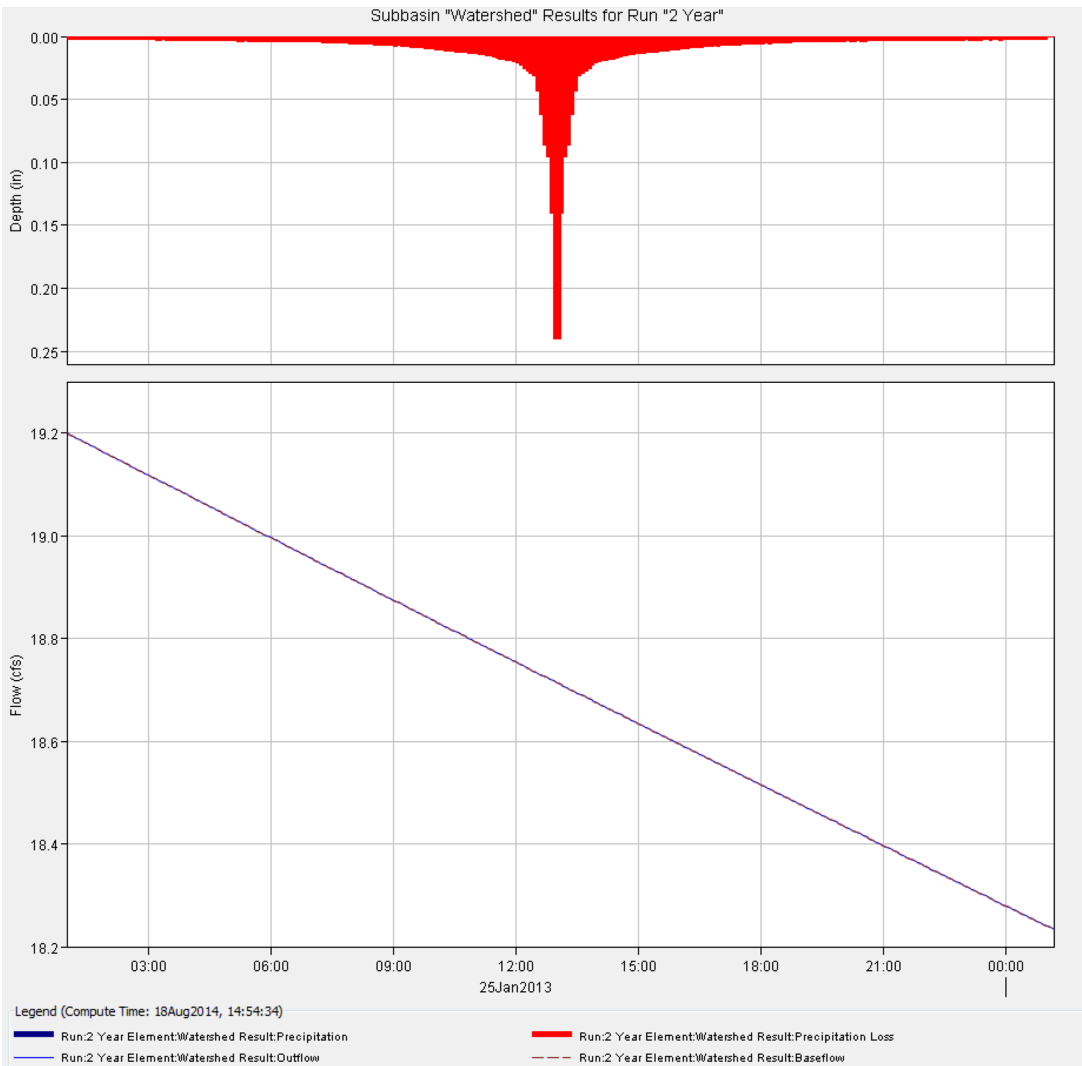
Subbasin: Watershed

Start of Run:	25Jan2013, 01:00	Basin Model:	Cedar Lake
End of Run:	26Jan2013, 01:10	Meteorologic Model:	2 Year
Compute Time:	18Aug2014, 14:54:34	Control Specifications:	Control 1

Volume Units: (•) IN ( ) AC-FT

Computed Results

Peak Discharge:	19.2 (CFS)	Date/Time of Peak Discharge:	25Jan2013, 01:00
Precipitation Volume:	3.30 (IN)	Direct Runoff Volume:	0.00 (IN)
Loss Volume:	3.30 (IN)	Baseflow Volume:	0.77 (IN)
Excess Volume:	0.00 (IN)	Discharge Volume:	0.77 (IN)



HEC-HMS Hydrologic Results

Project: Cedar Lake Dam

Storm Frequency: 10-Year

Project: Cedar Lake Dam CAL Simulation Run: 10 Year

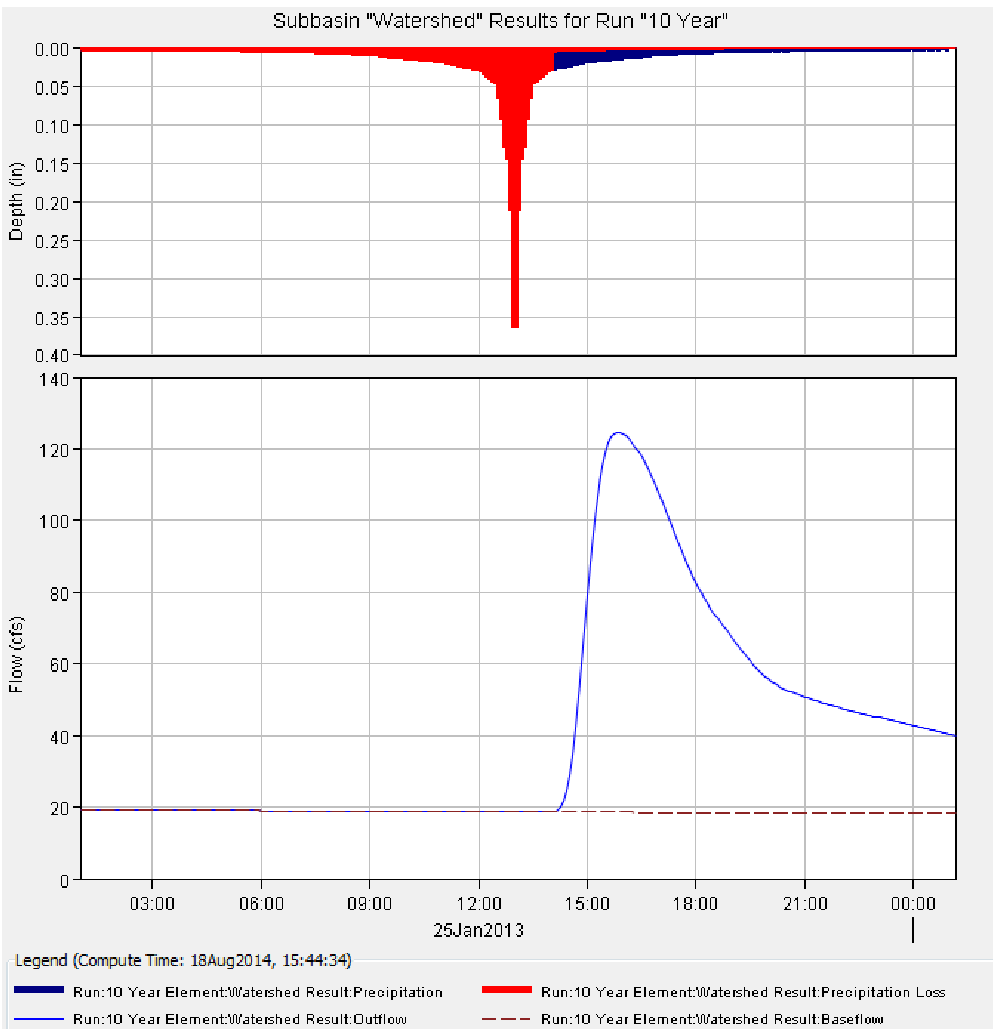
Subbasin: Watershed

Start of Run:	25Jan2013, 01:00	Basin Model:	Cedar Lake
End of Run:	26Jan2013, 01:10	Meteorologic Model:	10 Year
Compute Time:	18Aug2014, 15:44:34	Control Specifications:	Control 1

