Application for a Certificate of Environmental Compatibility and Public Need

illingly Energy Center

August 2016

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repare f r

NTE Connecticut, LLC

24 Cathedral Place
St. Augustine, FL 32084

repare y

Tetra Tech, Inc.

2 Lan Drive, Suite 210
Westford, MA 01886

TETRA TECH

Killingly Energy Center
an NTE Energy Project

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APPENDI A – NOTICE AND SERVICE DOC MENTATION

A-1 Legal Notice
A-2 Certification of Service of Application on State and Local Officials
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APPENDI A-1 – LEGAL NOTICE

LEGAL NOTICE

Notice is hereby given, pursuant to Section 16-50*l*(b) of the Connecticut General Statutes and Regulations pertaining thereto, of an Application to be submitted to the Connecticut Siting Council ("Council") on or about August 17, 2016 by NTE Connecticut, LLC ("NTE" or the "Applicant"). NTE is proposing to develop the Killingly Energy Center ("KEC"), an approximately 550 Mega Watt ("MW") air-cooled electric generating facility and related electric interconnection switchyard on a total of approximately 73 acres of land off Lake Road in Killingly, Connecticut. A 63-acre parcel north and west of Lake Road would support the power generating facility, including a 150-foot tall exhaust stack. The electric switchyard would be constructed on a separate 10-acre parcel south and east of Lake Road, adjacent to an existing Eversource electric transmission line right of way. The primary source of fuel for the KEC facility will be natural gas. Natural gas service to the KEC facility will require an approximately 2.5 mile gas line lateral extension constructed within an existing gas line right of way. During times of natural gas curtailment or service interruption, the KEC facility would operate on Ultra Low Sulfur Distillate ("ULSD") as a backup fuel.

The location, layout and design of certain elements and features of the proposed KEC facility are subject to change under provisions of Conn. Gen. Stat. § 16-50g et seq.

On the day of the Siting Council public hearing on this proposal, NTE will fly a balloon at a height of 150 feet, representing the tallest structure (the stack) at the KEC facility. Interested parties and residents are invited to review the Application during normal business hours after August 17, 2016, at any of the following offices:

Connecticut Siting Council
10 Franklin Square
New Britain, CT 06051

NTE Connecticut, LLC
800 South Street, Suite 620
Waltham MA 02453

Killingly Town Clerk
Town of Killingly
172 Main Street
Killingly, CT 06239

TetraTech
2 Lan Drive, Suite 210
Westford, MA 01886

or the offices of the undersigned. All inquiries should be addressed to the Connecticut Siting Council or to the undersigned.

NTE Connecticut, LLC

Kenneth C. Baldwin, Esq.
Robinson & Cole LLP
280 Trumbull Street
Hartford, CT 06103-3597
(860) 275-8200
Its Attorneys

APPENDI A-2 – CERTIFICATION OF SERVICE OF APPLICATION ON STATE AND LOCAL OFFICIALS

CERTIFICATION OF SERVICE

I hereby certify that copies of the Application and attachments were sent first class mail, postage prepaid, to the following:

STATE OFFICIALS:

The Honorable George Jepsen
Attorney General
Office of the Attorney General
55 Elm Street
Hartford, CT 06106

Dora B. Schriro, Commissioner
Department of Emergency Services and Public Protection
Emergency Management and Homeland Security Division
25 Sigourney Street, 6th Floor
Hartford, CT 06106-5042

Rob Klee, Commissioner
Department of Energy and Environmental Protection
79 Elm Street
Hartford, CT 06106

Raul Pino, M.D., M.P.H., Commissioner
Department of Public Health
410 Capitol Avenue
P.O. Box 340308, MS 13COM
Hartford, CT 06134-0308

Karl J. Wagener, Executive Director
Council on Environmental Quality
79 Elm Street
P.O. Box 5066
Hartford, CT 06106

Arthur House, Chairman
Public Utilities Regulatory Authority
Ten Franklin Square
New Britain, CT 06051

Benjamin Barnes, Secretary
Office of Policy and Management
450 Capitol Avenue
Hartford, CT 06106

Catherine Smith, Commissioner
Department of Economic and Community Development
505 Hudson Street
Hartford, CT 06106

James P. Redeker, Commissioner
Department of Transportation
P.O. Box 317546
2800 Berlin Turnpike
Newington, CT 06131-7546

Kristina Newman-Scott
Acting Director of Arts and Historic Preservation
State Historic Preservation Officer
Connecticut Commission on Culture & Tourism
One Constitution Plaza, 2nd Floor
Hartford, CT 06103

Steven K. Reviczky, Commissioner
Department of Agriculture
165 Capital Avenue
Hartford, CT 06106

Scott D. Jackson, Commissioner
Department of Labor
165 Capital Avenue
Hartford, CT 06106

Jonathan A. Harris, Commissioner
Department of Consumer Protection
165 Capital Avenue
Hartford, CT 06106

Melody A. Currey, Commissioner
Department of Administrative Services
165 Capital Avenue
Hartford, CT 06106

STATE REPRESENTATIVES

The Honorable Mae Flexer
Senator – 29th District
Legislative Office Building
Room 1800
Hartford, CT 06106

The Honorable Christine Randall
Representative – 44th District
Legislative Office Building
Room 4014
Hartford, CT 06106

The Honorable Daniel S. Rovero
Representative – 51st District
Legislative Office Building
Room 4004
Hartford, CT 06106

The Honorable Tony Guglielmo
Senator – 35th District
Legislative Office Building
Room 3400
Hartford, CT 06106

The Honorable Michael Alberts
Representative – 50th District
Legislative Office Building
Room 4200
Hartford, CT 06106

KILLINGLY TOWN OFFICIALS:

Sean Hendricks, Town Manager
Town of Killingly
172 Main Street
Killingly, CT 06239

Elizabeth M. Wilson, Town Clerk
Town of Killingly
172 Main Street
Killingly, CT 06239

Keith Thurlow, Chairperson
Planning and Zoning Commission
Town of Killingly
172 Main Street
Killingly, CT 06239

Brian Card, Secretary
Planning and Zoning Commission
Town of Killingly
172 Main Street
Killingly, CT 06239

Sheila Roddy, Member
Planning and Zoning Commission
Town of Killingly
172 Main Street
Killingly, CT 06239

Todd Nelson, Member
Planning and Zoning Commission
Town of Killingly
172 Main Street
Killingly, CT 06239

Milburn Stone, Member
Planning and Zoning Commission
Town of Killingly
172 Main Street
Killingly, CT 06239

William Ritter, Alternate
Planning and Zoning Commission
Town of Killingly
172 Main Street
Killingly, CT 06239

Ann-Marie L. Aubrey
Director of Planning and Development
Town of Killingly
172 Main Street
Killingly, CT 06239

Sandy Eggers, Chair
Inland Wetlands and Watercourses Commission
Town of Killingly
172 Main Street
Killingly, CT 06239

Jasen Cusson-Malone, Vice-Chair
Inland Wetlands and Watercourses Commission
Town of Killingly
172 Main Street
Killingly, CT 06239

Doretha Clemon, Member
Inland Wetlands and Watercourses Commission
Town of Killingly
172 Main Street
Killingly, CT 06239

Lucille Garcia, Member
Inland Wetlands and Watercourses Commission
Town of Killingly
172 Main Street
Killingly, CT 06239

Ronald Dass, Member
Inland Wetlands and Watercourses Commission
Town of Killingly
172 Main Street
Killingly, CT 06239

Rodney Galton, Member
Inland Wetlands and Watercourses Commission
Town of Killingly
172 Main Street
Killingly, CT 06239

Corina Torrey, Member
Inland Wetlands and Watercourses Commission
Town of Killingly
172 Main Street
Killingly, CT 06239

Frederick W. Ruhlemann, Alternate
Inland Wetlands and Watercourses Commission
Town of Killingly
172 Main Street
Killingly, CT 06239

Donna M. Bronwell, Chair
Conservation Commission
Town of Killingly
172 Main Street
Killingly, CT 06239

PUTNAM TOWN OFFICIALS:

Tony Falzarano, Mayor
Town of Putnam
126 Church Street
Putnam, CT 06260

Sara Seney, Town Clerk
Town of Putnam
126 Church Street
Putnam, CT 06260

Gerard Cotnoir, Chairman
Planning Commission
Town of Putnam
126 Church Street
Putnam, CT 06260

Patricia Hedenberg, Chairman
Zoning Commission
Town of Putnam
126 Church Street
Putnam, CT 06260

Donald Johnson, Town Planner
Town of Putnam
126 Church Street
Putnam, CT 06260

Ann Battersby, Chairman
Inland/Wetlands Commission
Town of Putnam
126 Church Street
Putnam, CT 06260

POMFRET TOWN OFFICIALS:

Craig Baldwin, First Selectman
Town of Pomfret
5 Haven Road
Pomfret Center, CT 06259

Cheryl A. Grist, Town Clerk
Town of Pomfret
5 Haven Road
Pomfret Center, CT 06259

Walter P. Hinchman, Chairman
Planning and Zoning Commission
Town of Pomfret
5 Haven Road
Pomfret Center, CT 06259

John Folsom, Chairman
Inland Wetlands and Watercourses Commission
Town of Pomfret
5 Haven Road
Pomfret Center, CT 06259

Pamela Cartledge, Chairman
Conservation Commission
Town of Pomfret
5 Haven Road
Pomfret Center, CT 06259

Northeastern Connecticut Council of Governments
125 Putnam Pike
Dayville, CT 06241

Kenneth C. Baldwin, Esq.
Robinson & Cole LLP
280 Trumbull Street
Hartford, CT 06103
Telephone: (860) 275-8200
Attorneys for Cellco Partnership d/b/a Verizon Wireless

APPENDI A-3 – AB TTER NOTICE LETTER AND ATTACHMENTS

KENNETH C. BALDWIN

280 Trumbull Street
Hartford, CT 06103-3597
Main (860) 275-8200
Fax (860) 275-8299
kbaldwin@rc.com
Direct (860) 275-8345

Also admitted in Massachusetts

August 15, 2016

Via Certified Mail Return Receipt Requested

«Name_and_Address»

Re: **NTE Connecticut, LLC Application for the Construction, Maintenance and Operation of an Electric Power Generating Facility on Property at 180 and 189 Lake Road, Killingly, Connecticut**

Dear «Salutation»:

NTE Connecticut, LLC ("NTE") will be submitting an application to the Connecticut Siting Council ("Council") on or about August 17, 2016, for approval of the construction of an electric power generating facility in the Town of Killingly, Connecticut.

NTE is proposing to develop the Killingly Energy Center ("KEC"), an approximately 550 Mega Watt ("MW") air-cooled electric generating facility and related electric interconnection switchyard on a total of approximately 73 acres of land off Lake Road in Killingly, Connecticut. A 63-acre parcel north and west of Lake Road would support the power generating facility including a 150-foot tall exhaust stack. The electric switchyard would be constructed on a separate 10-acre parcel south and east of Lake Road, adjacent to an existing Eversource electric transmission line right of way. The primary source of fuel for the KEC facility will be natural gas. Natural gas service to the KEC facility will require an approximately 2.5 mile gas line lateral extension constructed within an existing gas line right of way. During those limited times of natural gas curtailment or service interruption, the KEC facility would operate on Ultra Low Sulfur Distillate ("ULSD") as a backup fuel.

The location, layout and design of certain elements and features of the proposed KEC facility are subject to change under the provisions of Connecticut General Statutes § 16-50g et seq.

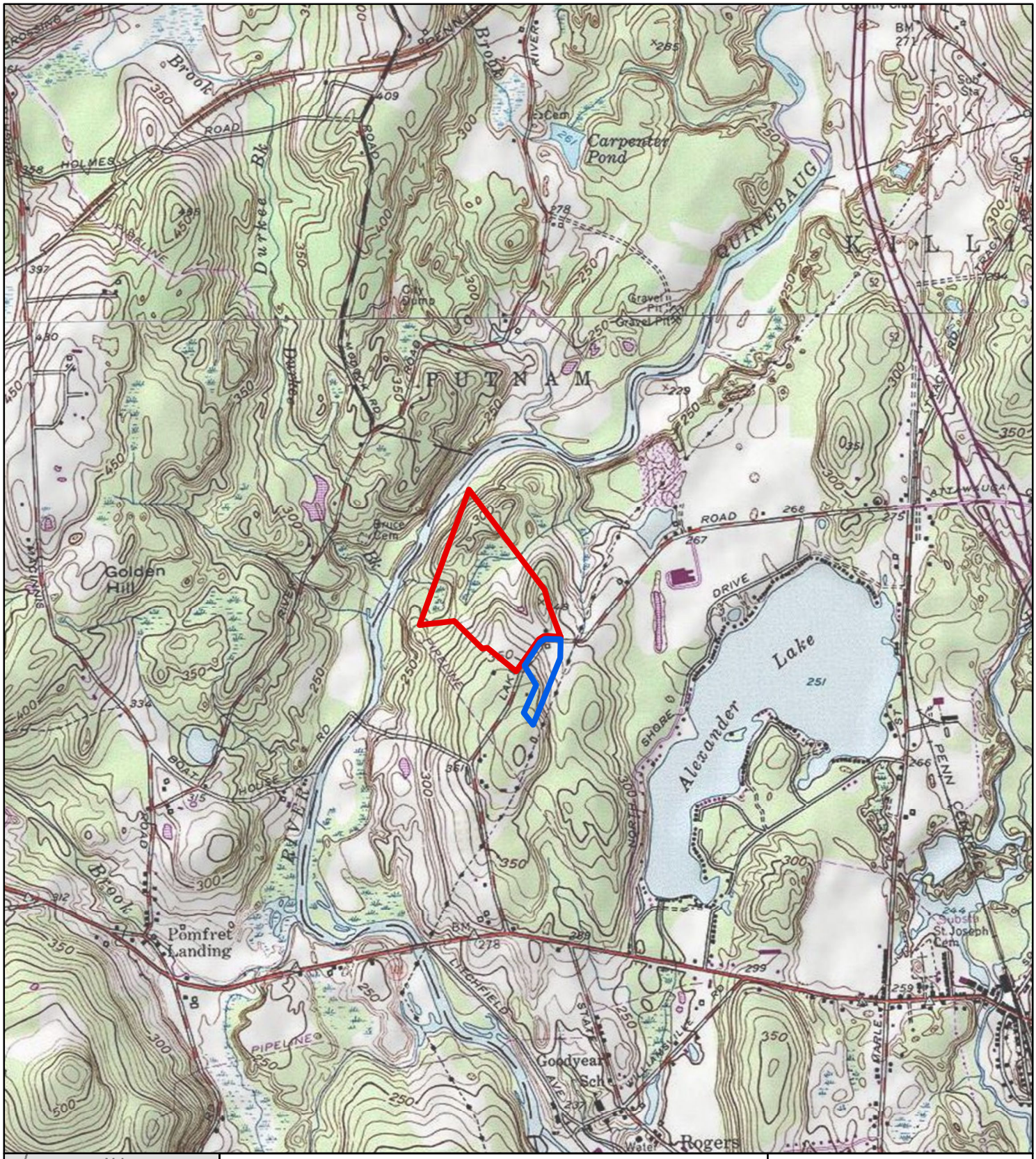
State law provides that owners of record of property which abuts a parcel on which a facility is proposed to be located must receive notice of the submission of this application. This notice is directed to you either because you may be an abutting land owner or as a courtesy notice. Copies of the application are available for review at Killingly Town Hall, the Killingly public library and on the KEC Project web site www.killinglyenergycenter.com .

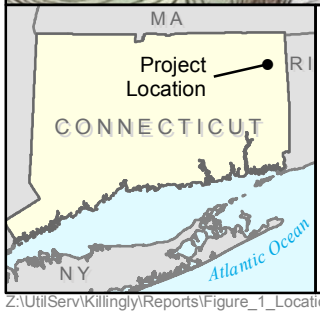
If you have any questions concerning the application, please direct them to either the Connecticut Siting Council or me. My address and telephone number are listed above. The Siting Council may be reached at its New Britain, Connecticut office at (860) 827-2935.

Very truly yours,

Kenneth C. Baldwin

Attachment





Legend

Generating Facility Site

Switchyard Site

N

0 1,000 2,000 Feet

Figure 2-1
KEC Site Location
(Topographic Map)

Killingly Energy Center
an NTE Energy Project

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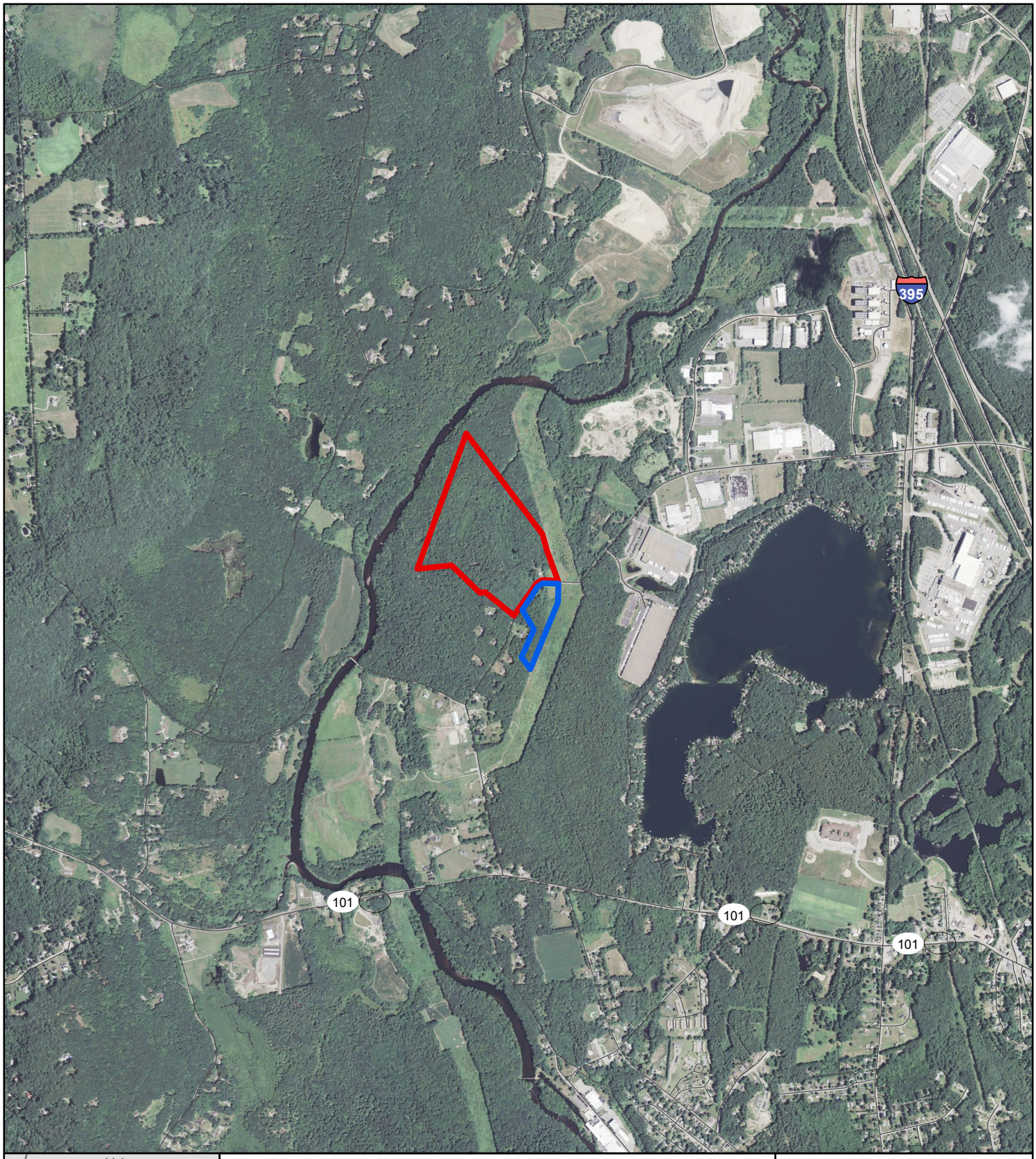

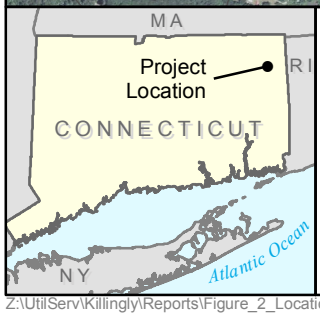

Legend

Generating Facility Site

Switchyard Site

N

0 1,000 2,000 Feet

Figure 2-2
KEC Site Location
(Aerial Photograph)

Killingly Energy Center
an NTE Energy Project

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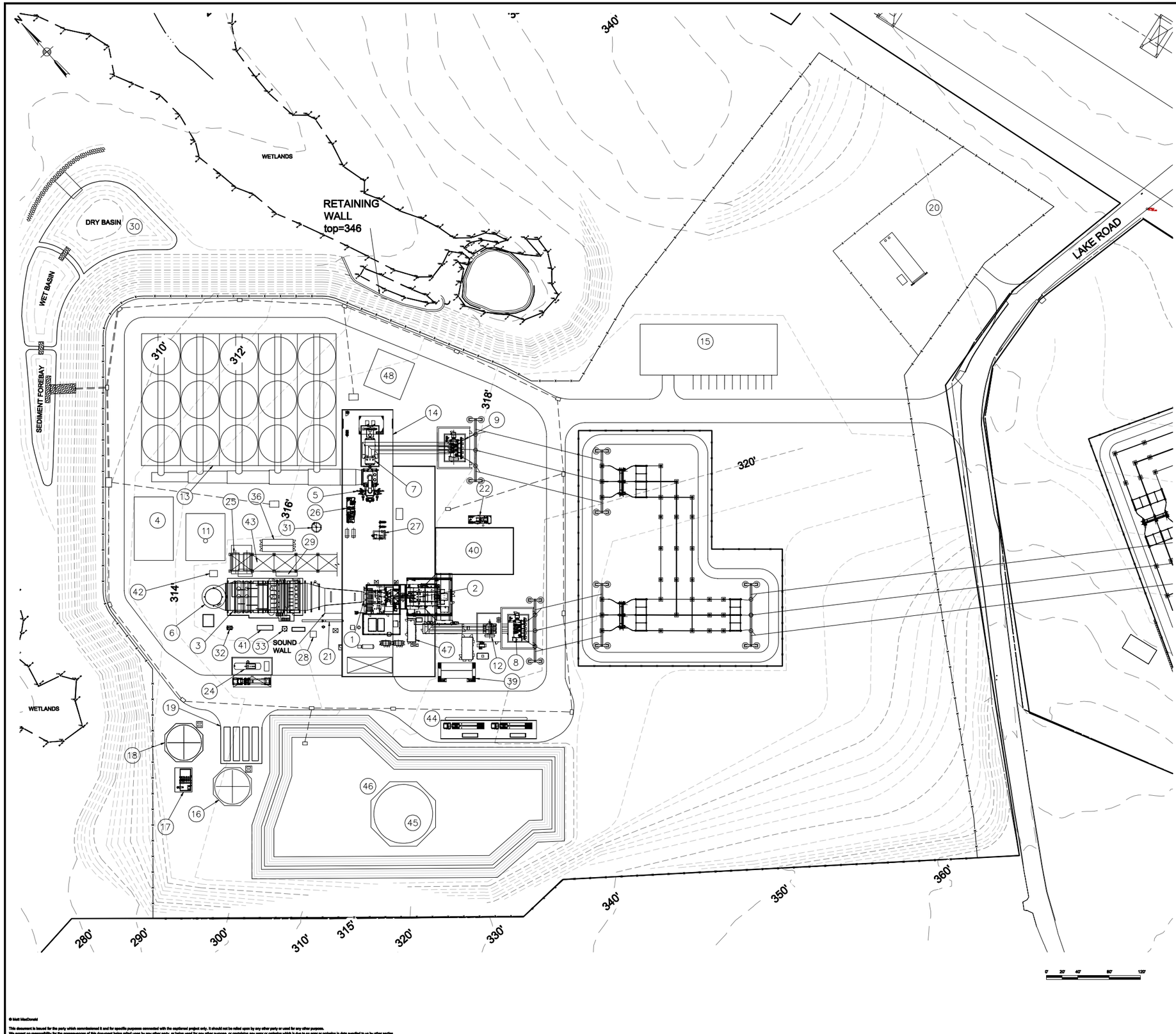

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Notes

Legend

1. COMBUSTION TURBINE (GT)
2. COMBUSTION TURBINE GENERATOR (GTG)
3. HEAT RECOVERY STEAM GENERATOR (HRSG)
4. CLOSED COOLING WATER
5. STEAM TURBINE (ST)
6. EXHAUST STACK
7. STEAM TURBINE GENERATOR (STG)
8. GENERATOR STEP-UP TRANSFORMER (GSU)
9. STG STEP-UP TRANSFORMER
10. AIR INLET FILTER HOUSE (NOT SHOWN)
11. AUXILARY BOILER
12. UNIT AUXILARY TRANSFORMER
13. AIR COOLED CONDENSER (ACC) & CONDENSATE COLLECTION ENCLOSURE
14. TURBINE BUILDING
15. ADMIN/ WAREHOUSE/ WATER TREATMENT BUILDING
16. RAW / FIRE WATER STORAGE TANK & RW PUMPS
17. FIRE PUMPS ENCLOSURE
18. DEMINERALIZED WATER STORAGE TANK & PUMPS
19. DEMINERALIZED WATER TRAILERS AREA
20. FUEL GAS METERING
21. FUEL GAS HEATER
22. DIESEL GENERATOR
23. PLANT SWITCHYARD
24. AMMONIA STORAGE TANK, PUMPS, & UNLOADING AREA
25. BOILER FEED PUMPS
26. STG LUBE OIL SKID
27. AIR COMPRESSORS, RECEIVERS & DRYERS SKID
28. FUEL GAS FINAL FILTER
29. DUCT BURNER SKID
30. DETENTION POND
31. STG DRAINS TANK & SUMP
32. HRSG BLOW OFF TANK & DRAINS PUMPS
33. HRSG BLOWDOWN SUMP
34. STORM WATER RETENTION POND
35. CIVIL OIL WATER SEPARATOR (NOT SHOWN)
36. BOP MOTOR CONTROL CENTER (MCC)
37. PLANT GATE (NOT SHOWN)
38. NOT USED
39. CTG ELECTRICAL PACKAGE
40. CENTRAL CONTROL ROOM / ELECTRICAL
41. AMMONIA INJECTION SKID
42. CONTINUOUS EMISSIONS MONITORING SYSTEM (CEMS)
43. PIPE RACK
44. FUEL OIL UNLOADING
45. FUEL OIL TANK
46. FUEL OIL BERM
47. GT LUBE OIL SKID
48. FUEL GAS COMPRESSORS

Reference Drawings

Rev	Date	Drawn	Description	Ch'k'd	App'd
H	07/14/16	AF	FOR CLIENT REVIEW	KP	JW
G	06/28/16	AF	FOR CLIENT REVIEW	KP	JW
F	06/24/16	AF	FOR CLIENT REVIEW	KP	JW
E	06/20/16	AF	FOR CLIENT REVIEW	KP	JW
D	06/04/16	AF	FOR CLIENT REVIEW	KP	JW
C	04/12/16	AF	FOR CLIENT REVIEW	KP	JW
B	04/11/16	AF	FOR CLIENT REVIEW	KP	JW
A	04/07/16	AF	FOR CLIENT REVIEW	KP	JW

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F +1 (781) 815-0201
W www.motmac.com

Client

NTE ENERGY

KILLINGLY ENERGY CENTER
KILLINGLY CONNECTICUT

Title

Figure 2-4

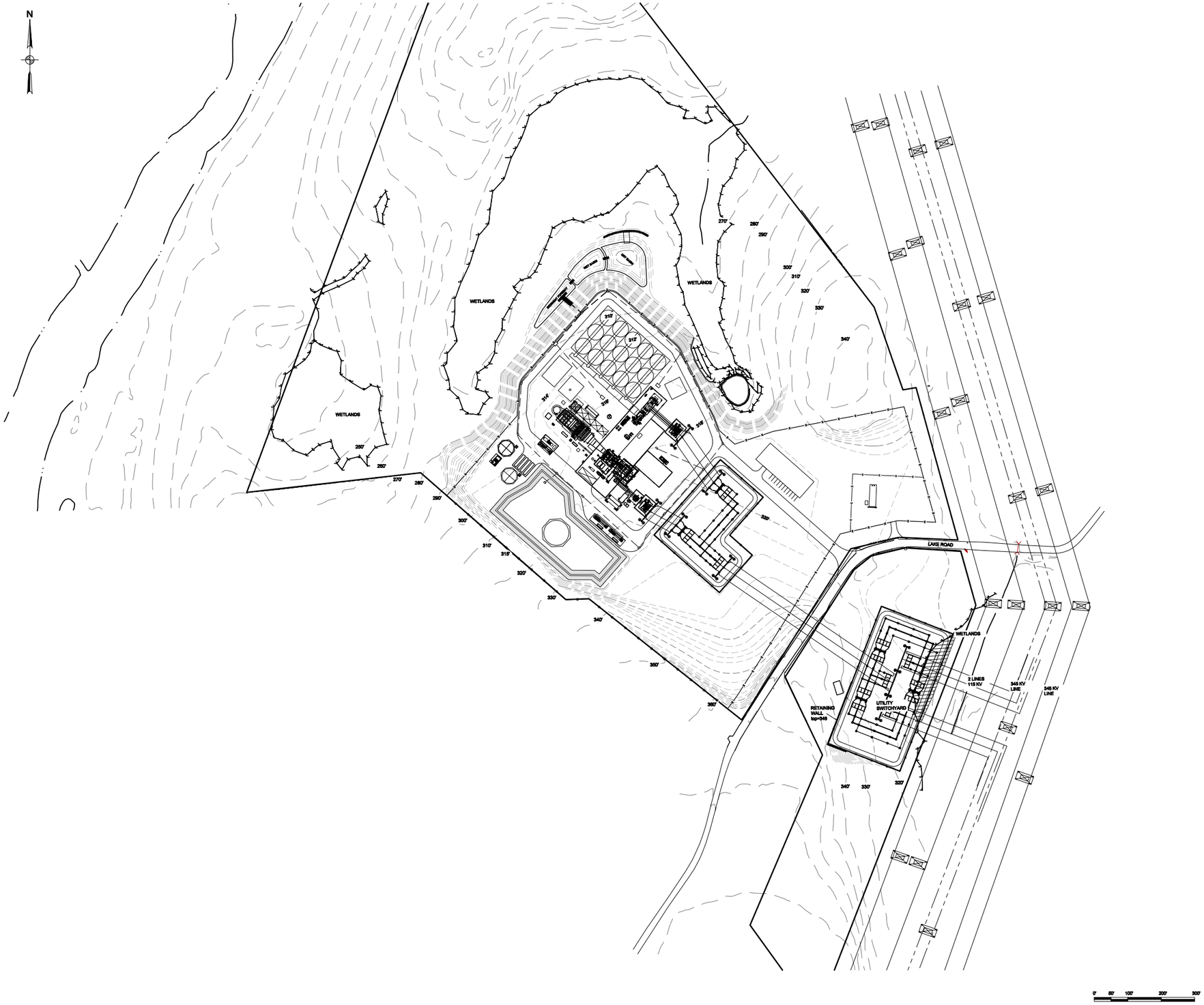
Site Layout and Grading

Killingly Energy Center
an NTE Energy Project

PRELIMINARY
NOT FOR CONSTRUCTION
REPLACE WITH ENGINEERS STAMP AT CONSTRUCTION AND/OR FABRICATION

Designed	-	Eng check	JW
Drawn	AF	Approved	-
Dwg check	KP	Project Mngr	JW
Scale at ANSI E 1" = 40'-0"		Date 04/07/16	Rev H

Drawing Number
334954CT-GA-203



Notes

Legend

Reference Drawings

Rev	Date	Drawn	Description	Ch'k'd	App'd
G	07/14/16	AF	FOR CLIENT REVIEW	KP	JW
F	06/28/16	AF	FOR CLIENT REVIEW	KP	JW
E	06/20/16	AF	FOR CLIENT REVIEW	KP	JW
D	04/27/16	AF	FOR CLIENT REVIEW	KP	JW
C	04/12/16	AF	FOR CLIENT REVIEW	KP	JW
B	04/11/16	AF	FOR CLIENT REVIEW	KP	JW
A	04/07/16	AF	FOR CLIENT REVIEW	KP	JW

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F +1 (781) 918-0001
W www.mottmac.com

Client

NTE ENERGY

KILLINGLY ENERGY CENTER
KILLINGLY CONNECTICUT

Title

Figure 2-5

Plot Plan

Killingly Energy Center
an NTE Energy Project

PRELIMINARY
NOT FOR CONSTRUCTION
REPLACE WITH ENGINEERS STAMP AT CONSTRUCTION AND/OR FABRICATION

Designed	-	Eng check	JW
Drawn	AF	Approved	-
Dwg check	KP	Project Mngr	JW
Scale at ANSI E		Date	Rev
1" = 100'-0"		04/07/16	G

Drawing Number
334954CT-SA-203

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We accept no responsibility for the consequences of this document being relied upon by any other party, or being used for any other purposes, or containing any error or omission which is due to an error or omission in data supplied to us by other parties.

P:\334954 NTE Development\334954CT Killingly\Drawings\CSA\334954CT-SA-203.dwg Jul 14, 2016 - 5:25PM fadi7976

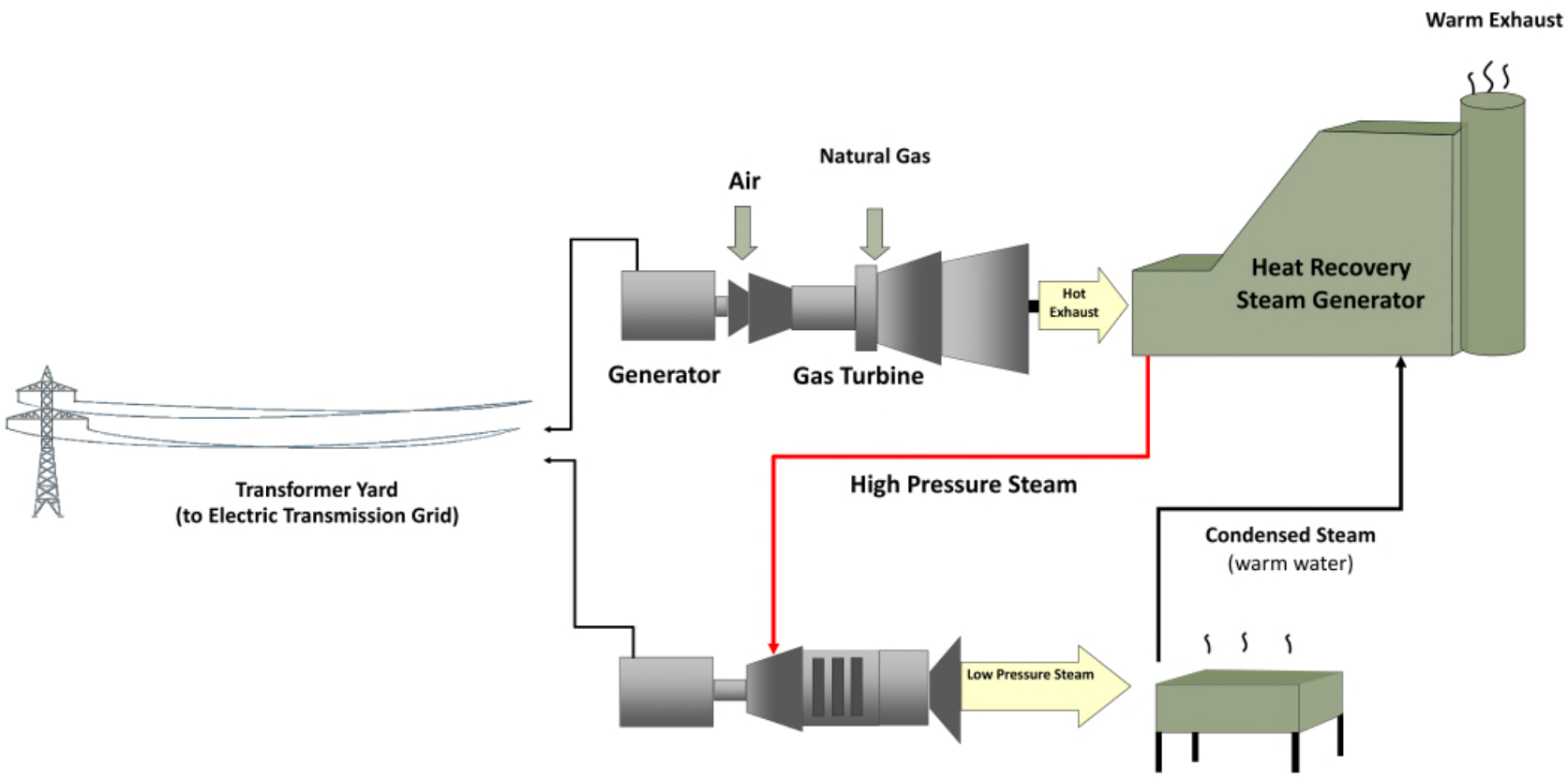

Figure 2-7

Combined Cycle Process

Killingly
Energy Center
an NTE Energy Project

ADJACENT PROPERTY OWNERS

PROJECT NAME: KILLINGLY ENERGY CENTER
180 AND 189 LAKE ROAD
KILLINGLY, CONNECTICUT

PARCEL ID. NOS: 001717 AND 001718

THE FOLLOWING ABUTTERS INFORMATION WAS COLLECTED FROM THE KILLINGLY TAX ASSESSOR'S RECORDS AND GIS RECORDS AS OF AUGUST 10, 2016.

	Property Address	Owner and Mailing Address
1.	161 Lake Road	Wyndham Land Trust Inc. P.O. Box 302 Pomfret Center, CT 06259
2.	295 Lake Road	Edith S. Garvey 295 Lake Road Killingly, CT 06241
3.	251 Lake Road	Maureen Lannon and Kathleen Berk 251 Lake Road Killingly, CT 06241
4.	209 Lake Road	Rocky River Realty Co. P.O. Box 270 Hartford, CT 06141-0270
5.	199 Lake Road	Connecticut Light & Power Co. P.O. Box 270 Hartford, CT 06141-0270
6.	70 Lake Road	Connecticut Light & Power Co. Attn: Property Tax Department P.O. Box 270 Hartford, CT 06141-0270
7.	144 Lake Road	Carl R. and Charlotte Desautels 144 Lake Road Killingly, CT 06241
8.	154 Lake Road	Pauline M. Lemieux 154 Lake Road Killingly, CT 06241

	Property Address	Owner and Mailing Address
9.	149 Lake Road	Norman E. and Terry F. Ross 149 Lake Road Killingly, CT 06241
10.	131 Lake Road	Paul J. and Elaine M. Gazzola 131 Lake Road Killingly, CT 06241
11.	115 Lake Road	Judith H. Jackson P.O. Box 215 Pomfret Center, CT 06259-0215

CERTIFICATION OF SERVICE

I hereby certify that a copy of the foregoing letter was sent by certified mail, return receipt requested, to each of the parties on the attached list of abutting landowners.

August 17, 2016
Date

Kenneth C. Baldwin, Esq.
Robinson & Cole LLP
280 Trumbull Street
Hartford, CT 06103

Attorneys for CELLCO PARTNERSHIP d/b/a
VERIZON WIRELESS

APPENDIX B – ANALYSIS OF NEED AND ECONOMIC & ENVIRONMENTAL IMPACTS

B-1 Addendum to the Killingly Energy Center: An Analysis of Need and Economic & Environmental Impacts
B-2 Killingly Energy Center: An Analysis of Need and Economic & Environmental Impacts

APPENDIX B-1 – ADDENDUM TO THE KILLINGLY ENERGY CENTER: AN ANALYSIS OF NEED AND ECONOMIC & ENVIRONMENTAL IMPACTS

ADDENDUM TO THE KILLINGLY ENERGY CENTER: AN ANALYSIS OF NEED AND ECONOMIC & ENVIRONMENTAL IMPACTS

In re nition of the comments and feedback NTE Connecticut ("NTE") and PA Consulting Group ("PA") have received from residents of the Town of Killingly related to PA's report entitled, _____ _____ ha prepare he f ll in a en . Thi a en e n han e he analy i n r fin in pre en e in he ri inal rep r . Ra her hi a en pr i e a i i nal e ail n he el e I an I inp ha ere e e el p PA's estimate of economic impacts resulting from the Killingly Energy Center's ("KEC") n r i n an n in pera i n an a i i nal e ail n PA's findings.

The models that PA used in its economic impacts analysis are the IMPLAN – Impact Analysis for Planning – and JEDI – Jobs and Economic Development Impacts – models. Both are industry standard models used to analyze economic impacts resulting from capital projects, such as building and operating a power plant. The IMPLAN model was used to assess the economic impacts resulting from the Killingly Energy Center's ("KEC") effect on wholesale electricity costs to Connecticut ratepayers. The JEDI model was used to assess the economic impacts from KEC's construction and operations.

PA's modeling methodology analyzed economic impacts across three categories: direct, indirect and induced impacts. Direct impacts reflect those effects resulting from KEC's direct expenditures. (For example, KEC hiring workers.) Indirect impacts reflect supply chain effects from KEC's direct expenditures. (For example, KEC workers buying groceries, eating at restaurants, staying at hotels, etc.) Lastly, induced impacts reflect effects from increased household income due to direct and indirect impacts, and wholesale electricity cost savings. (For example, spending by employees of a grocery store, restaurant, hotel, and/or spending by Connecticut electricity ratepayers etc.)

IMPLAN has been in use for more than 30 years and was originally commercialized by the Agricultural Department at the University of Minnesota. IMPLAN is used to assess economic impacts related to a wide variety of capital projects by federal and state agencies and private industry, including the U.S. Department of Agriculture, U.S. Department of Interior, U.S. Army Corps of Engineers, and U.S. Coast Guard. In addition to being used to assess the economic impacts of power plants, IMPLAN has also been used to assess impacts from baseball stadiums, forestry, factories (e.g. Tesla's 'Gigafactory'), etc.

JEDI was developed by the National Renewable Energy Laboratory ("NREL"), a Department of Energy laboratory. JEDI was created specifically to assess the economic impacts of power plant construction and operations, and has been in use by the power industry for 15 years.

The primary inputs to the JEDI model – projected expenditures (i.e. costs) in Connecticut – are summarized below for the construction (Table 1) and operations (Table 2) phases. As discussed in PA's original report, KEC's total equipment and construction costs are projected to be $537 million. Of that amount $142 million, 26% of the total project cost, is projected to be spent in Connecticut – as shown in Table 1.

Table 1: Connecticut Share of Total Expected Construction Costs

Expenditure Type	Connecticut Share of Total Cost (millions)	Connecticut Share of Total Cost ( )
Materials	**10**	**5**
Power Generation	$0	0%
Plant Equipment	$10	5%
Plant Construction Labor	**104**	**65**
Other[1]	**28**	**43**
Total	**142**	**26**

Tables 1 and 2 present the Connecticut share of KEC's construction and operations costs in both dollars, 'Connecticut Share of Total Cost ($millions)', and as a percentage of the total cost, 'Connecticut Share of

[1] Includes costs associated with general facilities, engineering/design, construction insurance, land, permitting fees, transmission grid connection, spare parts, and sales tax (materials and equipment purchases).

Total Cost (%)'. For example, PA's analysis does not assume any of KEC's power generation equipment (e.g. combustion and steam turbines) is purchased in Connecticut. Therefore, the 'Connecticut Share of Total Cost (%)' is zero, and there is no direct impact to the state of Connecticut from KEC's power generation equipment purchases. However, direct onsite labor is expected to be primarily performed by Connecticut-based workers, which is reflected in the $104 million in labor costs shown in Table 1. This $104 million value represents 65% of KEC's total costs for plant construction labor. Similarly, in Table 2, 85% of KEC's costs associated with 'Labor (incl. Services)' are projected to be spent in Connecticut. Based on PA's discussions with NTE Connecticut, the expectation is that many of the onsite jobs associated with this labor expenditure will be filled by residents of the Town of Killingly and the neighboring towns.

Table 2: Connecticut Share of Annual Expected Fixed Operation Costs

Expenditure Type	Connecticut Share of Total Cost (millions)	Connecticut Share of Total Cost ( )
Labor (incl. Services)[2]	5	85
Total	**5**	**85**

The primary input to the IMPLAN model is the projected electricity cost savings to Connecticut ratepayers from KEC's operations. PA's analysis projects KEC's operations to result in an annual average decrease of approximately 10% in wholesale electricity costs, all else equal, during the initial five years of KEC's operations. This equates to an average of approximately $215 million per year in wholesale electricity cost savings to Connecticut ratepayers.

The economic impacts of the expenditures presented in Table 1 (Connecticut Share of Total Expected Construction Costs) and Table 2 (Connecticut Share of Annual Expected Fixed Operation Costs), and the wholesale electricity cost savings to ratepayers as discussed above, is shown in Table 3 on the following page. Table 3 is the same as Table 2-3 in PA's original report (page 8), and illustrates the total economic impacts in terms of: (i) Employment (i.e. jobs), (ii) Earnings (i.e. wages); and (iii) economic output attributable to KEC to the state of Connecticut. These impacts are presented for both the construction period (2017 through mid-2020), and the initial five years of KEC's operations (mid-2020 through 2024)

For each category below (i.e. Employment Impact' (i.e. jobs created), 'Earnings Impact' (i.e. wages created), and 'Economic Output') the economic impacts from the expenditures presented in Table 1 are reflected in the 'Construction Period' lines. Similarly, the economic impacts from the expenditures presented in Table 2 are reflected in the 'Facility Operations' line items. The economic impacts from the wholesale electricity cost savings are reflected in the 'Cost Savings to Customer' line items. (The "Total Impacts', 'Total Outputs' lines in Table 3 reflect direct, indirect and induced impacts.)

[2] Includes $2-3 million in annual services costs.

Table 3: Total Economic Impacts on the State of Connecticut – Direct, Indirect and Induced

	2017	2018	2019	2020	2021	2022	2023	2024
Employment Impact (FTEs per year)								
Construction Period	180	515	386	51	-	-	-	-
Facility Operations	-	-	-	62	74	74	74	74
Cost Savings to Customer	-	-	-	291	956	1,200	1,319	1,300
Total Employment Impact	**180**	**515**	**386**	**404**	**1,030**	**1,274**	**1,393**	**1,374**
Earnings Impact ($ - millions)								
Construction Period	25	73	56	8	-	-	-	-
Facility Operations	-	-	-	6	7	8	8	8
Cost Savings to Customer	-	-	-	18	62	79	89	90
Total Earnings Impact	**25**	**73**	**56**	**32**	**69**	**87**	**97**	**98**
Economic Output ($ - millions)								
Construction Period	36	106	82	11	-	-	-	-
Facility Operations	-	-	-	13	17	17	17	18
Cost Savings to Customer	-	-	-	50	166	213	240	241
Total Economic Output	**36**	**106**	**82**	**74**	**183**	**230**	**257**	**259**

As discussed in PA's original report, KEC is projected to contribute to more than $1 billion of increased economic output from 2017-24. The $1 billion reflects the sum of the values in the 'Total Economic Output' line item in Table 3 above, beginning with $36 million in 2017 and ending with $259 million in 2024. The $215 million per year in electricity cost savings to Connecticut ratepayers is projected to result in an average of $180 million per year in increased economic output during KEC's first five years of operations. (PA's analysis assumes that electricity cost savings represent an increase in household income, and that for every $1.00 increase in household income Connecticut electricity ratepayers will spend approximately $0.85. This is why $215 million in electricity cost savings results in a slightly lower economic output of $180 million.) The average of $180 million per year is based on annual economic output (as shown in the 'Cost Savings to Customer' line item) of $50 million in 2020, $166 million in 2021, $213 million in 2022, $240 million in 2023 and $241 million in 2024.

Table 4: Construction Period and Facility Operations: Breakout of obs and Earnings Impacts – Direct, Indirect and Induced

	2017	2018	2019	2020	2021	2022	2023	2024
Direct Employment Impact (FTEs per year)								
Construction Period	95	273	204	27	-	-	-	-
Facility Operations	-	-	-	23	28	28	28	28
Indirect & Induced Employment Impact (FTEs per year)								
Construction Period	85	242	181	24	-	-	-	-
Facility Operations	-	-	-	38	46	46	46	46
Total Employment Impact	**180**	**515**	**386**	**113**	**74**	**74**	**74**	**74**
Direct Earnings Impact ($ - millions)								
Construction Period	18	53	40	5	-	-	-	-
Facility Operations	-	-	-	2	3	3	3	3
Indirect & Induced Earnings Impact ($ - millions)								
Construction Period	7	21	16	2	-	-	-	-
Facility Operations	-	-	-	4	5	5	5	5
Total Earnings Impact	**25**	**73**	**56**	**14**	**7**	**8**	**8**	**8**

As presented in PA's original report, in addition to the economic impacts on the state of Connecticut, KEC will also have economic impacts in and around the Town of Killingly. Table 4 is the same as Table 2-4 in PA's original report (page 9), and the values in Table 4 are included in the values presented in Table 3. (Similarly, Table 2-4 values in PA's original report are included in the values presented in Table 2-3.) The purpose of Table 4 is to highlight the direct employment and earnings impacts from KEC's construction and operations, which will originate in the Town of Killingly. These impacts will be driven by the direct onsite jobs created during construction and operations, illustrated in the upper portion of Table 4 under the 'Direct Employment Impact (FTEs per year)' heading. Construction jobs are projected to average 240 during the

height of construction (2018-19), with 25-30 long-term jobs created to support KEC's operations. These direct employment impacts result in associated wage creation and impacts, labeled as 'Direct Earnings Impact ($ - millions)' in Table 4, of $130 million from 2017 through 2024, with those impacts projected to be realized in and around the Town of Killingly. (The $130 million is based on $18 million of 'Construction Period' earnings in 2017 and ending with $3 million of 'Facility Operations' earnings in 2024.)