Volume Units: (•) IN ( ) AC-FT

Computed Results

Peak Discharge:	124.6 (CFS)	Date/Time of Peak Discharge:	25Jan2013, 15:50
Precipitation Volume:	5.00 (IN)	Direct Runoff Volume:	0.90 (IN)
Loss Volume:	4.06 (IN)	Baseflow Volume:	0.77 (IN)
Excess Volume:	0.94 (IN)	Discharge Volume:	1.67 (IN)



HEC-HMS Hydrologic Results

Project: Cedar Lake Dam

Storm Frequency: 25-Year

Project: Cedar Lake Dam CAL   Simulation Run: 25 Year

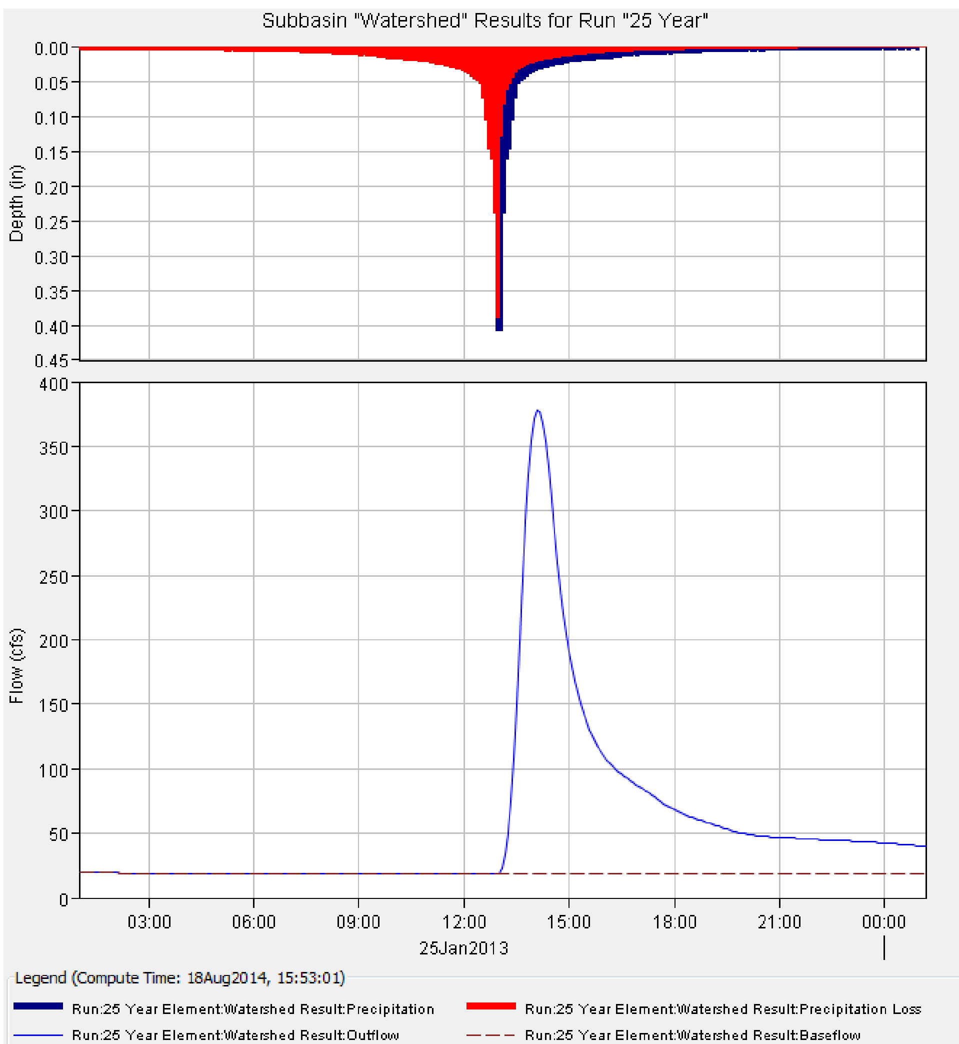
Subbasin: Watershed

Start of Run:	25Jan2013, 01:00	Basin Model:	Cedar Lake
End of Run:	26Jan2013, 01:10	Meteorologic Model:	25 Year
Compute Time:	18Aug2014, 15:53:01	Control Specifications:	Control 1

Volume Units: (•) IN ( ) AC-FT

Computed Results

Peak Discharge:	378.4 (CFS)	Date/Time of Peak Discharge:	25Jan2013, 14:05
Precipitation Volume:	5.60 (IN)	Direct Runoff Volume:	1.54 (IN)
Loss Volume:	4.02 (IN)	Baseflow Volume:	0.77 (IN)
Excess Volume:	1.58 (IN)	Discharge Volume:	2.31 (IN)



HEC-HMS Hydrologic Results

Project: Cedar Lake Dam

Storm Frequency: 50-Year

Project: Cedar Lake Dam CAL Simulation Run: 50 Year

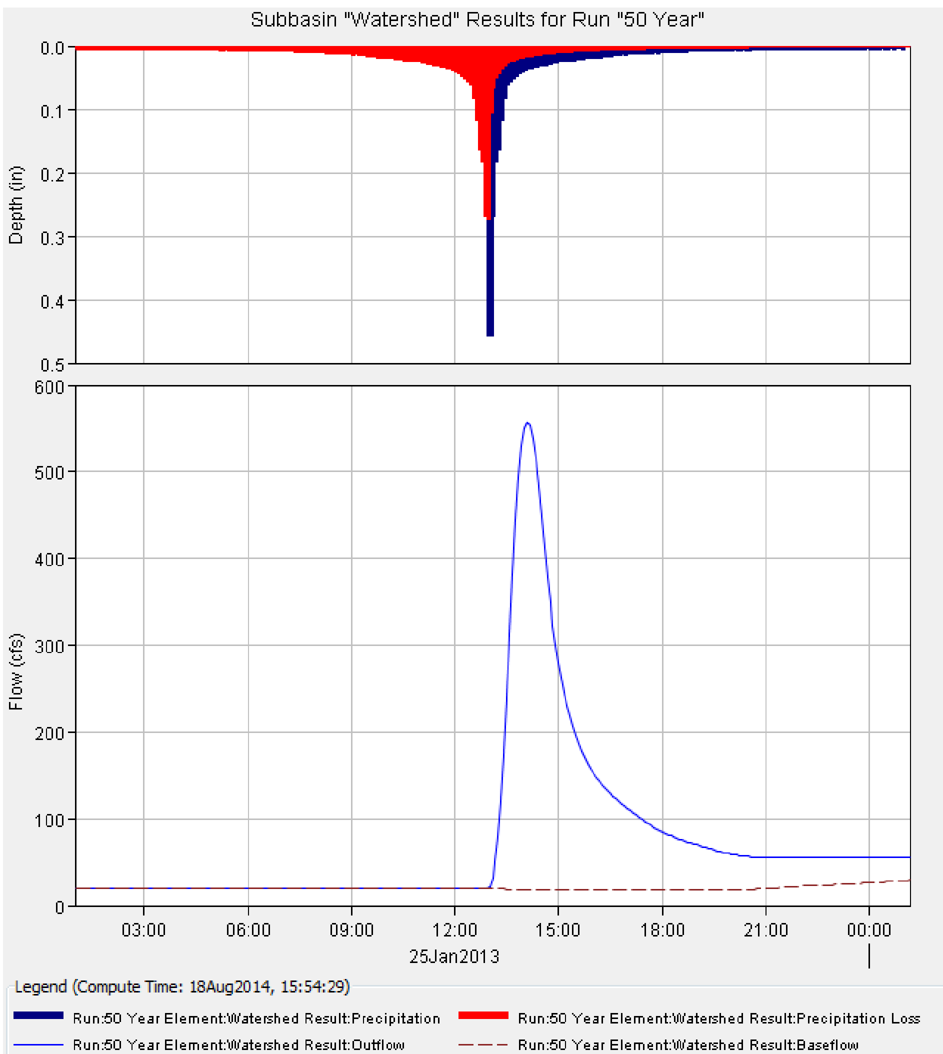
Subbasin: Watershed

Start of Run:	25Jan2013, 01:00	Basin Model:	Cedar Lake
End of Run:	26Jan2013, 01:10	Meteorologic Model:	50 Year
Compute Time:	18Aug2014, 15:54:29	Control Specifications:	Control 1

Volume Units: (•) IN ( ) AC-FT

Computed Results

Peak Discharge:	557.4 (CFS)	Date/Time of Peak Discharge:	25Jan2013, 14:05
Precipitation Volume:	6.30 (IN)	Direct Runoff Volume:	2.23 (IN)
Loss Volume:	4.03 (IN)	Baseflow Volume:	0.81 (IN)
Excess Volume:	2.27 (IN)	Discharge Volume:	3.04 (IN)



HEC-HMS Hydrologic Results
Project: Cedar Lake Dam

Storm Frequency: 100-Year

Project: Cedar Lake Dam CAL   Simulation Run: 100 yr

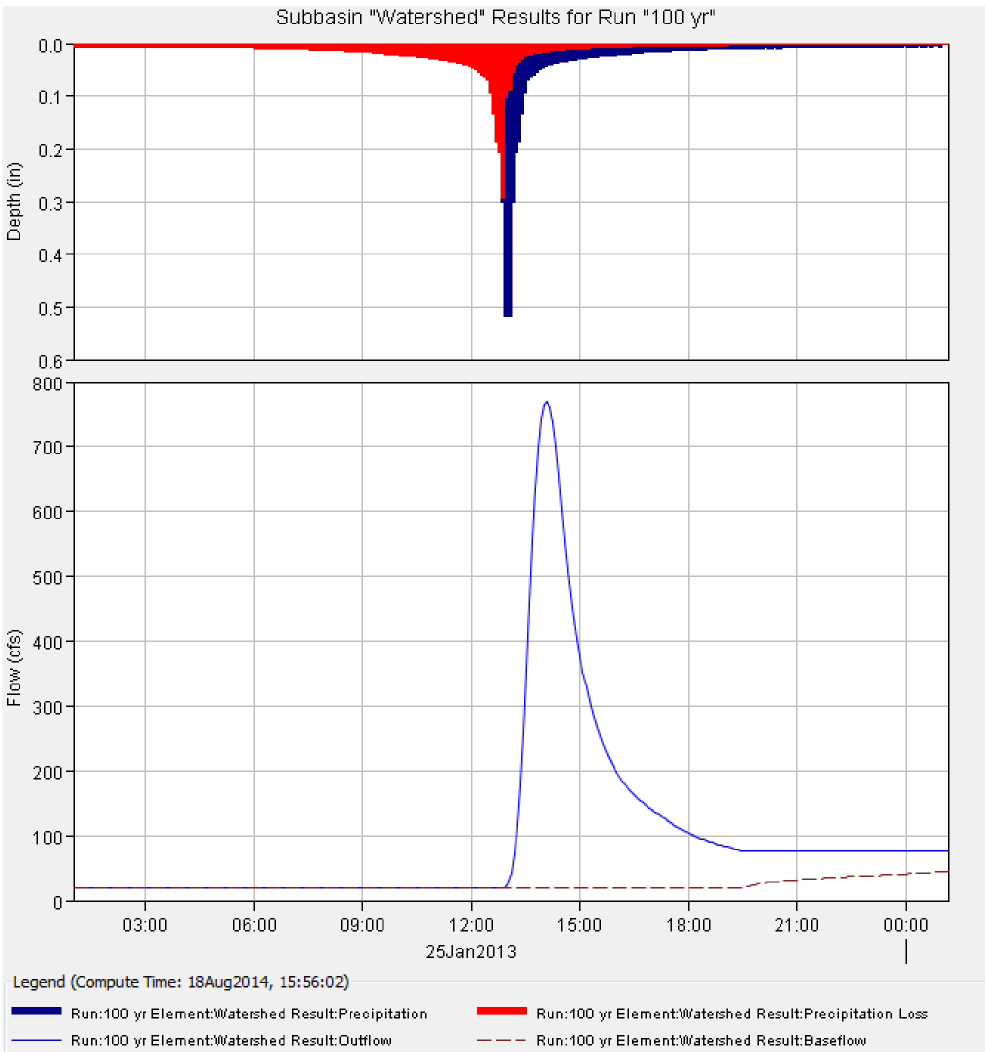
Subbasin: Watershed

Start of Run:	25Jan2013, 01:00	Basin Model:	Cedar Lake
End of Run:	26Jan2013, 01:10	Meteorologic Model:	100 yr
Compute Time:	18Aug2014, 15:56:02	Control Specifications:	Control 1

Volume Units: (●) IN ( ) AC-FT

Computed Results

Peak Discharge:	769.6 (CFS)	Date/Time of Peak Discharge:	25Jan2013, 14:05
Precipitation Volume:	7.10 (IN)	Direct Runoff Volume:	3.02 (IN)
Loss Volume:	4.03 (IN)	Baseflow Volume:	0.93 (IN)
Excess Volume:	3.07 (IN)	Discharge Volume:	3.95 (IN)



HEC-HMS Hydrologic Results

Project: Cedar Lake Dam

Storm Frequency: 500-Year

Project: Cedar Lake Dam CAL   Simulation Run: 500 Year

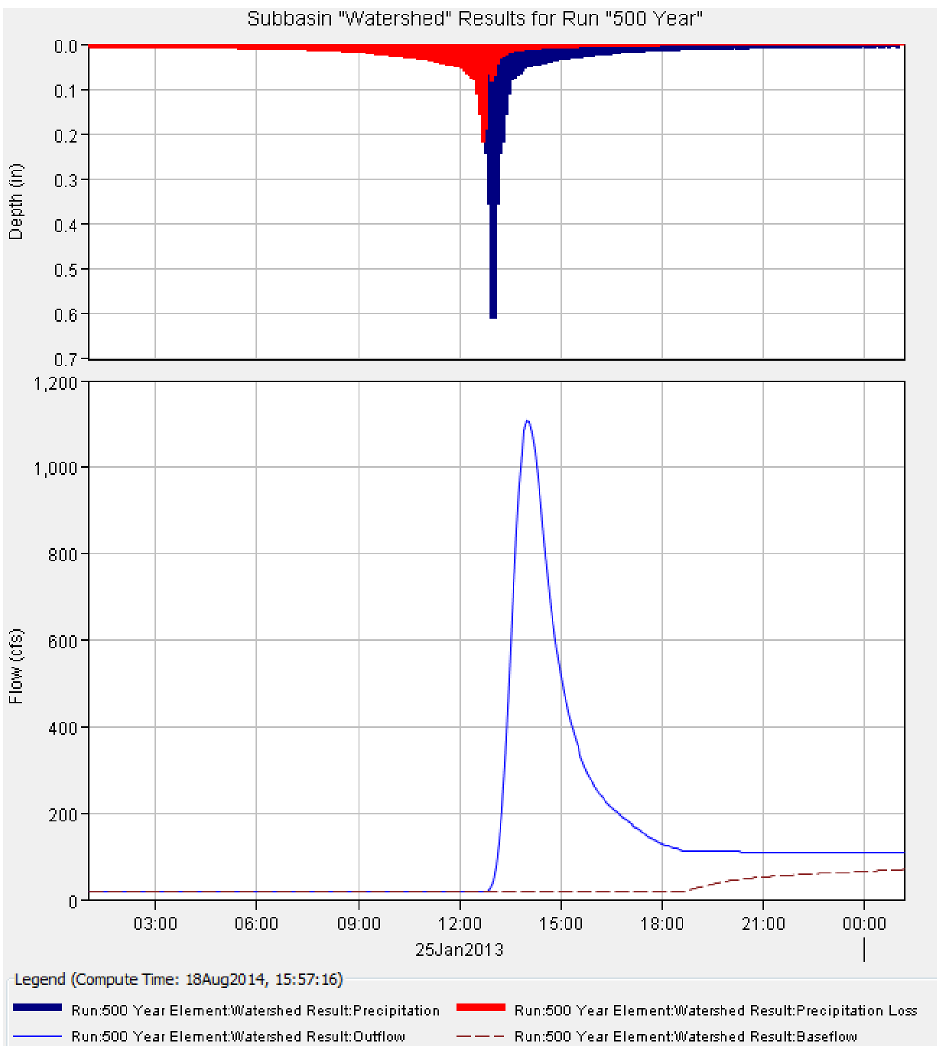
Subbasin: Watershed

Start of Run:	25Jan2013, 01:00	Basin Model:	Cedar Lake
End of Run:	26Jan2013, 01:10	Meteorologic Model:	500 Year (StreamStats)
Compute Time:	18Aug2014, 15:57:16	Control Specifications:	Control 1