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APPENDIX B-2 – KILLINGLY ENERGY CENTER: AN ANALYSIS OF NEED AND ECONOMIC & ENVIRONMENTAL IMPACTS

KILLINGLY ENERGY CENTER: AN ANALYSIS OF NEED AND ECONOMIC & ENVIRONMENTAL IMPACTS

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(vi) Nothing in PA's Reports should be taken as a promise or guarantee as to the occurrence of any future events.

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1 EXECUTIVE SUMMARY

The following report has been prepared by PA Consulting Group ("PA") at the request of NTE Connecticut ("NTE") to analyze the need for, and the potential economic and environmental benefits of, the Killingly Energy Center ("KEC"). KEC is a planned 500 MW natural gas-fired electric generating facility to be located in the Town of Killingly, Connecticut. KEC plans to begin construction in 2017 and enter commercial operations in 2020, at which point it will be one of the most efficient operating electric generating facilities in Connecticut.

PA's analysis relied on a series of industry standard and proprietary models to assess (i) the need for the facility and (ii) project the economic and environmental benefits of KEC.

The need for KEC in the state of Connecticut and the overall New England market was based on PA's modeling of the Forward Capacity Auction ("FCA") 11. PA's modeling of FCA 11, scheduled to be held in February 2017, projects KEC to clear approximately 500 MW. Clearing its capacity in FCA 11 will demonstrate that KEC is needed for the reliability of the electricity market in Connecticut and the wider New England market.

The economic benefits (e.g. jobs, wages, and total economic output) were developed using the JEDI and IMPLAN models, and the environmental benefits (e.g. decreases in emissions such as CO_2, SO_2 and NO_X) were developed using PA's proprietary electricity market models. In addition to a reduction in emissions such as CO_2, SO_2 and NO_X, KEC is projected to result in positive economic benefits during both its construction (2017-20) and operating (2020+) phases. At the height of its construction in 2018, KEC will directly employ nearly 300 workers with annual wages of more than $50 million, and it will create more than 500 jobs and $70 million in earnings including the indirect and induced impacts. After construction has been completed and the plant commences operations, KEC will provide more than 25 direct full-time jobs with annual wages of $3 million – not including the indirect and induced jobs and earnings – and will pay significant annual property taxes to the Town of Killingly.

The primary impacts of KEC on the Town of Killingly and state of Connecticut are summarized below.

The Town of illingly

- An average of 240 direct onsite construction jobs per year during the peak years of construction (2018-19) and more than 25 operating jobs in the long term (2020+) will be created in the Town of Killingly;
- These direct jobs will create an average of $45 million per year in wages during the peak years of construction (2018-19) and $3 million per year in long-term wages; and
- Significant annual property taxes to the Town of Killingly.

The State of Connecticut

- An average of 1,100 long-term jobs created from 2020 – 2024;
- $535 million in total wage creation from 2017 – 2024; and
- More than $1 billion in total economic output from 2017 – 2024.

The remainder of this report is structured into two main sections. The first section describes PA's methodology, analysis, and findings related to KEC's projected economic and environmental benefits. The

second section describes PA's methodology, analysis, and findings related to KEC's need for reliability in the New England electricity market, along with the project-specific details.

2 IMPACTS ANALYSIS

This section examines the economic and environmental benefits from KEC's construction and operations to the state of Connecticut and the Town of Killingly. As discussed below, KEC is projected to have both positive economic impacts, in the form of job and wage creation and increased economic activity, and positive environmental impacts from a reduction in emissions (e.g. CO_2, NOx and SO_2).

2.1 Overview of Connecticut and the Town of Killingly

The state of Connecticut has approximately 3.5 million people with a gross state product of approximately $260 billion and a per capita income of $65,000. The Town of Killingly (located in northeastern Connecticut) has a population of approximately 17,000 with an estimated per capita income of approximately $27,000. The top employment industries include education services, healthcare and social assistance (27%), manufacturing (16%), and retail trade (15%). Killingly's unemployment rate is estimated at over 9%.

Spanning 50 square miles with 7,000 households, Killingly's population density is 360 people per mile. The town is managed by a Town Council, made up of nine elected members with two-year terms. Approximately 2,800 students attend school in the town, from pre-kindergarten through Grade 12.

2.2 Assessment of economic benefits

KEC is projected to provide economic benefits to the state of Connecticut and the Town of Killingly during both its construction and operating periods. These economic benefits are expected to be realized in the three areas outlined below.

- KEC's construction – equipment, materials, and labor used during construction and state sales tax, permitting fees, and other activities.
- KEC's operations – fixed and variable costs associated with the materials and labor needed to operate the facility as well as annual property taxes to the Town of Killingly.
- Electricity cost savings to Connecticut ratepayers – KEC's entry will result in lower wholesale capacity and energy prices, thereby resulting in electricity cost savings to Connecticut ratepayers. Further detail on power market cost savings are included in Section 2.3.1.

For each of these areas, economic benefits are measured according to three factors: (i) job creation, (ii) wage creation, and (iii) economic output.

2.2.1 Methodology

To estimate the economic benefits, PA's analysis used an input-output (I-O) analysis. I-O analysis accounts for inter-industry relationships within a city, state, or expanded area, and employs the resulting economic activity multipliers to estimate how the local and regional economies are affected by a given investment. In this case, that investment is the construction and subsequent operations of the KEC facility.

Multiplier analysis is based on the notion of feedback through I-O linkages among firms and households who interact in regional markets. Firms buy and sell goods and services to other firms and pay wages to households. In turn, households buy goods from firms within the economic region. Therefore, the economic benefits of KEC extends to other local businesses through direct purchases and from purchases of locally produced goods and services that arise from the income derived by the employment that is created. Further benefits occur because of feedback effects – where other local firms require more labor and inputs to meet rising demand for their output, which has been stimulated by KEC's construction and operation.

The economic benefit of KEC's construction and operation can be categorized across three effects:

- **Direct** – jobs, income, output and fiscal benefits that are created directly by the construction and operations of KEC. The jobs (and other benefits) created may be short-term, as in the case of construction jobs, or long-term, such as the operations and maintenance positions that exist throughout the life of the facility.
- **Indirect** – jobs, income, output and fiscal benefits that are created throughout the supply chain and that are spawned by the direct investment to build and operate the facility. Indirect jobs include the jobs created to provide the materials, goods, and services required by the construction and operation of KEC, as well as the jobs created to provide the goods and services paid for with the wages from the direct jobs.
- **Induced** – jobs, salaries and wages, and output and fiscal benefits created by household spending of electricity cost savings or of income earned either directly from KEC or indirectly from businesses that are benefitted by KEC.

There is significant complexity involved in the calculation of these effects, particularly in the calculation of the indirect and induced effects, but a comprehensive estimate of economic benefits require all three. These estimates are also sensitive to the set of assumptions considered in the analysis, principally assumptions regarding the leakage of economic activity to outside of Connecticut. In addition, a series of variables, including changes to the price of electricity, will influence the multiplier impact analysis and, therefore, have been considered in tandem to assess the contribution of KEC to the local and regional economies.

2.2.2 Input-output models employed

The job creation, salaries and wages, and overall economic benefit of KEC has been analyzed using KEC's project-specific costs and two input-output models: IMPLAN and the National Renewable Energy Lab's Jobs and Economic Development Impact model ("JEDI").

IMPLAN is an economic analysis tool that takes data from multiple government sources and employs an estimation method based on industry accounts or an I-O Matrix that allows using multipliers to estimate how changes in income and spending benefit the local economy. IMPLAN estimates are generated by interacting the direct economic benefit of KEC with the Regional Input-Output Modeling System (RIMS II) multipliers for Connecticut. The U.S. Bureau of Economic Analysis ("BEA") provides these multipliers.

The JEDI model estimates the economic benefit of constructing and operating power generation plants at the state level. The JEDI model also uses an I-O methodology and was built utilizing economic data from IMPLAN as well as interviews with industry experts and project developers. The JEDI model allows estimating of the economic benefit of power generation investment in a state including local labor, services, materials, other components, fuel, and other inputs. The model also allows adjusting the portion of project investment that occurs locally.

2.2.3 Construction cost assumptions

Below is a high-level description of KEC's equipment and construction costs, which total $537 million. Details of the specific cost structure for KEC have been omitted due to their commercially sensitive nature.

Equipment

- Combustion Turbines and Generators
- Heat Recovery Steam Generators
- Exhaust Stacks
- Steam Turbine Generators
- Cooling and Related Systems
- Switchyard

Total Equipment Cost Estimate: 318 Million

Construction and Other Costs

- Development
- Design
- Construction

Total Construction Cost Estimate: 219 Million

2.3 Projected economic benefits

The construction, operations, and electricity ratepayer savings resulting from KEC's entry will create jobs, wages, and increased economic activity and output in the state of Connecticut and Town of Killingly. The economic benefit projections in this section include the direct, indirect, and induced effects of KEC's (i) construction period, (ii) facility operations, and (iii) electricity ratepayer savings (i.e. cost savings to customer) on Connecticut's economy.

2.3.1 Electricity cost savings to Connecticut customers

The electricity cost savings to Connecticut ratepayers, which are an input to the economic impacts input-output models discussed in Section 2.2, have been forecasted using PA's internal power market models. PA calculated the cost savings using its proprietary electricity market and capacity market simulation models, which simulated (i) the New England electricity market and the operations of the power plants within it, and (ii) the New England capacity auction. PA utilizes AURORA^{xmp} along with its proprietary stochastic model to assess both electricity markets and specific generator operations and economics. PA's capacity market model forecasts capacity prices based on its forecasts of (i) existing and new capacity, and (ii) FCA 11 demand curve parameters. These cost savings were determined by comparing Connecticut's total energy and capacity costs with and without KEC's entry into the market (in 2020).

PA's analysis found that KEC's entry would result in lower energy and capacity costs for Connecticut ratepayers. With the participation of KEC in New England's upcoming capacity auction, FCA 11, PA projects capacity prices for Connecticut to be approximately 10% lower than if KEC did not enter the market. Similarly, energy prices are projected to be 1% lower with KEC in the market, as it displaces less efficient generation in the market. The impact of these combined capacity and energy price decreases from KEC's entry is summarized in Table 2-3.

2.3.2 Total impacts to Connecticut employment, income, and economic output

Table 2-3 illustrates the total (i.e. direct, indirect, and induced) jobs, employee earnings, and economic output attributable to KEC on the state of Connecticut. The construction of KEC will result in significant investment and construction activity in Connecticut from 2017 to 2020, and the initial five years of operation will produce substantial energy and capacity cost savings to electricity ratepayers.

Table 2-3: Total Economic Impacts on the State of Connecticut – Direct, Indirect, and Induced

	2017	2018	2019	2020	2021	2022	2023	2024
Employment Impact (FTEs per year)								
Construction Period	180	515	386	51	-	-	-	-
Facility Operations	-	-	-	62	74	74	74	74
Cost Savings to Customer	-	-	-	291	956	1,200	1,319	1,300
Total Employment Impact	**180**	**515**	**386**	**404**	**1,030**	**1,274**	**1,393**	**1,374**
Earnings Impact ($ - millions)								
Construction Period	25	73	56	8	-	-	-	-
Facility Operations	-	-	-	6	7	8	8	8
Cost Savings to Customer	-	-	-	18	62	79	89	90
Total Earnings Impact	**25**	**73**	**56**	**32**	**69**	**87**	**97**	**98**
Economic Output ($ - millions)								
Construction Period	36	106	82	11	-	-	-	-
Facility Operations	-	-	-	13	17	17	17	18
Cost Savings to Customer	-	-	-	50	166	213	240	241
Total Economic Output	**36**	**106**	**82**	**74**	**183**	**230**	**257**	**259**

The economic benefits of KEC on the state of Connecticut, including direct, indirect, and inducted impacts, are summarized as follows.

- **obs** – During the peak years of construction (2018-19), KEC will create an average of 450 full-time jobs per year (including an average of 240 direct onsite jobs per year). After construction is completed, KEC's ongoing operations will create an average of 70 long-term jobs (including an average of more than 25 direct onsite jobs per year). Furthermore, the electricity cost savings to ratepayers will create an average of more than 1,000 additional jobs annually form 2020-2024.
- **Salaries and wages** – The construction of KEC will support the creation of approximately $160 million in salary and wages to Connecticut employees from 2017-2020 (including $115 million to direct onsite employees). Salaries and wages earned by Connecticut employees and generated from KEC's operations from 2020-2024 total approximately $35 million (including $13 million to direct onsite employees). Additionally, from 2020-2024, the electricity cost savings of Connecticut ratepayers will result in $335 million in additional induced income. Cumulatively, these impacts will result in nearly $535 million in wage creation from 2017-2024.
- **Economic output** – KEC is projected to result in more than $1 billion of increased economic output from 2017-24. During the construction period, 2017-2020, economic output is projected to total $235 million. KEC's operations are projected to contribute an additional $80 million, with electricity cost savings to ratepayers projected to contribute nearly $180 million per year in increased economic activity from 2020-2024.

In addition to economic impacts on the state of Connecticut, KEC will also bring economic benefits to the Town of Killingly, driven in particular by the direct onsite jobs created during construction and operation. Table 2-4 provides a breakdown of the jobs and earnings created by the construction and operation of KEC, isolating the direct onsite jobs and resulting income from the indirect and induced impacts. KEC's construction is projected to create an average of 240 direct onsite construction jobs during 2018-19, and once operations begin in 2020, KEC is expected to create more than 25 long-term jobs. Wages associated

with these jobs are projected to be $45 million per year in 2018-19 and $3 million per year in the long term. In addition, KEC is projected to pay a significant amount in property taxes each year to the Town of Killingly.

Table 2-4: Construction and Operations obs and Earnings Impacts – Direct, and Indirect Induced

	2017	2018	2019	2020	2021	2022	2023	2024
Direct Employment Impact (FTEs per year)								
Construction Period	95	273	204	27	-	-	-	-
Facility Operations	-	-	-	23	28	28	28	28
Indirect & Induced Employment Impact (FTEs per year)								
Construction Period	85	242	181	24	-	-	-	-
Facility Operations	-	-	-	38	46	46	46	46
Total Employment Impact	**180**	**515**	**386**	**113**	**74**	**74**	**74**	**74**
Direct Earnings Impact ($ - millions)								
Construction Period	18	53	40	5	-	-	-	-
Facility Operations	-	-	-	2	3	3	3	3
Indirect & Induced Earnings Impact ($ - millions)								
Construction Period	7	21	16	2	-	-	-	-
Facility Operations	-	-	-	4	5	5	5	5
Total Earnings Impact	**25**	**73**	**56**	**14**	**7**	**8**	**8**	**8**

2.4 Assessment of environmental benefits

In addition to the economic benefits discussed in the previous section, KEC will also have a positive environmental impact on the state of Connecticut and the surrounding region. More specifically, KEC's entry will result in a decrease in the annual amount of emissions by New England power plants due to KEC operating ahead of (i.e. displacing) older, inefficient power plants in the market (e.g. coal, steam natural gas/fuel oil). This section describes PA's modeling methodology, analysis, and findings related to reductions in New England CO_2, SO_2, and NO_X emissions as a result of KEC.

2.4.1 Methodology

This subsection provides an overview of the emissions reductions likely to result from KEC's entry into the New England market. Using a methodology similar to that used to determine the capacity and energy cost savings discussed in Section 2.2, PA determined the annual emission reductions from KEC's entry by simulating the ISO-NE power market with and without KEC. The analysis was performed using PA's proprietary electricity market model, which simulates the operations of power plants within ISO-NE and adjacent power markets (e.g. New York). PA also utilizes AURORA^{xmp} for its production cost modeling in order to dispatch generation units to minimize total system cost and project incremental compensation required to maintain reliability.

2.5 Projected emissions reductions

Table 2-5 below illustrates the environmental benefits, via pollutant emissions reductions, from KEC's entry. From 2020-2024, the initial five years of KEC's operations, region-wide emissions of carbon dioxide ("CO_2") is projected to decrease by 1.5 million tons, while nitrogen oxide ("NO_X") and sulfur dioxide ("SO_2") are projected to decrease by 3,500 tons and 1,900 tons, respectively. The cumulative decrease in CO_2 is equivalent to planting 35,000,000 trees.[1]

[1] US Environmental Protection Agency's Greenhouse Gas Equivalencies Calculator

Table 2-5: New England and New York Emission Reductions ($C0_2$ in 000's of tons; NO and SO_2 in tons)

Pollutant	2020	2021	2022	2023	2024
CO_2	(243)	(311)	(360)	(307)	(334)
NOx	(536)	(640)	(870)	(824)	(847)
SO_2	(229)	(406)	(458)	(424)	(441)

The reduction in emissions is primarily driven by KEC's high operating efficiency, which in technical terms equates to a low full load heat rate. (A full load heat rate is a measurement of a power plant's efficiency in converting feedstock (e.g. natural gas) into electricity at maximum operating output.) More specifically, as a highly efficient natural gas-fired electricity generating facility, KEC requires less fuel input (e.g. natural gas) per MWh of electricity produced than nearly all of existing natural gas, fuel oil and coal-fired power plants in New England. As such, when KEC produces electricity it will move ahead of (i.e.) displace less efficient (and less environmentally-friendly) forms of electricity generation that are currently operating in the market.

These market-wide emission reductions should not be taken as limiting the ability of the state of Connecticut to meet CO_2 emission reduction targets. As a participant in the Regional Greenhouse Gas Initiative ("RGGI"), all thermal power plants greater than 25 MW located within Connecticut (as well as the eight other participatory states) are subject to CO_2 emissions caps. As such, the addition of KEC will not impact the overall emissions reduction goals of RGGI given its emissions are also accounted for under the RGGI cap. KEC is likely to lead to an overall decrease in regional CO_2 emissions given the high operating efficiency of the facility, and may lead to an overall less costly compliance trajectory under the RGGI program. In addition, PA projects KEC will have either no impact or, more likely, a positive impact on Connecticut's ability to meet its emissions reduction targets set forth in the Environmental Protection Agency's ("EPA") Clean Power Plan ("CPP"). Whether KEC contributes to the state's compliance capability depends on how Connecticut ultimately decides to comply with the CPP. If Connecticut chooses to exclude new power plants from its compliance plan, then KEC will not be subject to CPP and, therefore, its development will have no impact on the state's ability to comply. If the state's compliance plan does include new power plants, then the entry of the highly efficient KEC would enhance Connecticut's ability to comply with the CPP.

3 NEEDS ANALYSIS AND PROJECT DETAILS

The following section outlines PA's analysis of (i) the need for KEC, (ii) how KEC contributes to the electric reliability of Connecticut and the overall New England electricity system, (iii) KEC's consistency with the Connecticut Department of Energy and Environmental Protection's long-term energy policy, and (iv) KEC's project details.

3.1 Standards for the determination of need

Load-serving entities ("LSE") located within the state of Connecticut are members of ISO-NE, an independent, non-profit Regional Transmission Organization ("RTO") serving Connecticut, Massachusetts, New Hampshire, Rhode Island, Vermont and portions of Maine. Among other items, ISO-NE operates the region's transmission network and administers the Federal Energy Regulatory Commission ("FERC") approved wholesale energy, ancillary, and capacity markets. In 1997, ISO-NE was created by NEPOOL market participants to operate the regional electricity system, create and administer the wholesale markets, and ensure open access to transmission. (See Figure 3-1 below for an illustration of ISO-NE footprint.) In 2005, FERC Order 2000 designated ISO-NE as an RTO; and as an RTO, ISO-NE assumed the additional responsibility for system planning.

Figure 3-1: Town of Killingly's Location in ISO-NE

ISO-NE accomplishes system planning for reliability via the Forward Capacity Market ("FCM") capacity procurement mechanism, approved by FERC in 2006. As members of ISO-NE, Connecticut LSEs rely upon ISO-NE's FCM capacity procurement mechanism to meet projected peak electricity demand plus a target amount of reserves (i.e., extra capacity). As described further in this section, it is through the FCM that ISO-NE determines the reliability-driven need for new capacity resources like KEC.

3.1.1 Governing statues, policy and regulation

In 1996, in accordance with FERC Orders 888 and 889, state regulators and LSEs throughout the New England region began the process of electricity market deregulation, and Connecticut's Department of Public Utility Control ("DPUC") began formal participation in the region's process of deregulation with the enactment of the Public Act No. 98-28. Subsequently, in 1998, Connecticut adopted an order approving retail choice for the state. Retail choice allows Connecticut electricity ratepayers the option to select a competitive retailer to supply their electricity needs, while still relying on the local electric utility for distribution service. Currently, there are two major distribution companies under the retail choice program operating in Connecticut. Connecticut Light & Power (dba Eversource) manages the distribution system for approximately 70% of Connecticut. United Illuminating Company, serving southwestern Connecticut, serves approximately 15% of Connecticut. The remaining 15% of the state is served by smaller distribution companies who are not in the retail choice territories. The town of Killingly is served by Eversource.

3.2 Determination of need analysis

The FCM capacity procurement mechanism is used by ISO-NE to ensure the regional electricity market has enough capacity resources to reliably meet current and future electricity demand. Under the FCM, Forward Capacity Auctions ("FCA") are used as a market-based approach to determine system-wide and localized needs for both existing and new capacity through a competitive auction process. This process is designed to select the appropriate amount of existing and new capacity resources that are needed for system-wide and local reliability while simultaneously maximizing social surplus. The capacity resources are selected by clearing the FCA. Therefore, capacity resources that clear the FCA are, by definition, needed for reliability.

3.3 Forward capacity market overview

FCAs are conducted three-years prior to the capacity commitment period (i.e., Delivery Year, or "DY") for which it is being held. The FCA is a descending clock auction whereby the auction starting price is reduced in each round until the amount of remaining capacity is equal to the value that ISO-NE places on additional excess capacity, based on its demand curve parameters. Capacity resources participating in the FCA do not submit sell offers; existing capacity resources that wish to withdraw from the auction must submit a de-list bid, which is subject to a reliability review. In addition to the FCA, ISO-NE holds annual, seasonal and monthly reconfiguration auctions in order to adjust the amount of capacity needed and to provide auction participants the opportunity to calibrate their forward capacity obligations.

The capacity that is required to meet ISO-NE's future system-wide demand is called the Installed Capacity Requirement ("ICR"). The ICR is the minimum amount of capacity required for ISO-NE to meet its resource adequacy planning criterion. Additionally, the FCM takes into account locational capacity needs to ensure that regional zones have sufficient capacity to maintain reliability when transmission constraints prevent the delivery of electricity to any particular capacity zone. Capacity requirements vary from year to year. For FCA 11, ISO-NE proposes to model two transmission-constrained zones: an import-constrained Southeastern New England Zone (Rhode Island and eastern Massachusetts) and an export-constrained Northern New England Zone (Maine, Vermont, and New Hampshire). The Connecticut capacity zone ("CT Zone"), where KEC will be located, and the Western Massachusetts zone will be included as part of the unconstrained Rest-of-Pool capacity zone ("ROP Zone").

For each FCA, capacity resources receive a capacity supply obligation ("CSO") of at least one year, which requires the capacity resource to bid into the energy market. In return, cleared capacity resources receive the applicable clearing price for that FCA (and can be financially penalized if they do not deliver on the

assigned capacity obligation). ISO-NE's next FCA is for the 2020/2021 DY ("FCA 11"), which will be held in February 2017. This auction will determine the capacity that is needed for reliability in ISO-NE during the 2020/2021 DY. KEC plans to participate in the auction for FCA 11.

3.3.1 Methodology

Since FCA 11 will not occur until February 2017, PA prepared an analysis of KEC's impacts within the ISO-NE wholesale electricity market, including (i) capacity projections for FCA 11, (ii) impacts on Connecticut electricity reliability, and (iii) impacts on Connecticut electricity ratepayer costs.

Using PA's proprietary FCM Simulation Model, within the context of PA's broader wholesale energy market analysis of the ISO-NE region and the aforementioned modeling architecture, PA's FCA capacity price forecast was developed based on its forecasts of (i) supply, including existing and new capacity; and (ii) demand, namely PA's projected FCA 11 demand curve and associated parameters as of June 2016.

3.3.2 Modeling assumptions

The supply curve for FCA 11 depends on several assumptions, including underlying cost and bidding behavior, retirement decisions of existing capacity, installed capacity requirements ("ICR") based on reliability criteria, as well as the cost of new entry for new capacity. KEC is projected to bid approximately 500 MW into the ROP Zone.

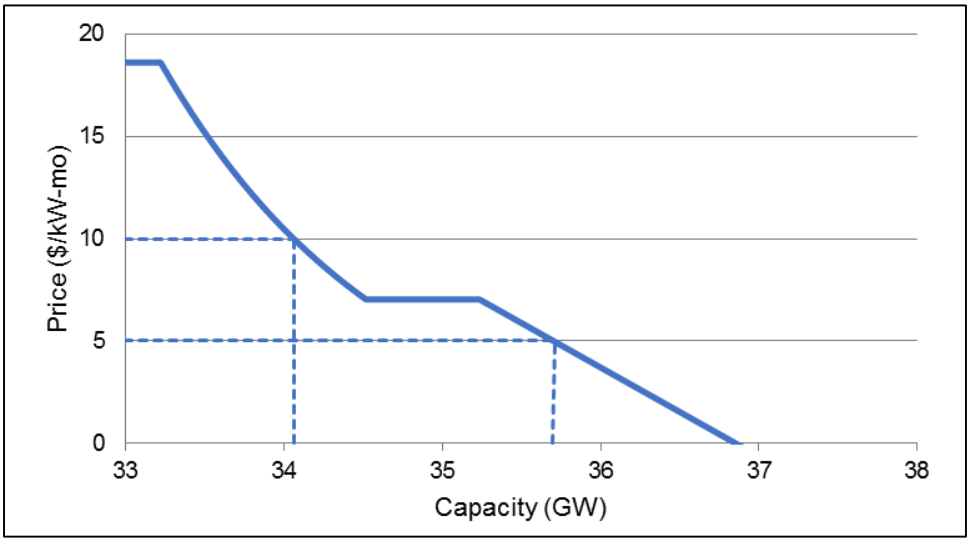
PA's view of demand assumes that ISO-NE will transition, as is currently proposed, from a linear sloped demand curve to a convex sloped demand curve in time for FCA 11. ISO-NE plans to transition to a fully convex curve within three years (depending on peak demand growth and the associated impact on ICR), which means that the curve for FCA 11 is only partially convex. Specifically, for FCA 11, the portion of the demand curve corresponding to prices above $7.03/kW-mo (i.e. the FCA 10 clearing price) is convex, whereas the portion of the demand curve corresponding prices below $7.03/kW-mo is linear. The two portions are connected by a flat "shelf" of 722 MW of capacity priced at a static $7.03/kW-mo.

In addition to a partially convex sloped system-wide demand curve, ISO-NE will for the first time implement a sloped demand curve for each transmission constrained capacity zone (e.g., NNE and SENE in FCA 11), which will replace the vertical demand curves used in prior auctions. Since PA projects the Connecticut Zone to be modeled as part of the ROP Zone for the duration of the study period, the zonal demand curve changes will not impact KEC's projections.

3.4 Projected FCA 11 results

Figure 3-2 shows an illustrative demand curve for FCA 11 and a hypothetical illustration of how capacity prices are derived. All else equal, as additional capacity clears the auction the clearing price will be lower, resulting in savings for ratepayers and greater social surplus. The figure below illustrates this concept.

Figure 3-2: FCA 11 Illustrative Price Calculation



For FCA 11, PA projects total cleared capacity of approximately 35.5 GW resulting in a clearing price of $6.19/kW-mo. At this clearing price, KEC is projected to clear the auction.

3.5 Findings on the determination of need

Based on the aforementioned analysis, PA projects KEC will clear FCA 11 at a price of $6.19/kW-mo. As previously discussed, by definition, if KEC clears FCA 11, then ISO-NE (and, by proxy, Connecticut LSEs that are participants in ISO-NE) will have determined KEC to be needed for the reliability of Connecticut and the wider New England market.

3.6 Fuel supply

KEC plans to use both firm natural gas transport and ultra-low sulfur diesel ("ULSD") as a backup fuel for its fuel supply needs.

KEC is contracting for firm natural gas fuel supply utilizing a firm delivered natural gas contract structure. Under the firm delivered natural gas contract structure, NTE enters into a natural gas fuel supply agreement with a single fuel supplier which provides interstate pipeline transportation, natural gas commodity, and balancing service bundled into one firm delivered natural gas fuel supply. The supplier holds a firm obligation to deliver natural gas regardless of market conditions; however, there could be circumstances where even firm natural gas pipeline transportation is curtailed due to operational flow orders or other operation events on the interstate pipeline even though a firm obligation exists. In this circumstance, KEC continues to have a delivery obligation to ISO-NE and thus must generate as required to maintain system integrity on the electric grid.

Therefore, back-up fuel is required in order to meet the capacity and delivery obligations of ISO-NE as these delivery obligations are not excused even in the event of curtailment of firm natural gas fuel supply. From an operations reliability standpoint this should advantageously position the facility versus other power plants in Connecticut that mostly rely on either interruptible natural gas transport or backup ULSD, but not both.

By having both a firm natural gas contract and ULSD backup KEC would be able to operate in virtually any situation.

KEC's planned firm natural gas transport contract will provide up to 95,000 MMBtu/day for seven years, starting in 2020. This is enough natural gas to support KEC's operations at maximum output for an entire day. KEC's use of ULSD will only be allowed when natural gas is unavailable (likely due to an extreme gas demand event) and for up to a maximum of 720 hours per year of operations. However it is expected that KEC would operate using ULSD for only a handful of hours at a time, and not likely in every year.

3.7 Transmission interconnection and power delivery

KEC will connect to the existing 345 kV electric transmission line (Lake Road to Card) located adjacent to the property's eastern boundary. Electrical equipment adjacent to the facility will convert (i.e. step up) the generated electricity from approximately 20 kV to 345 kV in order to provide electricity at the same voltage as the existing electric transmission circuit. A switchyard (configured as a three-breaker ring-bus) will be constructed on the portion of the property south of Lake Road to allow the transmission lines from KEC to interconnect directly with the existing transmission system.

3.8 Consistency with state plans

As part of Connecticut's 2014 Integrated Resources Plan ("IRP"), the Connecticut Department of Energy and Environmental Protection ("DEEP") has proposed several capacity resourcing strategies that it believes will help the state of Connecticut reach the goal of achieving a reliable, clean, and cost-effective pool of energy supply. Chief among these strategies is the goal of ensuring Connecticut has enough capacity to meet peak winter electricity demand in a clean and cost-effective manner.

The development of KEC supports both parts of this strategy. Not only would KEC add approximately 500 MW of reliable electricity generation to Connecticut – KEC's firm natural gas contract (see Section 3.6) and ULSD backup virtually guarantee KEC will be available to operate under almost any circumstance – but with natural gas prices at near-historic lows (and by using state-of-the-art turbine technology) it would do so in a cost-effective manner. When KEC enters the market in 2020 it is likely to be one of only a handful of facilities in New England with both firm natural gas and ULSD backup, and it would be 25% more efficient at generating electricity than today's average Connecticut power plant.

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APPENDIX C – GEOTECHNICAL ENGINEERING REPORT

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GEOTECHNICAL ENGINEERING REPORT
KILLINGLY ENERGY CENTER
KILLINGLY, CONNECTICUT

by Haley & Aldrich, Inc.
Rocky Hill, Connecticut

for NTE Connecticut, LLC
St Augustine, Florida

File No. 43434-000
July 2016

Executive Summary

This geotechnical report:

- Describes the existing site conditions and proposed conditions as they relate to earthwork and foundation engineering. The power island will be located on Tract One and the utility switch yard will be located on Tract Two.

- Describes the subsurface exploration program and laboratory testing program. A subsurface exploration program was performed at the site to sample and describe soil and rock.

- Provides an interpretation of the subsurface conditions. Subsurface conditions consist of glacial deposits overlying bedrock. Bedrock outcrops are present in the central part of Tract One.

- Provides engineering recommendations for foundations (buildings and retaining walls). Structures may be supported on spread footings, ring foundations, or mat foundations bearing on glacial till, weathered bedrock, and bedrock.

- Provides engineering recommendation for site development. Stable cut slopes into the native soil and rock can be engineered to lower the site grade. Stable fill slopes can be engineered using excavated soil and rock to raise the site grade. Retaining walls will be used where slopes are not feasible.

- Recommendations are provided for storm water management, flexible and rigid pavement, subgrade preparation, dewatering, and material specifications.

- Provides construction recommendations for earthwork. Native soil and rock may be reused to attempt to balance earthwork. Controlled blasting will be required to excavate bedrock. During construction, monitoring earthwork, subgrade preparation, and fill placement and compaction is recommended.

- Provides recommendations for future geotechnical investigations and engineering for final design. Additional field investigation and engineering evaluation are recommended for estimating rock excavation and balancing earthwork cuts and fills, for retaining wall foundation design, and for design of high cut and fill slopes.

Refer to Geotechnical Report for additional details.

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1. Introduction

1.1 GENERAL

This report provides our geotechnical engineering recommendations for the proposed Killingly Energy Center located in Killingly, Connecticut. The site location is shown on the Project Locus, Figure 1.

1.2 PURPOSE AND SCOPE

This investigation was undertaken to obtain information on subsurface soil, rock, and groundwater conditions, and to provide recommendations for foundation design for the proposed power plant and ancillary equipment. The scope of geotechnical engineering services included:

- Visiting the site to observe existing conditions.
- Reviewing existing information on subsurface soil and rock conditions and groundwater levels.
- Staking exploration locations.
- Monitoring a subsurface exploration program.
- Installing groundwater observation wells.
- Performing field soil resistivity testing.
- Performing field permeability testing.
- Performing geotechnical laboratory testing.
- Performing geochemical (for corrosion potential) laboratory testing.
- Preparing a Preliminary Geotechnical Engineering Report (dated 10 June 2016).
- Performing geotechnical analyses and preparing this report.

1.3 ELEVATION DATUM

Elevations in this report are in feet and refer to the North American Vertical Datum of 1988 (NAVD88).

1.4 SITE CONDITIONS

The site is located at 180 and 189 Lake Road. The 73-acre site is comprised of about 63 acres west of Lake Road (189 Lake Road – Tract One) and 10 acres east of Lake Road (180 Lake Road – Tract Two).

Tract One is wooded except for a 2-story house, shed, and 160-ft deep water supply well that was installed circa 2010 located in the eastern portion of the tract (along Lake Road). The tract includes a pond, an abandoned artesian well, and bedrock outcrops in the central portion of the tract, and wetlands in the northern portion of the tract. Grades slope down from about El. 360 in the southern portion and about El. 340 in the northeastern portion of the tract to about El. 250 in the western portion and about El. 310 in the eastern portion of the tract. Several stone walls are located on the tract.

Tract Two is wooded, except for the northern portion which contains a field and a dilapidated barn (along Lake Road). The tract includes a cemetery with about a dozen head stones located in the western portion of the tract and wetlands in the southern portion of the tract. Grades slope down from about El. 350 in the southern portion of the tract to about El. 310 in the northern portion of the tract.

1.5 PROPOSED CONSTRUCTION

The power plant and ancillary equipment (power island) are planned on Tract One. The finished grade will generally range from El. 313 to El. 317 (average about El. 315), except the administrative building (Area 15), plant switchyard (Area 23), and fuel gas metering (Area 20), which will be constructed at about El. 320. Cuts up to 27 ft are planned in the southern portion of the tract, and fills up to 38 ft are planned in the northern and western portion of the tract with transitions in grades planned using slopes generally ranging from 3H:1V to 4H:1V (portions of slope north and west of the power island to reduce impact to wetlands). A 165-ft-long retaining wall with maximum height of 20-ft is proposed east of the power island along wetlands (to reduce impact to wetlands). A storm water basin (Area 30) with three basins (bottom of basin near existing grade) is proposed north of the power island near wetlands. Mott MacDonald plans to support structures on ring foundations (tanks) and mat foundations or concrete pedestals bearing on foundations. A summary of proposed construction on Tract One is included in Appendix A.

A utility switchyard is planned on Tract Two. The switchyard will connect to the existing electric transmission lines to the east. The finished grade will generally range from about El. 325 to about El. 335 (average about El. 330). Cuts up to 25 ft are planned in the western portion of the switchyard, and fills up to 5 ft are planned in the eastern portion of the switchyard. A 275-ft-long retaining wall with a maximum height of 25-ft is proposed southwestern portion of the utility switchyard.

Proposed construction is shown on Figure 2 and on an untitled drawing prepared by Killingly engineering Associates, dated 30 July 2016, which is also provided in Appendix A.

1.6 LIMITATIONS

This report has been prepared for specific application to the project as it is planned at this time for the exclusive use of the project design team in connection with the geotechnical aspects of the project. In the event that changes in the nature, design, or location of structures are planned, the conclusions and recommendations contained in this report should not be considered valid unless the changes are reviewed and conclusions of this report modified or verified in writing. The analyses and recommendations are based in part upon data obtained from referenced explorations. The nature and extent of variations between the explorations may not become evident until construction. If variations then appear evident, it will be necessary to re-evaluate the recommendations of this report.

The planned construction will be supported on or in the soil or rock. Recommendations presented in this report for foundation and floor drainage, moisture protection, and waterproofing address only the conventional geotechnical engineering related aspects of design and construction and are not intended to provide an environment that would prohibit growth of mold or other biological pollutants. Our work scope did not include the development of criteria or procedures to minimize the risk of mold or other biological pollutant growth in or near structures. Additionally, evaluation of dynamic loads on foundations was beyond the scope of our services.

2. Subsurface Exploration and Laboratory Testing Programs

2.1 SITE GEOLOGY

Surficial geology maps describe the overburden soils as ground-moraine (glacial till) consisting of poorly sorted, poorly stratified deposits generally composed of glacial debris ranging from clay-size particles to boulders. Boulders were observed at the ground surface.

The Bedrock Geological Map of Connecticut identified the bedrock as Quinebaug Formation consisting of medium- to dark-gray, medium-grained, well-layered gneiss. Bedrock outcrops were observed in the central portion of Tract One (see Figure 2). Bedrock structure was mapped in the field on bedrock outcrops on Tract One. Strike ranged from 20 to 30 degrees and dip ranged from 315 to 335 degrees (25 to 45 degrees northwest).

2.2 OTHER SITE SUBSURFACE DATA

LaFramboise Well Drilling, Thompson, Connecticut, installed a 160-ft deep water well on Tract One circa 2010. The well drilling completion report indicates 10 ft of overburden soil and 150 ft of bedrock was encountered in the well. The well completion report is included in Appendix B.

2.3 LAYOUT FOR FIELDWORK

GM2 Associates Inc. (GM2), Glastonbury Connecticut, staked the test boring locations and soil resistivity locations on 16 and 17 May 2016 using RTK GPS methods. Staked boring and soil resistivity locations are shown on Figure 2. Borings B-04, B-08, and B-15 were offset in the field for access and boring B-11 was offset in the field per Mott MacDonald. Field offsets are noted on the boring logs.

Based on the site topographic (aerial) survey provided by NTE Connecticut, LLC (prepared by Killingly Engineering Associates) and the boring and soil resistivity locations staked by our surveyor (GM2), most ground surface elevations correlate well (within a few feet). However, ground surface elevations at B-07, B-08, and B-09 (located in the western portion of Tract One) do not correlate well (staked location is about 5 ft, 7.5 ft, and 10 ft higher than elevations on the topographic survey). The source of the localized discrepancy is obscured ground in aerial survey.

2.4 SUBSURFACE EXPLORATIONS

Haley & Aldrich monitored a test boring program consisting of eighteen test borings (B-01 through B-18). Mott MacDonald selected the boring locations and depths. Mott MacDonald removed boring B-09 from the program. Borings B-01 through B-15 were located west of Lake Road on Tract One and borings B-16 through B-18 were located east of Lake Road on Tract Two.

NYEG Drilling LLC, Brewerton New York, drilled the test borings on 23 May through 2 June 2016. The borings were advanced using hollow stem augers, wash rotary, air rotary, and down-the-hole hammer methods. Standard penetration tests were performed typically at 5-ft intervals using an automatic hammer. Bedrock was cored in each exploration, except B-01 and B-14 where bedrock was not encountered above the specified termination depth (20 ft).

Groundwater observation wells were installed in borings B-01, B-03, B-07, B-10, and B-12 (selected by Mott MacDonald). Wells were constructed using 2-in. diameter PVC, 10-ft long screen with a sand pack and riser to the ground surface with a surface seal.

Boring locations relative to existing site conditions and proposed construction are shown on Figure 2. Subsurface sections beneath the power island are shown on Figures 3 and 4. Boring logs and observation well installation reports are included in Appendix C. Subsurface data is summarized on Table 1.

2.5 IN-SITU HYDRAULIC CONDUCTIVITY TESTING PROGRAM

Haley & Aldrich performed in-situ falling-head hydraulic conductivity testing at five test boring locations (B-01, B-04, B-06, B-10, and B-11) selected by Mott MacDonald using a Guelph permeameter on 25 May 2016. Each test was run until steady-state flow conditions were established under 5 cm and 10 cm of hydraulic head. Testing was performed at a depth of about 3 ft below ground surface in native glacial till soil (typically silty sand). Field hydraulic conductivity test method was coordinated with Mott MacDonald. Field test results indicated the un-factored hydraulic conductivity of the glacial till soil ranged from 0.01 to 0.06 in/hr. Field test locations are shown on Figure 2. Results of this testing are summarized in Appendix D.

2.6 IN-SITU SOIL RESISTIVITY TESTING

Consulting Engineers Group, Inc., Hopedale Massachusetts, performed three Wenner Four-Electrode soil resistivity arrays using an AEMC model 6470 ground tester on 25 May 2016. Soil resistivity testing was performed at E-01 and E-02 located west of Lake Road on Tract One and E-03 located east of Lake Road on Tract Two. Array lengths ranged from 12 to 150 ft using an a-spacing of 4, 8, 12, 16, 20, 30, 40, and 50 ft. Pipes, pipelines, conduits, fences, or other long metal structures (which can interfere with soil resistivity measurements) were not located near the arrays. High voltage electric transmission lines (energized during testing) are located east of Tract Two and E-03. Soil resistivity array locations are shown on Figure 2. Soil resistivity test results are provided in Appendix E.

2.7 GEOTECHNICAL LABORATORY TESTING

Haley & Aldrich performed four grain size analyses on soil samples recovered from the explorations in general conformance with ASTM D422. Testing was performed to assist with visual classification of soils and help determine engineering properties. Test results are summarized on Table 2. Test data is provided in Appendix F.

2.8 GEOCHEMICAL LABORATORY TESTING

SoilCor, Inc., Murrieta California, performed corrosion tests consisting of pH, soluble sulfates, chloride ion, electrical resistivity, sulfides, and redox potential testing to evaluate corrosion potential on two soil samples recovered from the borings. One sample (glacial till composite) was obtained west of Lake Road on Tract One and one sample (glacial till composite) east of Lake Road on Tract Two. Testing was performed to assist with grounding grid design and selection of Portland cement type. Test results are summarized on Table 3. Test data is provided in Appendix G.

3. Subsurface Conditions

3.1 SOIL AND BEDROCK

Generalized descriptions of soil encountered in the test borings are presented below in order of increasing depth below ground surface. Strata thicknesses observed in the test borings are summarized on Table 1. Refer to logs of test borings in Appendix C for detailed information regarding subsurface conditions.

Approximate Range in Thickness, ft.	Generalized Description
1 to 5	TOPSOIL/SUBSOIL – Very lose to loose dark organic soil with silt and sand. Up to 2 ft of topsoil was encountered overlying 1 to 4 ft of subsoil. Cobbles and boulders were observed at the ground surface.
2 to >28	GLACIAL TILL – Dense to very dense gray-brown silty SAND (SM) consisting of fine to coarse sand with 20 to 45 percent silt and 10 to 30 percent fine to coarse gravel. Stratum includes numerous cobbles and boulders based on drill rig response and coring. Hydraulic conductivity ranged from 0.01 to 0.6 in/hr. Soil resistivity ranged from 100,000 to 500,000 ohm-centimeters based on field measurements (may be influenced by underlying bedrock) and 12,000 to 15,000 ohm-centimeters when saturated in the laboratory. Sulfate concentration was less than 150 mg/kg. Total unit weight of glacial till is anticipated to range from 125 pcf to 145 pcf. Natural moisture content ranged from about 6 to 12 percent.
--	BEDROCK – Hard gray gneiss to white quartzite with a low foliation angle. Bedrock was encountered in each exploration except B-01 and B-14, which were terminated at a depth of 20 ft. Locally, the bedrock surface is weathered. About 3 ft of weathered bedrock was encountered in borings B-10 and B-14. Where bedrock was encountered, top of bedrock elevation ranged from El. 280 to 340, about 3 to 24 ft below ground surface. Bedrock was not encountered in boring B-01 above El. 257.5. Bedrock outcrops were observed in the central portion of Tract One. Unit weight of bedrock is anticipated to range from 150 pcf to 160 pcf.

We did not observe oily, stained, or odorous soils in the explorations. Note that chemical screening or laboratory chemical testing was not performed, nor was historic research performed to try to locate borings in areas with potential environmental impacts as part of our scope.

Fill was not encountered in the explorations; however, fill may be encountered locally, particularly in the developed portions of the tracts.

3.2 GROUNDWATER

Groundwater levels measured in test borings (during and after drilling) and observation wells ranged from about El. 270 to 322, corresponding to 5 to 20 ft below ground surface. Water levels observed in the borings shortly after drilling are typically influenced by drilling operations (water used for and rock coring), thus may not represent stabilized conditions. Groundwater levels will fluctuate with season, precipitation, and nearby construction activity. The piezometric level in the artesian-spring-fed pond is near El. 289.

4. Geotechnical Engineering Recommendations

4.1 GENERAL

This section provides recommendations for design of proposed structure foundations. Foundations should be designed and constructed in accordance with the Connecticut State Building Code, latest edition, applicable laws, regulations and ordinances, and the recommendations herein.

Expansive, dispersive, liquefiable, or collapsing soil and karst conditions were not encountered.

4.2 FOUNDATION DESIGN RECOMMENDATIONS

4.2.1 Foundation Types

Design structures to be supported on spread footings, ring foundations, or mat foundations bearing on glacial till, weathered bedrock, bedrock, or on Compacted Granular Fill placed following removal of the above-referenced materials. A summary of proposed structures, estimated existing and proposed grades, anticipated subgrade conditions, and recommended foundation type is provided on Table 4. Recommendations assume that earthwork related aspects of foundation construction (e.g., soil and bedrock excavation, proof-compaction, backfilling, and subgrade preparation) are conducted in accordance with the Construction Considerations section herein.

4.2.2 Spread Footing and Ring Foundation Design Criteria

- Design footings for the following maximum net allowable bearing pressures:
  - Compacted Granular Fill Subgrades: 2.5 tons per sq. ft (tsf).
  - Glacial Till (and Weathered Bedrock) Subgrades: 4 tsf.
  - Bedrock Subgrades: 10 tsf.
- For footings less than 3 ft in least lateral dimension, design for an allowable bearing pressure in tsf equal to the above values multiplied by B/3, where B is the footing width in ft.
- Allowable bearing pressures may be increased by 1/3 for transient loading conditions.
- Design for a minimum footing width of 18 in.
- Design footings to bear a minimum 3.5 ft below proposed exterior grade for frost protection.
- Locate footings to bear below a 1.5H:1V slope from the bottom of new or existing utility pipes, pits or other planned localized excavations.

4.2.3 Floor Slab Design Criteria

- Design lowest floor slabs as soil-supported slabs-on-grade bearing on a 12 in. thickness of Compacted Granular Fill or ¾ in. Crushed Stone separated from underlying soils using a geotextile filter fabric (6 oz/sy minimum).

- Design for an un-factored modulus of subgrade reaction (i.e., 1 ft by 1 ft plate modulus) of 125 lbs. per cu. in.
- Underslab drains should be provided for the Turbine Building (Area 14), Administration / Warehouse / Water Treatment Building (Area 15), Central Control Room (area 40), and other large floor slab or floor slabs that are sensitive to moisture. Underslab drains should consist of a 6-in. diameter perforated pipe surrounded by crushed stone and wrapped in a geotextile fabric.

4.2.4 Mat Foundation Design Criteria

- Design mats for the following maximum net allowable bearing pressures:
  - Compacted Granular Fill Subgrades: 2.5 tsf.
  - Glacial Till Subgrades: 4 tsf.
  - Bedrock Subgrades: 10 tsf.
- Design mats for the following moduli of subgrade reaction:
  - Compacted Granular Fill Subgrades: 35 pci.
  - Glacial Till (and Weathered Bedrock) Subgrades: 55 pci.
  - Bedrock Subgrades: 300 pci.
- Design mats to bear a minimum 3.5 ft below proposed exterior grade for frost protection.
- Position new mats to bear below a reference line drawn upward and outward on a 1.5H:1V slope from the bottom of adjacent exterior utilities or other underground structures.

4.2.5 Equipment Pad Design Criteria

Equipment pads should be designed using the recommendations for floor slabs with the exception that the thickness of the slab base course layer (Compacted Granular Fill or Crushed Stone) should be increased to 24 in. for partial frost protection or to 36 in. if full frost protection is required (assuming a 6 in. minimum pad thickness).

4.2.6 Structures Bearing on Multiple Subgrades

Structures which bear on more than one subgrade material type (i.e., Compacted Granular Fill and bedrock, Compacted Granular Fill and glacial till, glacial till and bedrock, or all three) should be designed using the lowest bearing pressure to reduce the potential for differential settlement.

Alternatively, a structural break could be provided at the change in subgrade. However, this would likely require additional explorations to refine the understanding of subsurface conditions at the structure of interest.

4.2.7 Foundation Concrete

Results of sulfate testing (sulfate concentration less than 150 mg/kg) indicate that sulfate resistant concrete is not required for concrete features (footings/foundations, ducts, etc.) in contact with the glacial till stratum.

4.3 SETTLEMENT

For the recommended allowable bearing pressures for soil bearing conditions, we estimate total settlement of footings and mats will be less than 1 in., and differential settlement between adjacent footings and within the mat will be less than ½ in. over a 30-ft distance where they bear on similar materials and less than ¾ in. over a 30-ft distance where they bear on different materials.

For the recommended allowable bearing pressures for the bedrock bearing condition, we estimate total and differential settlements will be less than ½ in. for footings and mats where they bear entirely on bedrock. Differential settlements of up to ¾ in. are possible where they bear on different materials.

These settlements will largely occur as load is applied (short term settlement).

4.4 SEISMIC DESIGN

The soils at the site are not considered liquefaction susceptible and seismically-induced settlement will not be significant during the design earthquake (less than ½ in.). In accordance with the Building Code, the seismic soil design criteria are as follows:

Site Class = D
S_S=0.229g
S_1=0.062g

Shear wave velocity measurements in the field may permit use of site Class C for structures which bear entirely on glacial till or site Class B or A for structures which bear entirely on bedrock.

4.5 LATERAL PRESSURES

Building foundation walls should be designed in accordance with the applicable below-listed lateral pressures. These recommendations assume the height of the wall (H) is defined as the distance in feet between the top of the slab and the top of adjacent finished floor level (or exterior site grade) on the retained earth side of the wall, the wall is drained full height, and grade is level within a lateral distance H of the backside of wall.

- Static Earth: 55 pounds per cubic foot (pcf) equivalent fluid unit weight (EFUW) for restrained walls (designed to be pinned at top and bottom of wall); and 35 pcf EFUW for unrestrained walls (designed as a cantilevered retaining wall).

- Seismic Earth: 9.1H pounds per square foot (psf) at the top of the wall (distributed as an inverted triangle).

- Surcharge: 0.5 or 0.3 times the vertical surcharge pressure (psf), uniformly distributed over the height of the wall for restrained and unrestrained walls, respectively. It may be feasible to reduce surcharge pressures depending on the geometry of the surcharge relative to the geometry of the wall (particularly for footings behind the wall). Such reductions would be evaluated on a case by case basis.

For seismic loading conditions, walls should be designed to resist static plus seismic earth pressures. Surcharge loading does not need to be considered for seismic design unless the surcharge will be applied over an extended time.

For walls with upward sloping conditions on the retained earth side of the wall, static earth and seismic pressures should be increased by the following factors:

- 3H:1V backslope: Multiply static earth and seismic values by 1.1.
- 2H:1V backslope: Multiply static earth and seismic values by 1.4.

For example, for unrestrained walls with a 3H:1V backslope condition, the EFUW for calculating the static earth pressure would be 38.5 psf per foot depth (i.e., 35 times 1.1), and the magnitude of the top of the inverted triangle for calculating seismic lateral pressures would be 10.0H (i.e., 9.1H times 1.1).

Foundation walls designed as retaining walls should be designed for a factor of safety of 1.5 against sliding and overturning under static loading conditions and 1.2 under seismic loading conditions. Passive soil pressure should not be included as a resisting force.

For restrained walls, we recommend that the structural drawings in the construction contract document package include a note indicating the sequence of wall construction (and more importantly restrictions on its backfilling). Additionally, notes should be provided that indicate the section(s) of floor slab(s) and framing required to be in-place prior to placement of backfill above a certain elevation behind the wall, and that cautions against future penetrations in floor slabs or framing that may compromise the lateral stability of the wall without appropriate engineering.

4.6 RESISTANCE TO LATERAL LOADS

Lateral loads may be resisted using a combination of friction between bases of mats and footings and underlying bearing materials, and passive restraint on the sides of mats, footings, walls, and grade beams.

The resistance to lateral loads provided by friction should be calculated using a coefficient of friction (ultimate) equal to 0.5 for soil bearing conditions and 0.6 for bedrock bearing conditions.

The static net (passive minus active) lateral resistance provided by the soil surrounding mats, footings walls, and grade beams can be calculated using an equivalent fluid unit weight of 200 pcf. If the horizontal distance between adjacent elements is less than twice the height of the subject structural element, reduce the passive pressure proportionately to the distance (i.e., full pressure at twice the height away) to accommodate interaction of the elements.

4.7 RESISTANCE TO UPLIFT LOADS

Resistance to uplift loads may be provided by the weight of the structure plus the wedge of soil above the footing or mat rising outward and upward on a 2V:1H slope to ground surface. The unit weight of the soil should be assumed as 120 pounds per cubic foot (pcf) for Compacted Granular Fill and 125 pcf for glacial till. If additional uplift resistance is required, rock anchors could be considered.

4.8 VAPOR RETARDERS, WATERPROOFING, DAMPPROOFING, AND INSULATION

Where finished floor elevations for proposed buildings will be at or above planned adjacent site grades (and not near adjacent cut slopes), permanent foundation or underslab drainage systems are not necessary, and waterproofing of ground floor slabs is also not considered necessary. Foundation walls should be insulated and damp-proofed in accordance with the Building Code.

We recommend that a moisture vapor retarder membrane be provided directly beneath ground floor slabs in occupied and finished spaces of the new structures, in accordance with ACI 302.2R-06, especially if humidity control is desired or relatively vapor-tight coverings will be used on the floor. Water vapor pressures, that can adversely impact highly vapor-tight or vapor-sensitive floor coverings, or adversely affect interior space humidity, can be present even when groundwater is at significant depths. An example retarder would be a 10-mil virgin HDPE membrane having a water permeance of 0.3 perms or lower (this recommendation does not consider requirements for protection of occupied spaces from radon or other environmental vapors or contaminants). The slab concrete design and construction procedures should consider impacts of the presence of the vapor retarder.

Walls and slabs for below-grade pits or similar structures where located in structures that will be underdrained should be waterproofed and designed for full hydrostatic pressure.

4.9 RADON MITIGATION

The “Indoor Radon Potential Map of Connecticut”, prepared by the CT DEEP, dated 1997, indicates the site is located within a “moderate-high” area of radon potential. Moderate-High zones are defined as areas where 33% of the tested homes in that area have basement air radon levels greater than or equal to 4.0 picocuries per liter of air (pCi/l), respectively. Given the radon potential, we recommend the project team assess if a radon protection system is warranted (considering occupancy, ventilation, risk, etc.).

4.10 EXTERIOR GRADING

Where possible, surface runoff should be directed away from structures by sloping grades downward away from the structures and providing low permeability surface finish within 10 ft of exterior walls. Low permeability surface finishes may include bituminous pavements, concrete sidewalks, or a 6-in. minimum thickness of low-permeability Fill.

4.11 UTILITES

Utility invert elevations are not available at this time.

Utilities beneath and adjacent to slabs and pads should be located above foundation bearing levels or above a reference line drawn downward and away from the lower edge of the soil-supported foundation element at a 1.5H:1V slope. For mats, utilities should be installed in conduits or corridors within the mat.

Utilities may be soil-supported (with suitable bedding) bearing on Glacial Till or on Compacted Granular Fill. Where encountered, bedrock should be removed to at least 12 in. below utility invert elevations to limit “hard” spots and potential cracking of utilities. Subgrades should be proof-compacted prior to placement of bedding materials. Soft or weaving soils observed during proof-compaction should be replaced with compacted Granular Fill.

The glacial till is not corrosive to metal based on the corrosion potential laboratory test results.

5. SITE DEVELOPMENT RECOMMENDATIONS

5.1 RETAINING WALLS

Foundation design criteria apply to the site retaining walls, with the exception that walls should be designed with no passive resistance.

A mechanically stabilized earth wall appears feasible for the utility switchyard retaining wall. If bedrock is encountered in the cut, a rock slope may be feasible for the lower portion of the retaining wall. Due to limited space behind the wall, temporary earth retaining systems (i.e., temporary soil nail wall) may be required for construction of an MSE wall near the existing cemetery (behind the north-south segment of the wall) and the property line. Alternatively, a permanent soil nail wall or a soldier pile and lagging wall appear feasible, and would have the added benefit of requiring less working area behind the wall.

A mechanically stabilized earth wall appears feasible for the power island retaining wall. The wall will need to be designed to include the 15 to 35-ft-high earth slope behind the wall and traffic on the perimeter road behind the wall.

We recommend that swales constructed using low permeability materials be provided behind retaining walls to divert surface water runoff laterally away from the walls.

5.2 SLOPES

Cut slopes up to 20 ft and fill slopes up to 35 ft are proposed. The preliminary site grading plan indicates slopes constructed at 3H:1V or flatter.

Seepage breakout should be anticipated in cut slopes (and possibly in some fill slopes), and may require mitigation using drains installed at the top, bottom, and/or mid-height of the slope depending on the height of the slope. These slopes may also require surficial stabilization using turf mats or armoring. Final selection of the stabilization approach would be handled on a case by case basis. Additionally, flatter slopes may be warranted, particularly for north facing slopes, to reduce the potential for sloughing due freeze-thaw effects. Slopes should be vegetated when possible for erosion protection.

Slopes steeper than 3H:1V should be assessed by a geotechnical engineer, and may require design by a geotechnical engineer. Such slopes may require geogrid reinforcement, drainage, or armoring with moderate to heavy rip rap materials depending on slope height, slope inclination, slope type (cut or fill), orientation of slope face, potential for seepage, and proximity of improvements (i.e. structures, roadways, etc.) behind slope.

The perimeter road located at the top of the fill slopes along the northwestern and northeastern side of the power island includes storm water structures. We recommend that storm water structures and pipes at the top of the slope (CB-9 through CB-14 [northeastern side] and CB-6 to CB-8 and CB-14 [northwestern side]) be watertight (such as fused HDPE) to prevent storm water from infiltrating into the earth slopes. Storm water system is shown on the drawing in Appendix A.

5.3 IMPOUNDMENT EARTH STRUCTURES

Earth impoundments are planned for the fuel oil berm (Area 46) around the fuel oil tank (Area 45) and for the sedimentation pond (Area 30). Slopes should be:

- 2.5H:1V or flatter for dry slopes (fuel oil berm); or
- 3H:1V or flatter for wet slopes (sedimentation pond).

The top of the impoundment should be a minimum of 5 ft wide, or wider if vehicular access is needed. Impoundments may be constructed using low-permeable fill. Penetrations through earth structures should be sealed with clay.

5.4 STORM WATER INFILTRATION

Hydraulic conductivity of fill that is comprised of glacial till (excavated from the site) is expected to be similar to the hydraulic conductivity measured in the glacial till.

In-situ hydraulic conductivity will vary in the field with variation in soil gradation, fabric, density, saturation, and other factors. For design, a factor of safety should be applied to account for variation in subsurface conditions, changes in hydraulic conductivity over time, engineering application, etc. The Connecticut Department of Energy and Environmental Protection (CT DEEP) recommends a factor of safety of 2 be used for storm water infiltration.

5.5 PAVEMENT RECOMMENDATIONS

Pavement recommendations are based upon our local experience, subsurface conditions, HS-20 loading, and reference CONNDOT Form 816. Secondary roads will be unpaved. The recommendations assume a 20-year design life; that a stable, firm subgrade is achieved beneath the base and subbase courses; subgrades are prepared as recommended in the Construction Considerations section of this report; and that standard CONNDOT Form 816 materials are used.

Pavement maintenance (crack sealing, etc.) will be required. Design assumes some risk of misalignment over time due to frost effects, as is normal local practice. To eliminate frost heave, a 3.5 ft thickness of non-frost susceptible material would be required, which is not commonly provided and would result in additional cost.

5.5.1 Flexible Pavement Design

We recommend flexible pavement for roadways and parking lots.

Material	**Thickness (in.)**			**Specification** (CONNDOT Form 816)
	Parking Lot	Standard Roads	Heavy Duty Roads	
Bituminous Top Course	1.5 in.	1.5 in.	1.5 in.	M.04.02 Class 2
Bituminous Binder Course	1.5 in.	2.5 in.	3.5 in.	M.04.02 Class 1
Processed Aggregate Base	4 in.	6 in.	8 in.	M.05.01
Compacted Gravel Subbase	8 in.	8 in.	8 in.	M.02.06 Grading B

5.5.2 Rigid Pavement Design

We recommend rigid pavement in the Ammonia Unloading Area (Area 24), Fuel Oil Unloading Area (Area 44) and other chemical unloading areas.

Material	Thickness (in.)	Specification (CONNDOT Form 816)
	Unloading Area	
Reinforced Concrete	8 in.	
Processed Aggregate Base	8 in.	M.05.01
Compacted Gravel Subbase	8 in.	M.02.06 Grading B

5.5.3 Pavement Drainage

Pavement design should consider that some of the on-site glacial till soils contain 20 to 45 percent fines, which would be frost susceptible. To reduce the potential for freezing of trapped water within the aggregate base course, the pavement subgrade should have a minimum transverse slope of at least 2 percent to provide drainage and pavement drains located along the outer edges of roadways and spaced at 50 ft intervals for parking lots.

6. Construction Considerations

This section provides comments related to foundation construction, earthwork and other geotechnical aspects of the project. It will aid those responsible for the preparation of contract plans and specifications and those involved with construction monitoring. Contractors must evaluate potential construction problems on the basis of their own knowledge and experience in the area and on the basis of similar localities, taking into account their own proposed construction methods and procedures.

6.1 EXCAVATION

Excavations up to 25 to 30 ft deep are proposed to reach subgrade. Excavation will be in glacial till and bedrock.

6.1.1 Soil Excavation

Conventional heavy construction equipment appears practical for excavation of overburden soils, and portions of the weathered rock. Cobbles and boulders will be encountered at the ground surface and in the glacial till.

Open cuts appear feasible. Excavation geometry should conform to OSHA excavation regulations contained in 29 CFR Part 1926, latest revision. Temporary soil slopes of 1.5H:1V, or flatter, appear suitable but should be confirmed during construction based on conditions at the time of excavation. Near-vertical temporary cuts in bedrock may be planned.

Depending on staging/sequencing construction, excavation support systems may be needed.

In areas where significant fill slopes are planned and existing grades slope steeper than 2.5H:1V, excavation subgrades should be prepared in “steps” for slope stability purposes. The step geometry should be assessed on a case by case basis.

6.1.2 Bedrock excavation

Hoe ramming and ripping may be feasible for shallow rock cuts but will not be feasible for mass rock excavation.

Blasting to remove bedrock will be required to establish proposed subgrades, and will need to be conducted in a controlled manner consistent with industry standards to limit over blasting, fly rock, and vibrations.

Pre-blast condition surveys should be conducted on structures of concern and structures located within 250 ft of the blast locations or as otherwise required under local ordinances/permits, if more stringent.

Perimeter control measures (e.g., line drilling, pre-splitting, or cushion blasting) are required where permanent rock slopes and steepened temporary rock slopes are planned. The purpose of these measures is to protect the integrity of the rock mass to remain.

To protect bearing surfaces and to reduce loss of integrity and unnecessary rock excavation caused by over blasting, we recommend that the maximum drill hole depth be limited to 2 ft below foundation and equipment pad bearing levels and 4 ft below slab and utilities subgrades.

Conventional blasting mats should be used during blasting to prevent fly rock. The Blasting Contractor should also be required to obtain all necessary local, state, and federal permits prior to blasting and should have a current license in the State of Connecticut.

Bedrock should be fractured or removed to a depth of at least:

- 12 in below bottom of foundations (to facilitate crushed stone placement) and utilities;
- 18 in. below pavement subgrade elevations to reduce the potential for reflective cracking of pavements;
- 18 in. below bottom of floor slabs; and
- 24 in. below the bottom of equipment pads.

Vibration monitoring during blasting should be conducted at and adjacent to structures of concern or between the blast and structure of concern (i.e. property line). We recommend that the Blasting Contractor be required to design blast rounds to maintain vibrations measured on the ground surface adjacent to structures of concern below the industry standards for vibrations as a function of frequency set forth in the United States Bureau of Mines Report of Investigation 8507. We further recommend that Threshold Values equal to 75% of the Limiting Value be adopted. The Blasting Contractor should be required to revisit its blasting plan with the Geotechnical Engineer should vibrations exceed the Threshold Values.

Rock excavation should be observed by a qualified representative of the Owner to assess if bedrock excavation is being conducted in accordance with the contract documents and the contractor's approved submittals.

To measure rock removal quantities for payment, we recommend performing a top of rock survey before rock removal commences, and using predetermined limits and methods to calculate the volume.

6.2 SUBGRADE PREPARATION

This section provides recommendations for preparation of subgrades for foundations, slabs, pavements, and general site. Subgrades should be observed in the field by the geotechnical engineer to confirm bearing conditions. Use of the recommended allowable bearing pressures is contingent upon observation to confirm and document that field conditions are consistent with the assumptions and design concept herein.

6.2.1 Site Preparation

Site preparation within the footprint of the proposed development should broadly include removal of the following:

- Vegetation, roots, and stumps;
- Stone walls;

- Topsoil;
- Subsoil (at a minimum in building, structure, retaining wall, and slope areas; may be feasible to leave in-place below mass fills in pavement areas and landscaped areas);
- Fill soil;
- Unsuitable materials;
- Structures and foundations; and
- Subsurface utilities.

Upon removal of the above materials, subgrades should be re-compacted, and excavations backfilled and compacted in engineered lifts to subgrades using the materials indicated herein.

6.2.2 Bedrock Bearing Foundations

Bedrock bearing foundations should be constructed on a 12-in. thick layer of ¾ in. crushed stone placed over the underlying bedrock. Excavation of rock should be controlled to reduce overbreak at bearing surfaces, such as can occur when blast holes are loaded too deeply. Where overbreak extends deeper than 2 ft below the bearing surface or overburden soils are present, disturbed and fractured rock and overburden soils should be removed and replaced with lean concrete up to the bottom of the crushed stone layer. Rock bearing surfaces should be inclined flatter than 4H:1V.

Survey elevation control will be required during blast hole drilling and during rock excavation to avoid overblasting the rock or excavating too deep below footings. Test sections should be blasted and excavated at the beginning of construction to aid in determining blast design and excavation methods and evaluate overbreak effects.

6.2.3 Soil Bearing (and Weathered Bedrock) Bearing Foundations

Subgrades that consist of soil or weathered bedrock should be proof-compacted with a vibratory plate compactor with a minimum 5,000 lbs. centrifugal force. Soft or yielding materials observed during proof-compaction should be replaced with Compacted Granular Fill. Following proof-compaction, subgrades should be protected by placing a 6 in. minimum thickness of ¾ in. size crushed stone (fully wrapped in geotextile) or a 3-in. thick concrete mudmat. Boulders that project above subgrades will need to be removed, and backfilled with Compacted Granular Fill. Large boulders may be partially removed using a hoe ram. Partial removals should extend a minimum of 6 in. below subgrades.

Unsuitable materials, where present below the bearing elevation, require excavation and replacement with suitable backfill within the Zone of Influence (ZOI) of the foundation element. The ZOI is defined by lines extending 2 ft laterally from the outside lower edges of the foundation element and down a 1H:1V slope to the top of suitable bearing materials (i.e., Glacial Till, weathered Bedrock). Alternatively, the footings can be lowered to bear on the exposed suitable bearing materials or can be supported on lean concrete placed following excavation of unsuitable materials. Where the lean concrete block approach is used, the block should: 1) be formed near-vertically, and 2) extend a minimum of 1 ft beyond the edges of the footing.

6.2.4 Floor Slabs and Equipment Pads

Topsoil, fill, and other unsuitable materials should be removed beneath the slabs prior to placing Compacted Granular Fill. The subgrade should be proof-compacted with at least four passes of a minimum 10-ton vibratory roller until firm. If soft or unsuitable material is encountered at the exposed subgrade, remove the unsuitable material and then backfill with Compacted Granular Fill until a firm and stable surface is achieved. Boulders that project above subgrades will need to be removed, and backfilled with Compacted Granular Fill. Large boulders may be partially removed using a hoe ram. Partial removals should extend a minimum of 12 in. below subgrades. Bedrock and/or over-blasted rock may remain in-place below a depth of 12 in. beneath the slab. Up to 2 ft of over-blasted rock may be left in-place beneath the slab subgrade provided the surface is re-compacted with several passes of a 10-ton vibratory roller, and then choked with suitable material.

6.2.5 Pavements

If a cut is necessary to reach the subbase subgrade elevation, the exposed subgrade should be proof-rolled with at least six passes of a heavy drum vibratory roller (25,000 lbs dynamic force). Soft or weaving areas exposed by the proof-rolling should be excavated to firm material or to a maximum depth of 18 in. below the pavement subbase elevation, and replaced with compacted layers of Common Fill or Compacted Granular Fill. In fill areas, unsuitable materials should be removed and the subgrade should be proof-rolled as noted above. Common Fill or Compacted Granular Fill should then be used as fill to reach the proposed subbase elevation.

6.3 DEWATERING

Final excavation, subgrade preparation, filling, foundation construction, and utility construction should be conducted "in the dry". Since most excavations will be in low permeability soils and bedrock, we anticipate that temporary construction dewatering activities will likely be minor, and largely related to control of precipitation that falls on excavations and surface water runoff into excavations. Seepage of groundwater through fissures in the bedrock should also be anticipated.

We anticipate that dewatering can be accomplished by open pumping from sumps, temporary ditches, and trenches within and around excavations. Dewatering systems should be designed and operated to prevent pumping of fines, disturbance to subgrades and undermining of previous construction. Excavations should be performed to direct accumulated water away from work areas to sump locations and away from the excavation itself. Subgrades which become disturbed due to the presence of water should be re-excavated and stabilized. Stabilization methods may include placement of crushed stone with filter fabric with approval of the Geotechnical Engineer.

6.4 BACKFILL MATERIALS

6.4.1 Compacted Granular Fill

Compacted Granular Fill is recommended for the following areas:

- to replace unsuitable soil under footings, floor slabs, mats, and utilities; and
- to provide drainage against foundation walls or retaining walls.

Compacted Granular Fill should be placed in maximum 12-in. thick lifts and compacted to at least 95 percent of the maximum dry density determined by ASTM D1557. In confined areas, the lift thickness should be reduced to 6-in. maximum. Compaction equipment in confined areas may consist of hand-guided vibratory equipment or mechanical tampers.

Compacted Granular Fill should consist of sandy gravel or gravelly sand, free of organic material, environmental contaminants, snow, ice, frozen soil, or other unsuitable material, and be well-graded within the following limits:

U.S. Standard Sieve Size	Percent Finer by Weight
6 in. (1)	100
No. 4	30-80
No. 40	10-50
No. 200 (2)	0-8

(1) Use a maximum 3-in. size for fill placed within 6 in. of concrete slabs or footings, and within 3 ft of foundation walls.
(2) For Compacted Granular Fill placed as part of perimeter drainage systems behind foundation walls or retaining walls, the maximum percent passing the No. 200 sieve should be 5% unless otherwise approved by the Geotechnical Engineer.

6.4.2 Crushed Stone Fill

Crushed stone is recommended for the following areas:

- surrounding the drain pipes for foundation walls and retaining walls;
- surrounding the drain pipes for pavement drains;
- to provide drainage against foundation walls or retaining walls; and
- footing bearing surface protection below groundwater level (6 in. thick on geotextile).

Crushed stone should consist of No. 6 crushed stone (3/4-in. size) in accordance with Connecticut Department of Transportation Form 816, M.01.01.

6.4.3 Common Fill

Common fill may be used for raising grades below pavement sections and landscaped areas. Common Fill should consist of mineral sandy soil, free from organic matter, plastic, metal, wood, ice, snow, debris, recycled materials, or other deleterious material and should have the characteristic that it can be readily placed and compacted. Common Fill imported to the site should have a maximum of 80 percent passing the No. 4 sieve and a maximum of 30 percent finer than the No. 200 sieve. The maximum particle size should be the smaller of 2/3 the lift thickness or 6 in. Silty common fill soils will require moisture control during placement and compaction.

6.4.4 Low-Permeable Fill

Low permeable fill is recommended as the final 12 in. thickness of fill at ground surface above foundation wall backfill except in areas where pavements or other structures are constructed at ground surface. Low-permeable fill should consist of common fill with a minimum 20 percent passing a No. 200 sieve.

6.4.5 Geotextile

A filtration-type geotextile is recommended between crushed stone and surrounding soil. Geotextile should consist of Tencate Mirafi 160N or equivalent.

6.4.6 Compaction

Recommended compaction requirements are as follow:

Location	Minimum Compaction Requirements
Beneath and around footings, under slabs	95%
Parking, roadways	92% up to 3 ft below finished grade 95% in the upper 3 ft
Landscaped areas	90%

Minimum compaction requirements refer to percentages of the maximum dry density determined in accordance with ASTM D1557C.

6.5 USE OF ON-SITE EXCAVATED SOIL AND ROCK

6.5.1 Soils

Excavation will be in topsoil, subsoil, potentially fill soils locally, glacial till, or bedrock. Topsoil may be reused as topsoil, subject to meeting nutrient requirements, and as Common Fill in landscaped areas.

The subsoil is not suitable for re-use as Compacted Granular Fill due to its high silt content. Subsoil may be reused in landscaped areas as Common Fill or where at least 3 ft below pavements.

Fill soils, if encountered, will need to be evaluated on a case by case basis for reuse.

Although the Glacial Till may not meet the specifications for Compacted Granular Fill, it may be technically feasible from a geotechnical perspective to use it as such during favorable weather and where free-draining material is not required, provided it can be placed to the specified degree of compaction and cobbles and boulders are removed prior to reuse. The Glacial Till will be difficult to impossible to reuse if it becomes wet. As such, careful moisture control will be

required to achieve satisfactory compaction. Wet materials will need to be dried, blended with other materials, or amended with lime stabilization prior to placement and compaction, which can result in delays particularly during relatively cold or wet weather. Rainfall or melting snow can readily saturate stockpiled soils. Providing drainage away from and/or covering a stockpile can help limit this potential problem. The Glacial Till will require considerable drying time if left in an unprotected stockpile for an extended period of time. Screening and removal of oversized materials (i.e., 2/3 the lift thickness or 6-in.) will be necessary. Where Glacial Till is placed in fills exceeding 5 ft, the material will require placement dry of its optimum moisture content to limit the potential for post-placement settlement.

6.5.2 Bedrock, Cobbles, and Boulders

Blast rock, cobbles, and boulders may be reused as compacted rock fill below footings and slabs or for general site grade raises. Blast Rock Fill may be placed and compacted above the prepared excavation subgrade to within 5 ft of footing subgrades, utility inverts, and finished site grades. Above the Blast Rock Fill, Processed Rock Fill may be placed and compacted to footing and slab bearing levels. Geotextile filter fabric is required to be placed over the Processed Blast Rock Fill prior to placing other soil fill materials. Suitable choking material(s) are required to be placed over Blast Rock Fill prior to placing other soil fill materials.

Blast Rock Fill could consist of well-graded unprocessed or processed on-site, angular blast rock. Individual rocks in Blast Rock Fill should have a largest dimension not exceeding approximately 15 in. Blast Rock Fill must be substantially free of soil-sized material. Blast Rock Fill should be placed in layers not exceeding 20 in. in loose lift measure and compacted by a minimum of four passes of heavy self-propelled vibratory equipment imparting a dynamic force of at least 40,000 lbs. The development of proper construction specifications and monitoring of the fill placement will be important to the satisfactory performance of compacted Blast Rock Fill.

Blast rock may be used on-site as Blast Rock Fill, provide the blasting program (i.e., blast hole diameter, spacing and loading) is carefully planned to obtain the specified gradation. Rocks larger than 15 in. must be segregated and removed prior to use as Blast Rock Fill.

Processed Rock Fill should consist of well-graded rock with a largest particle size of 1.5 in. It is anticipated that the Processed Rock Fill will consist of blast rock processed by crushing on-site.

Processed rock fill may also be mixed with excavated Glacial Till soil to reduce the fines fraction and increase the coarse fraction (of the Glacial Till) to facilitate ease of placement and compaction and increase reuse of the silty Glacial Till.

6.6 EARTHWORK DURING FREEZING WEATHER

Precautions should be taken if work takes place while temperatures are below freezing. Frozen soil or soil containing snow or ice should not be used as compacted fill. Placement of fill should not be conducted when air temperatures are below freezing. Soil bearing surfaces below slabs and foundations must be protected against freezing, before and after placement of concrete. Frost protection should be provided as soon as possible after foundations are constructed.

Fill should not be placed on snow, ice or frozen subgrades. At the end of each day's operations, the last lift of placed fill should be rolled by a smooth-wheeled roller to eliminate ridges of uncompacted soil to aid runoff and drainage. Silty site soils are susceptible to disturbance by freezing, especially in the presence of water and traffic.

6.7 ABANDONING WELLS

The five ground water observation wells installed during the subsurface explorations and the 160-ft deep water well installed circa 2010 should be abandoned in accordance with CT DEEP requirements. Abandonment per CTDEP requirements is intended to protect groundwater.

7. Recommendations for Future Geotechnical Services

7.1 ADDITIONAL SUBSURFACE EXPLORATIONS FOR ESTIMATING ROCK EXCAVATION

Rock excavation is expected; we recommend additional borings be performed in cut areas (central portion of power island) to better define rock excavation quantities and attempt to balance earthwork cut and fill. Current boring spacing is too large to accurately estimate rock excavation quantity. We recommend borings be spaced about 100 ft apart and advanced to a depth of 5 feet below the proposed finished grade and core a minimum of 5 ft of rock where rock is encountered (to determine if the rock is bedrock or a boulder).

7.2 ADDITIONAL SUBSURFACE EXPLORATIONS FOR FOUNDATION DESIGN

Borings were generally widely spaced and no borings were performed along the proposed retaining walls on Tract One and Tract Two. We recommend additional borings be performed along retaining walls and in the footprint of the power island and switchyards, to assist with defining the limits of glacial till and bedrock subgrade for each structure (and determine location of subgrade changes). In cut areas (foundations likely to bear on rock), borings should be advanced to a depth of 5 feet below the proposed finished grade and core a minimum of 5 ft of rock where rock is encountered (to determine if the rock is bedrock or a boulder). In fill areas (foundations likely to bear on soil), borings should be advanced to a depth of 15 to 20 ft below the existing grade and core a minimum of 5 ft of rock where rock is encountered (to determine if the rock is bedrock or a boulder).

7.3 ADDITIONAL SUBSURFACE INVESTIGATIONS AND SLOPE STABILITY ANALYSIS

We recommend additional borings be performed along proposed permanent soil cut slopes to evaluate slope stability, drainage, safety measures, and construction considerations. Currently, no borings are located at the proposed soil cut slope in the southern portion of Tract One (south of power island) or southwest of the utility switchyard (on Tract Two). For soil cut slopes greater than 10 ft high, we recommend that borings be performed along the slope at about 100 ft spacing and the borings extend to a depth of about twice the cut height (below existing grade) and core a minimum of 5 ft of rock where rock is encountered (to determine if the rock is bedrock or a boulder).

We recommend additional borings be performed along proposed permanent soil fill slopes to evaluate slope stability (considering structures and earth structures near the crest of the slope), drainage, safety measures, and construction considerations. Currently, no borings are located at the proposed soil fill slopes in the northern and western portions of Tract One (north and west of the power island). For soil fill slopes greater than 10 ft high, we recommend that borings be performed along the slope at about 100 ft spacing and the borings extend to a depth of about the fill height (below existing grade) and core a minimum of 5 ft of rock where rock is encountered (to determine if the rock is bedrock or a boulder).

Where rock cuts are planned, we recommend additional borings be performed along proposed permanent rock cut slopes to evaluate slope stability, the need for fall zones and other safety measures, and construction considerations. Where rock cut slopes are planned, we recommend that borings be performed along the slope at about 100 ft spacing and the borings extend to a depth of the rock cut plus a minimum of 5 ft. Laboratory testing on rock specimens may also be recommend.

7.4 SHEAR WAVE VELOCITY MEASUREMENTS

Shear wave velocity measurements were beyond the scope of our work. Shear wave velocity measurements in the field may permit use of site Class C for structures which bear entirely on glacial till or site Class B or A for structures which bear entirely on bedrock. Use of alternate Site Class may reduce the seismic demand of the structure and reduce the cost of construction for those structures.

7.5 COMPRESSION WAVE VELOCITY MEASUREMENTS

Compression wave velocity measurements were beyond the scope of our work. Compression wave velocity measurements in the field can provide data to assist with determining if the rock is rippable or if blasting will be required.

7.6 ALTERNATE FOUNDATION RECOMMENDATIONS

Should other foundations (piles, caissons, rock anchor, etc.) be required, we can provide recommendations for alternate foundation types once the load is available. Additional borings may be recommended for alternate foundations.

7.7 CONTRACT DOCUMENTS

We recommend that Haley & Aldrich prepare specifications for geotechnical aspects of the proposed construction including earthwork, dewatering, controlled blasting and review geotechnical aspects of the final plans and specifications prepared by others in order to confirm that our recommendations were interpreted and implemented as intended.

7.8 SUBMITTAL, SPECIFICATION, AND PLAN REVIEW

We recommend that Haley & Aldrich review submittals and design documents prepared by the earthwork and blasting contractors for general compliance with industry procedures and project requirements.

7.9 CONSTRUCTION MONITORING

The recommendations contained in this report are based on known and predictable behavior of properly engineered and constructed foundations and other facilities. We recommend that personnel qualified by training and experience perform full-time field observations of the geotechnical aspects of construction, including:

- removal of unsuitable materials;
- mass earthwork excavation and filling;
- processing and preparation of excavated soil and rock for reuse;
- construction of temporary and permanent soil and bedrock slopes;
- preparation of foundation bearing surfaces;
- preparation of pavement subgrades;
- installation of foundation and pavement drainage systems;
- placement and compaction of crushed stone and granular fill (including field compaction control testing);

- well abandonment; and
- blasting and associated vibration monitoring.

It is recommended that Haley & Aldrich be retained to perform field observations of the geotechnical aspects of construction based on familiarity with the subsurface conditions, design concepts, and specifications. Field observations are intended to confirm compliance with the design concepts and specifications and to allow design changes in the event that subsurface conditions differ from those anticipated prior to construction.

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Table 1
Summary of Subsurface Explorations
Killingly Energy Center
Killingly, Connecticut
Project Number: 43434-000

BORING NO.	GROUND SURFACE ELEVATION	NORTHING	EASTING	EXPLORATION TYPE	TOTAL DEPTH (FT)	THICKNESS OF STRATA (FT)				BEDROCK LEVEL (FT)		WATER LEVEL (FT)		NOTES
						TOPSOIL	SUBSOIL	GLACIAL TILL	WEATHERED BEDROCK	DEPTH	ELEVATION	DEPTH	ELEVATION	
B-01(OW)	277.5	876663.3	1227059.1	boring, well, permeability	20.0	1.5	1.0	17.5	--	--	< 257.5	7.3	270.3	Terminated at planned depth (20 feet).
B-02	301.4	876440.6	1227007.8	boring	21.0	0.8	0.6	14.6	--	16.0	285.4	11.0	290.4	
B-03(OW)	299.6	876278.6	1226824.1	boring, well	26.0	0.4	2.6	17.5	--	20.5	279.1	20.3	279.3	
B-04[6]	317.9	876250.7	1227065.6	boring, permeability	16.0	0.5	1.5	9.0	--	11.0	306.9	8.4	309.5	
B-05	308.9	876214.3	1227178.0	boring	28.5	0.5	1.5	21.5	--	23.5	285.4	8.0	300.9	
B-06	324.4	876135.9	1226980.6	boring, permeability	8.0	0.5	0.5	2.0	--	3.0	321.4	--	--	
B-07(OW)	345.3	875991.4	1227082.8	boring, well	10.5	0.4	0.6	4.5	--	5.5	339.8	--	--	
B-08[6]	299.5	876108.5	1226670.1	boring	20.5	0.7	3.8	11.0	--	15.5	284.0	--	--	
B-09	320.9	875968.8	1226776.7	boring	--	--	--	--	--	--	--	--	--	Omitted per Mott MacDonald.
B-10(OW)	322.8	875909.5	1226821.1	boring, well, permeability	22.4	0.5	1.5	13.0	3.0	18.0	304.8	14.6	308.2	
B-011[6]	312.3	876073.5	1227369.9	boring, permeability	28.0	1.5	2.0	18.5	--	22.0	290.3	NR	NR	Offset 26' north and 83' east per Mott MacDonald.
B-12(OW)	330.5	875928.2	1227230.1	boring, well	29.0	0.6	1.0	22.4	--	24.0	306.5	9.0	321.5	
B-13	343.8	875733.8	1227120.0	boring	28.0	0.6	1.4	16.0	--	18.0	325.8	NR	NR	
B-14	343.4	875647.1	1227443.2	boring	22.0	0.7	0.5	17.8	3.0	--	<321.4	--	--	Terminated beyond planned depth (20 feet).
B-15[6]	321.4	876020.5	1227764.4	boring	21.0	1.2	1.3	3.3	--	--	<300.4	--	--	Offset 65' northwest to avoid house. Cored 15 feet (cobbles and boulders).
B-16	310.9	875521.0	1227859.9	boring	25.0	0.6	4.4	15.0	--	20.0	290.9	4.5	306.4	
B-17	325.7	875296.1	1227766.5	boring	30.0	2.0	--	28.0	--	--	<295.7	--	--	Cored 4.5 feet (cobbles and boulders).
B-18	310.8	875720.5	1227885.2	boring	30.0	0.7	3.0	14.3	--	18.0	292.8	7.4	303.4	
E-01	323.9	876206.3	1227019.1	soil resistivity										
E-02	318.7	876022.7	1227309.9	soil resistivity										
E-03	314.2	875431.9	1227820.2	soil resistivity										

NOTES:

1. ">" indicates greater than
   "<" indicates less than
2. Elevations are in feet and reference North American Vertical Datum of 1988 (NAVD88).
3. Refer to test boring logs for detailed soil descriptions.
4. Fill thickness includes topsoil.
5. Exploration locations staked by GM2 Associates on 16 and 17 May.
6. Offset noted on boring log

"--" indicates not encountered
"NR" indicates data not reported

Table 2
Summary of Geotechnical Laboratory Test Results
Killingly Energy Center
Killingly, Connecticut
Project Number: 43434-000

Boring Identification	Sample Identification	Depth (feet)	Sample Type	Strata	Moisture Content (percent)	USCS Symbol	Sieve Analysis		
							Gravel (percent)	Sand (percent)	Fines (percent)
B-4	S2	2-4	SPT	Glacial Till	6.1	SM	37.3	40.7	22.0
B-10	S2	2-4	SPT	Glacial Till	11.1	SM	7.5	48.8	43.7
B-12	S4	7-9	SPT	Glacial Till	11.2	SM	10.4	46.7	42.9
B-13	S4	7-9	SPT	Glacial Till	8.8	SM	29.3	41.3	29.4
		Method (general accordance) -->			ASTM D2216		ASTM D422		

NOTES:

1. Refer to laboratory test results in Appendix for additional information.

Table 3
Summary of Corrosion Potential Laboratory Test Results
Killingly Energy Center
Killingly, Connecticut
Project Number: 43434-000

Boring Identification	Sample Identification	Depth (feet)	Sample Type	Soil Strata	pH	Electrical Resistivity[1] (ohm-cm)	Electrical Resistivity[2] (ohm-cm)	Sulfate Concentration (mg/kg)	Chloride Concentration (mg/kg)	Sulfides Concentration (mg/kg)	Redox Potential (mv)
B-16/B-17/B-18	East	1-5	Bulk	Glacial Till	7.1	16,000	12,000	80	10	0.67	73
B-02/B-04/B-06/B-08/B-10/B-12	West	1-5	Bulk	Glacial Till	6.1	42,000	15,000	50	10	0.35	284
				Method (general accordance) -->	ASTM G51	ASTM G57	ASTM G57	ASTM D516	ASTM D512	SM 4500-S2-D	SM 2580 B

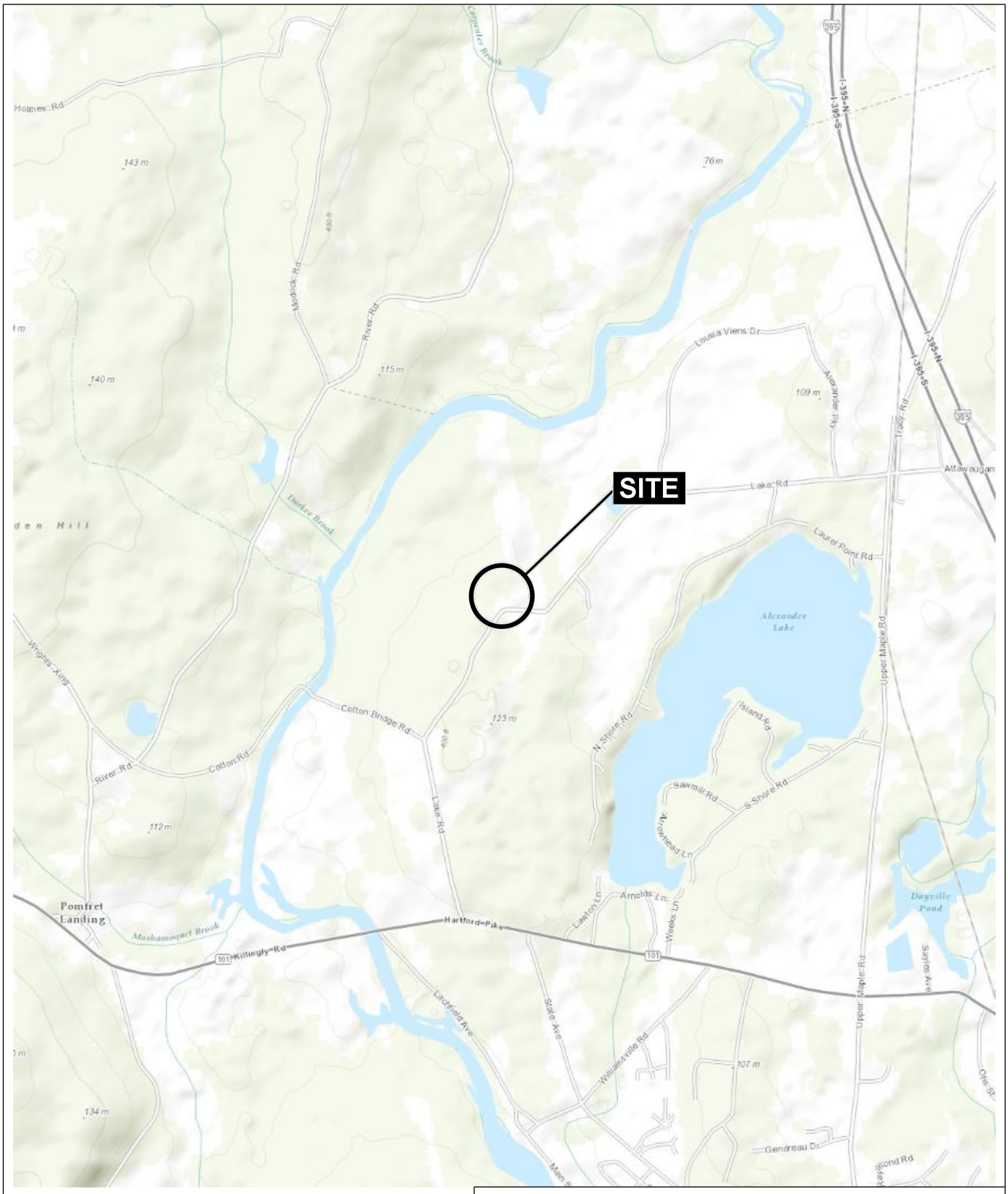
NOTES:

1. Electrical resistivity at moisture content received by laboratory.
2. Saturated electrical resistivity.
3. Refer to laboratory test results in Appendix for additional information.