Volume Units: IN AC-FT

Computed Results

Peak Discharge:	1107.0 (CFS)	Date/Time of Peak Discharge:	25Jan2013, 14:00
Precipitation Volume:	8.35 (IN)	Direct Runoff Volume:	4.24 (IN)
Loss Volume:	4.04 (IN)	Baseflow Volume:	1.16 (IN)
Excess Volume:	4.31 (IN)	Discharge Volume:	5.40 (IN)



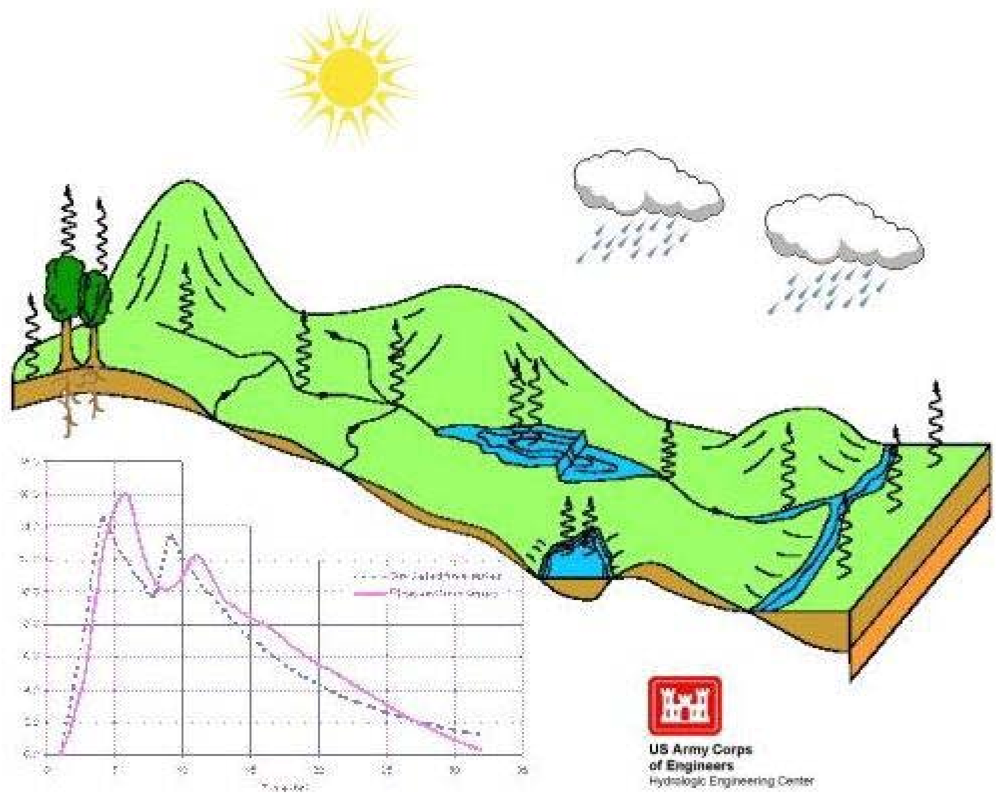
APPENDIX F

HEC-HMS OUPUT

HEC-HMS Output
Project: Cedar Lake Dam

Wolcott, Connecticut

August 2014



HRP *Associates, Inc.*

ENVIRONMENTAL/CIVIL ENGINEERING & HYDROGEOLOGY

197 Scott Swamp Road

Farmington, CT 06032

(860) 674-9570

HEC-HMS Output
Project: Cedar Lake Dam

Existing Conditions: 100-Year

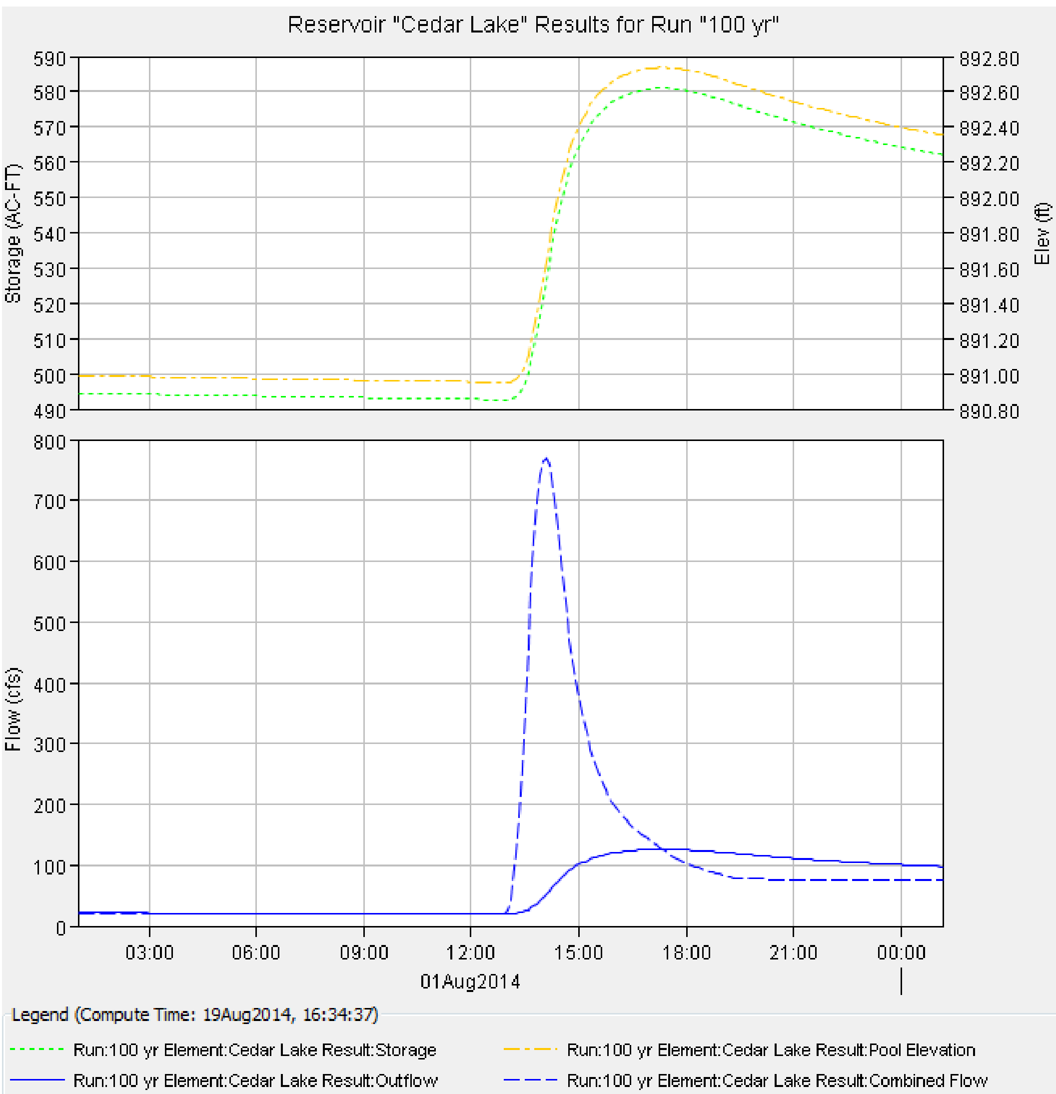
Project: Cedar Lake Dam Existing   Simulation Run: 100 yr
Reservoir: Cedar Lake

Start of Run:	01Aug2014, 01:00	Basin Model:	Cedar Lake
End of Run:	02Aug2014, 01:10	Meteorologic Model:	100 yr
Compute Time:	19Aug2014, 16:34:37	Control Specifications:	Control 1

Volume Units: (•) IN ( ) AC-FT

Computed Results

Peak Inflow:	769.6 (CFS)	Date/Time of Peak Inflow:	01Aug2014, 14:05
Peak Discharge:	125.8 (CFS)	Date/Time of Peak Discharge:	01Aug2014, 17:20
Inflow Volume:	3.95 (IN)	Peak Storage:	581.0 (AC-FT)
Discharge Volume:	2.56 (IN)	Peak Elevation:	892.7 (FT)