Table 4
Summary of Geotechnical Recommendations
Killingly Energy Center
Killingly, Connecticut
Project Number: 43434-000

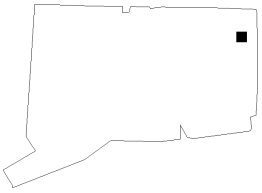
Structure[1]	Nearest Boring	Existing Grade	Proposed Grade	Grade Change (feet)	Expected Subgrade Material[2]	Estimated Load: Weight (pounds) or Pressure (psf)[1]	Planned Support[1]	Recommended Foundation Type	Comments[1]
1. Combustion Turbine (CT)	B-06	320 to 330	315	cut 5 to cut 15	bedrock	---	---	mat foundation	---
2. Combustion Turbine Generator (GTG)	B-07	326 to 336	315	cut 11 to cut 21	bedrock	1,700,000	mat foundation	mat foundation	dynamic loads (sensitive to settlement)
3. Heat Recovery Steam Generator (HRSG)	B-03	298 to 310	315	fill 17 to fill 5	granular fill	8,000,000	mat foundation	mat foundation	static loads
4. Closed Cooling Water	B-03	290 to 296	315	fill 25 to fill 19	granular fill	---	---	ring or mat foundation	---
5. Steam Turbine (ST)	B-04	318	315	fill 3	granular fill	---	---	mat foundation	---
6. Exhaust Stack	B-03	296 to 300	315	fill 19 to fill 15	granular fill	---	---	mat foundation	21' diameter by 175' tall
7. Steam Turbine Generator (STG)	B-04	306 to 314	315	fill 9 to fill 1	granular fill	1,900,000	concrete pedestal	mat foundation	dynamic loads (sensitive to settlement)
8. Generator Step-Up Transformer (GSU)	B-07	338 to 342	315	cut 23 to cut 27	bedrock	410,000	concrete pedestal	mat foundation	---
9. STG Step-Up Transformer	B-05	306 to 314	315	fill 9 to fill 1	granular fill	---	---	equipment pad	
10. Air Inlet Filter House	---	---	---	---	---	---	---	spread foundation	Not shown on plan
11. Auxiliary Boiler	B-03	296 to 302	315	fill 19 to fill 13	granular fill	---	---	spread foundation	---
12. Auxiliary Transformer	B-07	336 to 340	315	cut 21 to cut 25	bedrock	120,000	concrete pedestal	mat foundation	---
13. Air Cooled Condenser (ACC) & Collector Enclosure	B-02	288 to 310	315	fill 27 to fill 5	granular fill	---	---	spread foundation	15 cells
14. Turbine Building	B-04/B-05/B-06/B-07	306 to 336	315	fill 9 to cut 21	granular fill / glacial till / bedrock	---	---	spread foundation	---
15. Admin/Warehouse/Water Treatment Building	B-11	300 to 310	320	fill 20 to fill 10	granular fill	500 office / 1000 warehouse	---	spread foundation	65' by 175' prefabricated steel structure
16. Raw/Fire Water Storage Tank & RW Pumps (at-grade tank)	B-08	294 to 296	315	fill 21 to fill 19	granular fill	---	ring or mat foundation	ring foundation	45' diameter by 45' tall (450,000 gallons)
17. Fire Pumps Enclosure	B-08	288 to 292	315	fill 27 to fill 23	granular fill	---	---	spread foundation	---
18. Demineralized Water Storage Tank and Pumps (at-grade tank)	B-08	284 to 290	315	fill 31 to fill 25	granular fill	---	ring or mat foundation	ring foundation	45' diameter by 45' tall (450,000 gallons)
19. Demineralized Water Trailers Area	B-08	290 to 296	315	fill 25 to fill 19	granular fill	---	---	equipment pad	---
20. Fuel Gas Metering	B-15	330 to 332	320	cut 10 to cut 12	bedrock	---	---	equipment pad	---
21. Fuel Gas Heater	B-06	308 to 312	315	fill 7 to fill 3	granular fill	---	---	equipment pad	---
22. Diesel Generator	B-05	322 to 326	315	cut 7 to cut 11	glacial till	---	---	equipment pad	---
23. Plant Switchyard	B-11/B-12	310 to 340	320	fill 10 to cut 20	glacial till	---	---	equipment pad	---
24. Ammonia Storage Tank, Pumps & Unloading Area (at-grade tank	B-03	296 to 300	315	fill 19 to fill 15	granular fill	---	---	ring or mat foundation	---
25. Boiler Feed Pumps	B-03	302 to 306	315	fill 13 to fill 9	granular fill	---	---	equipment pad	---
26. STG Lube Oil Skid	B-04	316 to 320	315	cut 1 to cut 5	glacial till	20,000	---	mat foundation	---
27. Air Compressors, Receivers & Dryers Skid	B-04	326 to 328	315	cut 11 to cut 13	bedrock	---	---	equipment pad	---
28. Fuel Gas Final Filter	B-06	308	315	fill 7	granular fill	---	---	equipment pad	---
29. Duct Burner Skid	B-04	308 to 310	315	fill 7 to fill 5	granular fill	---	---	equipment pad	---
30. Detention Pond (earth structure)	B-01	272 to 280	310	fill 38 to fill 30	granular fill	---	---	earth structure	---
31. STG Drains Tank & Sump	B-04	314	315	fill 1	glacial till	---	---	equipment pad	---
32. HRSG Blow Off Tank & Drain Pumps	B-03	298	315	fill 17	granular fill	---	---	equipment pad	---
33. HRSG Blowdown Sump	B-03	302 to 304	315	fill 13 to fill 11	granular fill	---	---	equipment pad	---
34. Storm Water Retention Pond (earth structure)	---	---	---	---	---	---	---	earth structure	Not shown on plan
35. Civil Oil Water Separator	---	---	---	---	---	---	---	spread foundation	Not shown on plan
36. BOP Motor Control Center (MCC)	B-04	308 to 310	315	fill 7 to fill 5	granular fill	---	---	spread foundation	---
37. Plant Gate	---	---	---	---	---	---	---	spread foundation	Not shown on plan
39. CTG Electrical Package	B-07	326 to 332	315	cut 11 to cut 17	bedrock	---	---	equipment pad	---
40. Central Control Room/Electrical	B-07	324 to 338	315	cut 9 to cut 23	bedrock	---	---	spread foundation	---
41. Ammonia Injection Skid	B-03	302 to 304	315	fill 13 to fill 11	granular fill	---	---	equipment pad	---
42. Continuous Emissions Monitoring System (CEMS)	B-03	298	315	fill 17	granular fill	---	---	spread foundation	---
43. Pipe Rack	B-03	300 to 320	315	fill 15 to cut 5	granular fill / glacial till	---	---	pier/spread foundation	---
44. Fuel Oil Unloading	B-07	324 to 334	315	cut 9 to cut 19	bedrock	---	---	equipment pad	---
45. Fuel Oil Tank (at-grade tank)	B-10	316 to 324	315	cut 1 to cut 9	glacial till	---	ring or mat foundation	ring foundation	75' diameter by 45' tall (1,000,000 gallons)
46. Fuel Oil Berm (earth structure)	B-10	300 to 324	315	fill 15 to cut 9	glacial till	---	---	earth structure	---
47. GT Lube Oil Skid	B-07	324 to 326	315	cut 9 to cut 11	bedrock	---	---	equipment pad	---
48. Fuel Gas Compressors	B-05	294 to 300	315	fill 21 to fill 15	granular fill	---	---	equipment pad	---
A. Power Control Modules (PCM)	---	---	---	---	---	750 dead	---	mat foundation	Not shown on plan (6' to 8' above grade)
B. Plant Road	B-14	---	---	---	---	---	---	not applicable	---
C. Utility Switchyard	B-16/B-17/B-18	320 to 350	325	fill 5 to cut 25	granular fill / glacial till / bedrock	---	---	---	---
D. Utility Switchyard - Retaining Wall	B-17	330 to 350	325	cut 5 to cut 25	glacial till / bedrock	---	---	spread foundation	---

NOTES: "--" data not available
1 Appendix A (provided by NTE Energy)
2 Recommendations are preliminary for structures not shown on plan or no data provided



MAP SOURCE: ESRI

SITE COORDINATES: 41°51'45"N, 71°54'50"W



HALEY ALDRICH

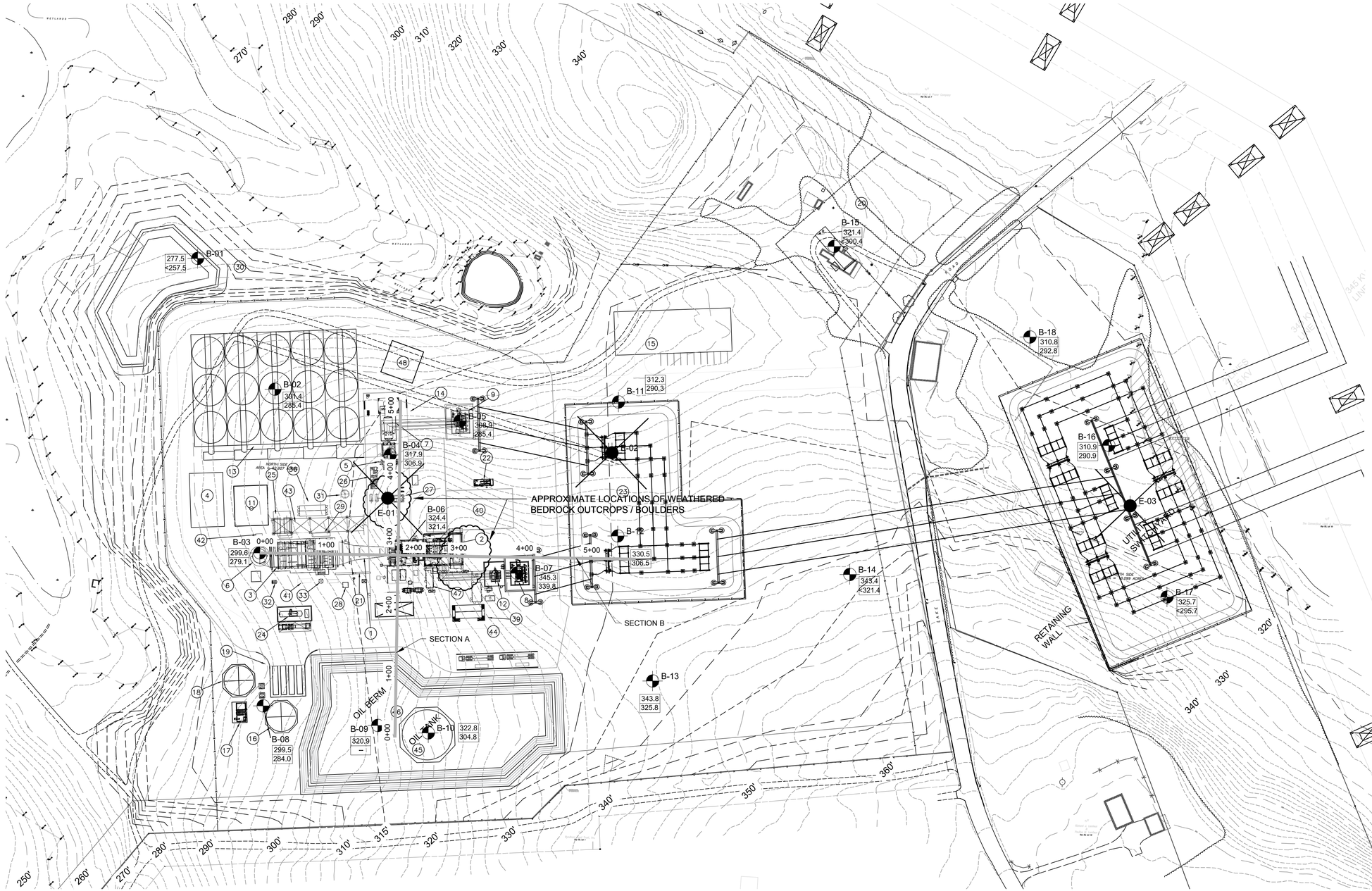
NTE ENERGY
KILLINGLY ENERGY CENTER
180 & 189 LAKE ROAD
KILLINGLY, CONNECTICUT

PROJECT LOCUS

APPROXIMATE SCALE: 1 IN = 2000 FT
MAY 2016

FIGURE 1

43434-000_1_LOCUS.PDF



STRUCTURE IDENTIFICATION LEGEND:

1. COMBUSTION TURBINE (GT)
2. COMBUSTION TURBINE GENERATOR (GTG)
3. HEAT RECOVERY STEAM GENERATOR (HRSG)
4. CLOSED COOLING WATER
5. STEAM TURBINE (ST)
6. EXHAUST STACK
7. STEAM TURBINE GENERATOR (STG)
8. GENERATOR STEP-UP TRANSFORMER (GSU)
9. STG STEP-UP TRANSFORMER
10. AIR INLET FILTER HOUSE (NOT SHOWN)
11. AUXILARY BOILER
12. UNIT AUXILARY TRANSFORMER
13. AIR COOLED CONDENSER (ACC) & CONDENSATE COLLECTION ENCLOSURE
14. TURBINE BUILDING
15. ADMIN/ WAREHOUSE/ WATER TREATMENT BUILDING
16. RAW / FIRE WATER STORAGE TANK & RW PUMPS
17. FIRE PUMPS ENCLOSURE
18. DEMINERALIZED WATER STORAGE TANK & PUMPS
19. DEMINERALIZED WATER TRAILERS AREA
20. FUEL GAS METERING
21. FUEL GAS HEATER
22. DIESEL GENERATOR
23. PLANT SWITCHYARD
24. AMMONIA STORAGE TANK, PUMPS, & UNLOADING AREA
25. BOILER FEED PUMPS
26. STG LUBE OIL SKID
27. AIR COMPRESSORS, RECEIVERS & DRYERS SKID
28. FUEL GAS FINAL FILTER
29. DUCT BURNER SKID
30. DETENTION POND
31. STG DRAINS TANK & SUMP
32. HRSG BLOW OFF TANK & DRAINS PUMPS
33. HRSG BLOWDOWN SUMP
34. STORM WATER RETENTION POND
35. CIVIL OIL WATER SEPARATOR (NOT SHOWN)
36. BOP MOTOR CONTROL CENTER (MCC)
37. PLANT GATE (NOT SHOWN)
38. NOT USED
39. CTG ELECTRICAL PACKAGE
40. CENTRAL CONTROL ROOM / ELECTRICAL
41. AMMONIA INJECTION SKID
42. CONTINUOUS EMISSIONS MONITORING SYSTEM (CEMS)
43. PIPE RACK
44. FUEL OIL UNLOADING
45. FUEL OIL TANK
46. FUEL OIL BERM
47. GT LUBE OIL SKID
48. FUEL GAS COMPRESSORS

LEGEND

B-01 — APPROXIMATE LOCATION OF HALEY & ALDRICH TEST BORING DRILLED BY NYEG DRILLING BETWEEN 23 MAY AND 2 JUNE 2016.

E-01 — APPROXIMATE LOCATION OF FIELD ELECTRICAL RESISTIVITY TEST BY CONSULTING ENGINEERING GROUP ON 25 MAY 2016.

EXISTING GRADE

PROPOSED GRADE

301.4 — APPROXIMATE GROUND SURFACE ELEVATION

285.4 — APPROXIMATE TOP OF BEDROCK ELEVATION

NOTES

1. BASEPLAN IS DRAWING "16042_OVERALL.DWG" PROVIDED BY MOTT MACDONALD ON 19 MAY 2016.
2. PROPOSED STRUCTURE LOCATIONS AND DESIGNATIONS ARE FROM DRAWINGS "334954CT-BOUND_5.20.16_2010.DWG" AND "334954CT-ELECBOUND_2010.DWG" PROVIDED BY MOTT MACDONALD ON 7 JUNE 2016.

HALEY ALDRICH

NTE ENERGY
KILLINGLY ENERGY CENTER
180 & 189 LAKE ROAD
KILLINGLY, CONNECTICUT

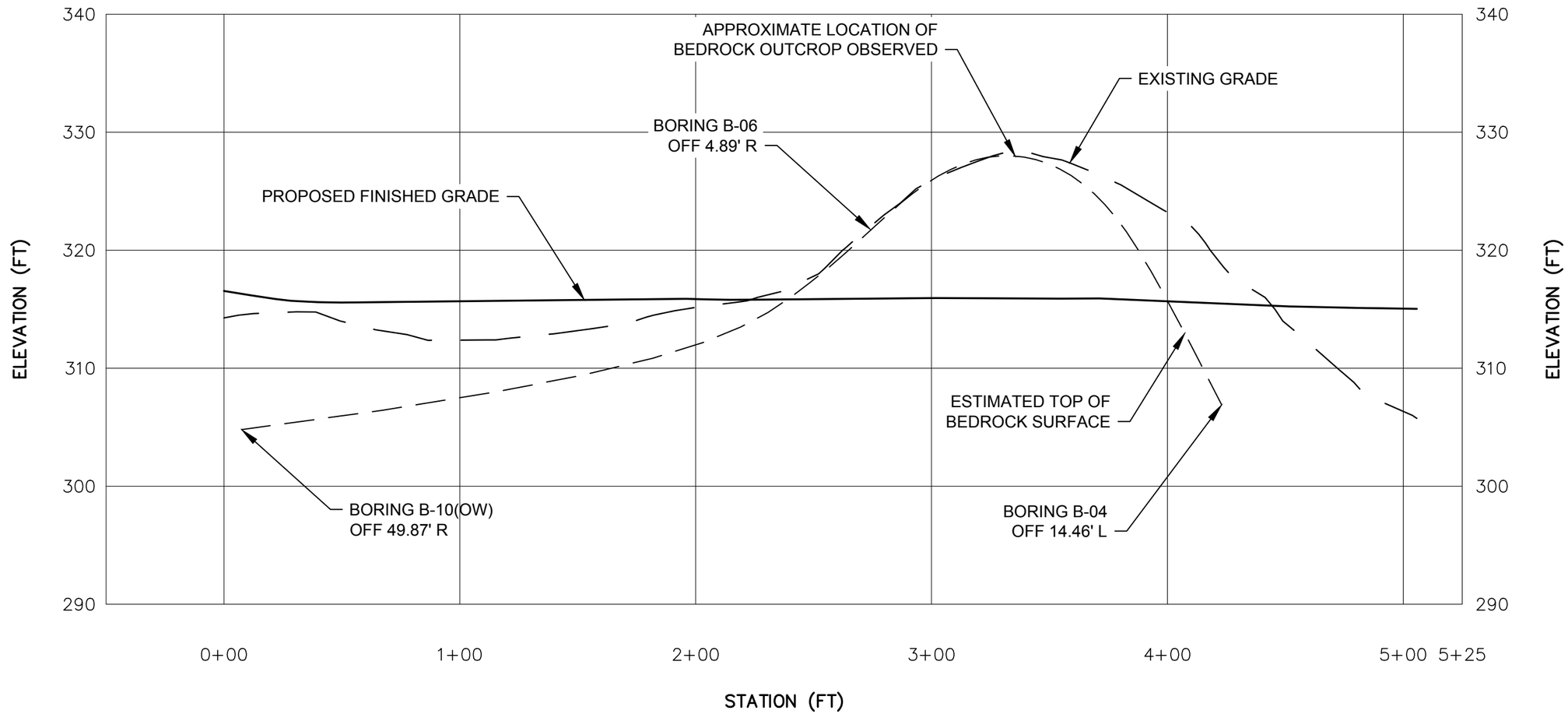
EXPLORATION LOCATION PLAN

SCALE: AS SHOWN
JUNE 2016

FIGURE 2

ACOSTA, JOSE Printed:6/27/2016 7:08 PM Layout: HA-FIG-D-L 80 SCALE
G:\PROJECTS\43434-000\2016-0627_43434 ELP-001.DWG

SECTION - A



NOTES

1. BASED ON THE SITE TOPOGRAPHIC (AERIAL) SURVEY PROVIDED BY NTE ENERGY (PREPARED BY KILLINGLY ENGINEERING ASSOCIATES) AND THE BORING AND SOIL RESISTIVITY LOCATIONS STAKED BY GM2 ASSOCIATES, MOST GROUND SURFACE ELEVATIONS CORRELATE WELL(WITHIN A FEW FEET). HOWEVER, GROUND SURFACE ELEVATIONS AT B-07, B-08, AND B-09 DO NOT CORRELATE WELL (STAKED LOCATION IS ABOUT 5 FT. 7.5 FT AND 10 FT HIGHER THAN ELEVATIONS ON THE TOPOGRAPHIC SURVEY). THE SOURCE OF THE LOCALIZED DISCREPANCY IS LIKELY BASED ON OBSCURED GROUND IN AERIAL SURVEY.

2. SEE FIGURE 2 FOR SECTION LOCATION AND NOTES.

HORIZ. 0 50 100
VERT. 0 10 20
SCALE IN FEET

HALEY ALDRICH

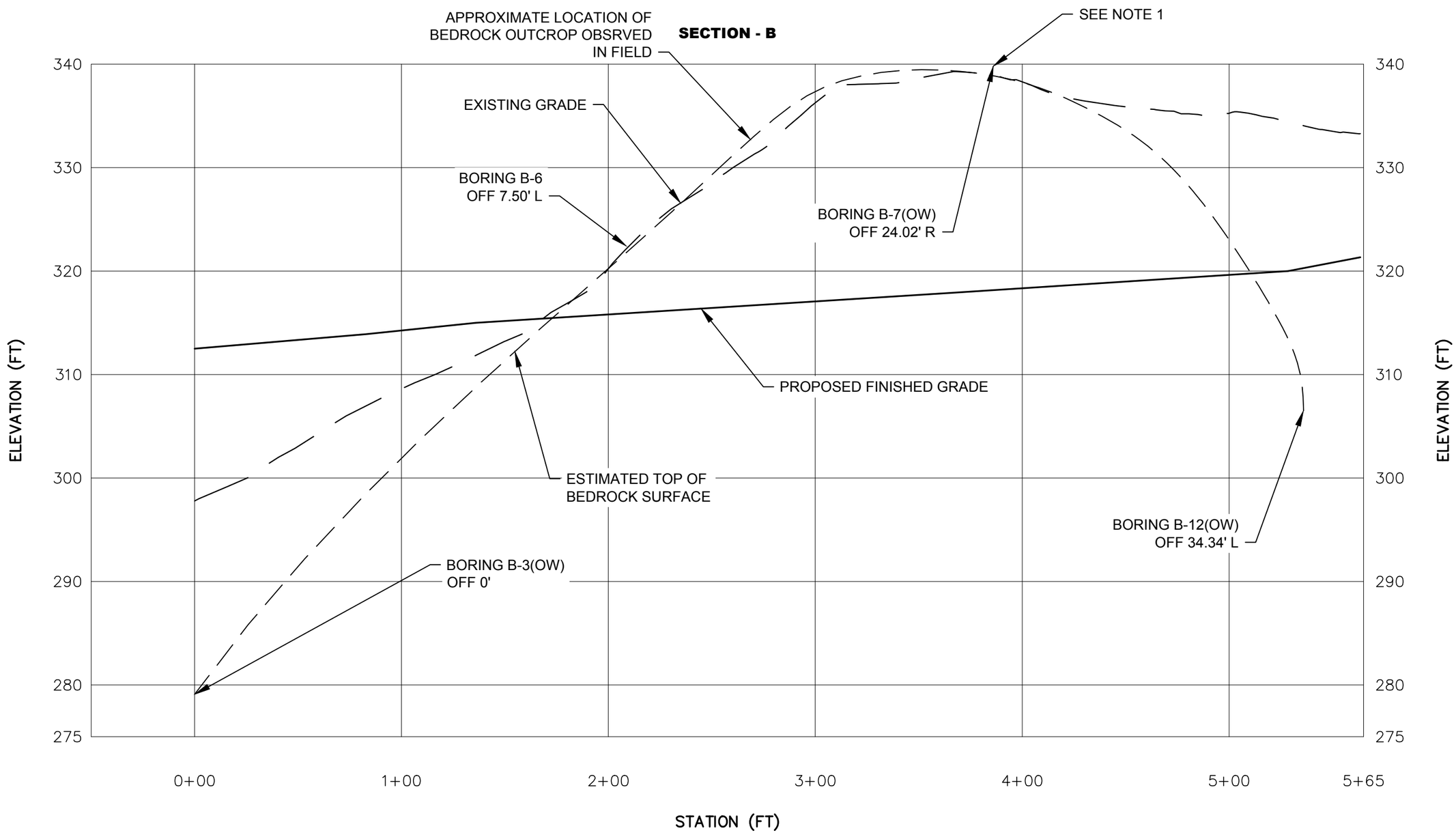
NTE ENERGY
KILLINGLY ENERGY CENTER
180 AND 189 LAKE ROAD
KILLINGLY CONNECTICUT

SECTION A

SCALE: AS SHOWN
JUNE 2016

FIGURE 3

ACOSTA, JOSE Printed: 6/27/2016 7:12 PM Layout: FIGURE 3
G:\PROJECTS\43434-000\FIGURE 3.DWG



NOTES

1. BASED ON THE SITE TOPOGRAPHIC (AERIAL) SURVEY PROVIDED BY NTE ENERGY (PREPARED BY KILLINGLY ENGINEERING ASSOCIATES) AND THE BORING AND SOIL RESISTIVITY LOCATIONS STAKED BY GM2 ASSOCIATES, MOST GROUND SURFACE ELEVATIONS CORRELATE WELL(WITHIN A FEW FEET). HOWEVER, GROUND SURFACE ELEVATIONS AT B-07, B-08, AND B-09 DO NOT CORRELATE WELL (STAKED LOCATION IS ABOUT 5 FT. 7.5 FT AND 10 FT HIGHER THAN ELEVATIONS ON THE TOPOGRAPHIC SURVEY). THE SOURCE OF THE LOCALIZED DISCREPANCY IS LIKELY BASED ON OBSCURED GROUND IN AERIAL SURVEY.

2. SEE FIGURE 2 FOR SECTION LOCATION AND NOTES.

HORIZ. 0 50 100
VERT. 0 10 20
SCALE IN FEET

HALEY ALDRICH

NTE ENERGY
KILLINGLY ENERGY CENTER
180 AND 189 LAKE ROAD
KILLINGLY CONNECTICUT

SECTION B

SCALE: AS SHOWN
JUNE 2016

FIGURE 4

ACOSTA, JOSE
G:\PROJECTS\43434-000\FIGURE 4.DWG
Printed: 6/27/2016 7:12 PM
Layout: FIGURE 4

APPENDIX A

Project Description

APPENDIX "A"

A-1.0 PROJECT DESCRIPTION

The proposed Killingly Energy Center project is to be located in Killingly, Connecticut. The partially wooded site is located north of Route 101, on the north side of Lake Road.

This project is located on a sloping site, which ranges in existing grade elevation from El. 340 feet down to El 290 within the areas of new equipment, excluding the switchyard areas. To balance the cut and fill soil quantity, a preliminary site grade elevation for the power island has been established at El 315 feet for estimating purposes only, which results in maximum fill depth of 30 feet.

A-2.0 EQUIPMENT INFORMATION

The following is a preliminary list of the major equipment as shown on Boring Location Plan 334954CT–BR-101 Boring Plan for use in evaluating foundation systems:

- Steam Turbine Generator [STG] – The STG will be mounted on a steel skid. The STG unit may be supported on a raised concrete pedestal. The STG unit is a rotating equipment type, subject to dynamic loads during operation, and is sensitive to settlement. The estimated weight of the STG unit is 1,900,000 pounds. Ancillary STG equipment includes a Lube Oil Skid, with an approximate weight of 20,000 pounds. A Steam Condenser, with an estimated weight of 500,000 pounds, will be located in close proximity to the STG, which may be also supported on a raised concrete pedestal.

- Gas Turbine Generator – The CTG unit will be mounted on a steel skid, and may be supplied with pre-fabricated sound enclosures, complete with intake air system, exhaust ducts, and ancillary equipment. The estimated weight of the CTG unit is 1,700,000 pounds. The CTG Units shall be supported at grade on mat foundations. The CTG Units are rotating equipment, subject to dynamic loads during operation, and are sensitive to settlement.

- Heat Steam Recovery Generator [HRSG] – The HRSG unit shall be constructed of pre-fabricated steel bents, field assembled, complete with an SCR, steam drums, platforms, stairs, and ladders. The HRSG Units shall be supported at grade on mat foundations. The estimated weight of the HRSG unit is 8,000,000 pounds. The HRSG Units are subject to static operational loads, thermal expansion, and are sensitive to differential settlement between the bents.

- Stack – The HRSG exhaust stack is to be constructed of lined steel. The Stack will likely be 22 feet in diameter and 150' in height.

- Air Cooled Condenser – The air cooled condenser unit will consist of up to 15 cells, each cell consisting of a center stanchion support, elevated heat exchanger surface, structural cross bracing and a 200 hp motor.

- Tanks – Steel tanks will be supported on ring or mat foundations at grade. Preliminary sizes for the larger tanks are a Fuel Oil Storage tank, 75 foot diameter x 45 feet tall, 1,000,000 gallons, a Raw Water tank, 45 foot diameter x 45 feet tall, 450,000 gallons and a Demineralized Water tank45 foot diameter x 45 feet tall, 450,000 gallons. Additional tanks and vessels will be constructed to contain process related materials and founded at grade.

- Yard Equipment - Ancillary yard equipment, including pumps, totes, will be supported on reinforced concrete foundations, founded at grade.

- Administration/Warehouse Building – The administration building will be an occupied, single story, pre-fabricated steel structure, 65 feet x 175 feet. The building will enclose control room, offices, conference room, break room, toilets, sampling laboratory, maintenance shop, parts storage, and a warehouse. The design floor live load at grade is 500 psf, with 1,000 psf in the storage and warehouse areas. The warehouse portion of the building will have a two story interior height.

- Power Control Modules [PCM] – The PCM units are pre-fabricated modules, single story units, which range is sizes from approximately 12 feet x 40 feet to 20 feet x 60 feet. The modules will enclose electrical equipment and switchgear for each of the equipment islands. The modules may be elevated 6 to 8 feet above finish grade for the entry of electrical tray. These modules typically have a dead weight of 750 psf, including enclosed equipment.

- Transformers – The oil filled transformers will be supported on reinforced concrete pedestals, within concrete containments. The estimated weights of the GSU Transformers and the Auxiliary Transformer are 410,000 pounds and 120,000 pounds respectively.

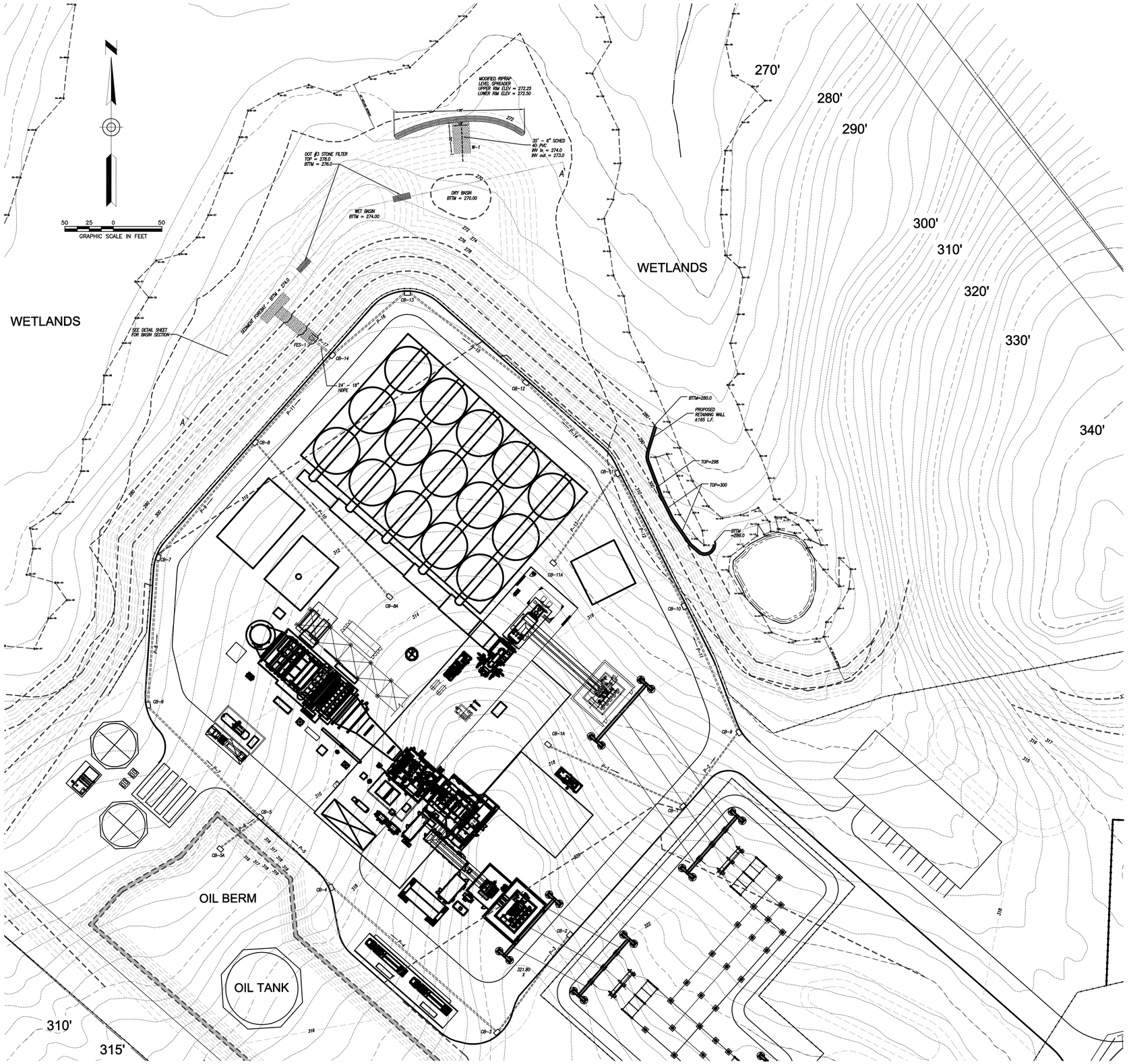
- Switchyard – The switchyard will consist of transformers, a pre-fabricated control house, circuit breakers, disconnect switches, and dead-end structures.

- Pipe Racks – Multiple tiered, structural steel racks shall run between major equipment and ancillary components to support services including piping, electrical conduit and communication. Where the racks cross roads, the services shall be either supported on pipe bridges above road or run in covered trenches below the road elevation.

- Plant Roads – The plant roads are to be bituminous or concrete aggregate paved, medium to heavy duty, designed for AASHTO HS-20 wheel loads. Ammonia and chemical unloading areas located in the roads shall be reinforced concrete with containment. Secondary roads within the switchyard and around the perimeter of the Cooling Tower will be unpaved.

A-3.0 ADDITIONAL INFORMATION

The Owner may provide additional facility and/or equipment information, preliminary equipment studies, and equipment procurement for geotechnical consideration.



STORM DRAINAGE STRUCTURE SCHEDULE

STRUCTURE ID	STRUCTURE TYPE	FRAME ELEV.	PIPE INVERT ELEVATION N	S	E	W	SUMP
CB-1A	TYPE C-L	317.75		OUT: 313.25 (SE)			309.25
CB-1	TYPE C	319.80	IN: 311.71 (NW)		OUT: 311.61 (NE)		307.61
CB-2	TYPE C	321.00		OUT: 316.50 (SW)			312.50
CB-3	TYPE C	321.00			IN: 315.22 (NE)	OUT: 315.12 (NW)	311.12
CB-4	TYPE C	315.34			IN: 310.58 (SE)	OUT: 310.48 (NW)	306.48
CB-5A	TYPE C-L	315.00			OUT: 311.48 (NE)		307.48
CB-5	TYPE C	315.36		IN: 310.00 (SW)		OUT: 309.90 (NW)	305.90
CB-6	TYPE C	312.25	OUT: 307.30		IN: 307.40 (SE)		303.30
CB-7	TYPE C	310.00		IN: 305.50	OUT: 305.40 (NE)		301.40
CB-8A	TYPE C-L	313.00				OUT: 309.00 (NW)	305.00
CB-8	TYPE C	309.20		IN: 303.50 (SW)	IN: 303.50 (SE)	OUT: 303.40 (NW)	299.40
CB-9	TYPE C	319.00		IN: 310.69 (SW)		OUT: 310.59 (NW)	306.59
CB-10	TYPE C	316.64	OUT: 308.63	IN: 308.73			304.63
CB-11A	TYPE C-L	316.80			OUT: 312.80 (NE)		308.80
CB-11	TYPE C	313.60	OUT: 307.00	IN: 307.10		IN: 307.10	303.00
CB-12	TYPE C-L	311.20	OUT: 305.59	IN: 305.69			301.59
CB-13	TYPE C	308.20	OUT: 303.50 (NW)	IN: 303.60			299.50
CB-14	TYPE C	309.20		IN: 301.00 (SW)	IN: 301.00 (NE)	OUT: 300.90 (NW)	296.90

PIPE SCHEDULE

PIPE ID	OUTLET DIA. (IN.)	MATERIAL	LENGTH (FT.)	SLOPE (%)
P-1	12	HDPE	154	1.0%
P-2	12	HDPE	92	1.0%
P-3	12	HDPE	128	1.0%
P-4	15	HDPE	227	2.0%
P-5	15	HDPE	102	1.0%
P-6	12	HDPE	50	1.0%
P-7	15	HDPE	165	1.52%
P-8	15	HDPE	153	1.17%
P-9	15	HDPE	156	1.22%
P-10	12	HDPE	211	2.6%
P-11	15	HDPE	141	1.5%
P-12	15	HDPE	153	1.0%
P-13	12	HDPE	114	5.0%
P-14	15	HDPE	131	1.0%
P-15	15	HDPE	152	1.3%
P-16	15	HDPE	100	2.5%
P-17	18	HDPE	24	4.2%

STRUCTURE ID	TYPE	INVERT ELEVATION
FES-1	FLARED END	300.00
W-1	OVERFLOW WEIR	277.00

DATE	DESCRIPTION

REVISIONS

Killingly Engineering Associates
Civil Engineering & Surveying
114 Westcott Road
P.O. Box 421
Killingly, Connecticut 06241
(860) 779-7299
www.killinglyengineering.com

DATE: 06/30/2016	DRAWN: NET
SCALE: 1"=50'	DESIGN: NET
SHEET: 1 OF X	CHK BY: ---
DWG. No: CLIENT FILE	JOB No: 16042

APPENDIX B

Water Well Completion Report

/95

Do NOT fill in
STATE WELL NO.
OTHER NO.

STATE OF CONNECTICUT
DEPARTMENT OF CONSUMER PROTECTION
REAL ESTATE & PROFESSIONAL TRADES DIVISION

WELL DRILLING COMPLETION REPORT

165 Capitol Avenue, Hartford, Connecticut 06106

OWNER	NAME Geoffrey Sarrow		ADDRESS 189 Lake Rd Danielson CT	
LOCATION OF WELL	(No. & Street) 189 Lake Rd	(Town) Killingly	(Lot Number)	
PROPOSED USE OF WELL	☑ DOMESTIC	☐ BUSINESS ESTABLISHMENT	☐ FARM	☐ TEST WELL
	☐ PUBLIC SUPPLY	☐ INDUSTRIAL	☐ AIR CONDITIONING	☐ OTHER (Specify)
DRILLING EQUIPMENT	☐ ROTARY	☑ COMPRESSED AIR PERCUSSION	☐ CABLE PERCUSSION	☐ OTHER (Specify)

CASING DETAILS	LENGTH (feet)	DIAMETER (inches)	WEIGHT PER FOOT	☑ THREADED ☐ WELDED	DRIVE SHOE ☑ YES ☐ NO	WAS CASING GROUTED? ☑ YES ☐ NO
	20	6	17			

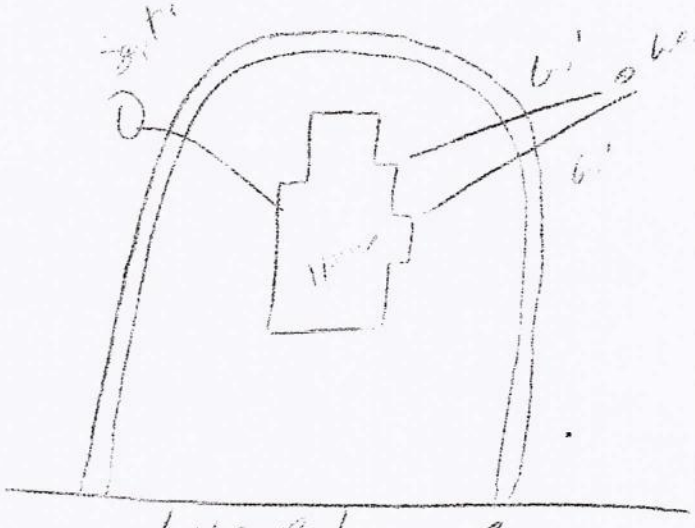
YIELD TEST	☐ BAILED	☐ PUMPED	☑ COMPRESSED AIR	HOURS 1	YIELD (GPM) 20

WATER LEVEL	MEASURE FROM LAND SURFACE - STATIC (Specify feet)	DURING YIELD TEST (feet)	Depth of Completed Well in feet
	10	100	100

SCREEN DETAILS	MAKE					LENGTH OPEN TO AQUIFER (feet)	
	SLOT SIZE	DIAMETER (inches)	IF GRAVEL PACKED:	Diameter of well including gravel pack (inches)	GRAVEL SIZE (inches)	FROM (feet)	TO (feet)

DEPTH FROM LAND TO SURFACE FEET TO FEET		FORMATION DESCRIPTION
0	10	Gravel Topsoil
10	100	Bedrock

Sketch exact location of well with distances, to at least two permanent landmarks



If yield was tested at different depths during drilling, list below

FEET	GALLONS PER MINUTE

DATE WELL COMPLETED	PERMIT NO	REGISTRATION NO	DATE OF REPORT	WELL DRILLER (Signature)
8/5/10	241577	13	1/10/11	

APPENDIX C

Logs of Test Borings

TEST BORING REPORT

Boring No. B-01 (OW)

Project	Killingly Energy Center, Killingly, Connecticut
Client	NTE Energy
Contractor	NYEG Drilling

File No.	43434-000
Sheet No.	1 of 2
Start	May 24, 2016
Finish	May 24, 2016
Driller	J. Rauscher
H&A Rep.	S. Poff
Elevation	277.5 (est.)
Datum	NAVD88
Location	See Plan N 876663.3 E 1227059.1

	Casing	Sampler	Barrel
Type	HSA	S	--
Inside Diameter (in.)	4 1/4	1 3/8	--
Hammer Weight (lb)	--	140	-
Hammer Fall (in.)	--	30	-

Drilling Equipment and Procedures

Rig Make & Model: Track mounted Diedrich D120
Bit Type: Cutting Head
Drill Mud: None
Casing: Spun
Hoist/Hammer: Winch Automatic Hammer
PID Make & Model: None

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)
0	WOH 2 2 4	S1 6	0.0 2.0	277.3 0.2	ML/OL	-FOREST LITTER- Very loose dark brown SILT and ORGANIC SILT, little gravel, sand, with roots, topsoil odor, moist -TOPSOIL/LOAM-
	4 11 16 17	S2 12	2.0 4.0	276.0 1.5	SM	Loose yellow-brown silty medium to fine SAND, some coarse to fine gravel, trace coarse sand, no odor, dry -SUBSOIL-
				275.0 2.5	SM	Medium dense light brown coarse to fine gravelly coarse to fine SAND, little silt, no odor, dry, seam of yellow medium to fine sand from 3.8 to 4.0 ft, no mottling
5	4 8 14 18	S3 14	5.0 7.0	272.5 5.0	SM	Medium dense light brown to gray-brown coarse to fine gravelly coarse to fine SAND, some silt, no odor, dry, no mottling
	17 10 8 8	S4 16	7.0 9.0		SM	Similar to S3
10	9 12 15 57	S5 22	10.0 12.0		SM	Similar to S4, no odor, moist
						Note: Drill action indicates occasional cobbles.
15	8 9 16 24	S6 12	15.0 17.0		SM	Similar to S5, split-spoon wet
	8 11 16 20	S7 14	18.0 20.0		SM	Similar to S6
20						-GLACIAL TILL-

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
5/24/2016	10:00	0.5	--	--	11.5
5/27/2016	14:20	77.0	--	--	7.25

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	20.0
Rock Cored (ft)	--
Samples	7S

Boring No. B-01 (OW)

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 HA-LIB09-BOS.GLB HA-TB+CORE+WELL-07-1.GDT G:\43434_NTE ENERGY - KILLINGLY ENERGY CENTER\CONFIDENTIAL\000\GINT\43434-000_TB.GPJ Jun 27, 16

HALEY ALDRICH

TEST BORING REPORT

Boring No. B-01 (OW)

File No. 43434-000
Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Well Diagram	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)
					257.5 20.0		BOTTOM OF EXPLORATION 20.0 FT Note: Installed temporary groundwater observation well in completed borehole.

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. B-01 (OW)

GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No. B-01 (OW)

Project Killingly Energy Center
Location Killingly, Connecticut
Client NTE Energy
Contractor NYEG Drilling
Driller J. Rauscher

Initial Water Level (depth bgs) 11.5 ft

Well Diagram
- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No. 43434-000
Date Installed 24 May 2016
H&A Rep. S. Poff
Location N 876663.3
E 1227059.1

Ground El. 277.5 (est.)
Datum NAVD88

SOIL/ROCK CONDITIONS	DEPTH (ft.)	GRAPHIC	WELL DETAILS	DEPTH (ft.)	ELEVATION (ft.)
				0.0	277.5
FOREST LITTER	0.2				
TOPSOIL/LOAM				1.0	276.5
	1.5				
SUBSOIL					
	2.5				
				4.0	273.5
				6.0	271.5
GLACIAL TILL					
				16.0	261.5
				16.2	261.3
	20.0			20.0	257.5

WELL CONSTRUCTION DETAILS

Type of protective cover: None

Height of NA above ground surface: NA

Height of top of riser above ground surface: 3.5 ft

Type of protective casing: NA

Length: --

Inside diameter: --

Depth of bottom of NA: -

Type of riser pipe: Schedule 40 PVC

Inside diameter of riser pipe: 2.0 in.

Depth of bottom of riser pipe: 6.0 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Bentonite	1.0	3.0
	-	-
	-	-

Diameter of borehole: 6.0 in.

Depth to top of well screen: 6.0 ft

Type of screen: Machine slotted Sch 40 PVC

Screen gauge or size of openings: 0.010 in.

Diameter of screen: 2.0 in.

Type of Backfill around Screen: Filter Sand

Depth to bottom of well screen: 16.0 ft

Bottom of silt trap: 16.2 ft

Depth of bottom of borehole: 20.0 ft

COMMENTS:

HA-LIB09-BOS.GLB GW INSTALLATION REPORT-07-1 G:\43434_NTE ENERGY - KILLINGLY ENERGY CENTER\CONFIDENTIAL\000\GINT\43434-000_TB.GPJ Jun 27, 16

TEST BORING REPORT

HALEY ALDRICH

Boring No. B-02

Project	Killingly Energy Center, Killingly, Connecticut
Client	NTE Energy
Contractor	NYEG Drilling

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HSA	S	NX	Rig Make & Model: Track mounted Diedrich D120
Inside Diameter (in.)	4 1/4	1 3/8	1 7/8	Bit Type: Cutting Head
Hammer Weight (lb)	--	140	-	Drill Mud: None
Hammer Fall (in.)	--	30	-	Casing: Spun
				Hoist/Hammer: Winch Automatic Hammer
				PID Make & Model: None

File No.	43434-000
Sheet No.	1 of 2
Start	May 26, 2016
Finish	May 26, 2016
Driller	J. Rauscher
H&A Rep.	S. Poff
Elevation	301.4 (est.)
Datum	NAVD88
Location	See Plan N 876440.6 E 1227007.8

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)
0				301.2		-FOREST LITTER-
	2 4 4 7	S1 12	0.0 2.0	0.2 300.6	ML/ OL	-TOPSOIL/LOAM-
				0.8 300.0	SM	Loose orange-brown silty coarse to fine SAND, some coarse to fine gravel, trace roots, no odor, dry
				1.4	GM	-SUBSOIL-
	19 28 20 38	S2 16	2.0 4.0		GM	Light brown coarse to fine sandy coarse to fine GRAVEL, little silt, with cobbles, no odor, dry Similar to S1 below 1.4 ft
5				296.4 5.0		
	13 29 50/2"	S3 6	5.0 6.2		SM	Very dense light brown coarse to fine gravelly SAND, some silt, with cobbles, no odor, dry
	19 39 50/3"	S4 12	7.0 8.3		SM	Similar to S3
10	18 16 17 29	S5 16	10.0 12.0		SM	Similar to S4, except dense
				290.4 11.0	SM	Dense light brown to tan coarse to fine gravelly SAND, some silt, occasional poorly-defined layering/stratification, no odor, dry
15	17 50/4"	S6 7	15.0 15.8		SM	Similar to S5 below 11.0 ft
				285.4 16.0		Note: Auger and roller bit refusal at 16.0 ft. Begin rock coring at 16.0 ft. -GLACIAL TILL- SEE CORE BORING REPORT FOR ROCK DETAILS
20						

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
5/27/2016	--	24.0	--	13.0	11.0

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	16.0
Rock Cored (ft)	5.0
Samples	6S, 1C

Boring No. B-02

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 HA-LIB09-BOS.GLB HA-TB+CORE+WELL-07-1.GDT G:\43434_NTE ENERGY - KILLINGLY ENERGY CENTER\CONFIDENTIAL\000\GINT\43434-000_TB.GPJ Jun 27, 16

HALEY ALDRICH

CORE BORING REPORT

Boring No. B-02
File No. 43434-000
Sheet No. 2 of 2

Depth (ft)	Drilling Rate (min./ft)	Run No.	Run Depth (ft)	Recovery/RQD in.	Recovery/RQD %	Weath-ering	Elev./ Depth (ft)	Visual Description and Remarks
								SEE TEST BORING REPORT FOR OVERBURDEN DETAILS
	3.5	C1	16.0	54	90	Slight to High	285.4 16.0	Hard slightly weathered gray and white medium to fine grained muscovite-biotite-quartz GNEISS; Foliation low angle, extremely thin, planar to slightly undulating; Primary (foliation) joints low angle, close to moderately spaced, smooth to rough, planar to slightly undulating, discolored to slightly decomposed, tight to open; Secondary joints moderately dipping across foliation, widely spaced, rough, planar to stepped, discolored, open to tight
	3.5		21.0	17	28			
	3.5							
	3.5							
20	1.5							
							280.9 20.5	Similar to above except soft to medium hard, completely to highly weathered
							280.4 21.0	-QUINEBAUG FORMATION- -BEDROCK-
								BOTTOM OF EXPLORATION 21.0 FT
								Note: Borehole left open for 24 hours for groundwater measurement. Backfilled with cuttings after measurement.
25								
30								
35								
40								
45								
50								

H+A_CORE+WELL07-1 HA-LIB09-BOS.GLB HA-TB+CORE+WELL-07-1.GDT G:\43434_NTE ENERGY - KILLINGLY ENERGY CENTER\CONFIDENTIAL\000\GINT\43434-000_TB.GPJ Jun 27, 16

TEST BORING REPORT

Boring No. B-03 (OW)

Project	Killingly Energy Center, Killingly, Connecticut
Client	NTE Energy
Contractor	NYEG Drilling

File No.	43434-000
Sheet No.	1 of 3
Start	May 24, 2016
Finish	May 25, 2016
Driller	J. Rauscher
H&A Rep.	S. Poff
Elevation	299.6 (est.)
Datum	NAVD88
Location	See Plan N 876278.6 E 1226824.1

	Casing	Sampler	Barrel
Type	HSA	S	NX
Inside Diameter (in.)	4 1/4	1 3/8	1 7/8
Hammer Weight (lb)	--	140	-
Hammer Fall (in.)	--	30	-

Drilling Equipment and Procedures

Rig Make & Model: Track mounted Diedrich D120
Bit Type: Cutting Head
Drill Mud: None
Casing: Spun
Hoist/Hammer: Winch Automatic Hammer
PID Make & Model: None

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)
0	WOH/12" -- 1 1	S1 17	0.0 2.0	299.4 0.2		-FOREST LITTER-
				299.2 0.4	SM	-TOPSOIL/LOAM-
						Very loose orange-brown to yellow-brown silty fine SAND, trace coarse to medium sand, no structure, no odor, dry, no mottling
	2 4 12 22	S2 20	2.0 4.0	297.6 2.0	SM	Loose yellow-brown to tan fine SAND, some silt, trace coarse to medium sand, no structure, no odor, dry, no mottling
				296.6 3.0	SM	-SUBSOIL-
						Dense light brown coarse to fine SAND, some coarse to fine gravel, silt, frequent cobbles, no structure, no odor, dry
5	13 20 24 19	S3 22	5.0 7.0		SM	Similar to S2 below 3.0 ft
	15 20 17 19	S4 19	7.0 9.0		SM	Similar to S3
				291.8 7.8	ML	Dense tan fine sandy SILT, little fine gravel, trace coarse to medium sand, no odor, dry, blocky structure, occasional poorly-defined layering/stratification
10	11 17 25 24	S5 18	10.0 12.0	289.6 10.0	SM	Dense tan to light gray-brown silty fine SAND, little coarse to medium sand, fine gravel, no odor, dry
						Note: Occasional cobbles from 10.0 to 15.0 ft.
15	23 14 20 17	S6 20	15.0 17.0			Dense tan silty fine SAND, trace coarse to fine gravel, coarse to medium sand, blocky structure, no odor, dry to moist
						Note: Drill action suggests gravel and cobbles common from approximately 17.5 to 20 ft.
20						

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
5/27/2016	15:35	52.0	--	--	20.3

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	20.5
Rock Cored (ft)	5.5
Samples	7S, 2C

Boring No. B-03 (OW)

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

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TEST BORING REPORT

Boring No. B-03 (OW)
File No. 43434-000
Sheet No. 2 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Well Diagram	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)
20	50/0" --	S7 0	20.0 20.5		19.1 20.5		Note: Split spoon refusal at 20.0 ft. Auger refused at 20.5 ft, begin rock coring. -GLACIAL TILL- SEE CORE BORING REPORT FOR ROCK DETAILS
25							

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

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HALEY ALDRICH

CORE BORING REPORT

Boring No. B-03 (OW)
File No. 43434-000
Sheet No. 3 of 3

Depth (ft)	Drilling Rate (min./ft)	Run No.	Run Depth (ft)	Recovery/RQD in.	Recovery/RQD %	Weath-ering	Well Dia-gram	Elev./ Depth (ft)	Visual Description and Remarks
									SEE TEST BORING REPORT FOR OVERBURDEN DETAILS
	3	C1	20.5	6	100	Fresh to Slight		279.1	Note: Core barrel blocked up at 21.0 ft. Emptied core barrel, continue coring.
		C2	21.0	0	0			20.5	Hard fresh with slightly weathered zone from approximately 23.7 to 25 ft, gray and white fine grained muscovite-biotite-quartz GNEISS; Foliation low angle, extremely thin, planar to slightly undulating; Primary (foliation) joints low angle, close to moderately spaced, rough, planar to slightly undulating, discolored (brown), open to tight; Secondary joints moderately dipping to high angle across foliation, moderately spaced, rough, planar, discolored to decomposed, open to tight
	3.5		21.0	59	98				
			26.0	46	77				
	3.5								
	4.5								
	3								Note: Completely weathered seam from approximately 23.9 to 24.2 ft. Loss of drill water through seam. Missing 1.0 in. of recovery likely washed out from this zone.
25									-QUINEBAUG FORMATION-
	3								-BEDROCK-
								273.6 26.0	BOTTOM OF EXPLORATION 26.0 FT
									Note: Installed temporary groundwater observation well in completed borehole.
30									
35									
40									
45									
50									
55									

H+A_CORE+WELL07-1 HA-LIB09-BOS.GLB HA-TB+CORE+WELL-07-1.GDT G:\43434_NTE ENERGY - KILLINGLY ENERGY CENTER\CONFIDENTIAL\000\GINT\43434-000_TB.GPJ Jun 27, 16

GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No. B-03 (OW)

Project Killingly Energy Center
Location Killingly, Connecticut
Client NTE Energy
Contractor NYEG Drilling
Driller J. Rauscher

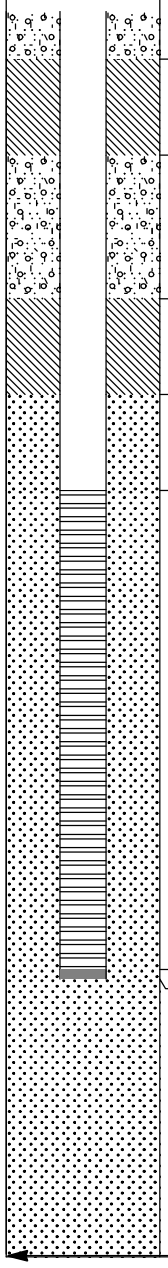
Initial Water Level (depth bgs) 20.3 ft

Well Diagram
- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No. 43434-000
Date Installed 25 May 2016
H&A Rep. S. Poff
Location N 876278.6
E 1226824.1

Ground El. 299.6 (est.)
Datum NAVD88

SOIL/ROCK CONDITIONS	DEPTH (ft.)	GRAPHIC	WELL DETAILS	DEPTH (ft.)	ELEVATION (ft.)
				0.0	299.6
FOREST LITTER	0.2				
TOPSOIL/LOAM	0.4			1.0	298.6
SUBSOIL	3.0			3.0	296.6
				6.0	293.6
				8.0	291.6
				10.0	289.6
GLACIAL TILL					
				20.0	279.6
	20.5			20.2	279.4
QUINEBAUG FORMATION | BEDROCK					
	26.0			26.0	273.6



WELL CONSTRUCTION DETAILS

Type of protective cover: None

Height of NA above ground surface: NA

Height of top of riser above ground surface: 2.5 ft

Type of protective casing: NA

Length: --

Inside diameter: --

Depth of bottom of NA: -

Type of riser pipe: Schedule 40 PVC

Inside diameter of riser pipe: 2.0 in.