HEC-HMS Output

Project: Cedar Lake Dam

Existing Conditions: 500-Year

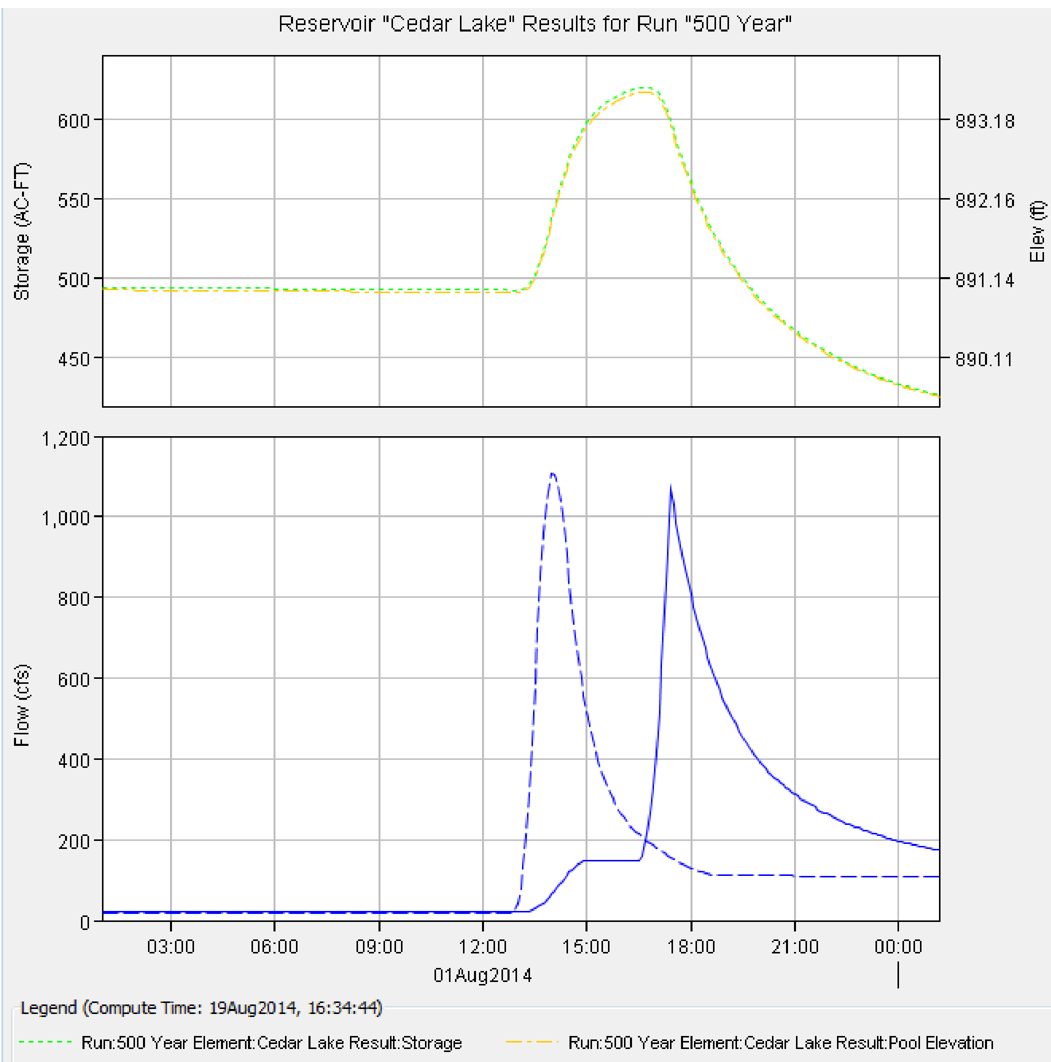
Project: Cedar Lake Dam Existing   Simulation Run: 500 Year
Reservoir: Cedar Lake

Start of Run:	01Aug2014, 01:00	Basin Model:	Cedar Lake
End of Run:	02Aug2014, 01:10	Meteorologic Model:	500 Year (StreamStats)
Compute Time:	19Aug2014, 16:34:44	Control Specifications:	Control 1

Volume Units: (•) IN ( ) AC-FT

Computed Results

Peak Inflow:	1107.0 (CFS)	Date/Time of Peak Inflow:	01Aug2014, 14:00
Peak Discharge:	1067.8 (CFS)	Date/Time of Peak Discharge:	01Aug2014, 17:25
Inflow Volume:	5.40 (IN)	Peak Storage:	620.0 (AC-FT)
Discharge Volume:	6.79 (IN)	Peak Elevation:	893.5 (FT)



HEC-HMS Output
Project: Cedar Lake Dam

Alternative 1 - Proposed Conditions: 500-Year

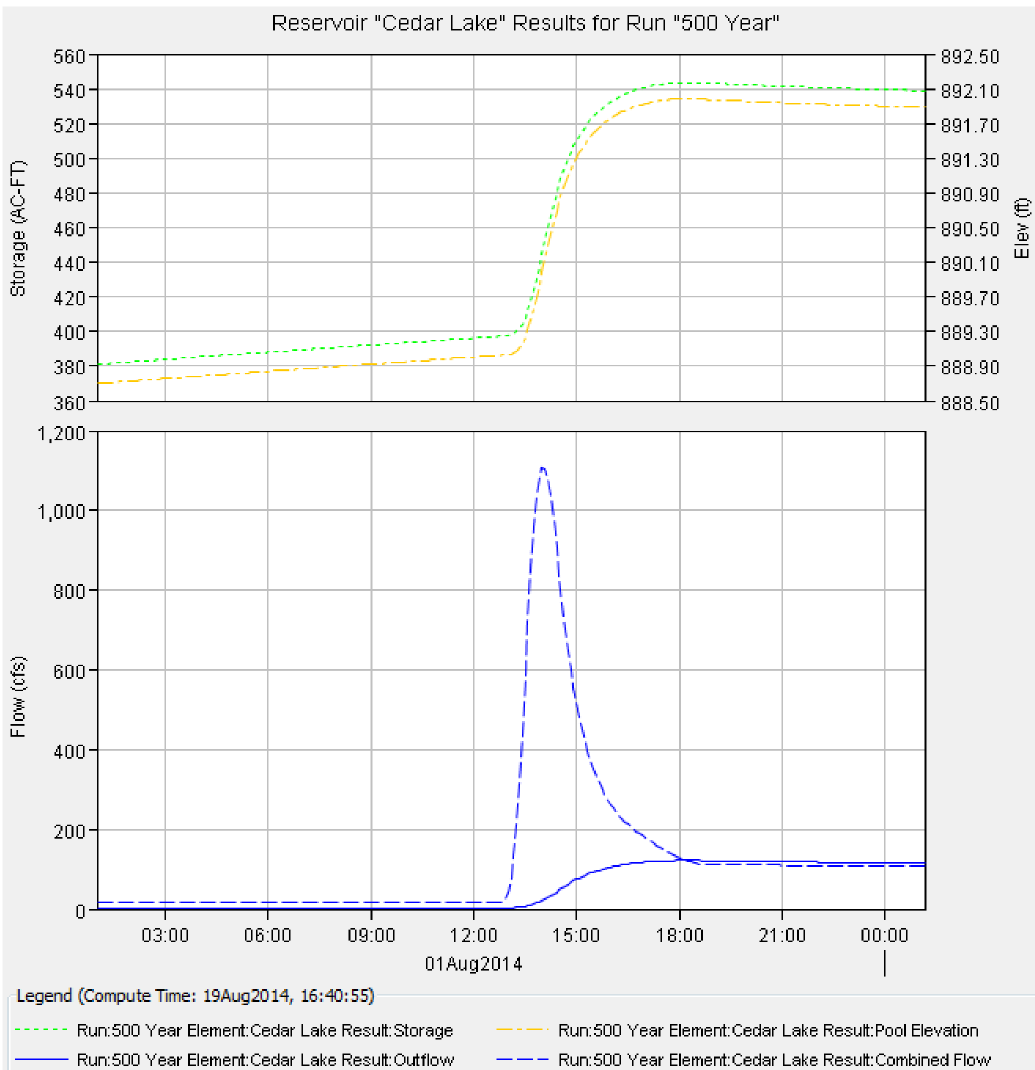
Project: Cedar Lake Dam Existing   Simulation Run: 500 Year
Reservoir: Cedar Lake

Start of Run:	01Aug2014, 01:00	Basin Model:	Cedar Lake
End of Run:	02Aug2014, 01:10	Meteorologic Model:	500 Year (StreamStats)
Compute Time:	19Aug2014, 16:40:55	Control Specifications:	Control 1