Depth of bottom of riser pipe: 10.0 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Bentonite	1.0	2.0
Bentonite	6.0	2.0
	-	-

Diameter of borehole: 6.0 in.

Depth to top of well screen: 10.0 ft

Type of screen: Machine slotted Sch 40 PVC

Screen gauge or size of openings: 0.010 in.

Diameter of screen: 2.0 in.

Type of Backfill around Screen: Filter Sand

Depth to bottom of well screen: 20.0 ft

Bottom of silt trap: 20.2 ft

Depth of bottom of borehole: 26.0 ft

COMMENTS:

HA-LIB09-BOS.GLB GW INSTALLATION REPORT-07-1 G:\43434_NTE ENERGY - KILLINGLY ENERGY CENTER\CONFIDENTIAL\000\GINT\43434-000_TB.GPJ Jun 27, 16

TEST BORING REPORT

HALEY ALDRICH

Boring No. B-04

Project	Killingly Energy Center, Killingly, Connecticut
Client	NTE Energy
Contractor	NYEG Drilling

File No.	43434-000
Sheet No.	1 of 2
Start	May 25, 2016
Finish	May 25, 2016
Driller	J. Rauscher
H&A Rep.	S. Poff
Elevation	317.9 (est.)
Datum	NAVD88
Location	Offset 33.0 ft S N 876250.7 E 1227065.6

	Casing	Sampler	Barrel
Type	HSA	S	NX
Inside Diameter (in.)	4 1/4	1 3/8	1 7/8
Hammer Weight (lb)	--	140	-
Hammer Fall (in.)	--	30	-

Drilling Equipment and Procedures

Rig Make & Model: Track mounted Diedrich D120
Bit Type: Cutting Head
Drill Mud: None
Casing: Spun
Hoist/Hammer: Winch Automatic Hammer
PID Make & Model: None

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)
0	1 2 3 3	S1 15	0.0 2.0	317.7 0.2		-FOREST LITTER-
				317.4 0.5	ML	-TOPSOIL/LOAM-
						Loose orange-brown fine sandy SILT, trace fine gravel, coarse to medium sand, no odor, dry
				315.9 2.0		-SUBSOIL-
	10 18 28 36	S2 20	2.0 4.0		SM	Dense brown silty SAND, some gravel, no structure, no odor, dry
5	16 27 24 22	S3 18	5.0 7.0		SM	Similar to S2, except very dense, frequent cobbles
	26 50/5"	S4 9	7.0 7.9		SM	Similar to S3, split spoon refusal at 7.9 ft on cobbles
10	15 50/2"	S5 7	10.0 10.7		SM	Similar to S4 Note: Auger and roller bit refusal at 11.0 ft. Begin rock coring at 11.0 ft.
				306.9 11.0		-GLACIAL TILL-
						SEE CORE BORING REPORT FOR ROCK DETAILS
15						

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
5/27/2016	--	42.0 *COLLAPSED	--	8.6*	8.4

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	11.0
Rock Cored (ft)	5.0
Samples	5S, 1C

Boring No. B-04

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

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CORE BORING REPORT

Boring No. B-04
File No. 43434-000
Sheet No. 2 of 2

Depth (ft)	Drilling Rate (min./ft)	Run No.	Run Depth (ft)	Recovery/RQD in.	Recovery/RQD %	Weath-ering	Elev./ Depth (ft)	Visual Description and Remarks
								SEE TEST BORING REPORT FOR OVERBURDEN DETAILS
	4	C1	11.0 16.0	49 14	82 23	High to Slight	306.9 11.0	Hard highly weathered from approximately 11 to 11.4 ft, slightly weathered from approximately 11.4 to 16 ft, dark gray and white medium to fine grained biotite-quartz GNEISS; Foliation low angle, extremely thin, planar to slightly undulating; Primary (foliation) joints low angle, extremely close to close, smooth to rough, planar to undulating, decomposed to discolored, open to tight; Secondary joints moderately dipping to high angle across foliation, rough, planar to undulating, discolored to decomposed (fine sand, silt), open to tight; Pitted from approximately 14.7 to 14.8 ft, pits approximately 0.25 to 0.75 in. diameter.
	3.5							
	3.5							
	4							
15	4							-QUINEBAUG FORMATION- -BEDROCK-
							301.9 16.0	BOTTOM OF EXPLORATION 16.0 FT
20								
25								
30								
35								
40								
45								

H+A_CORE+WELL07-1 HA-LIB09-BOS.GLB HA-TB+CORE+WELL-07-1.GDT G:\43434_NTE ENERGY - KILLINGLY ENERGY CENTER\CONFIDENTIAL\000\GINT\43434-000_TB.GPJ Jun 27, 16

TEST BORING REPORT

HALEY ALDRICH

Boring No. B-05

Project	Killingly Energy Center, Killingly, Connecticut
Client	NTE Energy
Contractor	NYEG Drilling

File No.	43434-000
Sheet No.	1 of 3
Start	May 26, 2016
Finish	May 26, 2016
Driller	J. Rauscher
H&A Rep.	S. Poff
Elevation	308.9 (est.)
Datum	NAVD88
Location	Offset 7.0 ft east N 876214.3 E 1227178

	Casing	Sampler	Barrel
Type	HSA	S	NX
Inside Diameter (in.)	4 1/4	1 3/8	1 7/8
Hammer Weight (lb)	--	140	-
Hammer Fall (in.)	--	30	-

Drilling Equipment and Procedures

Rig Make & Model: Track mounted Diedrich D120
Bit Type: Cutting Head
Drill Mud: None
Casing: Spun
Hoist/Hammer: Winch Automatic Hammer
PID Make & Model: None

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	PID Readings (ppm) (sample/bkgd)
0	2 3 3 5	S1 6	0.0 2.0	308.4 0.5		-TOPSOIL/LOAM-	
					ML	Loose orange-brown fine sandy SILT, little coarse to fine gravel, trace corase to medium sand, with roots, no odor, dry	
				306.9 2.0		-SUBSOIL-	
	10 20 35 25	S2 16	2.0 4.0		SM	Very dense light brown coarse to fine gravelly coarse to fine SAND, little silt, no odor, dry	
5				303.9 5.0			
	16 16 19 32	S3 18	5.0 7.0		SM	Similar to S2, except dense, some silt	
	24 24 24 23	S4 16	7.0 9.0		SM	Similar to S3	
						Note: Frequent cobbles from 2.0 to 10.0 ft.	
10	9 27 22 19	S5 9	10.0 12.0		SM	Similar to S4	
						Note: Auger grinding through cobbles/boulders from approximately 13 to 14 ft.	
15	11 17 50/3"	S6 10	15.0 16.3		SM	Similar to S5, except very dense, wet	
						Note: Auger refusal at 17.0 ft. Core barrel advanced from 17.0 to 22.0 ft, recovered 10.0 in. of boulder pieces and 8.0 in. of Glacial Till.	
20							

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
5/27/2016	--	-- *COLLAPSED	--	8.0*	8.0

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	23.5
Rock Cored (ft)	5.0
Samples	6S, 1C

Boring No. B-05

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

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HALEY ALDRICH

TEST BORING REPORT

Boring No. B-05

File No. 43434-000

Sheet No. 2 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	PID Readings (ppm) (sample/bkgd)
20							
						Note: Roller bit advanced to 23.5 ft and began rock coring.	
				285.4		-GLACIAL TILL-	
				23.5		SEE CORE BORING REPORT FOR ROCK DETAILS	
25							

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. B-05

H&A-TEST BORING-09 HA-LIB09-BOS.GLB HA-TB+CORE+WELL-07-1.GDT G:\43434_NTE ENERGY - KILLINGLY ENERGY CENTER\CONFIDENTIAL\000\GINT\43434-000_TB.GPJ Jun 27, 16

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CORE BORING REPORT

Boring No. **B-05**
File No. 43434-000
Sheet No. 3 of 3

Depth (ft)	Drilling Rate (min./ft)	Run No.	Run Depth (ft)	Recovery/RQD in.	Recovery/RQD %	Weath-ering	Elev./ Depth (ft)	Visual Description and Remarks
								SEE TEST BORING REPORT FOR OVERBURDEN DETAILS
	4	C1	23.5 28.5	59 22.5	98 38	Slight to Moderate	285.4 23.5	Hard to very hard slightly weathered with moderately weathered zones from approximately 24.2 to 24.7 ft and 26.1 to 26.8 ft light gray and white (with yellow-brown discoloration) fine grained QUARTZITE; Foliation low angle, extremely thin, planar to slightly undulating; Primary (foliation) joints low angle, very close to moderately spaced, rough, planar to undulating, decomposed to discolored, open to tight; Secondary joints moderately dipping to high angle, close to moderately spaced, rough, planar to slightly undulating, decomposed to discolored, open; Completely weathered seam from approximately 26.8 to 27 ft
25	4							
	4							
	4							
	4							
								-QUINEBAUG FORMATION- -BEDROCK-
							280.4 28.5	BOTTOM OF EXPLORATION 28.5 FT
30								
35								
40								
45								
50								
55								

H+A_CORE+WELL07-1 HA-LIB09-BOS.GLB HA-TB+CORE+WELL-07-1.GDT G:\43434_NTE ENERGY - KILLINGLY ENERGY CENTER\CONFIDENTIAL\000\GINT\43434-000_TB.GPJ Jun 27, 16

TEST BORING REPORT

HALEY ALDRICH

Boring No. B-06

Project	Killingly Energy Center, Killingly, Connecticut
Client	NTE Energy
Contractor	NYEG Drilling

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HSA	S	NX	Rig Make & Model: Track mounted Diedrich D120
Inside Diameter (in.)	4 1/4	1 3/8	1 7/8	Bit Type: Cutting Head
Hammer Weight (lb)	--	140	-	Drill Mud: None
Hammer Fall (in.)	--	30	-	Casing: Spun
				Hoist/Hammer: Winch Automatic Hammer
				PID Make & Model: None

File No.	43434-000
Sheet No.	1 of 2
Start	May 31, 2016
Finish	June 1, 2016
Driller	J. Rauscher
H&A Rep.	S. Poff/ C. Snow
Elevation	324.4 (est.)
Datum	NAVD88
Location	See Plan N 876135.9 E 1226980.6

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)
0				324.2		-FOREST LITTER-
	2 3 3 5	S1 18	0.0 2.0	0.2 323.9	ML/ OL	-TOPSOIL/LOAM-
				0.5 323.4	SM	Loose orange-brown silty coarse to fine SAND, little coarse to fine gravel, trace roots, no odor, dry -SUBSOIL-
				1.0	SM	Loose light brown silty fine SAND, some coarse to fine gravel, little coarse to medium sand, no odor, dry
	6 26 36 50/2"	S2 12	2.0 3.0	321.9	SM	Similar to S1 below 1.0 ft
				321.4	GP	-GLACIAL TILL-
				3.0		Very dense gray coarse to fine sandy fine GRAVEL, little silt, no odor, dry, resembles weathered floiated rock Note: Split spoon refusal at 2.7 ft. Advance core barrel to 3.0 ft to begin core run.
						SEE CORE BORING REPORT FOR ROCK DETAILS
5						

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
NOT ENCOUNTERED					

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	3.0
Rock Cored (ft)	4.0
Samples	2S

Boring No. B-06

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 HA-LIB09-BOS.GLB HA-TB+CORE+WELL-07-1.GDT G:\43434_NTE ENERGY - KILLINGLY ENERGY CENTER\CONFIDENTIAL\000\GINT\43434-000_TB.GPJ Jun 27, 16

CORE BORING REPORT

HALEY ALDRICH

Boring No. B-06
File No. 43434-000
Sheet No. 2 of 2

Depth (ft)	Drilling Rate (min./ft)	Run No.	Run Depth (ft)	Recovery/RQD in.	Recovery/RQD %	Weath-ering	Elev./ Depth (ft)	Visual Description and Remarks
								SEE TEST BORING REPORT FOR OVERBURDEN DETAILS
	2.5	C1	3.0	16	38	High	321.4	Very hard highly weathered gray to white (with orange to yellow discoloration) fine grained QUARTZITE; Foliation low angle to moderately dipping, very thin, planar to slightly undulating; Primary (foliation) joints low angle to moderately dipping, likely very close to close (indiscernible in core recovered); Secondary joints high angle to vertical (otherwise indiscernible in core recovered)
	3		6.5	0	0		3.0	
5	5							
	9							
								Note: Core barrel jammed at 6.5 ft, core run terminated. Roller bit advanced to 8.0 ft through probable weathered rock.
							316.4	-PROBABLE BEDROCK-
							8.0	BOTTOM OF EXPLORATION 8.0 FT
10								
15								
20								
25								
30								
35								

H+A_CORE+WELL07-1 HA-LIB09-BOS.GLB HA-TB+CORE+WELL-07-1.GDT G:\43434_NTE ENERGY - KILLINGLY ENERGY CENTER\CONFIDENTIAL\000\GINT\43434-000_TB.GPJ Jun 27, 16

TEST BORING REPORT

Boring No. B-07(OW)

Project	Killingly Energy Center, Killingly, Connecticut
Client	NTE Energy
Contractor	NYEG Drilling

File No.	43434-000
Sheet No.	1 of 2
Start	May 31, 2016
Finish	May 31, 2016
Driller	J. Rauscher
H&A Rep.	S. Poff
Elevation	345.3 (est.)
Datum	NAVD88
Location	Offset 24.0 ft N 875991.4 E 1227082.8

	Casing	Sampler	Barrel
Type	HSA	S	NX
Inside Diameter (in.)	4 1/4	1 3/8	1 7/8
Hammer Weight (lb)	--	140	-
Hammer Fall (in.)	--	30	-

Drilling Equipment and Procedures

Rig Make & Model: Track mounted Diedrich D120
Bit Type: Cutting Head
Drill Mud: None
Casing: Spun
Hoist/Hammer: Winch Automatic Hammer
PID Make & Model: None

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)
0	3 11 24 10	S1 19	0.0 2.0	345.2 0.1	ML/ OL	-FOREST LITTER-
				344.9 0.4	ML	-TOPSOIL/LOAM-
				344.3 1.0	SP- SM	Medium dense orange-brown fine sandy SILT, trace fine gravel, coarse to medium sand, roots, no odor, dry -SUBSOIL- Dense gray coarse to fine SAND, some fine gravel, little silt, no odor, dry, angular particles (weathered boulder fragments)
	8 9 10 9	S2 14	2.0 4.0		SM	Medium dense orange-brown to light brown silty fine SAND, some coarse to fine gravel, little coarse to medium sand, with cobbles, no odor, dry
5	50/4" --	S3 3	5.0 5.5	339.8 5.5	SM	Similar to S2, except very dense, split spoon refusal at 5.3 ft Note: Auger refusal at 5.5 ft, began rock coring. -GLACIAL TILL- SEE CORE BORING REPORT FOR ROCK DETAILS
10						

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
NOT ENCOUNTERED					

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	5.5
Rock Cored (ft)	5.0
Samples	3S, 1C

Boring No. B-07(OW)

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 HA-LIB09-BOS.GLB HA-TB+CORE+WELL-07-1.GDT G:\43434_NTE ENERGY - KILLINGLY ENERGY CENTER\CONFIDENTIAL\000\GINT\43434-000_TB.GPJ Jun 27, 16

HALEY ALDRICH

CORE BORING REPORT

Boring No. **B-07(OW)**
File No. 43434-000
Sheet No. 2 of 2

Depth (ft)	Drilling Rate (min./ft)	Run No.	Run Depth (ft)	Recovery/RQD in.	Recovery/RQD %	Weath-ering	Well Dia-gram	Elev./ Depth (ft)	Visual Description and Remarks
									SEE TEST BORING REPORT FOR OVERBURDEN DETAILS
	3.5	C1	5.5	53	88	Slight		339.8	Hard slightly weathered dark gray to light gray, medium to fine grained muscovite-biotite-quartz GNEISS; Foliation low angle, extremely to very thin, planar to slightly undulating; Primary (foliation) joints low angle, very close to close, smooth to rough, planar to slightly undulating, slightly decomposed to discolored, open; Secondary joints high angle across foliation, widely spaced, rough, undulating, discolored, open
	5		10.5	6	10			5.5	
	4								
	5							336.6	Similar to above, except light gray to white fine grained QUARTZITE with orange-brown discoloring throughout
	4							8.7	-QUINEBAUG FORMATION-
10									-BEDROCK-
								334.8	BOTTOM OF EXPLORATION 10.5 FT
								10.5	
									Note: Installed temporary groundwater observation well in completed borehole.
15									
20									
25									
30									
35									
40									

H+A_CORE+WELL07-1 HA-LIB09-BOS.GLB HA-TB+CORE+WELL-07-1.GDT G:\43434_NTE ENERGY - KILLINGLY ENERGY CENTER\CONFIDENTIAL\000\GINT\43434-000_TB.GPJ Jun 27, 16

GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No. B-07(OW)

Project: Killingly Energy Center
Location: Killingly, Connecticut
Client: NTE Energy
Contractor: NYEG Drilling
Driller: J. Rauscher
Initial Water Level (depth bgs): ft

Well Diagram: Riser Pipe, Screen, Filter Sand, Cuttings, Grout, Concrete, Bentonite Seal

File No. 43434-000
Date Installed: 31 May 2016
H&A Rep.: S. Poff
Location: N 875991.4, E 1227082.8
Ground El.: 345.3 (est.)
Datum: NAVD88

SOIL/ROCK CONDITIONS	DEPTH (ft.)	GRAPHIC	WELL DETAILS	DEPTH (ft.)	ELEVATION (ft.)
				0.0	345.3
FOREST LITTER	0.1				
TOPSOIL/LOAM	0.4			0.5	344.8
SUBSOIL	1.0			1.5	343.8
				2.5	342.8
GLACIAL TILL	5.5			7.5	337.8
				7.8	337.6
QUINEBAUG FORMATION | BEDROCK	10.5			10.5	334.8

WELL CONSTRUCTION DETAILS

Type of protective cover: None
Height of NA above ground surface: NA
Height of top of riser above ground surface: 2.5 ft
Type of protective casing: NA
Length: --
Inside diameter: --
Depth of bottom of NA: -
Type of riser pipe: Schedule 40 PVC
Inside diameter of riser pipe: 2.0 in.
Depth of bottom of riser pipe: 2.5 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Bentonite	0.5	1.0
	-	-
	-	-

Diameter of borehole: 4.3 in.
Depth to top of well screen: 2.5 ft
Type of screen: Machine slotted Sch 40 PVC
Screen gauge or size of openings: 0.010 in.
Diameter of screen: 2.0 in.
Type of Backfill around Screen: Filter Sand
Depth to bottom of well screen: 7.5 ft
Bottom of silt trap: 7.8 ft
Depth of bottom of borehole: 10.5 ft

COMMENTS:

HA-LIB09-BOS.GLB GW INSTALLATION REPORT-07-1 G:\43434_NTE ENERGY - KILLINGLY ENERGY CENTER\CONFIDENTIAL\000\GINT\43434-000_TB.GPJ Jun 27, 16

TEST BORING REPORT

HALEY ALDRICH

Boring No. B-08

Project	Killingly Energy Center, Killingly, Connecticut
Client	NTE Energy
Contractor	NYEG Drilling

File No.	43434-000
Sheet No.	1 of 2
Start	May 24, 2016
Finish	May 24, 2016
Driller	J. Rauscher
H&A Rep.	S. Poff
Elevation	299.5 (est.)
Datum	NAVD88
Location	Offset 34.0 ft SE N 876108.5 E 1226670.1

	Casing	Sampler	Barrel
Type	HSA	S	NX
Inside Diameter (in.)	4 1/4	1 3/8	1 7/8
Hammer Weight (lb)	--	140	-
Hammer Fall (in.)	--	30	-

Drilling Equipment and Procedures

Rig Make & Model: Track mounted Diedrich D120
Bit Type: Cutting Head
Drill Mud: None
Casing: Spun
Hoist/Hammer: Winch Automatic Hammer
PID Make & Model: Nonw

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)
0	WOH/18" -- -- 1	S1 18	0.0 2.0	299.3 0.2	ML/ OL	-FOREST LITTER-
				298.8 0.7		-TOPSOIL/LOAM-
					ML	Very loose brown to yellow-brown fine sandy SILT, trace fine gravel, coarse to medium sand, roots, no odor, moist
	1 1 1 2	S2 24	2.0 4.0	297.0 2.5	ML	Similar to S1
					SM	Very loose light brown to tan fine SAND, some silt, no odor, dry
				295.0 4.5		-SUBSOIL-
5	6 8 13 15	S3 19	5.0 7.0		SM	Medium dense yellow-brown to light brown coarse to fine SAND, some coarse to fine gravel, little silt, no odor, dry
	24 31 50/4"	S4 14	7.0 8.3		SP-SM	Very dense light brown coarse to fine gravelly SAND, little silt, no odor, dry, boulder fragments from 7.9 to 9.0 ft
						Note: Grind auger through boulder from approximately 7.9 to 9.0 ft.
10	22 25 36 50/4"	S5 18	10.0 11.8		SM	Very dense light brown to gray-brown coarse to fine gravelly fine SAND, some silt, little coarse to medium sand, no structure, no odor, dry
						Note: Auger grinding from 11.5 to 12.0 ft on cobble.
15	50/4" --	S6 3	15.0 15.5	284.0 15.5		Similar to S5 Note: Auger refusal at 15.5 ft, began rock coring.
						-GLACIAL TILL-
						SEE CORE BORING REPORT FOR ROCK DETAILS
20						

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
5/27/2016	9:40	66.0	--	14.0	DRY

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	15.5
Rock Cored (ft)	5.0
Samples	6S, 1C

Boring No. B-08

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 HA-LIB09-BOS.GLB HA-TB+CORE+WELL-07-1.GDT G:\43434_NTE ENERGY - KILLINGLY ENERGY CENTER\CONFIDENTIAL\000\GINT\43434-000_TB.GPJ Jun 27, 16

HALEY ALDRICH

CORE BORING REPORT

Boring No. **B-08**
File No. 43434-000
Sheet No. 2 of 2

Depth (ft)	Drilling Rate (min./ft)	Run No.	Run Depth (ft)	Recovery/RQD in.	Recovery/RQD %	Weath-ering	Elev./ Depth (ft)	Visual Description and Remarks
								SEE TEST BORING REPORT FOR OVERBURDEN DETAILS
	4	C1	15.5 20.5	53 7.5	88 13	Slight to Moderate	284.0 15.5	Very hard slightly weatered (15.5 to 17.6 ft, 17.9 to 18.7 ft) to moderately weatherd (17.6 to 17.9 ft, 18.7 to 20.5 ft) gray and white fine grained muscovite-biotite-quartz GNEISS; Foliation low angle, extremely thin, planar to slightly undulating; Primary (foliation) joints low angle, very close to close, smooth to rough, planar to slightly undulating, discolored (orange-brown), open to tight
	4							
	3.5							
	1.5							Note: Moderately weathered zone from 18.7 to 20.5 ft includes completely weathered seams from approximately 18.8 to 18.9 ft, 19 to 19.2 ft, and 19.3 to 19.4 ft. Continuous loss of drill water below 18.7 ft.
	2.5							-QUINEBAUG FORMATION-
20							279.0 20.5	-BEDROCK-
								BOTTOM OF EXPLORATION 20.5 FT
25								
30								
35								
40								
45								
50								

H+A_CORE+WELL07-1 HA-LIB09-BOS.GLB HA-TB+CORE+WELL-07-1.GDT G:\43434_NTE ENERGY - KILLINGLY ENERGY CENTER\CONFIDENTIAL\000\GINT\43434-000_TB.GPJ Jun 27, 16

TEST BORING REPORT

HALEY ALDRICH

Boring No. B-09

Project	Killingly Energy Center, Killingly, Connecticut
Client	NTE Energy
Contractor	NYEG Drilling

File No. 43434-000
Sheet No. 1 of 1
Start
Finish
Driller
H&A Rep.

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type		--	--	Rig Make & Model:
Inside Diameter (in.)		--	--	Bit Type:
Hammer Weight (lb)	--	--	-	Drill Mud:
Hammer Fall (in.)	--	--	-	Casing:
				Hoist/Hammer:
				PID Make & Model:

Elevation 320.9 (est.)
Datum NAVD88

Location See Plan
N 875968.8
E 1226776.7

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)
						Note: B-09 was omitted from exploration program by Mott MacDonald.

Water Level Data					
Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water

Sample ID
- O - Open End Rod
- T - Thin Wall Tube
- U - Undisturbed Sample
- S - Split Spoon Sample

Well Diagram
- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

Summary
- Overburden (ft)
- Rock Cored (ft)
- Samples

Boring No. B-09

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Plasticity**: N - Nonplastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

TEST BORING REPORT

Boring No. B-10 (OW)

Project	Killingly Energy Center, Killingly, Connecticut
Client	NTE Energy
Contractor	NYEG Drilling

File No.	43434-000
Sheet No.	1 of 2
Start	May 27, 2016
Finish	May 27, 2016
Driller	J. Rauscher
H&A Rep.	S. Poff
Elevation	322.8 (est.)
Datum	NAVD88
Location	Offset 6.5 ft south N 875909.5 E 1226821.1

	Casing	Sampler	Barrel
Type	HSA	S	NX
Inside Diameter (in.)	4 1/4	1 3/8	1 7/8
Hammer Weight (lb)	--	140	-
Hammer Fall (in.)	--	30	-

Drilling Equipment and Procedures

Rig Make & Model: Track mounted Diedrich D120
Bit Type: Cutting Head
Drill Mud: None
Casing: Spun
Hoist/Hammer: Winch Automatic Hammer
PID Make & Model: None

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)
0	1 2 3 5	S1 10	0.0 2.0	322.6 0.2	ML/OL	-FOREST LITTER-
				322.3 0.5		-TOPSOIL/LOAM-
					SM	Loose orange-brown silty fine SAND, little coarse to fine gravel, coarse to medium sand, no odor, dry -SUBSOIL-
	7 10 15 19	S2 21	2.0 4.0	320.8 2.0	SM	Medium dense brown silty SAND, trace gravel, no odor, dry
5	12 14 21 29	S3 19	5.0 7.0			Similar to S2, except dense, some gravel
	30 25 25 28	S4 20	7.0 9.0	315.8 7.0	SM	Very dense brown to light brown to tan coarse to fine gravelly coarse to fine SAND, some silt, occasional poorly-defined layering/stratification
10	11 15 18 22	S5 18	10.0 12.0		SM	Similar to S4, except dense
						-GLACIAL TILL-
15	10 18 15 25	S6 12	15.0 17.0	307.8 15.0	SM	Dense brown to orange-brown fine gravelly coarse to fine SAND, little silt, laminated/foliated (relict structure), no odor, wet
						Note: Auger refusal at 18.0 ft, began rock coring.
				304.8 18.0		-WEATHERED BEDROCK-
						SEE CORE BORING REPORT FOR ROCK DETAILS
20						

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
5/27/2016	--	--	15.0	17.0	14.6

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	18.0
Rock Cored (ft)	4.4
Samples	6S, 1C

Boring No. B-10 (OW)

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 HA-LIB09-BOS.GLB HA-TB+CORE+WELL-07-1.GDT G:\43434_NTE ENERGY - KILLINGLY ENERGY CENTER\CONFIDENTIAL\000\GINT\43434-000_TB.GPJ Jun 27, 16

HALEY ALDRICH

CORE BORING REPORT

Boring No. **B-10 (OW)**
File No. 43434-000
Sheet No. 2 of 2

Depth (ft)	Drilling Rate (min./ft)	Run No.	Run Depth (ft)	Recovery/RQD in.	Recovery/RQD %	Weath-ering	Well Dia-gram	Elev./ Depth (ft)	Visual Description and Remarks
									SEE TEST BORING REPORT FOR OVERBURDEN DETAILS
	3.5	C1	18.0	51	97	Slight to Fresh		304.8	Hard slightly weathered to fresh gray and white medium to fine grained muscovite-biotite-quartz GNEISS; Foliation low angle, extremely thin, planar to slightly undulating; Primary (foliation) joints low angle, very close to close, smooth to rough, planar to slightly undulating, discolored to fresh, open to tight; Secondary joints moderately dipping across foliation, widely spaced, rough, planar to stepped, discolored, open
	3.5		22.4	17.5	33			18.0	Note: Core barrel jammed at 22.4 ft, core run terminated.
20	3.5								-QUINEBAUG FORMATION-
	3								-BEDROCK-
	4							300.4	
								22.4	BOTTOM OF EXPLORATION 22.4 FT
									Note: Installed temporary groundwater observation well in completed borehole.
25									
30									
35									
40									
45									
50									

H+A_CORE+WELL07-1 HA-LIB09-BOS.GLB HA-TB+CORE+WELL-07-1.GDT G:\43434_NTE ENERGY - KILLINGLY ENERGY CENTER\CONFIDENTIAL\000\GINT\43434-000_TB.GPJ Jun 27, 16

GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No. B-10 (OW)

Project Killingly Energy Center
Location Killingly, Connecticut
Client NTE Energy
Contractor NYEG Drilling
Driller J. Rauscher

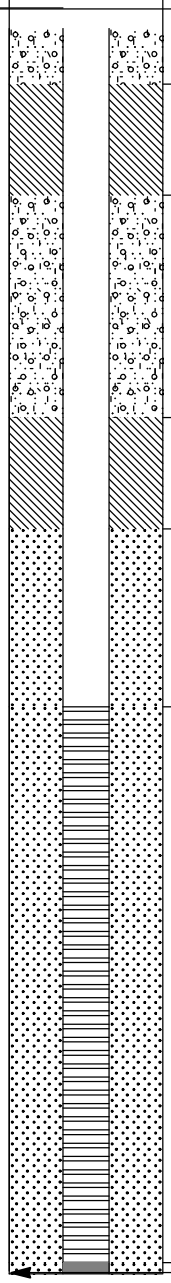
Initial Water Level (depth bgs) 14.6 ft

Well Diagram
- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No. 43434-000
Date Installed 27 May 2016
H&A Rep. S. Poff
Location N 875909.5
E 1226821.1

Ground El. 322.8 (est.)
Datum NAVD88

SOIL/ROCK CONDITIONS	DEPTH (ft.)
FOREST LITTER	0.2
TOPSOIL/LOAM	0.5
SUBSOIL	2.0
GLACIAL TILL	15.0
WEATHERED BEDROCK	18.0
QUINEBAUG FORMATION | BEDROCK	22.4



DEPTH (ft.)	ELEVATION (ft.)
0.0	322.8
1.0	321.8
3.0	319.8
7.0	315.8
9.0	313.8
12.2	310.6
22.2	300.6

WELL CONSTRUCTION DETAILS

Type of protective cover: None
Height of NA above ground surface: NA
Height of top of riser above ground surface: 2.3 ft
Type of protective casing: NA
Length: --
Inside diameter: --
Depth of bottom of NA: -
Type of riser pipe: Schedule 40 PVC
Inside diameter of riser pipe: 2.0 in.
Depth of bottom of riser pipe: 12.2 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Bentonite	1.0	2.0
Bentonite	7.0	2.0
	-	-

Diameter of borehole: 6.0 in.
Depth to top of well screen: 12.2 ft
Type of screen: Machine slotted Sch 40 PVC
Screen gauge or size of openings: 0.010 in.
Diameter of screen: 2.0 in.
Type of Backfill around Screen: Filter Sand
Depth to bottom of well screen: 22.4 ft
Bottom of silt trap: 22.4 ft
Depth of bottom of borehole: 22.4 ft

COMMENTS:

HA-LIB09-BOS.GLB GW INSTALLATION REPORT-07-1 G:\43434_NTE ENERGY - KILLINGLY ENERGY CENTER\CONFIDENTIAL\000\GINT\43434-000_TB.GPJ Jun 27, 16

TEST BORING REPORT

HALEY ALDRICH

Boring No. B-11

Project	Killingly Energy Center, Killingly, Connecticut
Client	NTE Energy
Contractor	NYEG Drilling

File No. 43434-000
Sheet No. 1 of 3
Start June 1, 2016
Finish June 1, 2016
Driller J. Rauscher
H&A Rep. C. Snow
Elevation 312.3 (est.)
Datum NAVD88
Location See Plan
N 876073.5
E 1227369.9

	Casing	Sampler	Barrel
Type	HSA	S	NX
Inside Diameter (in.)	4 1/4	1 3/8	1 7/8
Hammer Weight (lb)	--	140	-
Hammer Fall (in.)	--	30	-

Drilling Equipment and Procedures

Rig Make & Model: Track mounted Diedrich D120
Bit Type: Cutting Head
Drill Mud: None
Casing: Spun
Hoist/Hammer: Winch Automatic Hammer
PID Make & Model: None

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)
0	2 3 3 3	S1 12	0.0 2.0	312.1 0.2	ML/ OL	-FOREST LITTER- Loose dark brown SILT and ORGANIC SILT, little coarse to fine gravel, coarse to fine sand, trace roots, topsoil-like odor, moist
				310.8 1.5	SM	-TOPSOIL- Loose light brown to orange-brown medium to fine SAND, some silt, trace coarse sand, gravel, no odor, dry
	2 3 4 13	S2 19	2.0 4.0	308.8 3.5	SP	-SUBSOIL- Tan coarse to fine SAND, little gravel, trace silt, no odor, dry
	12 24 25 21	S3 15	4.0 6.0		SP	Similar to above, except dense, some cobbles, well-bonded, no odor, moist
5	18 27 24 15	S4 9	6.0 8.0		SP	Very dense tan coarse to fine SAND, some gravel, trace silt, no odor, wet, poorly stratified
	2 6 10 10	S5 11	8.0 10.0	304.3 8.0	SM	Medium dense tan coarse to fine SAND, little gravel, silt, no odor, wet
10	10 11 11 14	S6 16	10.0 12.0		SM	Similar to S5
15	2 6 10 10	S7 12	15.0 17.0	297.3 15.0	SM	Medium dense tan to gray sandy GRAVEL, coarse to fine sand, little silt, no odor, wet
20						

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
		NOT MEASURED			

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary
Overburden (ft) 22.0
Rock Cored (ft) 6.0
Samples 8S, 2C

Boring No. B-11

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 HA-LIB09-BOS.GLB HA-TB+CORE+WELL-07-1.GDT G:\43434_NTE ENERGY - KILLINGLY ENERGY CENTER\CONFIDENTIAL\000\GINT\43434-000_TB.GPJ Jun 27, 16

TEST BORING REPORT

HALEY ALDRICH

Boring No. B-11

File No. 43434-000

Sheet No. 2 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)
20	36 37 48 21	S8 17	20.0 22.0	291.3 21.0	SM	Very dense gray coarse to medium SAND, stratified, coarser with depth, little gravel, no odor, wet
				290.3 22.0	GM	Very dense gray sandy GRAVEL, no odor, wet -GLACIAL TILL- Note: Auger refusal at 22.0 ft, began rock coring.
						SEE CORE BORING REPORT FOR ROCK DETAILS
25						

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. B-11

HALEY ALDRICH

CORE BORING REPORT

Boring No. B-11
File No. 43434-000
Sheet No. 3 of 3

Depth (ft)	Drilling Rate (min./ft)	Run No.	Run Depth (ft)	Recovery/RQD in.	Recovery/RQD %	Weath-ering	Elev./ Depth (ft)	Visual Description and Remarks
								SEE TEST BORING REPORT FOR OVERBURDEN DETAILS
	4 3.5 3.5 4.5	C1	22.0 26.0	39 21	81 44	Moderate to Slight	290.3 22.0	Hard to very hard gray and white (with orange and red discoloring) medium to fine grained muscovite-biotite-quartz GNEISS; Foliation low angle, extremely thin, planar to slightly undulating; Primary (foliation) joints low angle, extremely close to moderately spaced, smooth to rough, planar to slightly undulating to stepped, decomposed to discolored, open to tight; Secondary joints moderately dipping to high angle across foliation, moderately spaced, smooth to rough, planar to slightly undulating, slightly decomposed to discolored, tight; Biotite seam from approximately 23.3 to 23.7 ft.
25	5 4.5	C2	26.0 28.0	21 15.5*	88 65*	Slight		Similar to C1, except foliation joints close to moderately spaced; Quartzite seam with garnets approximately 26.4 to 27.3 ft. *RQD qualifier: Closed high angle fracture through RQD zone from 26.7 to 28.1 ft, healed with secondary mineralization (probable biotite and pyrite)
							284.3 28.0	-QUINEBAUG FORMATION- -BEDROCK- BOTTOM OF EXPLORATION 28.0 FT Note: Boring offset 26.0 ft north and 83.0 ft east per Mott MacDonald (to N 876,101, E 12,27,457).
30								
35								
40								
45								
50								
55								

H+A_CORE+WELL07-1 HA-LIB09-BOS.GLB HA-TB+CORE+WELL-07-1.GDT G:\43434_NTE ENERGY - KILLINGLY ENERGY CENTER\CONFIDENTIAL\000\GINT\43434-000_TB.GPJ Jun 27, 16

TEST BORING REPORT

Boring No. B-12 (OW)

Project	Killingly Energy Center, Killingly, Connecticut
Client	NTE Energy
Contractor	NYEG Drilling

File No.	43434-000
Sheet No.	1 of 3
Start	May 26, 2016
Finish	May 26, 2016
Driller	C. Stone
H&A Rep.	S. Poff
Elevation	330.5 (est.)
Datum	NAVD88
Location	See Plan N 875928.2 E 1227230.1

	Casing	Sampler	Barrel
Type	HSA	S	NX
Inside Diameter (in.)	4 1/4	1 3/8	1 7/8
Hammer Weight (lb)	--	140	-
Hammer Fall (in.)	--	30	-

Drilling Equipment and Procedures

Rig Make & Model: Track mounted CME 850
Bit Type: Cutting Head
Drill Mud: None
Casing: Spun
Hoist/Hammer: Winch Automatic Hammer
PID Make & Model: None

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)
0	1 2 5 9	S1 8	0.0 2.0	330.3 0.2	ML/OL	-FOREST LITTER-
				329.9 0.6		-TOPSOIL/LOAM-
				328.9 1.6	SM	Loose yellow-brown silty fine SAND, trace coarse to fine gravel, coarse to fine sand, no odor, dry -SUBSOIL-
	10 10 20 32	S2 14	2.0 4.0		SM	Medium dense light brown to yellow-brown silty medium to fine SAND, little coarse to fine gravel, coarse sand, no odor, dry
5	10 52 50 20	S3 16	5.0 7.0		SM	Similar to S2, cobble fragments from 5.5 to 6.7 ft
	32 28 34 42	S4 18	7.0 9.0		SM	Medium dense light brown silty SAND, little gravel, no odor, dry, cobble fragments from 8.2 to 8.7 ft
10	14 31 45 42	S5 16	10.0 12.0		SM	Very dense light brown to gray-brown coarse to fine gravelly SAND, some silt, with cobbles, no odor, dry
15	25 18 22 18	S6 23	15.0 17.0		SM	Similar to S5, except dense, moist
20						

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
5/31/2016	17:00	96.0	--	--	9.0

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	24.0
Rock Cored (ft)	5.0
Samples	7S, 1C

Boring No. B-12 (OW)

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

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TEST BORING REPORT

HALEY ALDRICH

Boring No. B-12 (OW)
File No. 43434-000
Sheet No. 2 of 3

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Well Diagram	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)
20	24 13 20 50/1"	S7 12	20.0 21.6			GM	Dense light brown to gray-brown coarse to fine sandy GRAVEL, some silt, no odor, wet
							Note: Auger grinding/chattering from 21.6 to 24.0 ft. Auger refusal at 24.0 ft, began rock coring.
					306.5 24.0		-GLACIAL TILL-
							SEE CORE BORING REPORT FOR ROCK DETAILS
25							

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 HA-LIB09-BOS.GLB HA-TB+CORE+WELL-07-1.GDT G:\43434_NTE ENERGY - KILLINGLY ENERGY CENTER\CONFIDENTIAL\000\GINT\43434-000_TB.GPJ Jun 27, 16

HALEY ALDRICH

CORE BORING REPORT

Boring No. **B-12 (OW)**
File No. 43434-000
Sheet No. 3 of 3

Depth (ft)	Drilling Rate (min./ft)	Run No.	Run Depth (ft)	Recovery/RQD in.	Recovery/RQD %	Weath-ering	Well Dia-gram	Elev./ Depth (ft)	Visual Description and Remarks
									SEE TEST BORING REPORT FOR OVERBURDEN DETAILS
	6	C1	24.0 29.0	55 7	92 12	Slight		306.5 24.0	Hard, slightly weathered, gray and white (with orange to red discoloring throughout), medium to fine grained muscovite-biotite-quartz GNEISS; Foliation low angle, extremely thin, planar to slightly undulating; Primary (foliation) joints low angle, extremely to very close, smooth to rough, planar to slightly undulating, decomposed to discolored, open; Secondary joints moderately dipping to high angle across foliation, close to moderately spaced, rough, slightly undulating to stepped, slightly decomposed to discolored, open; Occasional garnets: Quartzite seam from approximately 28.7 to 29.0 ft.
25	6								
	5								
	5								
	5								-QUINEBAUG FORMATION- -BEDROCK-
								301.5 29.0	BOTTOM OF EXPLORATION 29.0 FT
30									Note: Installed temporary groundwater observation well in completed borehole.
35									
40									
45									
50									
55									

H+A_CORE+WELL07-1 HA-LIB09-BOS.GLB HA-TB+CORE+WELL-07-1.GDT G:\43434_NTE ENERGY - KILLINGLY ENERGY CENTER\CONFIDENTIAL\000\GINT\43434-000_TB.GPJ Jun 27, 16

GROUNDWATER OBSERVATION WELL INSTALLATION REPORT

HALEY ALDRICH

Well No. B-12 (OW)

Project: Killingly Energy Center
Location: Killingly, Connecticut
Client: NTE Energy
Contractor: NYEG Drilling
Driller: C. Stone
Initial Water Level (depth bgs): 9.0 ft

Well Diagram
- Riser Pipe
- Screen
- Filter Sand
- Cuttings
- Grout
- Concrete
- Bentonite Seal

File No. 43434-000
Date Installed: 26 May 2016
H&A Rep.: S. Poff
Location: N 875928.2, E 1227230.1
Ground El.: 330.5 (est.)
Datum: NAVD88

SOIL/ROCK CONDITIONS	DEPTH (ft.)	GRAPHIC	WELL DETAILS	DEPTH (ft.)	ELEVATION (ft.)
				0.0	330.5
FOREST LITTER	0.2			0.5	330.0
TOPSOIL/LOAM	0.6				
SUBSOIL	1.6			3.0	327.5
				6.0	324.5
				8.0	322.5
				10.0	320.5
GLACIAL TILL					
				20.0	310.5
				20.2	310.3
	24.0				
QUINEBAUG FORMATION | BEDROCK					
	29.0			29.0	301.5

WELL CONSTRUCTION DETAILS

Type of protective cover	None
Height of NA above ground surface	NA
Height of top of riser above ground surface	2.6 ft
Type of protective casing	NA
Length	--
Inside diameter	--
Depth of bottom of NA	-
Type of riser pipe	Schedule 40 PVC
Inside diameter of riser pipe	2.0 in.
Depth of bottom of riser pipe	10.0 ft

Type of Seals	Top of Seal (ft)	Thickness (ft)
Concrete	0.0	0.5
Bentonite	8.0	2.0
	-	-

Diameter of borehole	6.0 in.
Depth to top of well screen	10.0 ft
Type of screen	Machine slotted Sch 40 PVC
Screen gauge or size of openings	0.010 in.
Diameter of screen	2.0 in.
Type of Backfill around Screen	Filter Sand
Depth to bottom of well screen	20.0 ft
Bottom of silt trap	20.2 ft
Depth of bottom of borehole	29.0 ft

COMMENTS:

HA-LIB09-BOS.GLB GW INSTALLATION REPORT-07-1 G:\43434_NTE ENERGY - KILLINGLY ENERGY CENTER\CONFIDENTIAL\000\GINT\43434-000_TB.GPJ Jun 27, 16

TEST BORING REPORT

HALEY ALDRICH

Boring No. B-13

Project	Killingly Energy Center, Killingly, Connecticut
Client	NTE Energy
Contractor	NYEG Drilling

File No.	43434-000
Sheet No.	1 of 2
Start	May 31, 2016
Finish	May 31, 2016
Driller	C. Stone
H&A Rep.	S. Poff
Elevation	343.8 (est.)
Datum	NAVD88
Location	See Plan N 875733.8 E 1227120

	Casing	Sampler	Barrel
Type	HSA	S	NX
Inside Diameter (in.)	4 1/4	1 3/8	1 7/8
Hammer Weight (lb)	--	140	-
Hammer Fall (in.)	--	30	-

Drilling Equipment and Procedures

Rig Make & Model: Track mounted CME 850
Bit Type: Cutting Head
Drill Mud: None
Casing: Spun
Hoist/Hammer: Winch Automatic Hammer
PID Make & Model: None

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)
0	1 3 2 3	S1 8	0.0 2.0	343.6 0.2	ML/OL	-FOREST LITTER-
				343.2 0.6	SM	-TOPSOIL/LOAM-
						Loose orange-brown coarse to fine gravelly fine SAND, some silt, little coarse to medium sand, with cobbles, no odor, dry
				341.8 2.0	SM	-SUBSOIL-
	5 10 13 14	S2 18	2.0 4.0			Medium dense light brown coarse to fine gravelly coarse to fine SAND, some silt, no odor, dry
5	25 22 35 48	S3 9	5.0 7.0	338.8 5.0	GP	Very dense light brown coarse to fine sandy coarse to fine GRAVEL, trace silt, with cobbles, no odor, dry
	33 28 38 44	S4 19	7.0 9.0	336.8 7.0	SM	Very dense brown silty SAND, some gravel, silt, no odor, dry
						Note: Auger grinding through boulder from approximately 8.8 to 9.8 ft.
10	20 10 13 5	S5 16	10.0 12.0			Similar to S4, except medium dense, wet at 12.0 ft
						Note: Auger grinding through boulder from approximately 12.5 to 13.7 ft.
15	23 30 50/1"	S6 4	15.0 16.1		GP	Very dense light brown to white coarse to fine sandy fine GRAVEL, trace silt, no odor, dry (quartzite fragments)
						Note: Auger chattering from 16.1 to 18.0 ft. Auger and roller bit refusal at 18.0 ft, began rock coring at 18.0 ft.
				325.8 18.0		-GLACIAL TILL-
						SEE CORE BORING REPORT FOR ROCK DETAILS
20						

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
		NOT MEASURED			

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	18.0
Rock Cored (ft)	10.0
Samples	6S, 1C

Boring No. B-13

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 HA-LIB09-BOS.GLB HA-TB+CORE+WELL-07-1.GDT G:\43434_NTE ENERGY - KILLINGLY ENERGY CENTER\CONFIDENTIAL\000\GINT\43434-000_TB.GPJ Jun 27, 16

CORE BORING REPORT

HALEY ALDRICH

Boring No. B-13
File No. 43434-000
Sheet No. 2 of 2

Depth (ft)	Drilling Rate (min./ft)	Run No.	Run Depth (ft)	Recovery/RQD in.	Recovery/RQD %	Weath-ering	Elev./ Depth (ft)	Visual Description and Remarks
								SEE TEST BORING REPORT FOR OVERBURDEN DETAILS
	11	C1	18.0 23.0	38 0	63 0	Moderate	325.8 18.0	Note: Core barrel jammed frequently. Hard, moderately weathered, black-gray-white (with orange-brown discoloring), medium to fine grained biotite-quartz GNEISS; Foliation low angle, extremely thin, planar to slightly undulating; Primary (foliation) joints low angle, extremely to very close, rough, planar to slightly undulating, decomposed to discolored, open; Secondary joints high angle to vertical, closely spaced, rough, planar to undulating, decomposed to discolored, open.
	11							
20	10							
	10							
	11							
	9	C2	23.0 28.0	31 5*	52 8*	Moderate		Similar to C1 *RQD qualifier: closed high angle fracture through RQD zone.
	9							
25	9							
	9							
	9							-QUINEBAUG FORMATION- -BEDROCK-
							315.8 28.0	
30								
35								
40								
45								
50								

H+A_CORE+WELL07-1 HA-LIB09-BOS.GLB HA-TB+CORE+WELL-07-1.GDT G:\43434_NTE ENERGY - KILLINGLY ENERGY CENTER\CONFIDENTIAL\000\GINT\43434-000_TB.GPJ Jun 27, 16

TEST BORING REPORT

HALEY ALDRICH

Boring No. B-14

Project	Killingly Energy Center, Killingly, Connecticut
Client	NTE Energy
Contractor	NYEG Drilling

File No.	43434-000
Sheet No.	1 of 2
Start	May 26, 2016
Finish	May 26, 2016
Driller	C. Stone
H&A Rep.	S. Poff
Elevation	343.4 (est.)
Datum	NAVD88
Location	See Plan N 875647.1 E 1227443.2

	Casing	Sampler	Barrel
Type	HSA	S	--
Inside Diameter (in.)	4 1/4	1 3/8	--
Hammer Weight (lb)	--	140	-
Hammer Fall (in.)	--	30	-

Drilling Equipment and Procedures

Rig Make & Model: Track mounted CME 8560
Bit Type: Cutting Head
Drill Mud: None
Casing: Spun
Hoist/Hammer: Winch Automatic Hammer
PID Make & Model: None

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)
0	1 1 12 18	S1 10	0.0 2.0	343.2 0.2	ML/ OL	-FOREST LITTER-
				342.7 0.7		-TOPSOIL/LOAM-
				342.2 1.2	SM	Very loose orange-brown to light brown silty fine SAND, little coarse to fine gravel, trace coarse to medium sand, trace roots, no odor, dry
					SM	-SUBSOIL-
	20 23 25 29	S2 21	2.0 4.0		SM	Medium dense light brown coarse to fine SAND, some coarse to fine gravel, little silt, no odor, dry S2: Dense light brown coarse to fine gravelly coarse to fine SAND, some silt, no odor, dry
						Note: Frequent cobbles from 4.0 to 15.0 ft.
5	19 25 25 18	S3 16	5.0 7.0		SM	Similar to S2
	25 30 24 20	S4 18	7.0 9.0		SM	Similar to S3, except light brown to orange-brown
10	10 15 30 32	S5 17	10.0 12.0		SM	Similar to S4, except dense
	33 40 35 53	S6 16	12.0 14.0		SM	Similar to S5, except very dense
15	14 30 32 45	S7 18	15.0 17.0		SM	Similar to S6
						Note: Auger grinding through boulder from approximately 17.0 to 18.0 ft.
						Note: Drill action suggests stratum change at approximately 19.0 ft.
				324.4 19.0		-GLACIAL TILL-
20						

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
5/27/2016	14:30	24.0 *COLLAPSED	--	18.3*	DRY

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	22.0
Rock Cored (ft)	--
Samples	8S

Boring No. B-14

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 HA-LIB09-BOS.GLB HA-TB+CORE+WELL-07-1.GDT G:\43434_NTE ENERGY - KILLINGLY ENERGY CENTER\CONFIDENTIAL\000\GINT\43434-000_TB.GPJ Jun 27, 16

HALEY ALDRICH

TEST BORING REPORT

Boring No. B-14

File No. 43434-000

Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)
20	6 5 6 6	S8 12	20.0 22.0		ML	Medium dense brown to gray-brown medium to fine sandy SILT, trace fine gravel, coarse sand, clay, laminated (possible relict structure), no odor, wet, resembles weathered rock -PROBABLE WEATHERED BEDROCK-
				321.4 22.0		BOTTOM OF EXPLORATION 22.0 FT

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. B-14

H&A-TEST BORING-09 HA-LIB09-BOS.GLB HA-TB+CORE+WELL-07-1.GDT G:\43434_NTE ENERGY - KILLINGLY ENERGY CENTER\CONFIDENTIAL\000\GINT\43434-000_TB.GPJ Jun 27, 16

TEST BORING REPORT

HALEY ALDRICH

Boring No. B-15

Project	Killingly Energy Center, Killingly, Connecticut
Client	NTE Energy
Contractor	NYEG Drilling

File No. 43434-000
Sheet No. 1 of 2
Start June 2, 2016
Finish June 2, 2016
Driller J. Rauscher
H&A Rep. C. Snow
Elevation 321.4 (est.)
Datum NAVD88
Location See Plan
N 876020.5
E 1227764.4

	Casing	Sampler	Barrel
Type	HSA	S	NX
Inside Diameter (in.)	4 1/4	1 3/8	1 7/8
Hammer Weight (lb)	--	140	-
Hammer Fall (in.)	--	30	-

Drilling Equipment and Procedures

Rig Make & Model: Track mounted CME 8560
Bit Type: Cutting Head
Drill Mud: None
Casing: Spun
Hoist/Hammer: Winch Automatic Hammer
PID Make & Model: None

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)
0	2 10 8 6	S1 14	0.0 2.0	320.2 1.2	ML/OL	Loose dark brown SILT and ORGANIC SILT, little coarse to fine gravel, coarse to fine sand, trace roots, topsoil-like odor, moist
						-TOPSOIL/LOAM-
					SP-SM	Medium dense orange-brown medium to fine SAND, little gravel, little silt, trace coarse sand, no odor, dry
	10 15 38 42	S2 17	2.0 4.0	318.9 2.5	SP-SM	Similar to above
						-SUBSOIL-
					SW	Medium dense light brown coarse to fine SAND, some gravel, trace silt, no odor, dry
	30 50/2"	S3 7	4.0 5.8		SW	Similar to S2, below 2.5 ft
5						-GLACIAL TILL-
				315.6 5.8		Note: Split spoon refusal on probable boulder/bedrock at 5.8 ft. Advanced HSA to 6.0 ft and began core run.
						SEE CORE BORING REPORT FOR ROCK DETAILS
10						
15						
20						

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
NOT ENCOUNTERED					

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft) 4.0
Rock Cored (ft) 15.0
Samples 3S, 3C

Boring No. B-15

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 HA-LIB09-BOS.GLB HA-TB+CORE+WELL-07-1.GDT G:\43434_NTE ENERGY - KILLINGLY ENERGY CENTER\CONFIDENTIAL\000\GINT\43434-000_TB.GPJ Jun 27, 16

HALEY ALDRICH

CORE BORING REPORT

Boring No. B-15
File No. 43434-000
Sheet No. 2 of 2

Depth (ft)	Drilling Rate (min./ft)	Run No.	Run Depth (ft)	Recovery/RQD in.	Recovery/RQD %	Weath-ering	Elev./ Depth (ft)	Visual Description and Remarks
								SEE TEST BORING REPORT FOR OVERBURDEN DETAILS
		C1	6.0 11.0	27 N/A	45			Recovered 27.0 in. of hard GNEISS BOULDER pieces
10								
								Note: Borehole reamed to 11.0 ft, core barrel advanced from 11.0 to 16.0 ft.
		C2	11.0 16.0	6 N/A	10			Recovered 6.0 in. of hard GNEISS and QUARTZITE COBBLE pieces
15								
								Note: Borehole reamed to 16.0 ft, core barrel advanced from 16.0 to 21.0 ft.
		C3	16.0 21.0	20 N/A	33			Recovered 20.0 in. of hard GNEISS and QUARTZITE COBBLE pieces
20								
							300.4 21.0	-GLACIAL TILL- BOTTOM OF EXPLORATION 21.0 FT
25								
30								
35								
40								

H+A_CORE+WELL07-1 HA-LIB09-BOS.GLB HA-TB+CORE+WELL-07-1.GDT G:\43434_NTE ENERGY - KILLINGLY ENERGY CENTER\CONFIDENTIAL\000\GINT\43434-000_TB.GPJ Jun 27, 16

TEST BORING REPORT

HALEY ALDRICH

Boring No. B-16

Project	Killingly Energy Center, Killingly, Connecticut
Client	NTE Energy
Contractor	NYEG Drilling

File No.	43434-000
Sheet No.	1 of 2
Start	May 25, 2016
Finish	May 26, 2016
Driller	C. Stone
H&A Rep.	S. Poff
Elevation	310.9 (est.)
Datum	NAVD88
Location	Offset 14.0 ft west, northwest N 875521 E 1227859.9

	Casing	Sampler	Barrel
Type	HSA	S	NX
Inside Diameter (in.)	4 1/4	1 3/8	1 7/8
Hammer Weight (lb)	--	140	-
Hammer Fall (in.)	--	30	-

Drilling Equipment and Procedures

Rig Make & Model: Track mounted CME 850
Bit Type: Cutting Head
Drill Mud: None
Casing: Spun
Hoist/Hammer: Winch Automatic Hammer
PID Make & Model: None

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)	PID Readings (ppm) (sample/bkgd)
0	1 1 1 1	S1 16	0.0 2.0	310.3 0.6	ML/OL	-TOPSOIL/LOAM-	
					SM	Very loose orange-brown to yellow-brown silty fine SAND, trace coarse to medium sand, no odor, dry	
	2 3 5 25	S2 10	2.0 4.0		SM	Similar to S1	
					SP	Medium dense brown to orange-brown medium to fine SAND, trace coarse sand, silt, stratified, no odor, moist	
				305.9 5.0		-SUBSOIL-	
5	7 10 8 10	S3 20	5.0 7.0		SM	Medium dense light brown coarse to fine SAND, some silt, little fine gravel, no structure, no odor, moist	
	14 15 15 20	S4 16	7.0 9.0		SM	Similar to S3	
10	13 20 18 20	S5 16	10.0 12.0		SM	Similar to S4, except dense	
				298.9 12.0			
	22 28 32 42	S6 15	12.0 14.0		SM	Very dense light brown to brown coarse to fine gravelly SAND, some silt, no structure, no odor, moist	
15	17 21 23 30	S7 18	15.0 17.0		SM	Similar to S6, except dense, wet	
	22 28 36 45	S8 19	17.0 19.0		SM	Similar to S7, except very dense	
				290.9		-GLACIAL TILL-	
20						Note: Auger grinding from approximately 19.5 to 20 ft. HSA refusal at 20.0 ft. Began rock coring at	

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
5/27/2016	--	24.0	--	8.0	4.5

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	20.0
Rock Cored (ft)	5.0
Samples	8S

Boring No. B-16

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 HA-LIB09-BOS.GLB HA-TB+CORE+WELL-07-1.GDT G:\43434_NTE ENERGY - KILLINGLY ENERGY CENTER\CONFIDENTIAL\000\GINT\43434-000_TB.GPJ Jun 27, 16

HALEY ALDRICH

CORE BORING REPORT

Boring No. B-16
File No. 43434-000
Sheet No. 2 of 2

Depth (ft)	Drilling Rate (min./ft)	Run No.	Run Depth (ft)	Recovery/RQD in.	Recovery/RQD %	Weath-ering	Elev./ Depth (ft)	Visual Description and Remarks
								SEE TEST BORING REPORT FOR OVERBURDEN DETAILS
20	10	C1	20.0 21.0	12 0	100 0	High	290.9 20.0	Very hard highly weathered light gray and white medium to fine grained muscovite-biotite-quartz GNEISS; Orange-brown discoloring throughout Note: Core barrel clogged at 21.0 ft. Core barrel emptied, rock coring continued at 21.0 ft. Similar to C1
	8	C2	21.0 25.0	48 24	100 50	High to Slight	289.2 21.7	Very hard slightly weathered gray and white (with orange-brown discoloring) medium to fine grained muscovite-biotite-quartz GNEISS; Foliation low angle, extremely thin, planar; Primary (foliation) joints low angle, very close to moderately spaced, smooth to rough, discolored (orange-brown), open to tight; Secondary joints moderately dipping to high angle across foliation, moderately spaced, rough, slightly undulating, discolored, open to tight
	6							
	6							
	6							
								-QUINEBAUG FORMATION-
25							285.9 25.0	-BEDROCK-
								BOTTOM OF EXPLORATION 25.0 FT
30								
35								
40								
45								
50								
55								

H+A_CORE+WELL07-1 HA-LIB09-BOS.GLB HA-TB+CORE+WELL-07-1.GDT G:\43434_NTE ENERGY - KILLINGLY ENERGY CENTER\CONFIDENTIAL\000\GINT\43434-000_TB.GPJ Jun 27, 16

TEST BORING REPORT

HALEY ALDRICH

Boring No. B-17

Project	Killingly Energy Center, Killingly, Connecticut
Client	NTE Energy
Contractor	NYEG Drilling

File No. 43434-000
Sheet No. 1 of 2
Start May 23, 2016
Finish May 23, 2016
Driller C. Stone
H&A Rep. S. Poff
Elevation 325.7 (est.)
Datum NAVD88
Location See Plan
N 875296.1
E 1227766.5

	Casing	Sampler	Barrel	Drilling Equipment and Procedures
Type	HSA	S	--	Rig Make & Model: Track mounted CME 850
Inside Diameter (in.)	4 1/4	1 3/8	--	Bit Type: Cutting Head
Hammer Weight (lb)	--	140	-	Drill Mud: None
Hammer Fall (in.)	--	30	-	Casing: Spun
				Hoist/Hammer: Winch Automatic Hammer
				PID Make & Model: None

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)
0	1 1 2 3	S1 6	0.0 2.0	325.6 0.1	ML	-FOREST LITTER- Very loose dark brown fine sandy SILT, trace coarse to medium sand, no odor, dry
				323.7 2.0		-TOPSOIL/LOAM-
	5 10 50/3"	S2 6	2.0 3.3		SM	Medium dense light gray-brown to tan coarse to fine gravelly SAND, trace silt, no odor, dry
						Note: Auger grinding through numerous cobbles from 3.3 to 6.5 ft.
5						
	26 60	S3 11	6.5 7.5		GM	Very dense gray to yellow-brown coarse to fine sandy GRAVEL, trace silt, no odor, dry
						Note: Auger refusal at 7.5 ft. Core barrel advanced to 12.5 ft, recovered 12.0 in. of cobble and gravel pieces.
10						
	50/1" --	S4 0	12.5 12.6			Split spoon refusal at 12.6 ft, no recovery
15	15 12 29 38	S5 18	15.0 17.0		GM	Dense light brown coarse to fine sandy GRAVEL, little silt, no structure, no odor, dry, decomposed cobble from approximately 16.5 to 17 ft.
20						

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
5/27/2016	--	41.0	--	20.3	DRY

Sample ID
O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram
Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary
Overburden (ft) 30.0
Rock Cored (ft) --
Samples 7S

Boring No. B-17

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 HA-LIB09-BOS.GLB HA-TB+CORE+WELL-07-1.GDT G:\43434_NTE ENERGY - KILLINGLY ENERGY CENTER\CONFIDENTIAL\000\GINT\43434-000_TB.GPJ Jun 27, 16

HALEY ALDRICH

TEST BORING REPORT

Boring No. B-17

File No. 43434-000

Sheet No. 2 of 2

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)
20	17 18 20 32	S6 18	20.0 22.0		GM	Similar to S5, except no odor, dry
25	50/4" --	S7 4	25.0 25.3		GM	Similar to S6, except split spoon refusal at 25.3 ft
						Note: Air rotary to 25.5 ft, began rock coring at 25.5 ft. Core barrel advanced from 25.5 to 30.0 ft. Core barrel jammed at 30.0 ft, difficulty retrieving core barrel. Recovered 12.0 in. of QUARTZITE, probable boulder. Unable to re-advance core barrel past 25.0 ft, boring terminated.
						-GLACIAL TILL-
30				295.7 30.0		BOTTOM OF EXPLORATION 30.0 FT

NOTE: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

Boring No. B-17

H&A-TEST BORING-09 HA-LIB09-BOS.GLB HA-TB+CORE+WELL-07-1.GDT G:\43434_NTE ENERGY - KILLINGLY ENERGY CENTER\CONFIDENTIAL\000\GINT\43434-000_TB.GPJ Jun 27, 16

TEST BORING REPORT

HALEY ALDRICH

Boring No. B-18

Project	Killingly Energy Center, Killingly, Connecticut
Client	NTE Energy
Contractor	NYEG Drilling

File No.	43434-000
Sheet No.	1 of 2
Start	May 23, 2016
Finish	May 23, 2016
Driller	J. Rauscher
H&A Rep.	S. Poff
Elevation	310.8 (est.)
Datum	NAVD88
Location	See Plan N 875720.5 E 1227885.2

	Casing	Sampler	Barrel
Type	HSA	S	NX
Inside Diameter (in.)	4 1/4	1 3/8	1 7/8
Hammer Weight (lb)	--	140	-
Hammer Fall (in.)	--	30	-

Drilling Equipment and Procedures

Rig Make & Model: Track mounted Diedrich D120
Bit Type: Cutting Head
Drill Mud: None
Casing: Spun
Hoist/Hammer: Winch Automatic Hammer
PID Make & Model: None

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Rec. (in.)	Sample Depth (ft)	Stratum Change Elev/Depth (ft)	USCS Symbol	VISUAL-MANUAL IDENTIFICATION AND DESCRIPTION (Density/consistency, color, GROUP NAME, max. particle size†, structure, odor, moisture, optional descriptions GEOLOGIC INTERPRETATION)
0	1 2 1 1	S1 16	0.0 2.0	310.1 0.7	ML/ OL	-TOPSOIL/LOAM-
					SM	Very loose orange-brown to yellow-brown fine SAND, some silt, trace roots, no odor, dry
	2 2 6 38	S2 17	2.0 4.0		SM	Loose orange-brown to tan fine SAND, little silt, poorly-stratified, no odor, dry
				307.1 3.7		-SUBSOIL-
					SP	Very dense brown to gray-brown fine gravelly SAND, trace silt, no odor, dry, angular gravel (cobble fragments)
5	23 75/5"	S3 10	5.0 5.9		SM	Very dense light brown coarse to fine SAND, little fine gravel, silt, no odor, moist
						Note: Cobble from approximately 5.9 to 6.5 ft.
	19 23 26 32	S4 12	7.0 9.0		SM	Dense light brown coarse to fine gravelly SAND, little silt, no odor, dry
				301.3 9.5		
10	18 24 33 37	S5 14	10.0 12.0		GP-GM	Very dense brown to gray-brown coarse to fine sandy GRAVEL, trace silt, no odor, moist, with 4.0 in. of cobble fragments at bottom of sample, split spoon wet at approximately 11 ft
						Note: Drill action indicates gravelly soils, numberous cobbles from 10.0 to 15.0 ft.
15	14 34 21 24	S6 16	15.0 17.0		GP-GM	Similar to S5, except wet
						Note: Drill action indicates gravelly soils, numerous cobbles from 15.0 to 18.0 ft. Auger grinding steadily from approximately 18 to 20 ft. Began coring at 20.0 ft.
				292.8 18.0		-GLACIAL TILL-
20						SEE CORE BORING REPORT FOR ROCK DETAILS

Water Level Data

Date	Time	Elapsed Time (hr.)	Depth (ft) to: Bottom of Casing	Bottom of Hole	Water
5/24/2016	13:30	-- *COLLAPSED	--	14.0*	7.4

Sample ID

O - Open End Rod
T - Thin Wall Tube
U - Undisturbed Sample
S - Split Spoon Sample

Well Diagram

Riser Pipe
Screen
Filter Sand
Cuttings
Grout
Concrete
Bentonite Seal

Summary

Overburden (ft)	20.0
Rock Cored (ft)	10.0
Samples	6S, 2C

Boring No. B-18

Field Tests: **Dilatancy**: R - Rapid S - Slow N - None **Toughness**: L - Low M - Medium H - High **Plasticity**: N - Nonplastic L - Low M - Medium H - High **Dry Strength**: N - None L - Low M - Medium H - High V - Very High

†Note: Maximum particle size (mps) is determined by direct observation within the limitations of sampler size.

Note: Soil identification based on visual-manual methods of the USCS as practiced by Haley & Aldrich, Inc.

H&A-TEST BORING-09 HA-LIB09-BOS.GLB HA-TB+CORE+WELL-07-1.GDT G:\43434_NTE ENERGY - KILLINGLY ENERGY CENTER\CONFIDENTIAL\000\GINT\43434-000_TB.GPJ Jun 27, 16

CORE BORING REPORT

HALEY ALDRICH

Boring No. B-18
File No. 43434-000
Sheet No. 2 of 2

Depth (ft)	Drilling Rate (min./ft)	Run No.	Run Depth (ft)	Recovery/RQD in.	Recovery/RQD %	Weath-ering	Elev./ Depth (ft)	Visual Description and Remarks
								SEE TEST BORING REPORT FOR OVERBURDEN DETAILS
20	7	C1	20.0	31	52	High to Moderate		Note: Continuous loss of drill water. Very hard to hard highly to moderately weathered yellow-gray-white QUARTZITE; Foliation low angle, extremely to very thin, planar, poorly-developed; Primary (foliation) joints low angle, very close to close, smooth, planar, discolored, open to tight; High angle, irregular, discolored (yellow), fractures throughout
	8		25.0	4	7			
	7							
	6							
	7							
							285.8	
25	5	C2	25.0	55	92	Moderate	25.0	Similar to C1, except moderately weathered; Primary (foliation) joints very close to close; Secondary joints moderately dipping to high angle across foliation, moderately spaced, rough, undulating, discolored (yellow to orange), open
			30.0	11.5	19			
	4							
	4							
	4							
							282.1	
	4						28.7	Similar to C2 above, except biotite-quartz GNEISS
								-QUINEBAUG FORMATION-
								-BEDROCK-
30							280.8 30.0	BOTTOM OF EXPLORATION 30.0 FT
35								
40								
45								
50								

H+A_CORE+WELL07-1 HA-LIB09-BOS.GLB HA-TB+CORE+WELL-07-1.GDT G:\43434_NTE ENERGY - KILLINGLY ENERGY CENTER\CONFIDENTIAL\000\GINT\43434-000_TB.GPJ Jun 27, 16

APPENDIX D

Field Permeability Test Results

Appendix D
Summary of Field Hydraulic Conductivitiy Testing
Killingly Eneregy Center
Killingly, Connecticut
Project Number: 43434-000

Location - Test Number	Test Depth (ft)	Soil Stratum	Soil Description	Percent Fines	Test Type	Hydraulic Conductivity (in./hr)
B-01	3.1 to 3.4	glacial till	Light brown coarse to fine gravelly coarse to fine SAND (SM), little silt	20 [2]	Field/Guelph[1.]	0.009
B-04	3.0 to 3.3	glacial till	Brown silty SAND (SM), some gravel	22.0	Field/Guelph[1.]	0.011
B-06	3.1 to 3.4	glacial till	Light brown silty fine SAND (SM), some coarse to fine gravel, little coarse to medium sand	20 [2]	Field/Guelph[1.]	0.053
B-10	3.0 to 3.3	glacial till	Brown silty SAND (SM), trace gravel	43.7	Field/Guelph[1.]	0.061
B-11	3.1 to 3.4	glacial till	Light brown to orange-brown medium to fine SAND (SP), trace coarse sand, gravel	10 [2]	Field/Guelph[1.]	0.017

Notes:
1. Guelph permeameter provides field measurement of the saturated hydraulic conductivity of the soil at the test depth.
2. Visual estimate.
3. A safety factor has not been applied to the hydraulic conductivity values shown above.
The design hydraulic conductivity should incorporate appropriate correction factors to account for site varability and long-term siltation.

APPENDIX E

Field Soil Resistivity Test Results

C
E
G

Providing Support and Service to the Power Industry

Engineering • Consulting • Field Services

One Charlesview Road • Hopedale, MA 01747 • Phone: 508.634.5300 • Fax: 508.634.5400

June 21, 2016

Gary Fuerstenberg
Haley and Aldrich
100 Corporate Place, Suite 205
Rocky Hill CT, 06067

Subject: **Soil Resistivity Measurements at the Killingly Site**

Consulting Engineer Group, Inc. (CEG) was contracted to perform soil resistivity testing for the Killingly Site in Killingly CT.

Attached with the cover letter you will find the individual data sheets for locations E01, E02, and E03. All locations were determined using the site map and stakes that were provided by Haley and Aldrich. At each staked location soil resistivity was tested in accordance with ASTM G 57, and utilizing the Wenner 4-Point method (Figures 1&2).

Three tests were performed using a probe spacing of 4, 8, 12, 16, 20, 30, 40, and 50 feet. Tests were performed at each location in a North-South and East-West directions. Tests were carried out in accordance with the testing procedures established by Haley and Aldrich.

On the data sheets a-spacing (probe spacing), measured resistance in ohms, date, time, air temperature, topography, GPS coordinates, drainage and indications of potential interferences were recorded. Additionally digital photographs were taken at each location. The apparent resistivity was calculated as $\rho=2\pi aR$ and reported in ohm-cm with the a-spacing (probe spacing) measured in feet and resistivity (R) in ohms. An AEMC model 6470 ground tester, calibrated on 1/28/2016, was used.

Should you have any questions or require additional information please give me a call at 508-634-5300xt104.

Sincerely,
Marek Rutkowski
Operation Manager

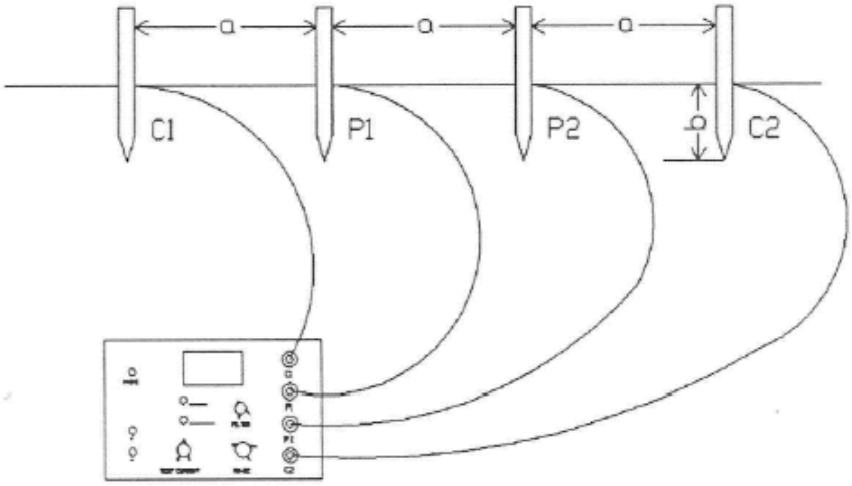


Figure 1 Werner 4 Point Method

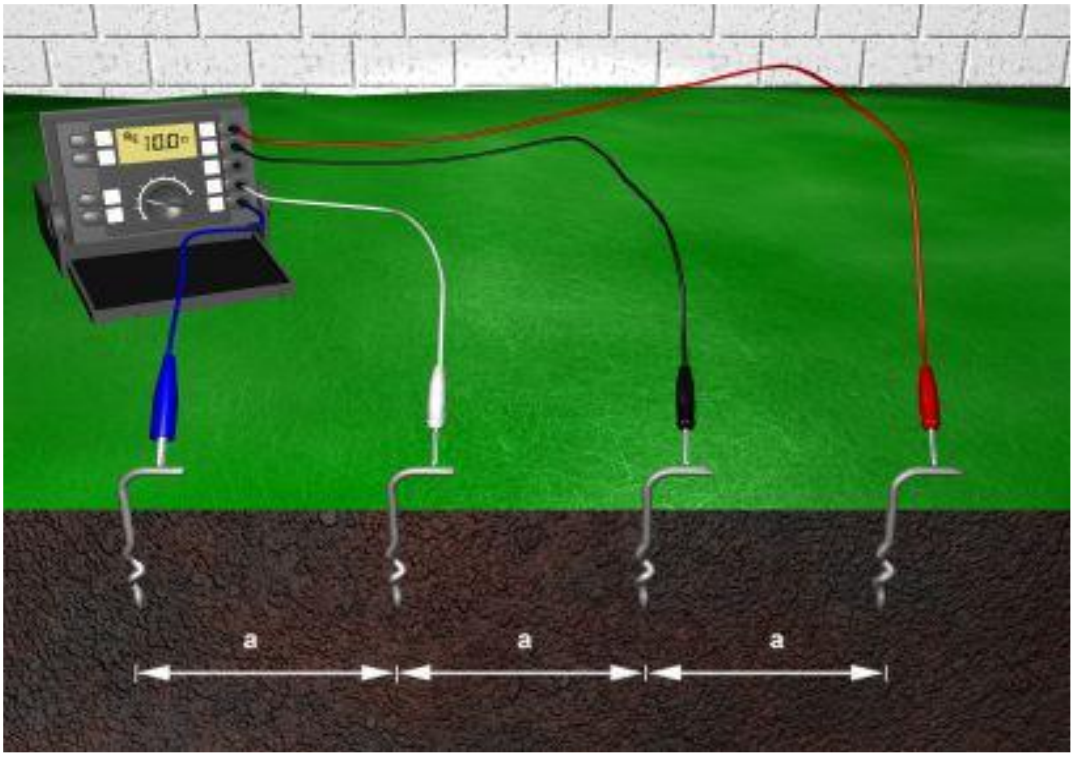


Figure 2 Werner 4 Point Method

CEG

Providing Support and Service to the Power Industry

Engineering / Consulting & Field Services

Wenner 4-Probe Test for Developing Soil Resistivity

Customer: Haley & Aldrich
Address: 100 Corporate Place Rocky Hill CT
Location: 180 & 189 Lake Road, Killingly, Connecticut
Identification: N 41° 51.631'/ W071° 54. 817'
Rain within the last 24 hour period: No
Soil Condition: Loamy
Topography: Flat
Drainage: Good
Indications of Potential Interferences: Small Hill

Date: 5/25/2016
Stake#: E03
Picture#: E03
Tested By: MB/JC
Season Spring
Weather: Sunny
Air Temp: 84°F
Humidity: 50%
Customer Rep.: Gary Fuerstenberg

Probe Depth(ft) (C)	Probe Depth(ft) (P)	Probe Spacing (ft)	C1	P1	P2	C2	Reading (Ohms)	Apparent Resistivity (Ohm-cm)
0.4	0.4	4	6	2	2	6	664	508639.51
0.8	0.8	8	12	4	4	12	355	543876.59
1	1	12	18	6	6	18	186	427441.03
1	1	16	24	8	8	24	108	330922.09
1	1	20	30	10	10	30	67.9	260064.93
1	1	30	45	15	15	45	29.4	168908.15
1	1	40	60	20	20	60	16.7	127925.90
1	1	50	75	25	25	75	11.4	109158.33

Notes: Test was taken in North South direction. AEMC model 6470 ground tester was used Calibrated on 1/28/2016.

CEG

Providing Support and Service to the Power Industry

Engineering / Consulting & Field Services

Wenner 4-Probe Test for Developing Soil Resistivity

Customer: Haley & Aldrich
Address: 100 Corporate Place Rocky Hill CT
Location: 180 & 189 Lake Road, Killingly, Connecticut
Identification: N 41° 51.631'/ W071° 54. 817'
Rain within the last 24 hour period: No
Soil Condition: Loamy
Topography: Flat
Drainage: Good
Indications of Potential Interferences: Small Hill

Date: 5/25/2016
Stake#: E03
Picture#: E03
Tested By: MB/JC
Season Spring
Weather: Sunny
Air Temp: 84°F
Humidity: 50%
Customer Rep.: Gary Fuerstenberg

Probe Depth(ft) (C)	Probe Depth(ft) (P)	Probe Spacing (ft)	C1	P1	P2	C2	Reading (Ohms)	Apparent Resistivity (Ohm-cm)
0.4	0.4	4	6	2	2	6	603	461912.09
0.8	0.8	8	12	4	4	12	326	499447.23
1	1	12	18	6	6	18	177	406758.40
1	1	16	24	8	8	24	104	318665.72
1	1	20	30	10	10	30	64.7	247808.56
1	1	30	45	15	15	45	27.4	157417.80
1	1	40	60	20	20	60	20.9	160098.88
1	1	50	75	25	25	75	10.6	101498.10

Notes: Test was taken in East West direction. AEMC model 6470 ground tester was used Calibrated on 1/28/2016.

CEG

Providing Support and Service to the Power Industry

Engineering / Consulting & Field Services

Wenner 4-Probe Test for Developing Soil Resistivity

Customer: Haley & Aldrich
Address: 100 Corporate Place Rocky Hill CT
Location: 180 & 189 Lake Road, Killingly, Connecticut
Identification: N 41° 51.723'/ W071° 54. 943'
Rain within the last 24 hour period: No
Soil Condition: Loamy/rocky
Topography: Slight incline
Drainage: Good
Indications of Potential Interferences: Rock Wall

Date: 5/25/2016
Stake#: E02
Picture#: E02
Tested By: MB/JC
Season Spring
Weather: Sunny
Air Temp: 70°F
Humidity: 60%
Customer Rep.: Gary Fuerstenberg

Probe Depth(ft) (C)	Probe Depth(ft) (P)	Probe Spacing (ft)	C1	P1	P2	C2	Reading (Ohms)	Apparent Resistivity (Ohm-cm)
0.4	0.4	4	6	2	2	6	580	444293.55
0.8	0.8	8	12	4	4	12	229	350838.70
1	1	12	18	6	6	18	115	264278.06
1	1	16	24	8	8	24	62.8	192425.07
1	1	20	30	10	10	30	57.9	221763.76
1	1	30	45	15	15	45	25.8	148225.52
1	1	40	60	20	20	60	14.2	108775.32
1	1	50	75	25	25	75	9.29	88954.46

Notes: Test was taken in East West direction. AEMC model 6470 ground tester was used Calibrated on 1/28/2016.

CEG

Providing Support and Service to the Power Industry

Engineering / Consulting & Field Services

Wenner 4-Probe Test for Developing Soil Resistivity

Customer: Haley & Aldrich
Address: 100 Corporate Place Rocky Hill CT
Location: 180 & 189 Lake Road, Killingly, Connecticut
Identification: N 41° 51.723'/ W071° 54. 943'
Rain within the last 24 hour period: No
Soil Condition: Loamy/rocky
Topography: Slight incline
Drainage: Good
Indications of Potential Interferences: Rock Wall

Date: 5/25/2016
Stake#: E02
Picture#: E02
Tested By: MB/JC
Season Spring
Weather: Sunny
Air Temp: 70°F
Humidity: 60%
Customer Rep.: Gary Fuerstenberg

Probe Depth(ft) (C)	Probe Depth(ft) (P)	Probe Spacing (ft)	C1	P1	P2	C2	Reading (Ohms)	Apparent Resistivity (Ohm-cm)
0.4	0.4	4	6	2	2	6	491	376117.47
0.8	0.8	8	12	4	4	12	226	346242.56
1	1	12	18	6	6	18	157	360797.00
1	1	16	24	8	8	24	93.3	285879.92
1	1	20	30	10	10	30	66.8	255851.80
1	1	30	45	15	15	45	24.1	138458.72
1	1	40	60	20	20	60	11.9	91156.78
1	1	50	75	25	25	75	7.98	76410.83

Notes: Test was taken in North South direction. AEMC model 6470 ground tester was used Calibrated on 1/28/2016.

CEG

Providing Support and Service to the Power Industry

Engineering / Consulting & Field Services

Wenner 4-Probe Test for Developing Soil Resistivity

Customer: Haley & Aldrich
Address: 100 Corporate Place Rocky Hill CT
Location: 180 & 189 Lake Road, Killingly, Connecticut
Identification: N 41° 51.769'/ W071° 55. 000'
Rain within the last 24 hour period: No
Soil Condition: Loamy/rocky
Topography: Slight incline
Drainage: Good
Indications of Potential Interferences: Large rocks

Date: 5/25/2016
Stake#: E01
Picture#: E01
Tested By: MB/JC
Season Spring
Weather: Sunny
Air Temp: 76°F
Humidity: 60%
Customer Rep.: Gary Fuerstenberg

Probe Depth(ft) (C)	Probe Depth(ft) (P)	Probe Spacing (ft)	C1	P1	P2	C2	Reading (Ohms)	Apparent Resistivity (Ohm-cm)
0.4	0.4	4	6	2	2	6	701	536982.38
0.8	0.8	8	12	4	4	12	415	635799.39
1	1	12	18	6	6	18	259	595200.15
1	1	16	24	8	8	24	198	606690.50
1	1	20	30	10	10	30	151	578347.64
1	1	30	45	15	15	45	86.1	494659.58
1	1	40	60	20	20	60	63.8	488722.90
1	1	50	75	25	25	75	40.1	383969.21

Notes: Test was taken in North South direction. AEMC model 6470 ground tester was used Calibrated on 1/28/2016.

CEG

Providing Support and Service to the Power Industry

Engineering / Consulting & Field Services

Wenner 4-Probe Test for Developing Soil Resistivity

Customer: Haley & Aldrich
Address: 100 Corporate Place Rocky Hill CT
Location: 180 & 189 Lake Road, Killingly, Connecticut
Identification: N 41° 51.769'/ W071° 55. 000'
Rain within the last 24 hour period: No
Soil Condition: Loamy/rocky
Topography: Slight incline
Drainage: Good
Indications of Potential Interferences: Large rocks

Date: 5/25/2016
Stake#: E01
Picture#: E01
Tested By: MB/JC
Season Spring
Weather: Sunny
Air Temp: 76°F
Humidity: 60%
Customer Rep.: Gary Fuerstenberg

Probe Depth(ft) (C)	Probe Depth(ft) (P)	Probe Spacing (ft)	C1	P1	P2	C2	Reading (Ohms)	Apparent Resistivity (Ohm-cm)
0.4	0.4	4	6	2	2	6	649	497149.16
0.8	0.8	8	12	4	4	12	334	511703.60
1	1	12	18	6	6	18	221	507873.49
1	1	16	24	8	8	24	145	444293.55
1	1	20	30	10	10	30	109	417482.73
1	1	30	45	15	15	45	63.2	363095.07
1	1	40	60	20	20	60	37.5	287258.76
1	1	50	75	25	25	75	19.2	183845.61

Notes: Test was taken in East West direction. AEMC model 6470 ground tester was used Calibrated on 1/28/2016.

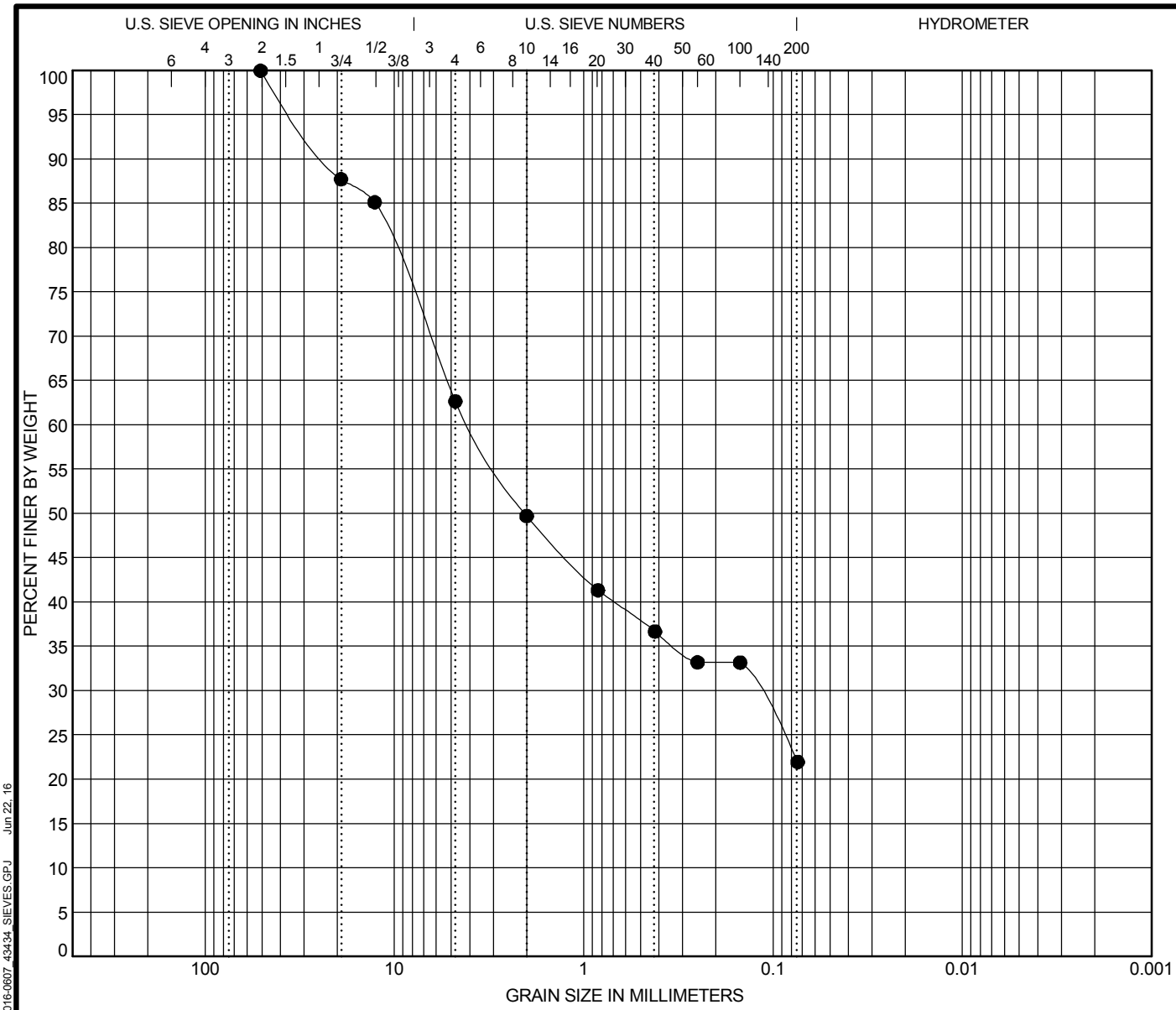
BORING E-01

BORING

BORINGEL-03

APPENDIX F

Geotechnical Laboratory Test Results



	COBBLES	% GRAVEL		% SAND			% FINES	
		COARSE	FINE	COARSE	MEDIUM	FINE	% SILT	% CLAY
●		**12.3**	**25.1**	**13.0**	**13.0**	**14.7**	**22.0**	

	Expl. No.	Sample No.	Depth (ft.)	LL	PL	PI	Water Content (%)	Cc	Cu
●	**B-4**	**S2**	**2-4**				**6.1**		

	Sample Description
●	**Brown silty SAND (SM), some gravel**

Remarks:

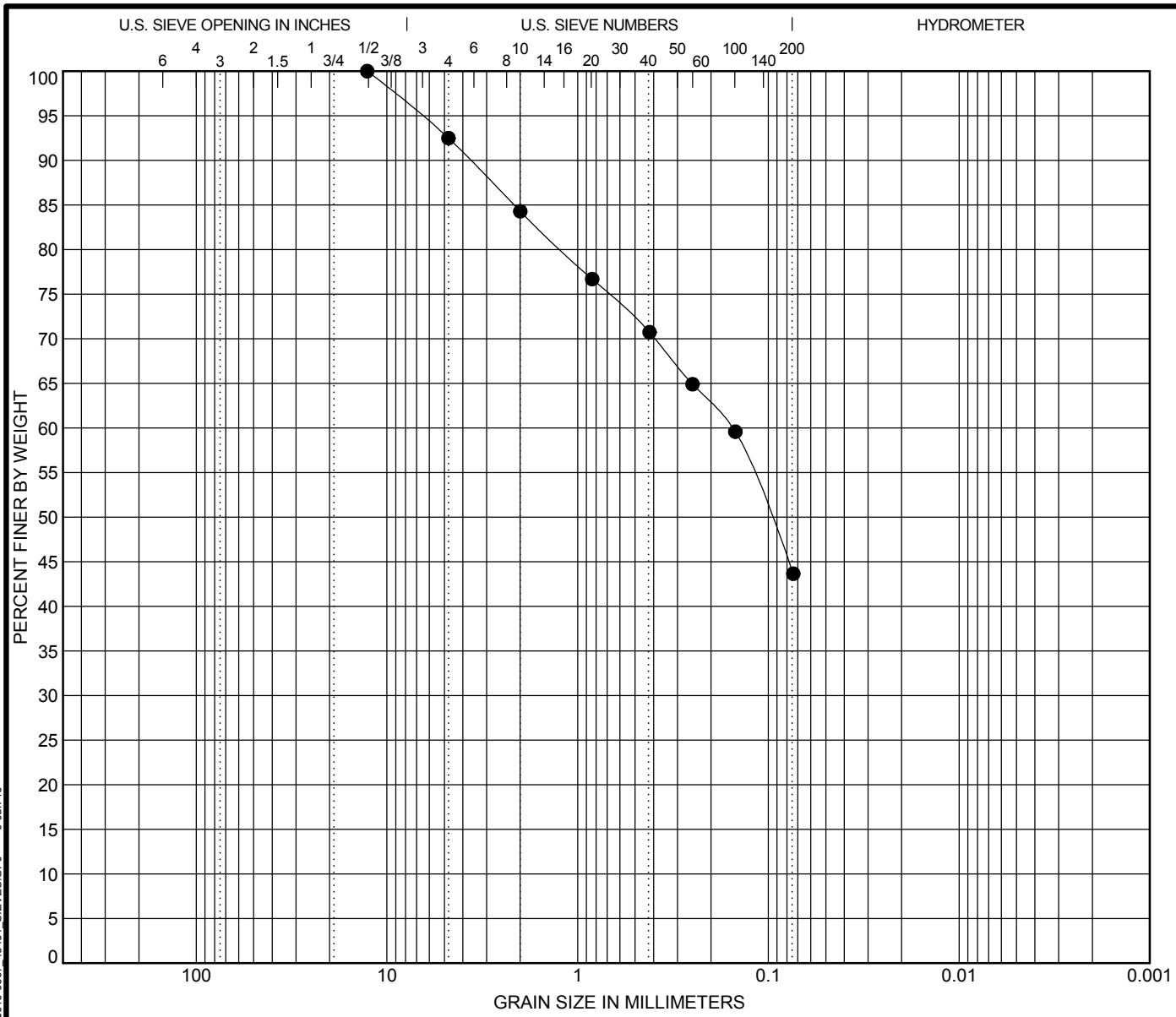
HALEY ALDRICH
Rocky Hill, Connecticut

Killingly Energy Center
Killingly, Connecticut

GRAIN SIZE DISTRIBUTION

Date: 6/8/2016 File No.: 43434-000

H&A SIEVE USCS LABTEMP.GDT G:\43434_NTE ENERGY - KILLINGLY ENERGY CENTER\CONFIDENTIAL\000\GINT\2016-0607_43434_SIEVES.GPJ Jun 22, 16



	COBBLES	% GRAVEL		% SAND			% FINES	
		COARSE	FINE	COARSE	MEDIUM	FINE	% SILT	% CLAY
●		**0.0**	**7.5**	**8.2**	**13.6**	**27.1**	**43.7**	

	Expl. No.	Sample No.	Depth (ft.)	LL	PL	PI	Water Content (%)	Cc	Cu
●	**B-10**	**S2**	**2-4**				**11.13**		

	Sample Description
●	**Brown silty SAND (SM), trace gravel**

Remarks:

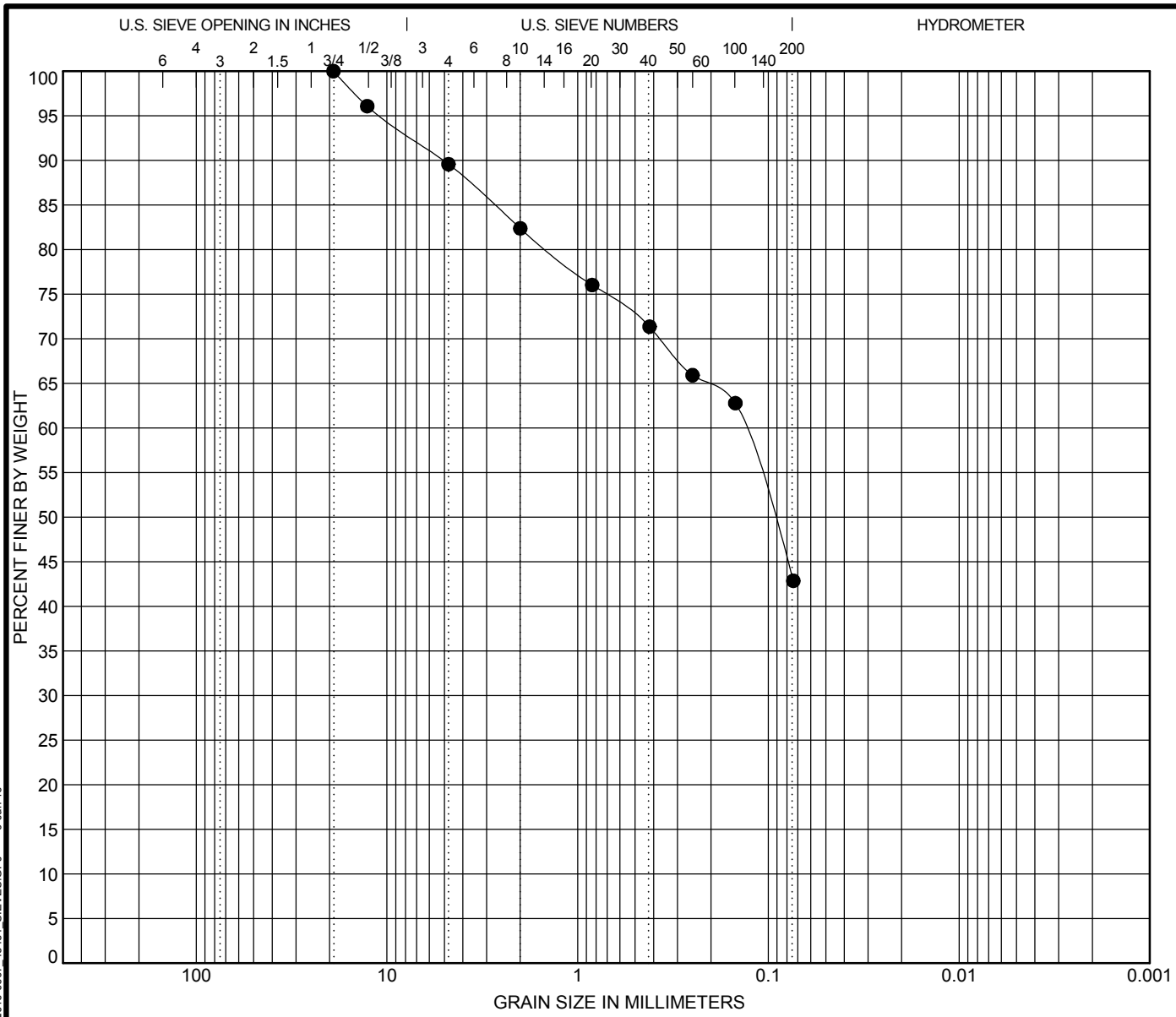
HALEY ALDRICH
Rocky Hill, Connecticut

Killingly Energy Center
Killingly, Connecticut

GRAIN SIZE DISTRIBUTION

Date: 6/8/2016 File No.: 43434-000

H&A SIEVE USCS LABTEMP.GDT G:\43434_NTE ENERGY - KILLINGLY ENERGY CENTER\CONFIDENTIAL\000\GINT\2016-0607_43434_SIEVES.GPJ 9 Jun 16