Volume Units: (•) IN ( ) AC-FT

Computed Results

Peak Inflow:	1107.0 (CFS)	Date/Time of Peak Inflow:	01Aug2014, 14:00
Peak Discharge:	122.2 (CFS)	Date/Time of Peak Discharge:	01Aug2014, 18:15
Inflow Volume:	5.40 (IN)	Peak Storage:	543.6 (AC-FT)
Discharge Volume:	2.15 (IN)	Peak Elevation:	892.0 (FT)



ELEVATION-DISCHARGE TABLES

High Flow Outlet Structure
Alternative I

Project: Cedar Lake Dam
Wolcott, CT

Calculations By: DT
Date: 8/19/2014

HRP *Associates, Inc.*

Low Flow - Contracted Horizontal Weir

$Q=3.33 * (L_2-0.2H2)*H2^{3/2}$

L2 (ft) 6 ft
Elevation 888.7

High Flow - Semicircular Weir

$Q=2.72 * L1 *(H1^{3/2})$

Radius =4.5 feet
Arc Length=14.1 feet
Adusted Arc length 8.15 ft (adjust arc length to account for horizontal weir)
Elevation 890.7

Pipe Capacity - Proposed 36" PVC Pipe

$Q=[(1.486)(A)(R^{2/3})(S^{1/2})] /n$

where Q = pipe capacity (cfs)
n = manning's n
A = cross-sectional flow area of the pipe (sf)
R = hydraulic radius, R=A/P (ft)
P = wetted perimeter (ft); pipe inside circumference
S = pipe slope (feet/foot)

n = 0.010
A = 7.07 sf
P = 9.42 ft
R = 0.75 ft
S = 0.026 feet/foot
Q = 139.8 cfs

	Elevation	Contracted Horizontal Weir Flow	Semicircular Weir Flow	Combined Flow	Culvert Capacity	Weir or Culvert Control?	Discharge
		(cfs)	(cfs)	(cfs)	(cfs)		(cfs)
Elev. of low flow weir	888.70	0.00	0.00	0.00	139.81	Weir	0.00
	889.00	3.25	0.00	3.25	139.81	Weir	3.25
	889.50	13.92	0.00	13.92	139.81	Weir	13.92
	890.00	28.33	0.00	28.33	139.81	Weir	28.33
	890.50	45.36	0.00	45.36	139.81	Weir	45.36
Elev. of high flow weir	890.70	52.74	0.00	52.74	139.81	Weir	52.74
	891.00	64.35	3.64	67.99	139.81	Weir	67.99
	891.50	84.88	15.86	100.74	139.81	Weir	100.74
	892.00	106.60	32.86	139.46	139.81	Weir	139.46
	892.50	129.26	53.53	182.79	139.81	Culvert	139.81
	893.00	152.62	77.32	229.94	139.81	Culvert	139.81

HEC-HMS Output
Project: Cedar Lake Dam

Alternative 2 - Proposed Conditions: 500-Year

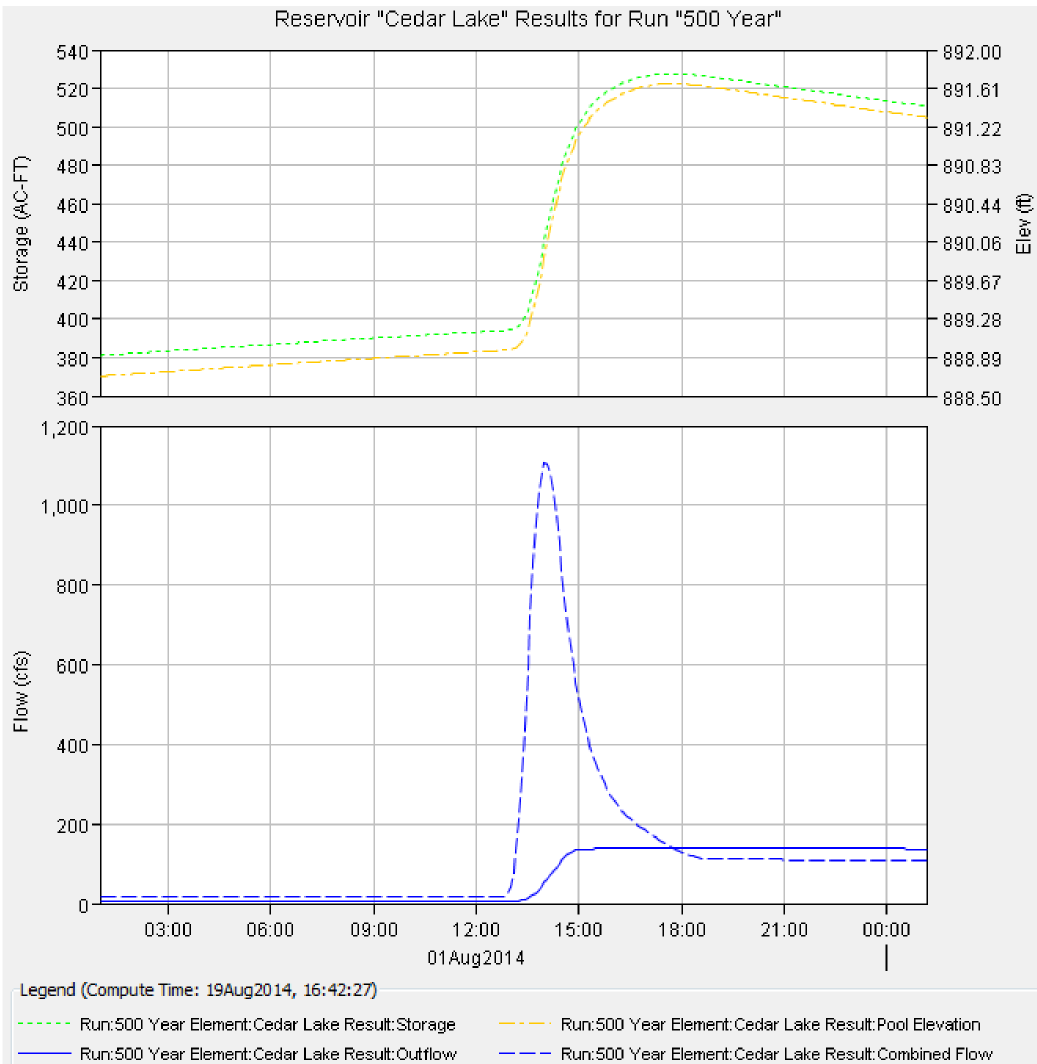
Project: Cedar Lake Dam Existing Simulation Run: 500 Year
Reservoir: Cedar Lake

Start of Run:	01Aug2014, 01:00	Basin Model:	Cedar Lake
End of Run:	02Aug2014, 01:10	Meteorologic Model:	500 Year (StreamStats)
Compute Time:	19Aug2014, 16:42:27	Control Specifications:	Control 1

Volume Units: (•) IN ( ) AC-FT

Computed Results

Peak Inflow:	1107.0 (CFS)	Date/Time of Peak Inflow:	01Aug2014, 14:00
Peak Discharge:	139.8 (CFS)	Date/Time of Peak Discharge:	01Aug2014, 16:00
Inflow Volume:	5.40 (IN)	Peak Storage:	527.6 (AC-FT)
Discharge Volume:	2.73 (IN)	Peak Elevation:	891.7 (FT)



ELEVATION-DISCHARGE TABLES

High Flow Outlet Structure
Alternative II

Project: Cedar Lake Dam
Wolcott, CT

Calculations By: DT
Date: 8/19/2014

HRP *Associates, Inc.*

Low Flow - Contracted Horizontal Weir

$Q=3.33 * (L_2-0.2H2)*H2^{3/2}$

L2 (ft) 1.85 ft
Elevation 888.7

High Flow - Semicircular Weir

$Q=2.72 * L1 *(H1^{3/2})$

Radius =4.5 feet
Arc Length=14.1 feet
Adusted Arc length 12.3 ft (adjust arc length to account for horizontal weir)
Elevation 888.7