	COBBLES	% GRAVEL		% SAND			% FINES	
		COARSE	FINE	COARSE	MEDIUM	FINE	% SILT	% CLAY
●		**0.0**	**10.4**	**7.2**	**11.0**	**28.5**	**42.9**	

	Expl. No.	Sample No.	Depth (ft.)	LL	PL	PI	Water Content (%)	Cc	Cu
●	**B-12**	**S4**	**7-9**				**11.24**		

	Sample Description
●	**Light brown silty SAND (SM), little gravel**

Remarks:

HALEY ALDRICH
Rocky Hill, Connecticut

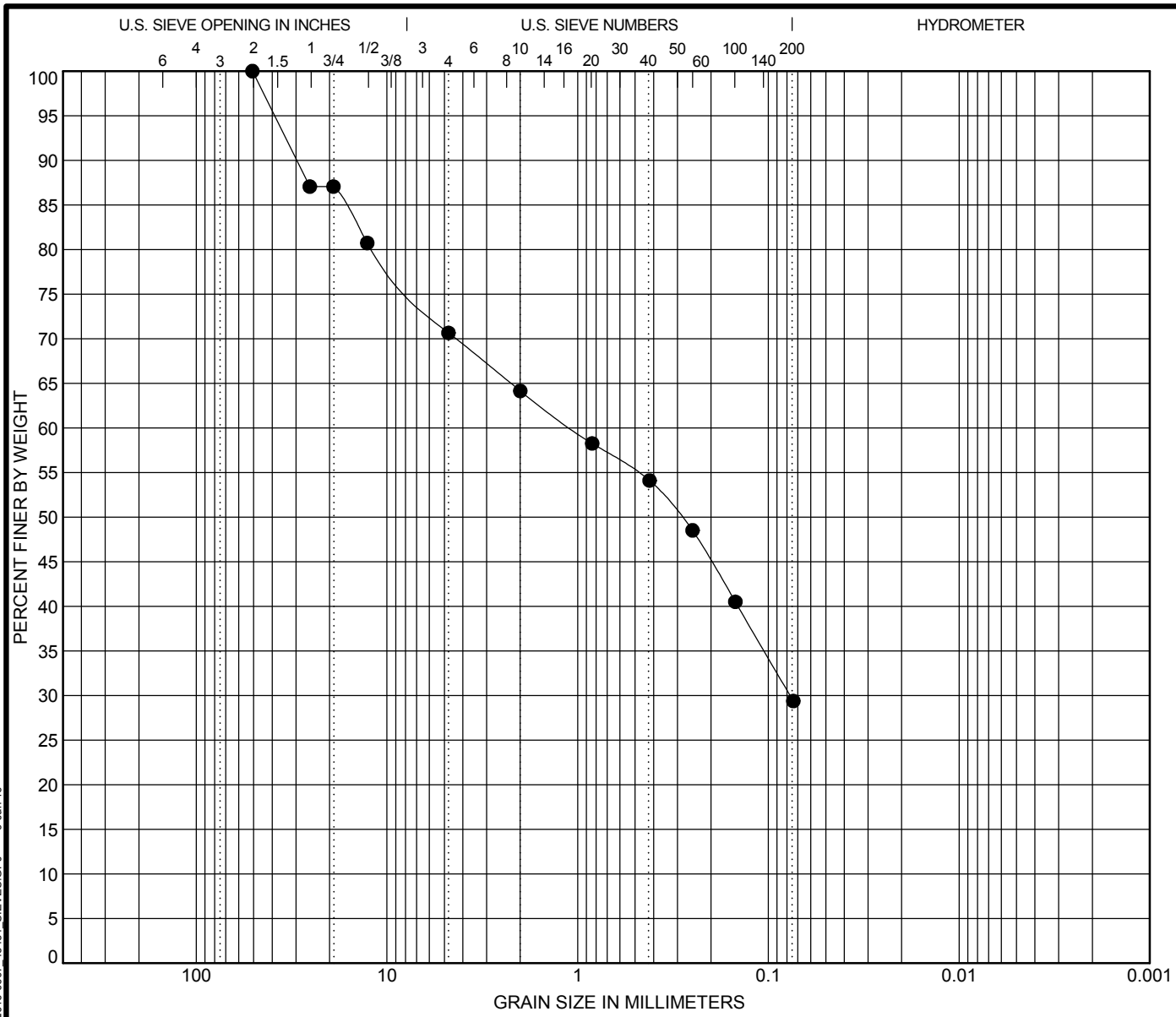
Killingly Energy Center
Killingly, Connecticut

GRAIN SIZE DISTRIBUTION

Date: 6/8/2016

File No.: 43434-000

H&A SIEVE USCS LABTEMP.GDT G:\43434_NTE ENERGY - KILLINGLY ENERGY CENTER\CONFIDENTIAL\000\GINT\2016-0607_43434_SIEVES.GPJ 9 Jun 16



	COBBLES	% GRAVEL		% SAND			% FINES	
		COARSE	FINE	COARSE	MEDIUM	FINE	% SILT	% CLAY
●		**12.9**	**16.4**	**6.5**	**10.0**	**24.7**	**29.4**	

	Expl. No.	Sample No.	Depth (ft.)	LL	PL	PI	Water Content (%)	Cc	Cu
●	**B-13**	**S4**	**7-9**				**8.76**		

	Sample Description
●	**Brown silty SAND (SM), some gravel**

Remarks:

HALEY ALDRICH
Rocky Hill, Connecticut

Killingly Energy Center
Killingly, Connecticut

GRAIN SIZE DISTRIBUTION

Date: 6/8/2016 File No.: 43434-000

H&A SIEVE USCS LABTEMP.GDT G:\43434_NTE ENERGY - KILLINGLY ENERGY CENTER\CONFIDENTIAL\000\GINT\2016-0607_43434_SIEVES.GPJ 9 Jun 16

APPENDIX G

Geochemical Laboratory Test Results

SoilCor
CORROSION & THERMAL SCIENCES
41765 Hawthorn Street Murrieta, CA 92562
ph (951) 894-2682 • fx (951) 894-2683

Work Order No.: 16F1353
Client: Haley & Aldrich
Project No.: 43434-000
Project Name: NTE Energy
Report Date: June 10, 2016

Laboratory Test(s) Results Summary

The subject soil samples were processed with the U.S. Standard No. 10 Sieve and tested per ASTM International Standards for pH (G 51-95 2005), Soil Resistivity (G 57-06), Sulfate Ion Content (D 516-07) and Chloride Ion Content (D 512-10) and in accordance with Standard Methods procedures for Sulfide Content (SM 4500-S2- D) and Oxidation-Reduction Potential (SM 2580 B Mod.). Redox Potential value(s) reflect temperature correction based on Light's standard solution measurements applied to the calculation in section 6 of the procedure. The results follow:

Sample Identification	pH (H+)	As Rec'd Resistivity (ohm-cm)	Saturated Resistivity (ohm-cm)	Sulfate Content (mg/kg)	Chloride Content (mg/L)	Sulfide Content (mg/L)	Redox Potential	
							Eh (mV)	Temp. (°C)
South @ 1' to 5'	7.1	16,000	12,000	80	10	0.67	73	22.6
North @ 1' to 5'	6.1	42,000	15,000	50	10	0.35	284	22.4

*ND=No Detection

We appreciate the opportunity to serve you. Please do not hesitate to contact us with any questions or clarifications regarding these results or procedures.

Ahmet K. Kaya, Laboratory Manager

APPENDIX D – STORMWATER POLLUTION PREVENTION PLAN

STORMWATER POLLUTION PREVENTION PLAN

Prepared for

NTE CONNECTICUT, LLC
LAKE ROAD
KILLINGLY CONNECTICUT

August 2016

Prepared for

Proposed Natural Gas Power Plant

Prepared by

Normand Thibeault Jr., P.E.
CT License #22834

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ATTACHMENTS

Attachment 1 ï USDA-NRCS Soils mapping
Attachment 2 ï CTDEEP Natural Diversity Database Mapping
Attachment 3 - HydroCAD Drainage Calculation Summaries (with drainage area maps)
Attachment 4 - Water Quality Basin Calculations
Attachment 5 ï Temporary Sedimentation Basin Requirements
Attachment 6 ï Sample Stormwater Construction Inspection Report

Grading Plans, Erosion and Sedimentation Control Plans & Details ï Separate Enclosure

1. Site Evaluation, Assessment & Planning

1.1 Project/Site Description

NTE Connecticut, LLC is seeking local and state approvals to develop the Killingly Energy Center (KEC), an approximately 550-MW air-cooled electric generating facility and related electrical interconnection switchyard to be located on an approximately 73-acre site off Lake Road in the Town of Killingly, Connecticut; a natural gas lateral will provide fuel to the Generating Facility. Approximately 63-acre parcel north of Lake Road is the proposed location of the Generating Facility and a 10-acre portion of the property located south of Lake Road is the proposed location of the Switchyard. KEC will be located in an area designated in the Townôs Plan of Conservation and Development for future industrial development in the northern portion of Killingly.

Structural stormwater collection and conveyance systems will be limited to the northern portion of the project with collection from paved surfaces and conveyance to a tiered stormwater detention/infiltration basin. The basin will be comprised of a sediment forebay, wet basin and dry basin with a low level outlet and high level weir overflow. The basin will discharge to a level spreader positioned on flat terrain (3% slope) approximately 60ô from the nearest wetland. The dry basin will also serve to infiltrate treated stormwater into the surrounding soil. The stormwater outlet will be reinforced with riprap outlet protection and the level spreaders outfall will sheet flow overland through natural vegetation. Conveyance of stormwater from the switchyard (southern portion of the site) will be via sheet flow over a crushed stone surface.

Where ever possible, sheet flow and overland discharge from pervious surfaces is incorporated into the design with limited storm drain installation and the construction of shallow depressions within the landscape to encourage infiltration and the preservation of natural terrain and ground cover adjacent to wetland resource areas Also, in accordance with the State of Connecticut 2004 Water Quality Guideline recommendations, stormwater runoff from impervious areas will be treated for water quality prior to discharge to the wetland resource areas.

1.2 Contact Information – Responsible Parties

Operator(s):

NTE Connecticut, LLC
24 Cathedral Place, Suite 300
St. Augustine, Florida

SWPPP Contact(s):

NTE Connecticut, LLC
24 Cathedral Place, Suite 300
St. Augustine, Florida
Mark Mirabito
904-687-1857

Killingly Engineering Associates
114 Westcott Road
P.O. Box 421, Dayville, CT
Normand Thibeault, Jr, P.E.
SWPPP Preparation
(860) 779-7299

SWPPP Preparation Date:

July 2016

Estimated Project Dates:

Project Start Date: Summer 2017
Project Completion Date: Spring/Summer 2020

Site Center Location:

Lake Road, Killingly, CT

N 875,990 E 1,227,084

1.3 Soils

According to the USDA-NRCS Web Soil Survey, the site consists of the following soils:

- Ridgebury, Leicester and Whitman soils - map unit 3;
- Walpole sandy loam ï map unit 13;
- Ninigret and Tisbury soils ï map unit 21;
- Hinckley loamy sand ï map unit 38;
- Sutton fine sandy loam ï map unit 52;
- Gloucester gravelly sandy loam ï map unit 58;
- Canton & Charlton soils ï map units 31 & 62;
- Charlton-Chatfield complex ï map unit 73;
- Hollis-Chatfield-rock outcrop ï map unit 75;

The presence of these soil series and soil mapping units were verified in the field by the project soil scientist in the course of delineating regulated wetlands and watercourses.

The bulk of the land disturbance and development will be conducted in areas shown as Canton and Charlton soils. These soils are well drained and stony but suitable for land development projects. For specific soil descriptions, please refer to the NRCS Web Soil Survey mapping provided as Attachment 1.

1.4 Existing Conditions

The site consists of approximately 73-acres and is located on the northern and southern sides of Lake Road. The site is divided by Lake Road that runs essentially in a northeast-southwest direction. The eastern 10.099-acre property where the switchyard will be constructed is wooded at the higher elevation on the southwestern end, and drains down gradient to the north and east toward an existing agricultural field and ultimately to a wetland system adjacent to the Connecticut Light and Power right of way. The larger northern portion of the property drains predominantly to the north to a large centrally located wetland system. This system flows off site to the northwest to a small depression shown on FEMA mapping as flood zone ñAò (flood elevation undetermined). This area is more than 40ô lower in elevation than the proposed development.

The existing drainage area to these wetlands is approximately 45 acres. The Quinebaug River is located further to the north and west from the proposed development; the project will not result in any direct stormwater discharge to the Quinnebaug River. A small western and northwestern section of the site separated from the bulk of the site by a prominent ridgeline, drains directly to the Quinebuag River via a seasonal watercourse.

The bulk of the area slated for development has been historically utilized for activities associated with agricultural purposes. Numerous on-site fam dump areas were identified adjacent to wetland resource areas. These on-site disposal areas are not uncommon to the area or with agricultural activities and contain household wastes (bottles & cans), paper and cardboard, appliances, and automobile and farm equipment parts.

The following statements can be made regarding the project:

- The project is not located within the Coastal Boundary and therefore a coastal site plan approval in accordance with Sections 22a-92 and 22a-93(15) of the Connecticut General Statutes is not required.
- The project is not located within an aquifer protection area. Statewide aquifer protection mapping available from the CTDEEP website http://cteco.uconn.edu/map_catalog/maps/state/stateAPA.pdf shows no aquifer protection areas in the area of the development.
- There will not be any direct stormwater discharge to the Quinebaug River. The nearest point of disturbance will be greater than 1000ô from the river and is protected by conservation land and higher terrain.
- Plan review certification will be provided by a qualified professional engineer.
- No direct wetland impacts are proposed on the northern portion of the project.

1.5 Proposed Conditions

Development on the northern side of Lake Road for the generating facility will result in the disturbance of approximately 24 acres of land (including construction laydown) and will require some significant grading to create a usable surface. Slopes throughout the site of the generating facility will be approximately 2% and surfaces will be comprised predominantly of pervious materials. Of the 24-acre disturbance on the north side of Lake Road, only 2.1 acres of paved surfaces are proposed and additional 4.3 acres of building and impervious surface for a fuel containment area; a total of 6.5 acres. The fuel containment area will be a bermed enclosure with an impervious liner. Drainage from this enclosure will be via a drainage structure with a manually gated outlet. No stormwater will be released from this area without a visual inspection after the end of a rain event.

The site does not and will not discharge directly to a perennial surface water body (the Quinebaug River). The single discharge from the proposed detention basin has been designed to drain adjacent to on-site wetlands. The discharge has been designed with the appropriate outlet protection and/or treatment in accordance with the state stormwater quality guidelines. After the discharge point, extended overland sheet flow is incorporated into the design prior to discharge to existing on-site wetlands.

Development on the south side of Lake Road for the switchyard will result in the disturbance of approximately 4 acres of land with a direct wetland impact of approximately 12,500 square feet. Again, this disturbance includes the construction laydown area. Grading at the south-southwest portion of the site will be minimized with the construction of a retaining wall and grades across the switchyard will be less than 3%. Total impervious surface around the perimeter of the switchyard will be 15,600 square feet. The remainder of the switchyard surface will be comprised of a crushed stone surface. In order to offset for the loss of wetlands, the eastern agricultural field adjacent to the switchyard will be mitigated in return at the completion of construction. Wetland replication shall take place within a portion of the agricultural field, adjacent to existing

wetland areas. This shall take place at the completion of construction and staging activities.

The drainage design and water quality mechanisms have been designed in accordance with the State of Connecticut 2004 Stormwater Quality Manual. Construction erosion and sedimentation control mechanisms follow the recommendations of the 2002 Connecticut Guidelines for soil erosion and sediment control.

1.6 Potential Sources of Pollution

Sources of water pollution on construction sites include: diesel and oil; paint, solvents, cleaners and other chemicals; and construction debris and dirt. When land is cleared it creates the potential for soil erosion which may lead to silt-bearing run-off, wind-blown soils and sediment, and sediment erosion into resource areas. Silt and soil that runs into natural waterways may turn them turbid, which ultimately restricts sunlight filtration and may affect aquatic life. The erosion and sedimentation controls during construction and water quality treatments designed for post construction assure that resource areas will not be detrimentally impacted by this project.

1.7 Endangered, Protected or Species of Concern

Reference to the June 2016 Natural Diversity Database Mapping shows the property may be subject to known listed species. The construction activity will not threaten the continued existence of any species listed pursuant to section 26-306 of the Connecticut General Statutes as endangered or threatened and will not result in the destruction or adverse modification of habitat designated as essential to such species (see Appendix A).

1.8 Historic Preservation

Phase I and Phase II Archeological investigations were conducted on site. Any areas of archeological sensitivity or concern as identified by the SHPO will be preserved.

2. Erosion & Sedimentation Control BMP's

Detailed Erosion and Sedimentation control measures have been outlined on the plans and are in accordance with the 2002 Guidelines.

2.1 Minimize Disturbed Areas and Protect Natural Features

The primary function of erosion and sediment controls is to absorb erosional energies and reduce runoff velocities that force the detachment and transport of soil and/or encourage the deposition of eroded soil particles before they reach any sensitive area.

2.1.1 Keep Land Disturbance Minimized

The more land that is in vegetative cover, the more surface water will infiltrate into the soil, thus minimizing stormwater runoff and potential erosion. Keeping land disturbance to a minimum not only involves minimizing the extent of exposure at any one time, but also the duration of exposure. Phasing, sequencing and construction scheduling are interrelated. Phasing divides a large project into distinct sections where construction work over a specific area occurs over distinct periods of time and each phase is not dependent upon a subsequent phase in order to be functional. A sequence is the order in which construction activities are to occur during any particular phase. A sequence should be developed on the premise of "first things first" and "last things last" with proper attention given to the inclusion of adequate erosion and sediment control measures. A construction schedule is a sequence with time lines applied to it and should address the potential overlap of actions in a sequence which may be in conflict with each other.

- Limit areas of clearing and grading. Protect natural vegetation from construction equipment with fencing, tree armoring, and retaining walls or tree wells.
- Route traffic patterns within the site to avoid existing or newly planted vegetation.
- Phase construction so that areas which are actively being developed at any one time are minimized and only that area under construction is exposed. Clear only those areas essential for construction.
- Sequence the construction of storm drainage systems so that they are operational as soon as possible during construction. Ensure outlets are stable before conveying storm drainage flow into them.
- Schedule construction so that final grading and stabilization is completed as soon as possible.

2.2 Phase Construction Activities

The project will disturb a total of approximately 25 acres over the duration of the construction (generation facility and switchyard). This disturbance consists of grading to create minimally sloped areas for site facilities and buildings, access roadway, facilities building, support buildings and parking. The clearing and grading activities will commence prior to any buildings or infrastructure with all required tree removal conducted as a single phase. Site work will be done per the sequence outlined on the design plans and as listed below. All construction will be conducted in accordance with the 2002 CTDEEP Guidelines for Soil Erosion and Sediment Control (the Guidelinesò). The construction will generally proceed as follows:

1. Flag the limits of construction disturbance necessary to facilitate the pre-construction meeting.
2. Contact Call Before You Dig at 1-800-922-4455 to mark out existing utilities.
3. Hold the pre-construction meeting.

4. Install the anti-tracking construction entrance.
5. Cut trees within the defined clearing limits and remove cut wood. Chip brush, branches and small trees and stockpile chips for use on site for erosion and sedimentation control.
6. Install perimeter erosion and sedimentation controls.
7. Remove stumps and transport off site. No stumps shall be buried on site.
8. Remove topsoil and grade construction staging and laydown area. Install crushed stone or rolled gravel surface and grade to provide positive drainage to perimeter of laydown area. Construct temporary sediment basin and install perimeter erosion controls in accordance with plans.
9. Strip and stockpile topsoil within the footprint of the construction phase area. Install perimeter erosion and sedimentation controls around stockpiles.
10. Make required cuts and fills and construct proposed retaining walls as fills are being placed adjacent to wetlands area and as cuts are made for the switchyard. Required rock blasting shall be conducted in accordance with Section 3.6 of this Plan and with applicable state and local regulations.
11. Establish the subgrade for topsoil areas, buildings, perimeter roadway and parking areas. Bench buildings to a subgrade and allow for sufficient area around building footprints for construction activities.
12. Begin building and equipment construction.
13. Install surface water controls such as temporary sedimentation basins, diversions, and stone or wood chip dikes and insure that discharge locations are stable. Engineer shall evaluate unstable conditions for recommended alternatives prior to installing surface controls.
14. Construct Stormwater basin, outlet and outlet protection and utilize basin as a temporary sedimentation basin during construction. Plug low level outlet until all areas on site have been stabilized and basin vegetation is established.
15. Install all utilities and drainage systems to within 5ô of the buildings and facilities or as modified by the site engineer for specific site conditions.
16. Prepare sub-base, slopes, parking areas, shoulder areas, access roads and any additional areas of disturbance for final grading.
17. Install topsoil on fill and cut slopes, seed disturbed areas and install erosion control fabric to protect against runoff erosion or raindrop impact.
18. Install and compact processed aggregate for pavement areas.
19. Install crushed stone surfaces where call for on the design plans.
20. Place remaining topsoil where required and complete perimeter landscaping. Fine grade, rake, seed and mulch to within 2ô of curbs or paved areas.
21. Upon substantial completion of the building(s) and plant equipment areas, complete the balance of the site work and stabilization of remaining disturbed areas. Install first course of paving.
22. When all other work has been completed, repair and sweep all paved areas for final course of paving. Inspect drainage system and stormwater basin and remove accumulated sediment.
23. Install final course of pavement and unplug low level outlet from stormwater basin.

24. After site is stabilized, remove all erosion and sedimentation controls such as geotextile silt fence. Stone or wood chip berms may be left in place upon the completion of construction.
25. With the exception of blasting, sequence is essentially repeated for both sides of Lake Road.

2.3 Control Stormwater Flowing onto and Through the Project

2.3 .1 Slow the Flow

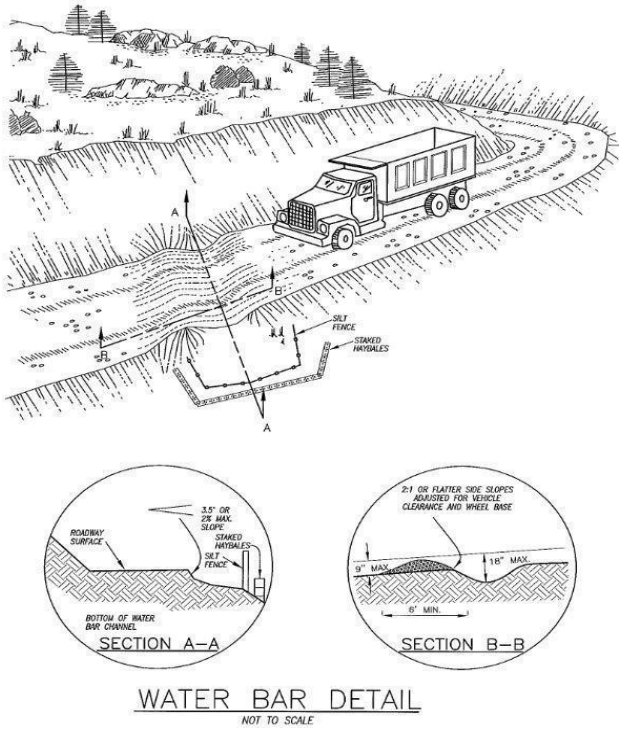
Detachment and transport of eroded soil must be kept to a minimum by absorbing and reducing the erosive energy of water. The erosive energy of water increases as the volume and velocity of runoff increases. The volume and velocity of runoff increases during development as a result of reduced infiltration rates caused by the removal of existing vegetation, removal of topsoil, compaction of soil and the construction of impervious surfaces.

- Use diversions, stone dikes, silt fences and similar measures to break flow lines and dissipate storm water energy.
- Avoid diverting one drainage system into another without evaluating the potential for downstream flooding or erosion.

2.3.2 Keep Clean Runoff Separated

Clean runoff should be kept separated from sediment laden water and should not be directed over disturbed areas without additional controls. Additionally, prevent the mixing of clean off-site generated runoff with sediment laden runoff generated on-site until after adequate filtration of on-site waters has occurred.

- Segregate construction waters from clean water.
- Divert site runoff to keep it isolated from wetlands, watercourses and drainage ways that flow through or near the development until the sediment in that runoff is trapped or detained.



2.4 Preserve & Stabilize Soils

The preserved areas of existing vegetation, as identified on the site plans, will be flagged in the field prior to clearing. Vehicles and equipment will be kept away from these areas. Topsoil stripped from the immediate construction area will be stockpiled as identified on the site plans. The stockpiles will be in areas that will not interfere with construction phases and at least 15 feet away from areas of concentrated flows or pavement. The slopes of the stockpiles will not exceed 2:1 to prevent erosion. A silt fence or wood chip berm will be installed around the perimeter of each stockpile immediately upon formation. Stockpiles that will stand for more than 30 days will be stabilized with temporary seeding PER Figure TS-2.

- Topsoiling including the stripping and reapplication of topsoil to promote the growth of vegetation following establishment of final grades. Distribute topsoil evenly to a minimum depth of 4ò.
- Land Grading Restrictions such as minimizing slope lengths, reverse benches for slopes exceeding 15ô in height, and compacting cuts and fills to reduce erosion for establishment of a stable slope.
- Provide Surface Roughening with tracked machinery up and down slopes to create horizontal depressions in the soil.

Figure TS-2 Temporary Seeding Rates and Dates

Species[4]	Seeding Rates (pounds) /Acre	Seeding Rates (pounds) /1000 sq. ft.	Optimum Seed Depth[2] (inches)	Optimum Seeding Dates[1] 3/1	3/15	4/1	4/15	5/1	5/15	6/1	6/15	7/1	7/15	8/1	8/15	9/1	9/15	10/1	10/15	Plant Characteristics
Annual ryegrass Lolium multiflorum	40	1.0	0.5			■	■	■	■	■	■				■	■	■	■	■	May be added in mixes. Will mow out of most stands
Perennial ryegrass Lolium perenne	40	1.0	0.5				■	■	■	■	■	■			■	■	■	■	■	Use for winter cover. Tolerates cold and low moisture.
Winter Rye Secale cereale	120	3.0	1.0						■	■	■	■				■	■	■	■	Quick germination and heavy spring growth. Dies back in June with little regrowth.
Oats Avena sativa	86	2.0	1.0			■	■	■	■	■	■				■	■	■			In northern CT. will winter kill with the first killing frost and may throughout the state in severe winters.
Winter Wheat Triticum aestivum	120	3.0	1.0						■	■	■	■				■	■	■	■	Quick germination with moderate growth. Dies back in June with no regrowth.
Millet Echinochloa crusgalli	20	0.5	1.0								■	■	■							Warm season small grain. Dies with frost in September.
Sudangrass Sorghum sudanense	30	0.7	1.0								■	■	■							Tolerates warm temperatures and droughty conditions.
Buckwheat Fagopyrum esculentum	15	0.4	1.0				■	■	■	■	■	■	■	■	■	■				Hardy plant that will reseed itself and is good as a green manure crop.
Weeping lovegrass Eragostis curbula	5	0.2	0.25								■	■	■							Warm-season perennial. May bunch. Tolerates hot, dry slopes, acid infertile soils. Excellent nurse crop. Usually winter kills.
DOT All Purpose Mix[3]	150	3.4	0.5			■	■	■	■	■						■	■	■		Suitable for all conditions.

[1] May be planted throughout summer if soil moisture is adequate or can be irrigated. Fall seeding may be extended 15 days in the coastal towns.

[2] Seed at twice the indicated depth for sandy soils.

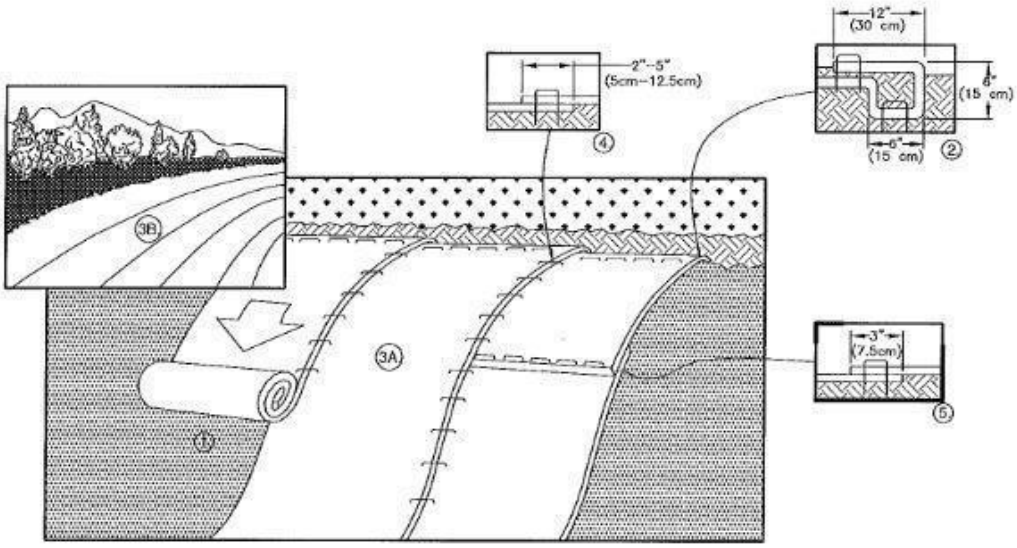
[3] See Permanent Seeding **Figure PS-3** for seeding mixture requirements.

[4] Listed species may be used in combinations to obtain a broader time spectrum. If used in combinations, reduce each species planting rate by 20% of that listed.

2.5 Protect Slopes

Provide erosion control blanketing/turf reinforcement Mats on slopes greater than 3:1.

Geotextile erosion control blankets or jute netting will be used to provide stabilization for slopes. The blanket will cover the entire area of the graded slopes which will be seeded and mulched before the blanket is applied. The blanket will be installed by digging a small trench on the upside of the slope, 12 inches wide by 6 inches deep, and stapling the leading edge of the blanket in the trench. The blanket will be rolled down the slope slowly to maintain soil contact and stapled in 12-inch intervals. If the blanket cannot cover the entire slope, the blankets will be overlapped (minimum of 2 inches) and stapled at the overlapped edge. The erosion control blanket will always be installed according to the manufacturerôs instructions and specifications.



1. PREPARE SOIL BEFORE INSTALLING BLANKETS, INCLUDING ANY NECESSARY APPLICATION OF LIME, FERTILIZER, AND SEED. NOTE: WHEN USING CELL-O-SEED DO NOT SEED PREPARED AREA. CELL-O-SEED MUST BE INSTALLED WITH PAPER SIDE DOWN.
2. BEGIN AT THE TOP OF THE SLOPE BY ANCHORING THE BLANKET IN A 6" (15cm) DEEP X 6" (15cm) WIDE TRENCH WITH APPROXIMATELY 12" (30cm) OF BLANKET EXTENDED BEYOND THE UP-SLOPE PORTION OF THE TRENCH. ANCHOR THE BLANKET WITH A ROW OF STAPLES/STAKES APPROXIMATELY 12" (30cm) APART IN THE BOTTOM OF THE TRENCH. BACKFILL AND COMPACT THE TRENCH AFTER STAPLING. APPLY SEED TO COMPACTED SOIL AND FOLD REMAINING 12" (30cm) PORTION OF BLANKET BACK OVER SEED AND COMPACTED SOIL. SECURE BLANKET OVER COMPACTED SOIL WITH A ROW OF STAPLES/STAKES SPACED APPROXIMATELY 12" (30cm) APART ACROSS THE WIDTH OF THE BLANKET.
3. ROLL THE BLANKETS (A.) DOWN OR (B.) HORIZONTALLY ACROSS THE SLOPE. BLANKETS WILL UNROLL WITH APPROPRIATE SIDE AGAINST THE SOIL SURFACE. ALL BLANKETS MUST BE SECURELY FASTENED TO SOIL SURFACE BY PLACING STAPLES/STAKES IN APPROPRIATE LOCATIONS AS SHOWN IN THE STAPLE PATTERN GUIDE. WHEN USING OPTIONAL DOT SYSTEM™, STAPLES/STAKES SHOULD BE PLACED THROUGH EACH OF THE COLORED DOTS CORRESPONDING TO THE APPROPRIATE STAPLE PATTERN.
4. THE EDGES OF PARALLEL BLANKETS MUST BE STAPLED WITH APPROXIMATELY 2"-5" (5cm-12.5cm) OVERLAP DEPENDING ON BLANKET TYPE. TO ENSURE PROPER SEAM ALIGNMENT, PLACE THE EDGE OF THE OVERLAPPING BLANKET (BLANKET BEING INSTALLED ON TOP) EVEN WITH THE COLORED SEAM STITCH™ ON THE PREVIOUSLY INSTALLED BLANKET.
5. CONSECUTIVE BLANKETS SPLICED DOWN THE SLOPE MUST BE PLACED END OVER END (SHINGLE STYLE) WITH AN APPROXIMATE 3" (7.5cm) OVERLAP. STAPLE THROUGH OVERLAPPED AREA, APPROXIMATELY 12" (30cm) APART ACROSS ENTIRE BLANKET WIDTH.

NOTES:

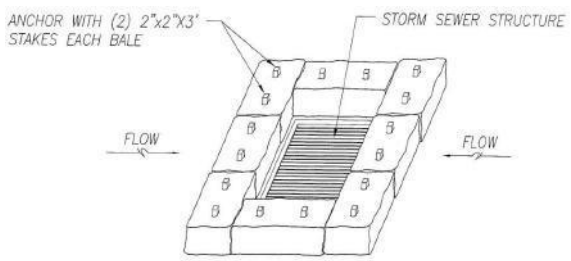
1. IN LOOSE SOIL CONDITIONS, THE USE OF STAPLE OR STAKE LENGTHS GREATER THAN 6" (15cm) MAY BE NECESSARY TO PROPERLY SECURE THE BLANKETS.
2. TURF REINFORCEMENT MAT SHALL BE NORTH AMERICAN GREEN P-300® OR APPROVED EQUIVALENT.

TURF REINFORCEMENT MAT INSTALLATION

NOT TO SCALE

2.6 Protect Storm Drain Inlets

Storm drains may be protected from sediment by installation of staked haybales prior to paving. After the first course of pavement has been installed, silt socks or sacks, crushed stone berms or stone filled geotextile may be used.

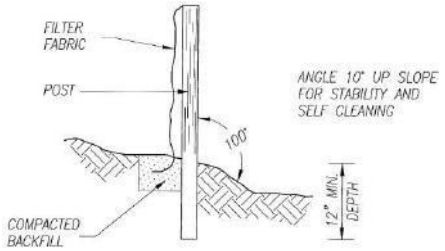


HAYBALE INSTALLATION AT CATCH BASIN

2.7 Establish Perimeter Controls & Sediment Barriers

While it may seem less complicated to collect all waters to one point of discharge for treatment and just install a perimeter control, it can be more effective to apply internal controls to many small sub-drainage basins within the site. By reducing sediment loading from within the site, the chance of perimeter control failure and the potential off-site damage that it can cause is reduced. It is generally more costly to correct off-site damage than it is to install proper internal controls.

- Control erosion and sedimentation in the smallest drainage area possible. It is easier to control erosion than to contend with sediment after it has been carried downstream and deposited in unwanted areas.
- Direct runoff from small disturbed areas to adjoining undisturbed vegetated areas to reduce the potential for concentrated flows and increase settlement and filtering of sediments.
- Concentrated runoff from development should be safely conveyed to stable outlets using rip rapped channels, waterways, diversions, storm drains or similar measures.
- Determine the need for sediment basins. Sediment basins are required on larger developments where major grading is planned and where it is impossible or impractical to control erosion at the source. Sediment basins are needed on large and small sites when sensitive areas such as wetlands, watercourses, and streets would be impacted by off-site sediment deposition. Do not locate sediment basins in wetlands or permanent or intermittent watercourses. Sediment basins should be located to intercept runoff prior to its entry into the wetland or watercourse.

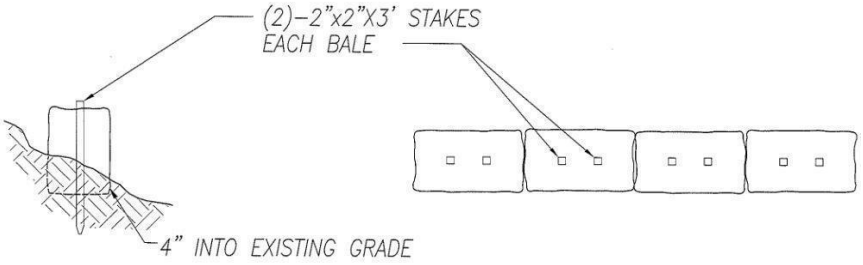


SILT FENCE

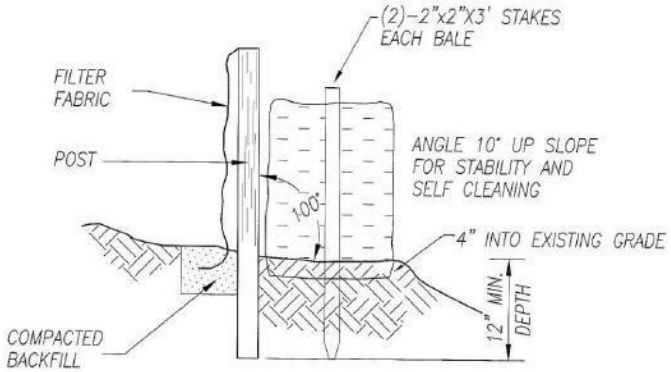
NOT TO SCALE

The silt fence barrier will be installed by excavating a 6-inch-deep trench. Wooden posts supporting the silt fence will be spaced 2 to 3 feet apart and driven securely into the ground; a minimum of 18 to 20 inches deep. The bottom edge of the silt fence will extend across the bottom of the trench and the trench will be backfilled and compacted to prevent stormwater and sediment from discharging underneath the silt fence.

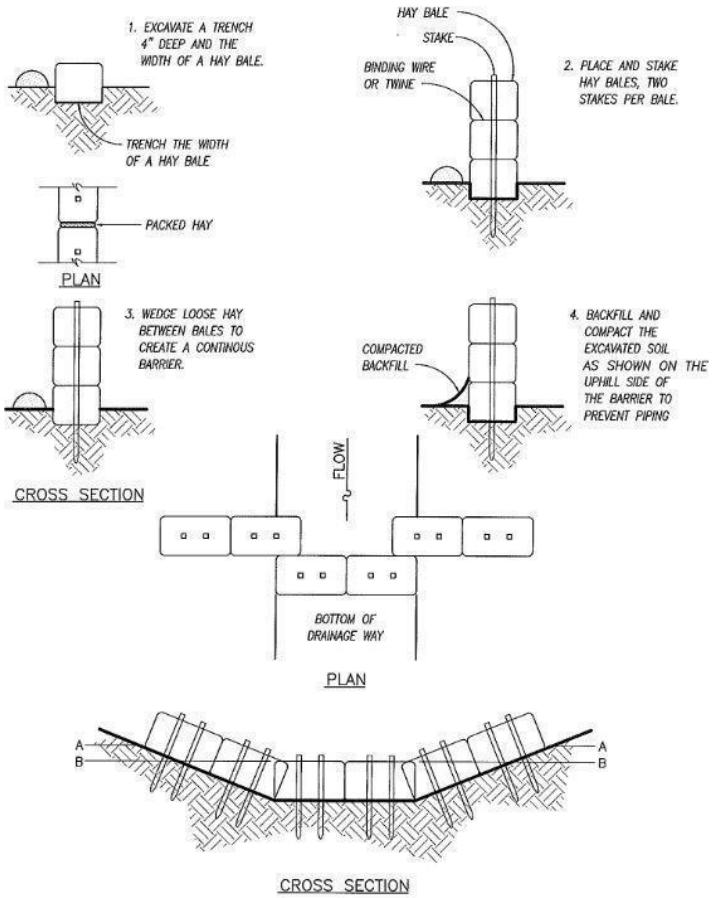
Hay bales may be utilized in lieu of silt fencing or as backing for silt fence in areas of excessive or problematic erosion. Bales may also be utilized as check dams in temporary swales or as protection around catch basins prior to paving.



HAYBALE BARRIER



SILT FENCE – BACKED WITH HAYBALES



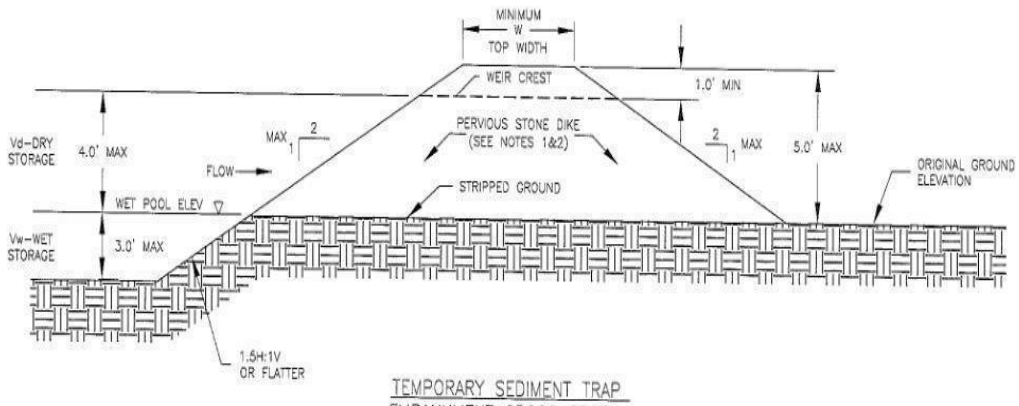
HAYBALE CHECK DAM

NOT TO SCALE

2.8 Construct Temporary Sediment Basins & Diversion Channels

Temporary Sediment Basins are designed and installed to intercept and retain sediment during construction. They prevent erosion and sediment near the source and reduce and/or abate water body impacts, prevent deposition of sediment into undeveloped or undisturbed areas. Basins should be constructed with controlled outlets and designed to have wet and dry storage capacities. Basins may be created by constructing a dam to trap and impound surface water (an embankment basin) or by excavation (an excavated sediment basin), or a combination of both. Method of construction shall be as shown in the detail below and in the locations shown on the design plans.

Diversion channels are constructed with a berm of tamped or compacted soil placed in a manner to divert runoff flows. They are typically constructed to divert sediment laden soils from disturbed areas to temporary sediment basins or to divert clean runoff away from disturbed areas of 25 acres or less. Refer to Figure TD-1 from the 2002 Guidelines. For diversions with slopes of greater than 2%, the necessity for stabilization of the channel should be evaluated (e.g. temporary seeding, riprap, erosion control blankets). For these channels, stone or wood chip check dams should be installed at every 2ô of grade change to slow and filter sediment laden stormwater.



TEMPORARY SEDIMENT TRAP
EMBANKMENT CROSS SECTION
NOT TO SCALE

TOP WIDTH VS. HEIGHT

H = HEIGHT OF EMBANKMENT
W= TOP WIDTH OF EMBANKMENT

H(ft)	W(ft)
1.5	2.0
2.0	2.0
2.5	2.5
3.0	2.5
3.5	3.0
4.0	3.0
4.5	4.0
5.0	4.5

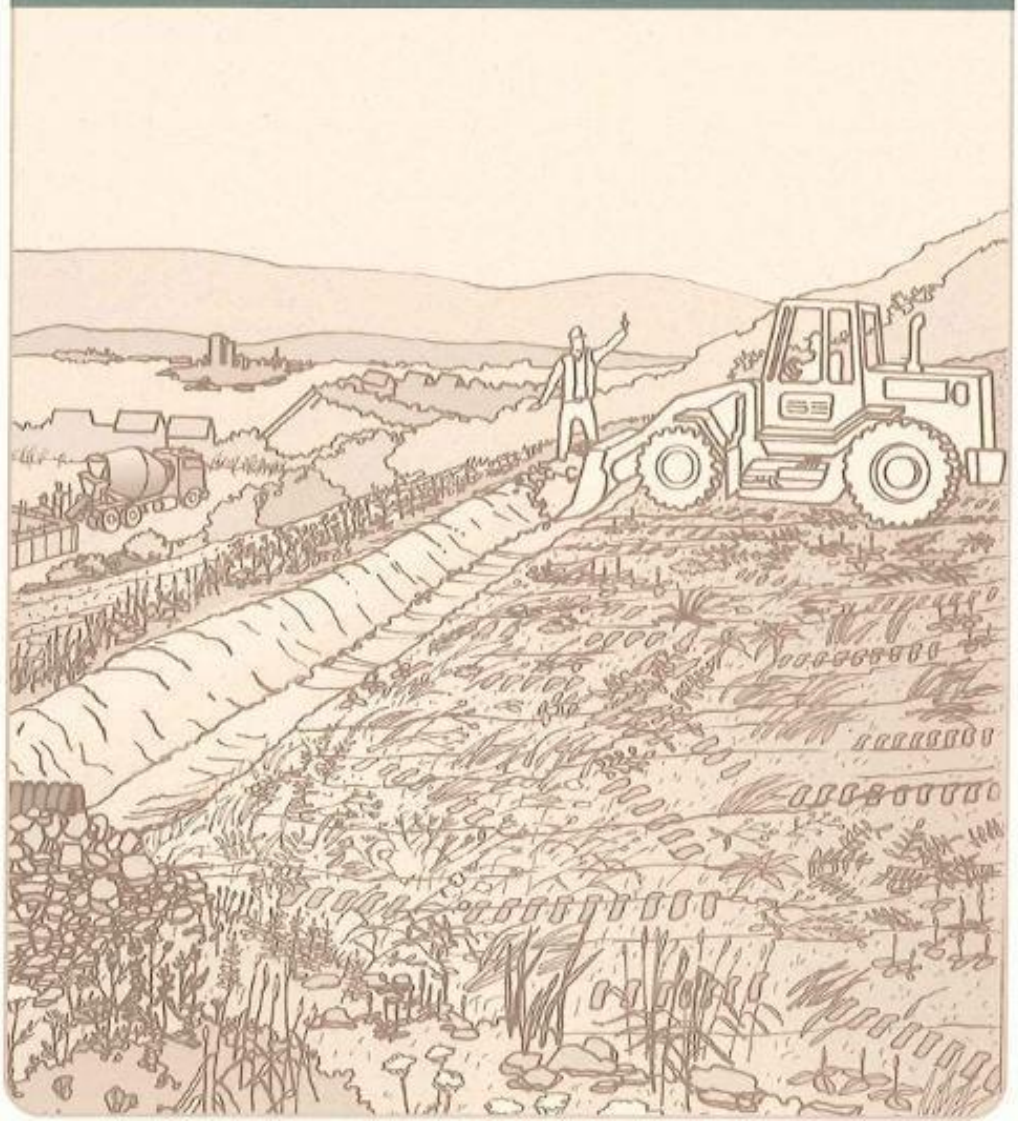
NOTES:

1. ALL CONSTRUCTION AND MATERIALS SHALL BE IN ACCORDANCE WITH THE 2002 CONNECTICUT GUIDELINES FOR SOIL AND EROSION CONTROL, SECTIONS 5-11-25 THRU 5-11-29.
2. PERVIOUS STONE DIKE SHALL BE CONSTRUCTED OF MODIFIED RIPRAP (CTDOT M.12.02) WITH #3 STONE ON FACE (CTDOT M.01.01).
3. NON-OVERFLOW PORTIONS AND ABUTMENTS OF TEMPORARY SEDIMENT TRAPS MAY BE CONSTRUCTED OF ENGINEER APPROVED BACKFILL COMPACTED IN 9" LAYERS. USE ONLY MATERIAL FOR THE EMBANKMENT THAT IS FREE FROM EXCESSIVE ORGANICS, DEBRIS, ROCKS OVER 6" IN DIAMETER OR OTHER UNSUITABLE MATERIALS.
4. IF, IN THE JUDGEMENT OF THE ENGINEER, MATERIALS FROM ON-SITE EXCAVATION ACTIVITIES ARE NOT SUITABLE FOR CONSTRUCTION OF SEDIMENT TRAP EMBANKMENTS, MATERIALS SHALL BE IMPORTED TO THE SITE.
5. EARTHEN EMBANKMENTS SHALL BE STABILIZED WITH TEMPORARY SEEDING, PERMENANT SEEDING OR STONE SLOPE PROTECTION IMMEDIATELY AFTER INSTALLATION.
6. TEMPORARY SEDIMENT TRAP(S) SHALL BE INSPECTED AT LEAST ONCE PER WEEK AND WITHIN 24 HOURS OF THE END OF A STORM OF 0.5 INCHES OF RAINFALL OR GREATER. REMOVE ACCUMULATED SEDIMENT WHEN ONE HALF OF THE MINIMUM WET STORAGE VOLUME HAS BEEN FILLED. DISPOSE OF REMOVED SEDIMENT IN A SUITABLE AREA AND IN SUCH A MANNER THAT IT WILL NOT ERODE.