Pipe Capacity - Proposed 36" PVC Pipe

$Q=[(1.486)(A)(R^{2/3})(S^{1/2})] /n$

where Q = pipe capacity (cfs)
n = manning's n
A = cross-sectional flow area of the pipe (sf)
R = hydraulic radius, R=A/P (ft)
P = wetted perimeter (ft); pipe inside circumference
S = pipe slope (feet/foot)

n = 0.010
A = 7.07 sf
P = 9.42 ft
R = 0.75 ft
S = 0.026 feet/foot
Q = 139.8 cfs

	Elevation	Contracted Horizontal Weir Flow	Semicircular Weir Flow	Combined Flow	Culvert Capacity	Weir or Culvert Control?	Discharge
		(cfs)	(cfs)	(cfs)	(cfs)		(cfs)
Elev. of low flow weir	888.70	0.00	0.00	0.00	139.81	Weir	0.00
	889.00	0.98	5.50	6.48	139.81	Weir	6.48
	889.50	4.03	23.94	27.97	139.81	Weir	27.97
	890.00	7.85	49.59	57.44	139.81	Weir	57.44
	890.50	11.98	80.79	92.78	139.81	Weir	92.78
Elev. of high flow weir	890.70	13.66	94.63	108.28	139.81	Weir	108.28
	891.00	16.15	116.70	132.84	139.81	Weir	132.84
	891.50	20.13	156.75	176.88	139.81	Culvert	139.81
	892.00	23.76	200.56	224.32	139.81	Culvert	139.81
	892.50	26.89	247.83	274.71	139.81	Culvert	139.81
	893.00	29.40	298.32	327.71	139.81	Culvert	139.81

HEC-HMS Output
Project: Cedar Lake Dam

Alternative 3 - Proposed Conditions: 500-Year

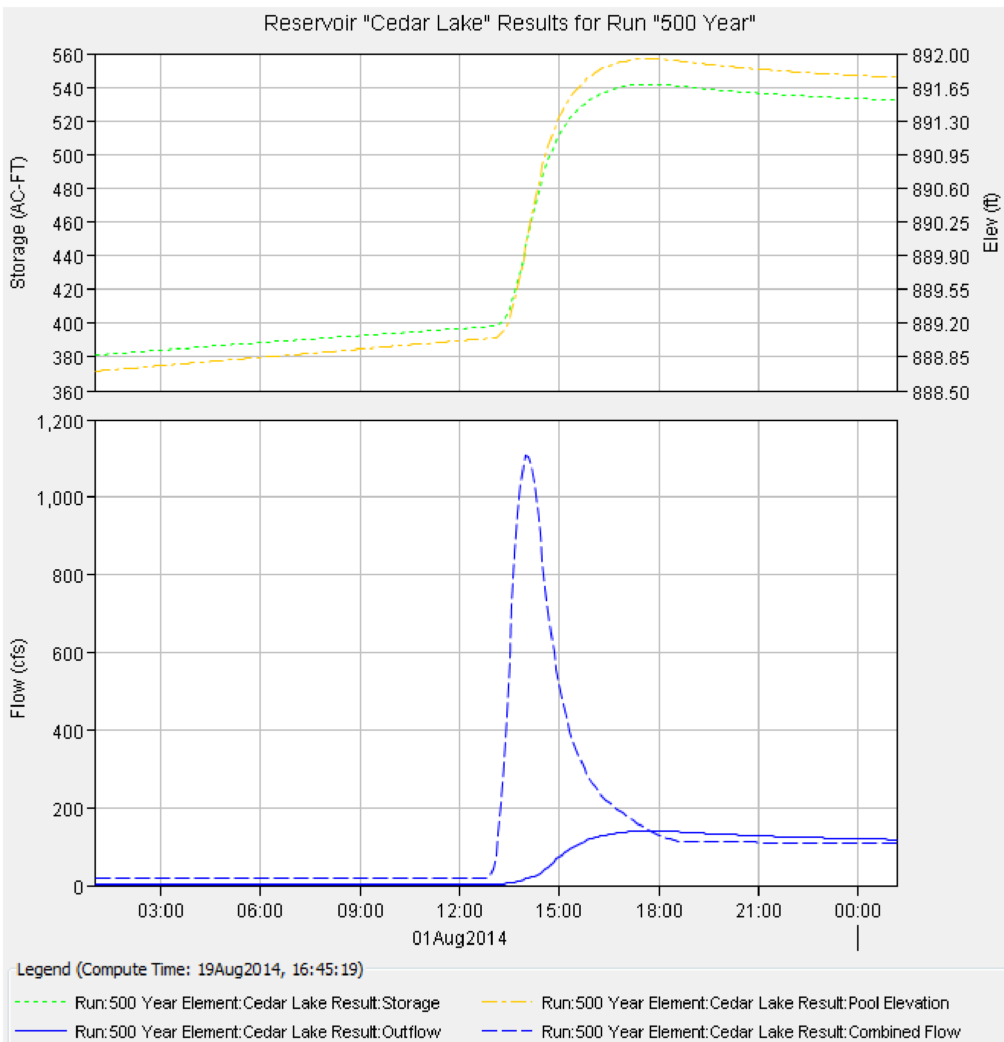
Project: Cedar Lake Dam Existing   Simulation Run: 500 Year
Reservoir: Cedar Lake

Start of Run:	01Aug2014, 01:00	Basin Model:	Cedar Lake
End of Run:	02Aug2014, 01:10	Meteorologic Model:	500 Year (StreamStats)
Compute Time:	19Aug2014, 16:45:19	Control Specifications:	Control 1

Volume Units: (•) IN ( ) AC-FT

Computed Results

Peak Inflow:	1107.0 (CFS)	Date/Time of Peak Inflow:	01Aug2014, 14:00
Peak Discharge:	140.1 (CFS)	Date/Time of Peak Discharge:	01Aug2014, 17:45
Inflow Volume:	5.40 (IN)	Peak Storage:	541.7 (AC-FT)
Discharge Volume:	2.29 (IN)	Peak Elevation:	891.9 (FT)



HEC-HMS Output

Project: Cedar Lake Dam

Alternative 4 - Proposed Conditions: 500-Year

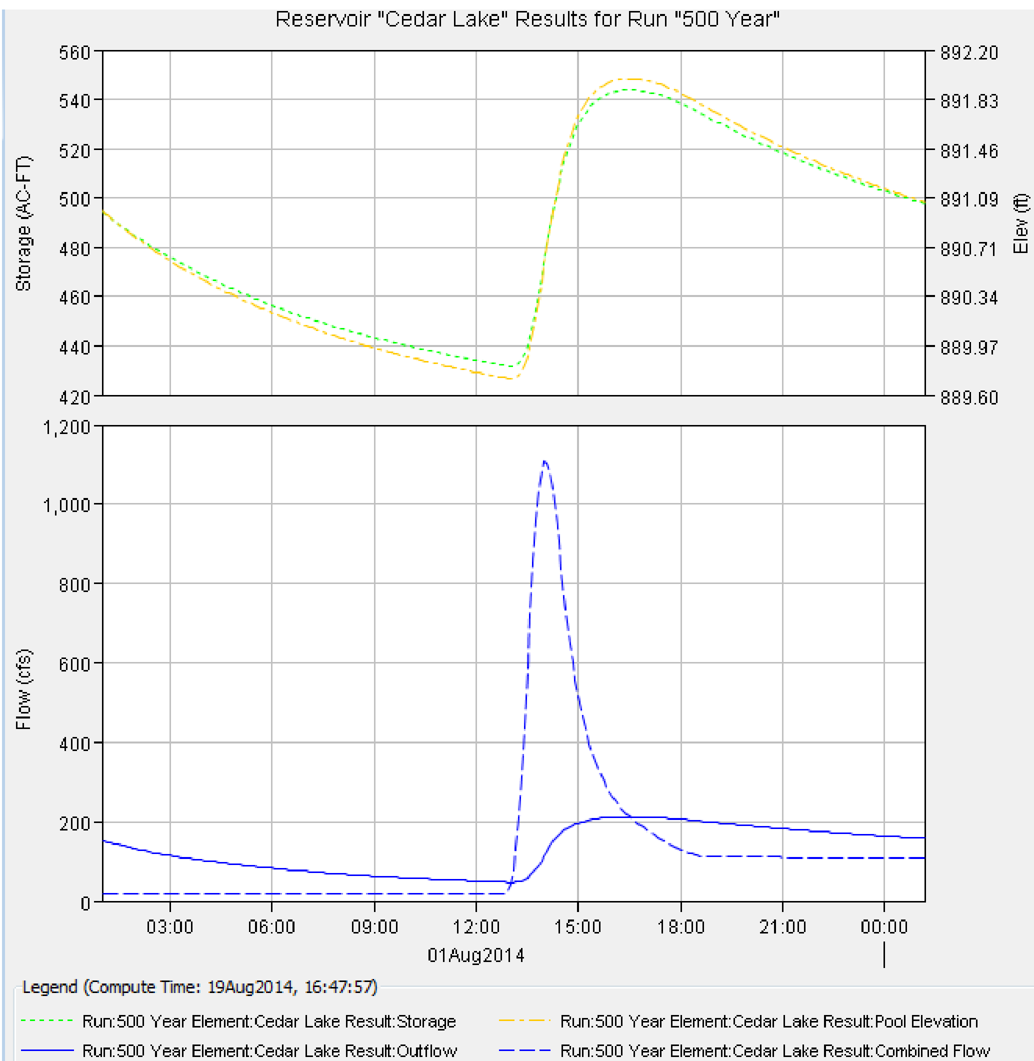
Project: Cedar Lake Dam Existing   Simulation Run: 500 Year
Reservoir: Cedar Lake

Start of Run:	01Aug2014, 01:00	Basin Model:	Cedar Lake
End of Run:	02Aug2014, 01:10	Meteorologic Model:	500 Year (StreamStats)
Compute Time:	19Aug2014, 16:47:57	Control Specifications:	Control 1

Volume Units: (•) IN ( ) AC-FT

Computed Results

Peak Inflow:	1107.0 (CFS)	Date/Time of Peak Inflow:	01Aug2014, 14:00
Peak Discharge:	212.3 (CFS)	Date/Time of Peak Discharge:	01Aug2014, 16:30
Inflow Volume:	5.40 (IN)	Peak Storage:	543.8 (AC-FT)
Discharge Volume:	5.33 (IN)	Peak Elevation:	892.0 (FT)



HEC-HMS Output
Project: Cedar Lake Dam

Alternative 5 - Proposed Conditions: 500-Year

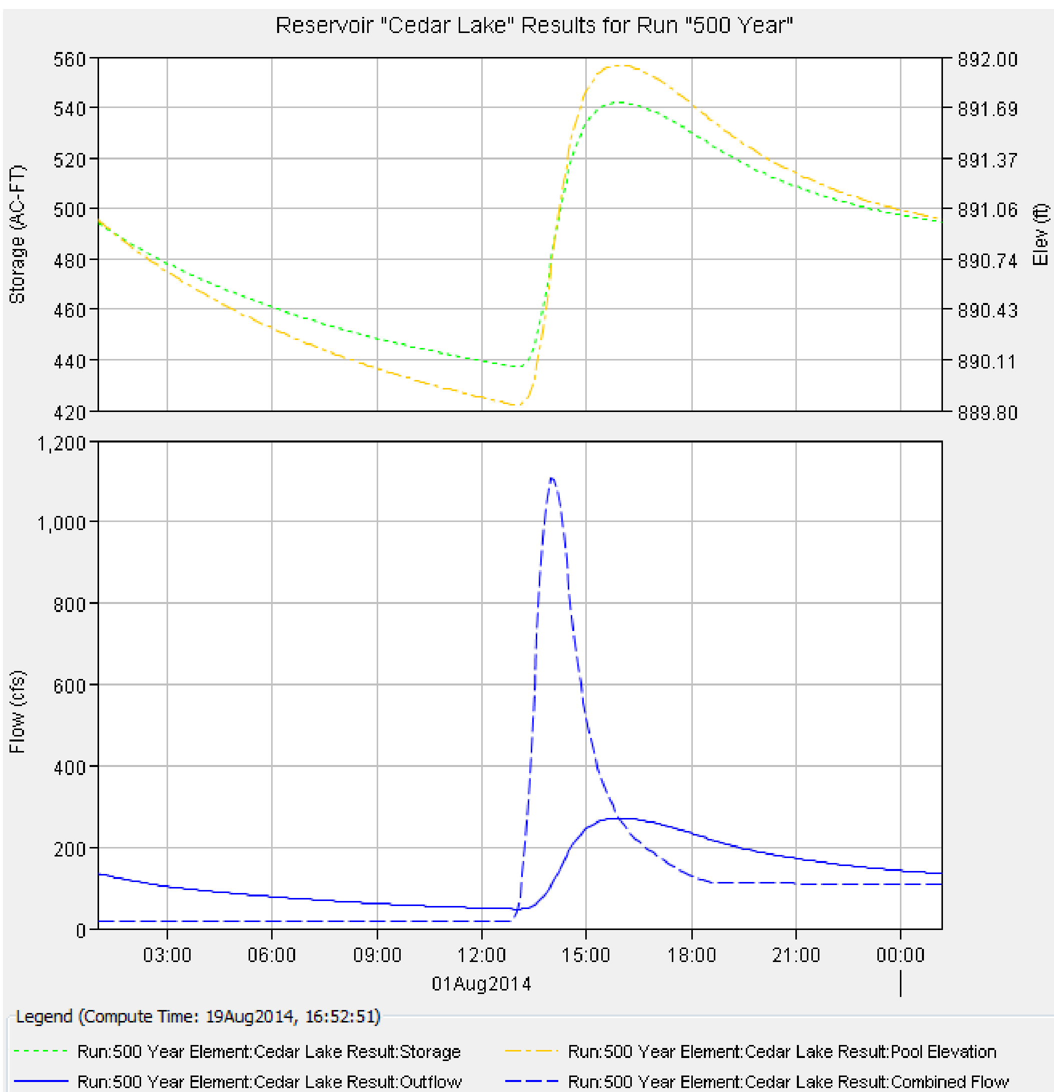
Project: Cedar Lake Dam Existing Simulation Run: 500 Year
Reservoir: Cedar Lake

Start of Run:	01Aug2014, 01:00	Basin Model:	Cedar Lake
End of Run:	02Aug2014, 01:10	Meteorologic Model:	500 Year (StreamStats)
Compute Time:	19Aug2014, 16:52:51	Control Specifications:	Control 1

Volume Units: IN AC-FT

Computed Results

Peak Inflow:	1107.0 (CFS)	Date/Time of Peak Inflow:	01Aug2014, 14:00
Peak Discharge:	271.2 (CFS)	Date/Time of Peak Discharge:	01Aug2014, 15:55
Inflow Volume:	5.40 (IN)	Peak Storage:	542.0 (AC-FT)
Discharge Volume:	5.40 (IN)	Peak Elevation:	891.9 (FT)



ELEVATION-DISCHARGE TABLES

High Flow Outlet Structure
Alternative I

Project: Cedar Lake Dam
Wolcott, CT

Calculations By: DT
Date: 8/19/2014

HRP *Associates, Inc.*

Low Flow - Contracted Horizontal Weir

$Q=3.33 * (L_2-0.2H2)*H2^{3/2}$

L2 (ft) 6 ft
Elevation 888.7

High Flow - Semicircular Weir

$Q=2.72 * L1 *(H1^{3/2})$

Radius =4.5 feet
Arc Length=14.1 feet
Adusted Arc length 8.15 ft (adjust arc length to account for horizontal weir)
Elevation 890.7

Pipe Capacity - Proposed 36" PVC Pipe

$Q=[(1.486)(A)(R^{2/3})(S^{1/2})] /n$

where Q = pipe capacity (cfs)
n = manning's n
A = cross-sectional flow area of the pipe (sf)
R = hydraulic radius, R=A/P (ft)
P = wetted perimeter (ft); pipe inside circumference
S = pipe slope (feet/foot)

n = 0.010
A = 7.07 sf
P = 9.42 ft
R = 0.75 ft
S = 0.026 feet/foot
Q = 139.8 cfs

	Elevation	Contracted Horizontal Weir Flow	Semicircular Weir Flow	Combined Flow	Culvert Capacity	Weir or Culvert Control?	Discharge
		(cfs)	(cfs)	(cfs)	(cfs)		(cfs)
Elev. of low flow weir	888.70	0.00	0.00	0.00	139.81	Weir	0.00
	889.00	3.25	0.00	3.25	139.81	Weir	3.25
	889.50	13.92	0.00	13.92	139.81	Weir	13.92
	890.00	28.33	0.00	28.33	139.81	Weir	28.33
	890.50	45.36	0.00	45.36	139.81	Weir	45.36
Elev. of high flow weir	890.70	52.74	0.00	52.74	139.81	Weir	52.74
	891.00	64.35	3.64	67.99	139.81	Weir	67.99
	891.50	84.88	15.86	100.74	139.81	Weir	100.74
	892.00	106.60	32.86	139.46	139.81	Weir	139.46
	892.50	129.26	53.53	182.79	139.81	Culvert	139.81
	893.00	152.62	77.32	229.94	139.81	Culvert	139.81