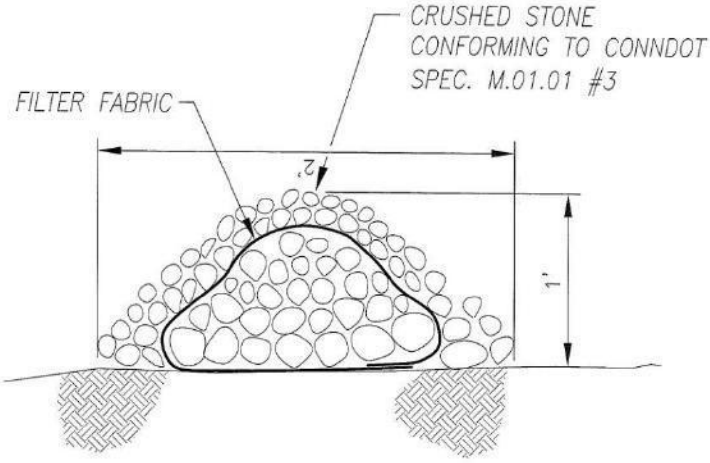
The erosion and sedimentation control design calls for temporary diversion channels during construction per figure TD-1 above to convey overland runoff from and around disturbed areas to temporary sediment basins. Temporary diversions are typically constructed with a berm of tamped or compacted soil placed in a manner to divert flows. Their purpose is to:

- Divert sediment-laden runoff from a disturbed area to a sediment-trapping facility such as a temporary sediment trap, sediment basin r vegetative filter.
- Divert water originating from undisturbed areas away from where construction activities are taking place.
- Fragment disturbed areas which thereby reduce the velocity and concentration of runoff.

Figure TD-1 Requirements for Non-Engineered Temporary Diversions



Stone check dams placed at 50ô intervals within the temporary diversions will assist in reducing velocities and providing a filtering mechanism for removal of sediment.

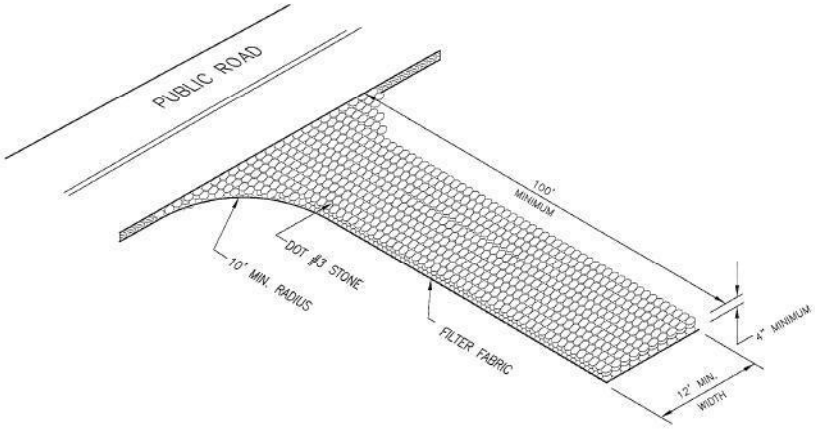


STONE CHECK DAM

NOT TO SCALE

2.9 Establish Stabilized Construction Entrances

Install stabilized construction entrances/anti tracking pads at any and all access/egress points to the site to prevent tire tracked soils and sediment onto paved surfaces.



CONSTRUCTION ENTRANCE

NOT TO SCALE

Construction shall be in accordance with 5-12-2 of the 2002 guidelines. These pads shall be maintained by the addition of stone or lengthening of the entrances as necessary to alleviate sediment transport.

2.10 Additional BMP's

2.10.1 Dust Control

Dust control measures should be taken when it has been determined that other measures for stabilization cannot be practically applied.

- Mechanical Sweeping shall be used on paved areas where dust and fine materials accumulate as a result of truck traffic or wind and water deposits from adjacent areas. Sweep daily in heavily trafficked areas.
- Apply water to exposed soil surfaces and unpaved travel ways.
- Non-asphaltic soil tackifiers may be use consisting of an emulsified liquid soil stabilizer of organic, inorganic or mineral origin. The solutions shall be non-toxic to human, animal or plant life, non-corrosive and nonflammable. Materials shall meet local, state nd federal guidelines for intended use and shall be applied per the manufacturerôs recommendations.

2.10.2 Wood Chips

Clearing of brush and woody vegetation for the purposes of construction will generate wood chips when unmarketable wood is chipped and slashed on site. These chips may be utilized as berms around the perimeter of site disturbances, check dams in swales where slopes are 3% or less, reinforcement behind silt fencing in areas of persistent problematic erosion. They may also be utilized as mulch and spread over exposed surfaces to prevent erosion from rain drop impact; an approved per EPA National Pollutant Discharge Elimination System (NPDES). http://cfpub.epa.gov/npdes/stormwater/menuofbmps/index.cfm?action=factsheet_results&view=specific&bmp=41

Chips may also be combined with compost to create filter berms to prevent sediment transport. In a combined effort, the Connecticut Department of Transportation and the CTDEEP collaborated on a 2-year research project to demonstrate the effectiveness of this application.
http://www.ct.gov/deep/cwp/view.asp?A=2718&Q=325354

3 Good Housekeeping BMP's

3.1 Material Handling & Housekeeping

This section sets forth the requirements for handling, storage, and disposal of material. It specifically addresses the requirements for storing material in open areas; stacking bagged material; storing material in bulk; storing lumber; storing bricks and masonry blocks; handling and storing cement and lime; handling and storing reinforcing sheet and structural steel; handling and storing pipe, conduit, and cylindrical material; storing sand, gravel, and crushed stone; handling and storing flammable and combustible liquids; handling asphalt and tar products; handling liquefied petroleum gas & diesel; and housekeeping.

Materials shall be stored in a manner that does not endanger worker safety. Hazardous materials shall be stored in accordance with the individual requirements. Store all materials on pallets and immediately clean up spills and leaks that could create environmental issues.

- Stack lumber on level and solidly supported sills so that the stacks are stable. Do not pile lumber more than 16 feet high.
- Bagged concrete, mortar or lime shall be stacked on pallets and kept covered at all times. Broken or torn bags shall be removed and disposed of offsite.
- Make sure cylindrical materials are stable when storing or handling. Stacking. Place pipe, conduit bar stock, and other cylindrical materials in racks or stack and block them on a firm, level surface to prevent spreading, rolling, or falling. Use either a pyramided or battened stack. Step back battened stacks at least one unit per tier and securely chock them on both sides of the stack.
- Locate stockpiles to provide safe access for withdrawing material. Material or vertical faces must not overhang. Stockpiles shall be surrounded with silt fence, staked haybales or wood chip berms to prevent erosion from the stockpiles or flow of water into them. Topsoil stockpiles left for more than 30 days shall be over seeded in accordance with Table TS-2, Section 2.4.
- Most flammable and combustible liquids are highly toxic. Use them only after determining their toxic characteristics. In handling toxic liquids, follow the appropriate safety and health requirements in the ñOccupational Healthò section.
- Closed tanks and containers for combustibles shall not exceed the requirements as outlined in the following table:

-Maximum allowable size of containers and portable tanks, combustible

	Flammable liquids			Liquids	
Container type	Class IA	Class IB	Class IB	Class II	Class III
Glass	1 pint	1 quart	1 gallon	1 gallon	5 gallons
Metal	1 gallon	5 gallons	5 gallons	5 gallons	5 gallons
Safety cans	2 gallon	5 gallons	5 gallons	5 gallons	5 gallons
Metal drums	60 gallons	60 gallons	60 gallons	60 gallons	60 gallons
Approved portable tanks	660 gallons	660 gallons	660 gallons	660 gallons	660 gallons
Polyethylene	1 gallon	5 gallons	5 gallons	60 gallons	60 gallons

- **Outdoor Housekeeping -** Keep the areas adjacent to facilities free from rubbish, waste, and tall, dry vegetation. Place combustible waste materials stored outdoors to await subsequent disposal at least 20 feet away from facilities.
- **Tools and Equipment** - To prevent tripping or injury, keep areas clear of tools and portable equipment. Adequately secure tools, materials, and equipment where a tripping hazard exists.
- **Wind** - Store loose or light materials on roofs or unenclosed height only if they are safely tied down or secured.
- **Sacks and Bags** - Remove empty bags that contained cement, lime, or other dust-producing material from the work area at least daily.
- **Excavated Materials** - Keep drives and walkways clear of excavated materials wherever possible. Where this is not possible, adequately post or barricade these areas and provide alternative access.

3.2 Construction Staging Areas

Construction staging areas shall be located as shown on the plans or within locations approved by the site inspector or engineer. Designate where vehicles or construction trailers will turn around or park, where excavated soil or building materials will be stockpiled, where excavation equipment will be unloaded and loaded, where job-site waste will be stored for recycling, etc. Setting up and ensuring use of staging areas requires installation of a packed pervious surface, free of organics or erodible soils. In areas of soft soils, installation of a geogrid prior to placement of a packed pervious surface may be necessary to stabilize surfaces for support of construction equipment and

materials. Staging areas will be evaluated prior to the start of construction to assess surface treatment needs.

3.3 Designate Vehicle Fueling and Maintenance Areas

Designated fueling areas shall be designed to prevent stormwater runoff and spills. It is recommended that fuel-dispensing areas be paved with cement, concrete, or an equivalent impervious surface, with a two to four percent slope to prevent ponding, and separated from the rest of the site by a grade break or berm that prevents run-on of stormwater.

Where practical, fuel dispensing areas should be covered, and the cover's minimum dimensions must be equal to or greater than the area within the grade break or the fuel dispensing area. The cover should not drain onto the fuel dispensing area. Use a perimeter drain or slope the surface inward so that runoff drains to a blind sump. It might be necessary to install and maintain an oil control device in catch basins that might receive runoff from the fueling area.

For fueling with a mobile fuel truck, consider establishing a designated fueling area. Place temporary "caps" over nearby catch basins or manhole covers so that if a spill occurs it is prevented from entering the storm drain). A form of secondary containment should be used when transferring fuel from the tank truck to the fuel tank. Storm drains in the vicinity should also be covered. Install vapor recovery nozzles to help control drips as well as reduce air pollution. Fueling areas should have a spill prevention plan and necessary spill kits located nearby.

General Fueling Requirements:

- When fueling must occur onsite, the contractor shall select and designate an area to be used, subject to approval of the Project Engineer or designee of the Town.
- Absorbent spill clean-up materials and spill kits shall be available in fueling areas and on fueling trucks and shall be disposed of properly after use.
- Drip pans or absorbent pads shall be used during vehicle and equipment fueling, unless the fueling is performed over an impermeable surface in a dedicated fueling area.
- Dedicated fueling areas shall be protected from storm water run-on and runoff, and shall be located at least 100 feet from downstream drainage facilities and watercourses. Fueling must be performed on level-grade areas.
- Nozzles used in vehicle and equipment fueling shall be equipped with an automatic shut-off to control drips. Fueling operations shall not be left unattended.
- Protect fueling areas with berms and/or dikes to prevent run-on, runoff, and to contain spills.
- Fuel tanks shall not be "topped-off."

- Vehicles and equipment shall be inspected on each day of use for leaks. Leaks shall be repaired immediately or problem vehicles or equipment shall be removed from the project site.
- Absorbent spill clean-up materials shall be available in fueling and maintenance areas and used on small spills instead of hosing down or burying techniques. The spent absorbent material shall be removed promptly and disposed of properly.
- Federal, state, and local requirements shall be observed for any stationary above ground storage tanks.
- Mobile fueling of construction equipment throughout the site shall be minimized. Whenever practical, equipment shall be transported to the designated fueling area.
- Fueling areas and storage tanks shall be inspected regularly.
- Keep an ample supply of spill cleanup material on the site.
- Immediately cleanup spills and properly dispose of contaminated soil and cleanup materials.

3.4 Vehicle Washing & Maintenance

The plans as presented do not consider on-site vehicle washing. Ideally, vehicle maintenance and washing occurs in garages and wash facilities, not on active construction sites. However, if these activities must occur onsite, operators should follow appropriate BMPs to prevent untreated nutrient-enriched wastewater or hazardous wastes from being discharged to surface or ground waters. Appropriate BMPs include the following:

- Provide a covered, paved area dedicated to vehicle maintenance and washing;
- Ensure that the areas are properly connected to a liquids collection system;
- Develop a spill prevention and cleanup plan;
- Prevent hazardous chemical leaks by properly maintaining vehicles and equipment;
- Properly cover and provide secondary containment for fuel drums and toxic materials;
- Properly handle and dispose of vehicle wastes and wash water;

Inspect construction vehicles daily, and repair any leaks immediately. Dispose of all used oil, antifreeze, solvents and other automotive-related chemicals according to manufacturer instructions. These wastes require special handling and disposal. Used oil, antifreeze, and some solvents can be recycled at designated facilities, but other chemicals must be disposed of at a hazardous waste disposal site.

Designate areas for vehicle repair. If cleaning is necessary, use blowers or vacuums instead of water to remove dry materials from vehicles if possible. Water alone can remove most dirt adequately, use high-pressure water spray without detergents at vehicle washing areas. If detergents must be used avoid phosphate- or organic-based cleansers to reduce nutrient enrichment and biological oxygen demand in wastewater. Use only

biodegradable products that are free of halogenated solvents. Clearly mark all washing areas.

3.5 Spill Prevention & Control

Small spills (5 gallons or less) of fuels, oils, chemicals or solvents at the site can be cleaned up in accordance with the following procedure:

1. Have proper protective equipment available for personnel cleaning up the spill.
2. Contain the spill - Oil Absorbent Socks are a containment option for smaller spills. Often used for quick containment around vehicles, valves, small leaks and machines, these absorbents are flexible enough to be quickly molded and curved to fit around a spill area
3. If the spill is from an equipment leak, stop the leak while using the proper protective equipment and ventilation.
4. Clean up small spills and leaks immediately using mops, rags, cloth, sawdust or compatible chemical binders such as bentonite, vermiculite or sawdust. If leak occur on a soil surface, remove the contaminated soil completely as soon as practical.
5. Place solvent-laden materials and/or binders in a covered, solvent-resistant metal container.
6. Arrange for proper waste disposal

For larger spills, contact local and state authorities:

Dayville Fire Department: 911 or 860-774-5525

CTDEEP Emergency Response & Spill Prevention: 866-377-7745

3.6 Rock Blasting

A. Best Management Practices for Blasting.

All activities related to blasting shall follow Best Management Practices (BMPôs) to prevent contamination of ground and surface water including:

- Preparing, reviewing and following an approved blasting plan;
- Proper drilling, explosive handling and loading procedures;
- Evaluating blasting performance;
- Handling and storage of blasted rock.
- Groundwater well monitoring

(1) Loading practices

The following blast hole loading practices to minimize environmental effects shall be followed

(a) Drilling logs shall be maintained by the driller and communicated directly to the blaster. The logs shall indicate depths and lengths of voids, cavities, and fault zones or other weak zones encountered as well as groundwater conditions.

(b) Explosive products shall be managed on-site so that they are either used in the bore hole, returned to the the delivery vehicle, or placed in secure containers for off-site disposal.

(c) Spillage around the borehole shall either be placed in the borehole or cleaned up and returned to an appropriate vehicle for handling or placement in secured containers for off-site disposal.

(d) Loaded explosives shall be detonated as soon as possible and shall not be left in the blastholes overnight, unless weather or other safety concerns reasonably dictate that detonation should be postponed.

(e) Loading equipment shall be cleaned in an area where wastewater can be properly contained and handled in a manner that prevents release of contaminants to the environment.

(f) Explosives shall be loaded to maintain good continuity in the column load to promote complete detonation. Industry accepted loading practices for priming, stemming, decking and column rise shall be attended to.

(2) Explosive Selection.

The following BMPs shall be followed to reduce the potential for ground or surface water contamination when explosives are used:

(a) Explosive products shall be selected that are appropriate for site conditions and safe blast execution.

(b) Explosive products shall be selected that have the appropriate water resistance for the site conditions present to minimize the potential for effect of the product upon ground or surface water.

(3) Prevention of Misfires.

Appropriate practices shall be developed and implemented to prevent misfires.

(4) Muck Pile Management.

Muck piles (the blasted pieces of rock) and rock piles shall be managed in a manner to reduce the potential for contamination by implementing the following measures:

(a) Remove the muck pile from the blast area as soon as reasonably possible.
(b) Manage the interaction of blasted rock piles and stormwater to prevent contamination of surface water.

(5) Groundwater Well Monitoring

A pre-blast survey of existing conditions shall be performed to evaluate structures of concern and all structures located within 250ô of blasting locations, including groundwater wells. Well levels will be monitored throughout the entirety of the blasting process.

4. Post Construction BMP's

For the purposes of this report, post construction BMPôs for impervious surfaces are separated into 3 categories:

1. Overland Flow Erosion Control ï Minimizing the release and suspension of pollutants, particularly erosion of roadway or paved surfaces shoulders by drainage. Erosion control BMPs typically are installed in the form of pervious cover (vegetation, etc.) or energy dissipation devices.
2. Roadway Drainage Conveyance ï Effectively and safely removing water from the roadway or other critical areas of the infrastructure (i.e. steep roadway shoulders or banks). Conveyance BMPs operate as either open (spillway, channel, etc.) or closed (culvert, conduit pipe, etc.) systems.
3. Water Quality and Treatment ï Water quality and treatment BMPs focus on the treatment (pollutant displacement/removal) of stormwater before discharging to and/or beyond the storm drain. Treatment BMPs operate by means of sedimentation, infiltration, filtration, and biological degradation.

The plans, drainage computations and stormwater management methods will need to be reviewed and approved by the CTDEEP in conjunction with a 401 Water Quality Certification and for the General Permit for Discharge of Stormwater Associated with Construction Activities. All proposed discharges and pre-treatment prior to this discharge points were designed to be in accordance with the 2004 Water Quality Guidelines. Where ever possible, non-structural methods of stormwater treatment have been implemented.

- Post construction control measures include promotion of groundwater recharge through pervious surfaces, as well as the construction of stormwater depressions for roof drainage, overland flow and sheet flow from pavement. A large portion of the stormwater from paved surfaces will be collected and treated by a large stormwater basin and discharged to a riprap level spreader constructed on level ground.
- Suspended solid and floatable removal is provided with sumped catch basins with hoods or elbow inserts. The goal of 80% of the annual anticipated sediment load can be achieved with these mechanisms.

- Velocity dissipation is achieved by the design and installation of riprap outlet protection. Flows from these devices discharge to gently sloped vegetated surfaces prior to final discharge to resource areas.
- Runoff reduction is accomplished by encouraging infiltration where practical and extended overland flows.

At the completion of construction, all stormwater collection and treatment devices should be inspected and cleaned in accordance with the plans, including but not limited to the removal of sediment from catch basin sumps & treatment devices, removal of silt fencing adjacent to stabilized areas, inspection of outlets for evidence of erosion or accumulation of sediment, inspection of detention & retention basins and removal of debris and sediment, removal of construction entrances. In addition, paved areas should be thoroughly swept and vegetated surfaces should be inspected to determine whether replacement plantings are necessary.

5. Drainage Summary

The drainage calculations separate drainage analysis for peak overall peak discharges from approximately 45 acres including the developed portion of the site and as well as more than half that will remain in its existing wooded condition.

The calculations utilized HydroCAD® Stormwater Modeling System, a computer model, to analyze pre and post development drainage conditions, and to aid in the design of the stormwater detention/infiltration system. The model used the Soil Conservation Service TR-20 method with a Type III 24-hour rainfall to calculate the runoff. The 2, 10 and 100-year frequency storms were analyzed to evaluate peak runoff flow to the wetlands and perimeter for pre and post construction conditions. All HydroCAD summaries and drainage area maps are included for reference herein as Attachment 3.

5.1 Drainage to Central Wetland

Table 1 summarizes the proposed peak runoff flows to the centrally located wetland (Drainage Area 1S). This drainage area is defined on the enclosed drainage area mapping and has been rounded to the nearest 0.1 CFS

Table 1: Summary of Existing and Proposed Peak Flows from Central Wetlands At Eastern Property Line*

Design Storm	Depth (in)	Existing Peak	Proposed Peak
2-Year	3.2	4.7 CFS	4.8 CFS
10-Year	4.8	24.8 CFS	19.6 CFS
100-Year	6.9	66.0 CFS	48.8 CFS

*All flows are in CFS (cubic feet per second)

As shown in Table 1, the post-construction peak runoff rates are equal to or less than post construction for all design storms. This has been accomplished by re-routing drainage areas to a proposed detention/water quality basin which includes a sediment forebay, a stormwater wetland/bioretention cell and a dry basin for groundwater recharge. Replacement of forested terrain with grassed, gravel and paved areas due to the construction of the proposed facility require this basin.

A small portion of the northern site (the Generating Facility site) discharges east via sheet flow; flow in this direction will continue in the same manner. Table 2 summarizes existing and proposed peak discharge rates at the eastern property boundary (Drainage Area 2S).

Table 2: Summary of Existing and Proposed Peak Flows East

Design Storm	Depth (in)	Existing Peak	Proposed Peak
2-Year	3.2	0.3 CFS	0.4 CFS
10-Year	4.8	1.8 CFS	2.6 CFS
100-Year	6.9	5.0 CFS	6.7 CFS

As the calculations demonstrate, there will be slight increases in peak runoff rates east but these peaks will be metered by construction of small depressions in the landscape to act as retention areas. The increases will be negligible as they are not direct (point) discharges from the property. Portions of the drainage flowing to the east will be intercepted by depressions in the terrain that will infiltrate

The switchyard on the southern side of Lake Road will be comprised substantially of a crushed stone surface that will sheet flow to wetlands located predominantly off site and within the CL&P right of way. The site drains in the same manner presently. Table 3 summarizes existing and proposed peak flows to this wetland area.

Table 3: Summary of Existing and Proposed Peak Flows from Switchyard

Design Storm	Depth (in)	Existing Peak	Proposed Peak
2-Year	3.2	1.8 CFS	2.6 CFS
10-Year	4.8	7.0 CFS	8.8 CFS
100-Year	6.9	16.1 CFS	19.1 CFS

Slight increases in peak runoff rates from the Switchyard will sheet flow overland through the proposed crushed stone surface and ultimately discharge to the wetlands system associated with the existing CL&P right of way.

5.2 Discharge Volume

Although the discharge rate to the central wetlands is significantly reduced for most design storms, it is important to preserve the hydrology of this area. Increased volumes will not adversely affect the wetland or cause erosion of stream banks, on and off the subject site as discharge rates are controlled.

The following table lists pre and post construction discharge volumes to the wetlands for each design storm:

Table 4: Summary of Existing and Proposed Discharge Volume To Central Wetlands in acre-feet

Design Storm	Depth (in)	Existing Volume	Proposed Volume
2-Year	3.2	1.19	1.73
10-Year	4.8	3.72	4.59
100-Year	6.9	8.25	9.37

The central portion wetland on site will continue to discharge off site to the northeast as it does presently. As shown in the computations, this wetland acts as a natural attenuator for existing and proposed flow discharges.

The calculations demonstrate that with construction of the tiered stormwater basin, overland flow and the creation of shallow depressions within the terrain, peak discharge rates to the wetlands will be reduced while the total volume of water to the wetlands will not be. Drainage from impervious areas will be collected, treated and discharged to the basin which ultimately will continue to recharge the wetland.

Drainage from building rooftops will be discharged to the ground or to shallow points in the terrain where ever possible to encourage sheet flow and infiltration. Roof coverings will be comprised of painted standing seam surfaces which are not prone to corrosion or the release of contaminants with rain events.

5.3 Infiltration/Groundwater Recharge

Groundwater recharge volume (GRV) is calculated using the hydrologic soil group approach per the State of CT 2004 Stormwater Quality Manual. For hydrologic soil group ñBò, average annual recharge is 12ò per year and the recharge depth (D) is 0.25ò. The net increase in impervious surface for the runoff to the proposed stormwater basin is 39.3%. Utilizing this information, the required GRV is (D)(A)(I)/12 = (0.25)(16.3)(.39)/12 = 0.132 acre-feet (5,770 cubic feet).

For the Canton and Charlton soils in the area of the proposed basin, the average saturated hydraulic conductivity is 39.6 micrometers per second which converts to 5.6 inches per

hour; the calculations conservatively assume 50% of the average (2.8 inches per hour). The following table summarizes the GRV for each design storm:

Table 5: Summary of Groundwater Recharge Volume

Design Storm	Depth (in)	Volume (ac-ft)
2-Year	3.2	0.29
10-Year	4.8	0.42
100-Year	6.9	0.75

The basin alone as designed exceeds the required GRV. Additional groundwater recharge is accomplished by the construction of small depressions in the terrain throughout the site.

6. Inspections & Reporting

6.1 Inspection Procedure

Within the first 30 days following the commencement of construction activity, the permittee shall contact the Town of Killingly or the project inspecting engineer to review site conditions. The site shall be inspected at least monthly during the first 90 days to insure proper installation of erosion control measures.

The site shall be routinely inspected for compliance with the General Permit and the Plan for the site until a Notice of Termination has been submitted. At least once a week and within 24 hours of a storm that generates a discharge, the qualified inspector shall inspect (at a minimum) the following:

- Disturbed areas of construction activity that have not been stabilized;
- All erosion and sedimentation control measures;
- All structural control measures; soil stockpile areas;
- Washout areas and site entrances;

These areas shall be inspected for evidence of or the potential for off-site impacts and sediment tracking. For storms that fall on a weekend, holiday or after a point where regular working hours will not commence for greater than 24-hours, inspections are required only for storms that equal or exceed 0.5ò.

The qualified inspector shall evaluate the effectiveness of E&S controls, structural controls, stabilization practices, and any other controls implemented to prevent pollution and determine if it is necessary to install, maintain or repair such controls and/or practices to improve the quality of stormwater discharges.

6.2 Reporting

Reports shall be prepared and retained as part of the SWPPP and shall contain the following information:

- Scope of the inspection;
- Name & qualifications of the qualified inspector generating the report;
- Date & weather conditions at the time of the inspection;
- Major observations regarding E&S controls;
- Descriptions of Stormwater Discharges;
- Any stormwater monitoring conducted during the inspection.

A sample report form is enclosed herein as Attachment 7; completed reports may be added to this section as record of inspections. The report should state whether the site is in compliance or out of compliance with the terms of the plans and permit. If the site is out of compliance, the report shall state the remedial actions required to bring the site back into compliance. Non-engineered corrective actions (i.e. silt fence repair, sediment removal, addition of E&S measures) shall be corrected within 24 hours of reporting. Engineered corrective actions (re-design of engineered controls) shall be implemented within 7 days of reporting and shall be incorporated into revised plans within 10 days of reporting.

Inspectors from the DEEP and Town may inspect the site ate any time for compliance with the anticipated General Permit or in terms of approval conditions from state and local authorities. These inspections may take place at any time while construction activities are being conducted or to review post-construction stormwater management measures.

6.3 Keeping Plans Current

The Permittee is responsible for keeping their Plan in compliance with the General Permit at all times, including the following:

A. The Plan shall be amended by the Permittee if the actions required by the plan fail to prevent pollution or fail to otherwise comply with any provisions of the General Permit. The plan shall be immediately amended upon a change in contractor, change in design or construction, operation or maintenance at the site which has the potential for discharge of pollutants to the waters of the state which has not been otherwise addressed in the Plan.

B. The Commissioner of the CTDEEP (the ñDepartmentò) may notify the Permittee at any time that the Plan and/or the site do not meet one or more of the one or more of the minimum requirements of the General Permit. The Permittee shall make any required changes within 7 days upon receipt of such notification and then shall submit certification to the Commissioner within 15 days that the requested changes have been made and implemented.

7. Turbidity Monitoring Requirements

Turbidity monitoring shall be conducted monthly at least monthly with sampling procedure consistent with 40 CFR Part 136.

7.1 Monitoring Frequency

a. Sampling shall be conducted when there is a discharge from the site while construction activity is ongoing, until final stabilization of the drainage areas associated with each outfall is achieved.
b. The Permittee is only required to take samples during regular work hours. If sampling is discontinued at the end of regular working hours, sampling shall resume the next working day as long as the discharge continues.
c. Sampling may be suspended if at any time conditions exist that may reasonably pose a threat to the safety of the person sampling. Such conditions may include high winds, lighting, intense rainfall or other hazardous condition. When the unsafe condition is no longer present, sampling may resume.

7.2 Sample Collection

a. All samples shall be collected from discharges resulting from a storm event that occurs at least 24 hours after any previous storm event that generates a stormwater discharge. Sampling of snow or ice melt without a storm event is not a valid sample.
b. Samples shall be grab samples taken at least three (3) separate times during a storm event and shall be representative of the flow and characteristics of the discharge. Samples may be taken manually or with an in-situ turbidity probe or other automatic sampling device equipped to take turbidity readings. The first sample shall be taken within the first hour of stormwater discharge from the site. If samples are collected manually and the discharge begins outside of normal working hours, the first sample shall be taken at the start of normal working hours and shall be noted.

7.3 Sampling Locations

Sampling is required from point discharges of stormwater from disturbed areas. Sampling points shall be at proposed stormwater outfalls as they are installed throughout the project.

7.4 Monitoring Reports

A. Within thirty (30) days following the end of each month, permittees shall enter the stormwater sampling result(s) on the Stormwater Monitoring Report (SMR) form (available at www.ct.gov/deep/stormwater) and submit it in accordance with the

NetDMR provisions as described below, or, if the permittee has opted out of NetDMR, to the following address:

Bureau of Materials Management and Compliance Assurance
Water Permitting and Enforcement Division (Attn: DMR Processing)
Connecticut Department of Energy and Environmental Protection
79 Elm Street
Hartford, CT 06106-5127

If there was no discharge during any given monitoring period, the permittee shall submit the form as required with the words ñno dischargeò entered in place of the monitoring results.

If the permittee monitors any discharge more frequently than required by this general permit, the results of this monitoring shall be included in additional SMRs for the month in which the samples were collected.
If sampling protocols are modified due to the limitations of normal working hours or unsafe conditions in accordance with Section 5(c)(1)(A)(ii) or (iii) above, a description of and reason for the modifications shall be included with the SMR.

If the permittee samples a discharge that is representative of two or more substantially identical discharge points, the permittee shall include the names or locations of the other discharge points.

NetDMR Reporting Requirements

Prior to one-hundred and eighty (180) days after the issuance of a permit, the
Permittee may either submit monitoring data and other reports to the Department in hard copy form or electronically using NetDMR, a web-based tool that allows Permittees to electronically submit stormwater monitoring reports through a secure internet connection. Unless otherwise approved in writing by the commissioner, no later than one-hundred and eighty (180) days after the issuance of the permit the Permittee shall begin reporting electronically using NetDMR. Specific requirements regarding subscription to NetDMR and submittal of data and reports in hard copy form and for submittal using NetDMR are described below:

Submittal of NetDMR Subscriber Agreement

On or before fifteen (15) days after the issuance of a permit, the Permittee and/or the person authorized to sign the Permitteeòs discharge monitoring reports (ñSignatory Authorityò) as described in RCSA Section 22a-430-3(b)(2) shall contact the Department at deep.netdmr@ct.gov and initiate the NetDMR subscription process for electronic submission of Stormwater Monitoring Report information. Information on NetDMR is available on the Departmentòs website at www.ct.gov/deep/netdmr on or before ninety (90) days after issuance of this permit the Permittee shall submit a signed and notarized copy of the Connecticut DEEP NetDMR Subscriber Agreement to the Department

Submittal of Reports Using NetDMR

Unless otherwise approved by the commissioner, on or before one-hundred and eighty (180) days after issuance of this permit, the Permittee and/or the Signatory Authority shall electronically submit SMRs required under the permit to the Department using NetDMR in satisfaction of the SMR submission requirements of Sections 5(c)(2)(A) of this permit.

SMRs shall be submitted electronically to the Department no later than the 30th day of the month following the completed reporting period. Any additional monitoring conducted in accordance with 40 CFR 136 shall be submitted to the Department as an electronic attachment to the SMR in NetDMR. Once a Permittee begins submitting reports using NetDMR, it will no longer be required to submit hard copies of SMRs to the Department. NetDMR is accessed from: http://www.epa.gov/netdmr

Submittal of NetDMR Opt-Out Requests

If the Permittee is able to demonstrate a reasonable basis, such as technical or administrative infeasibility, that precludes the use of NetDMR for electronically submitting SMRs, the commissioner may approve the submission of SMRs in hard copyform (ñopt-out requestò). Opt-out requests must be submitted in writing to the Department for written approval on or before fifteen (15) days prior to the date a Permittee would be required under this permit to begin filing SMRs using NetDMR. This demonstration shall be valid for twelve (12) months from the date of the Departmentôs approval and shall thereupon expire. At such time, SMRs shall be submitted electronically to the Department using NetDMR unless the Permittee submits a renewed opt-out request and such request is approved by the Department.

All opt-out requests and requests for the NetDMR subscriber form should be sent to the following address or by email at deep.netdmr@ct.gov:

Attn: NetDMR Coordinator
Connecticut Department of Energy and Environmental Protection
79 Elm Street
Hartford, CT 06106-5127

7.5 Reporting and Record Keeping Requirements

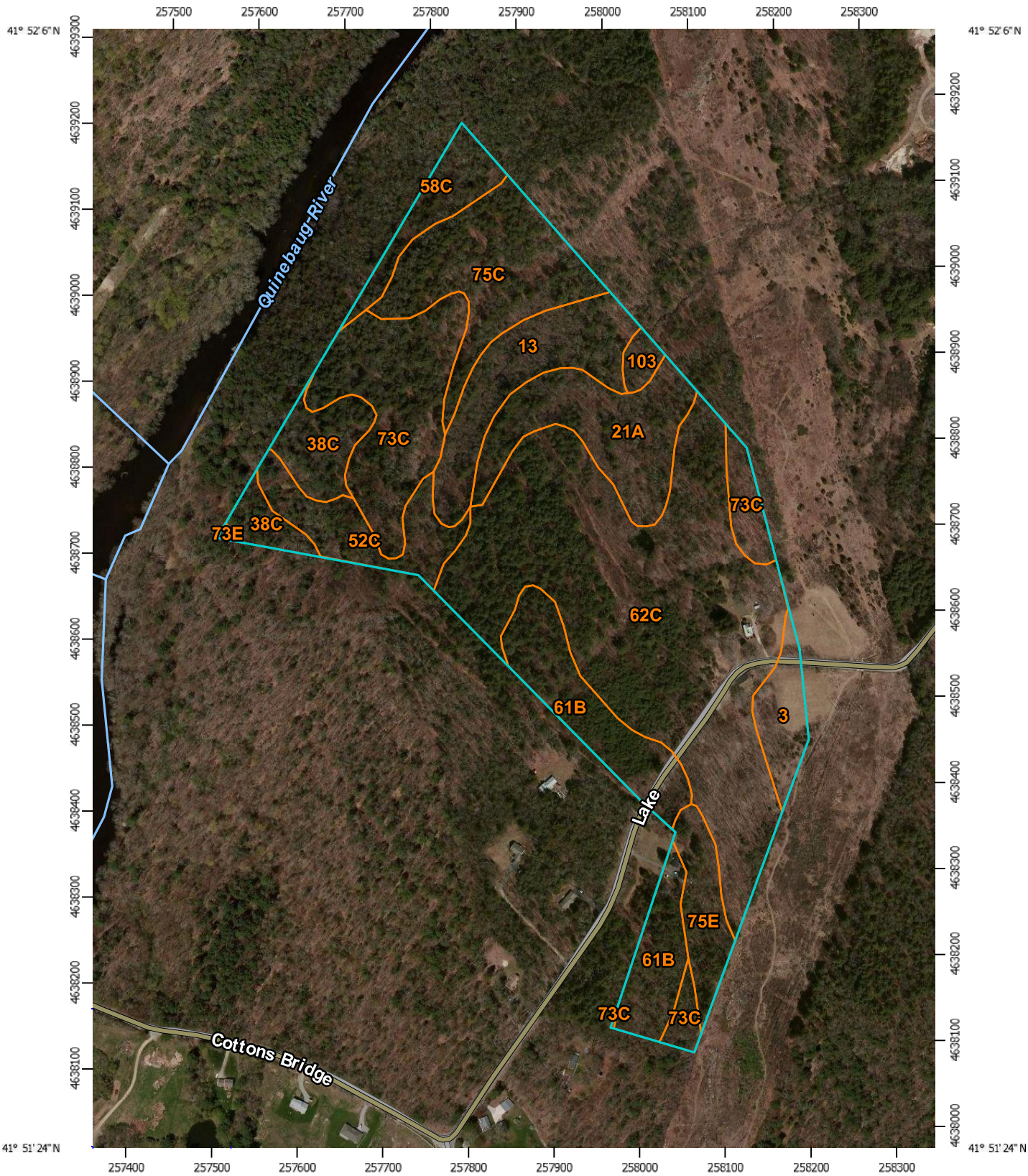
A. For a period of at least five years from the date that construction is complete, the permittee shall retain copies of the Plan and all reports required by the General Permit, and records of all data used to complete the registration for the General Permit, unless the commissioner specifies another time period in writing. Inspection records must be retained as part of the Plan for a period of five (5) years after the date of inspection.

B. The permittee shall retain an updated copy of the Plan required by this general permit at the construction site from the date construction is initiated at the site until the date construction at the site is completed.

ATTACHMENT 1

USDA-NRCS WEB SOIL SURVEY MAPPING

Soil Map—State of Connecticut
(NTE Connecticut - Lake Road)



Map Scale: 1:6,330 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 300 600 1200 1800

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 19N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

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 14, Sep 22, 2015

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

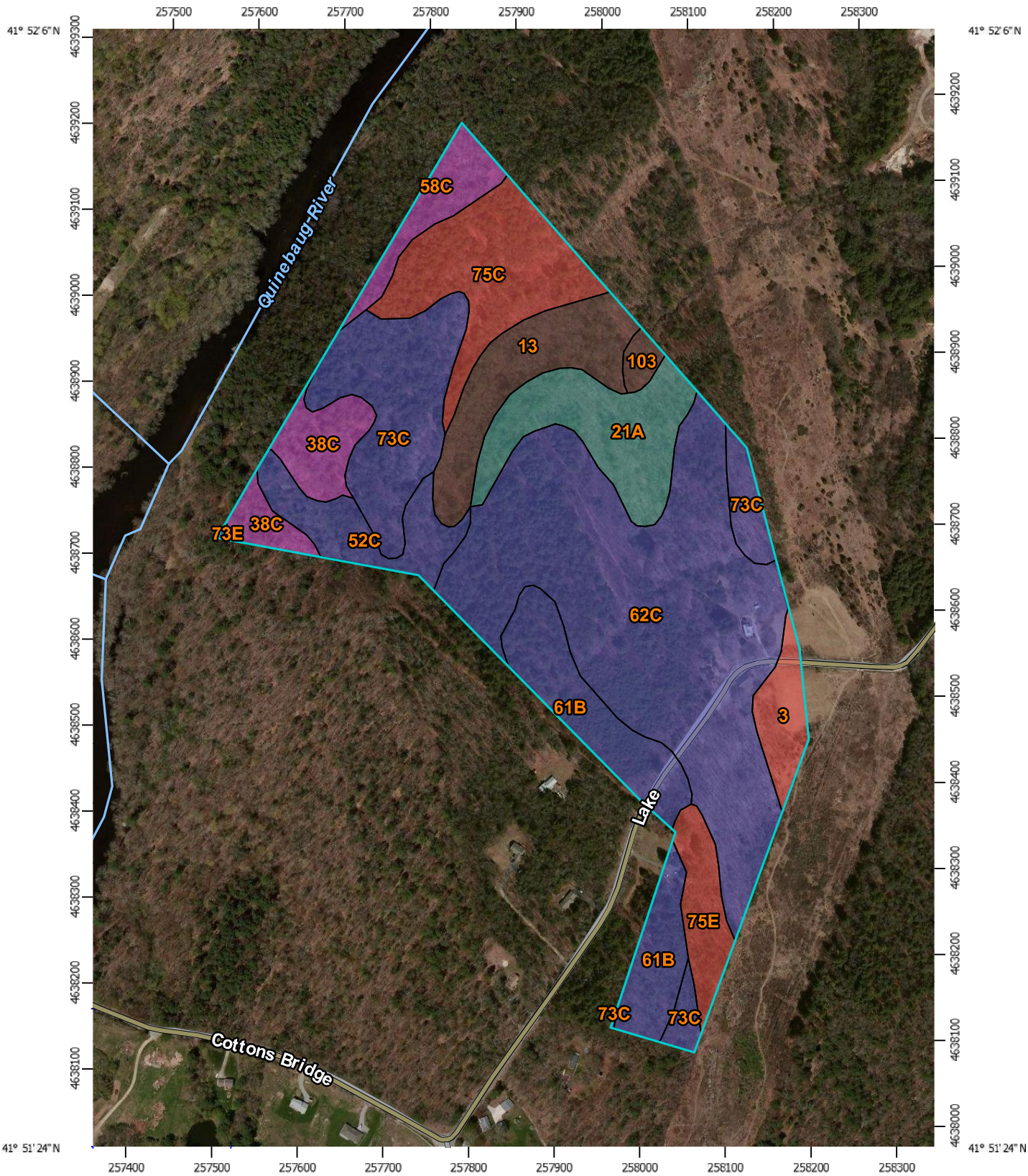
Date(s) aerial images were photographed: Mar 30, 2011—May 1, 2011

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.

Map Unit Legend

State of Connecticut (CT600)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
3	Ridgebury, Leicester, and Whitman soils, 0 to 8 percent slopes, extremely stony	2.0	2.6%
13	Walpole sandy loam, 0 to 3 percent slopes	5.3	7.0%
21A	Ninigret and Tisbury soils, 0 to 5 percent slopes	6.0	7.9%
38C	Hinckley loamy sand, 3 to 15 percent slopes	3.5	4.6%
52C	Sutton fine sandy loam, 2 to 15 percent slopes, extremely stony	3.5	4.6%
58C	Gloucester gravelly sandy loam, 8 to 15 percent slopes, very stony	2.3	3.1%
61B	Canton and Charlton soils, 3 to 8 percent slopes, very stony	7.2	9.5%
62C	Canton and Charlton soils, 3 to 15 percent slopes, extremely stony	26.6	35.1%
73C	Charlton-Chatfield complex, 3 to 15 percent slopes, very rocky	9.2	12.1%
73E	Charlton-Chatfield complex, 15 to 45 percent slopes, very rocky	0.1	0.1%
75C	Hollis-Chatfield-Rock outcrop complex, 3 to 15 percent slopes	7.2	9.5%
75E	Hollis-Chatfield-Rock outcrop complex, 15 to 45 percent slopes	2.5	3.2%
103	Rippowam fine sandy loam	0.6	0.8%
Totals for Area of Interest		**75.8**	**100.0%**

Hydrologic Soil Group—State of Connecticut
(NTE Connecticut - Lake Road)



Map Scale: 1:6,330 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 300 600 1200 1800

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 19N 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 14, Sep 22, 2015

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

Date(s) aerial images were photographed: Mar 30, 2011—May 1, 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, 0 to 8 percent slopes, extremely stony	D	2.0	2.6%
13	Walpole sandy loam, 0 to 3 percent slopes	B/D	5.3	7.0%
21A	Ninigret and Tisbury soils, 0 to 5 percent slopes	C	6.0	7.9%
38C	Hinckley loamy sand, 3 to 15 percent slopes	A	3.5	4.6%
52C	Sutton fine sandy loam, 2 to 15 percent slopes, extremely stony	B	3.5	4.6%
58C	Gloucester gravelly sandy loam, 8 to 15 percent slopes, very stony	A	2.3	3.1%
61B	Canton and Charlton soils, 3 to 8 percent slopes, very stony	B	7.2	9.5%
62C	Canton and Charlton soils, 3 to 15 percent slopes, extremely stony	B	26.6	35.1%
73C	Charlton-Chatfield complex, 3 to 15 percent slopes, very rocky	B	9.2	12.1%
73E	Charlton-Chatfield complex, 15 to 45 percent slopes, very rocky	B	0.1	0.1%
75C	Hollis-Chatfield-Rock outcrop complex, 3 to 15 percent slopes	D	7.2	9.5%
75E	Hollis-Chatfield-Rock outcrop complex, 15 to 45 percent slopes	D	2.5	3.2%
103	Rippowam fine sandy loam	B/D	0.6	0.8%
Totals for Area of Interest			**75.8**	**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.

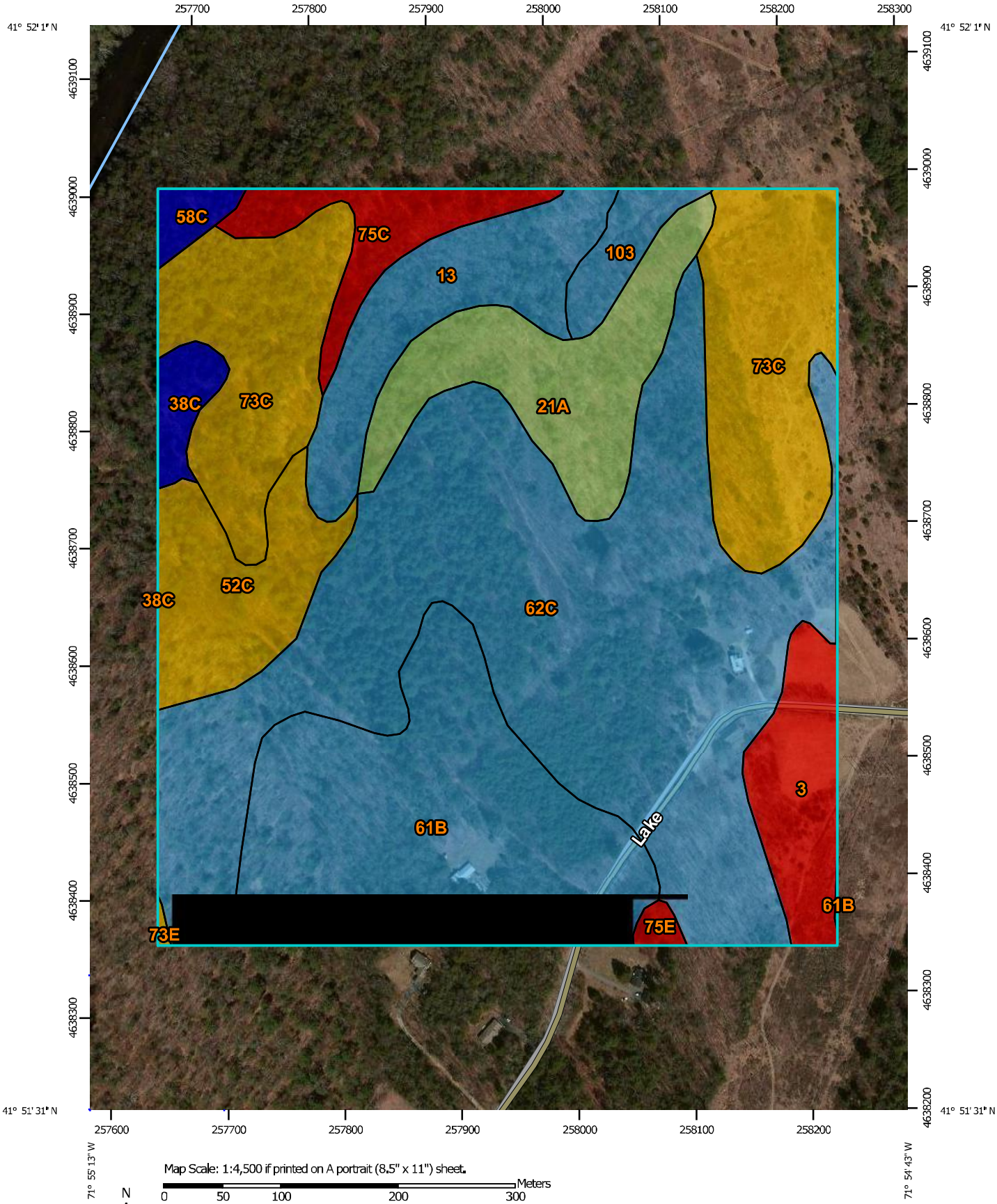
Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Higher

Saturated Hydraulic Conductivity (Ksat)—State of Connecticut
(NTE Connecticut, Killingly)



Map Scale: 1:4,500 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 200 400 800 1200

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 19N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- <= 10.0139
- > 10.0139 and <= 24.9231
- > 24.9231 and <= 34.7253
- > 34.7253 and <= 44.6703
- > 44.6703 and <= 100.0000
- Not rated or not available

Soil Rating Lines

- <= 10.0139
- > 10.0139 and <= 24.9231
- > 24.9231 and <= 34.7253
- > 34.7253 and <= 44.6703
- > 44.6703 and <= 100.0000
- Not rated or not available

Soil Rating Points

- <= 10.0139
- > 10.0139 and <= 24.9231
- > 24.9231 and <= 34.7253
- > 34.7253 and <= 44.6703
- > 44.6703 and <= 100.0000
- 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.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

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 14, Sep 22, 2015

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

Date(s) aerial images were photographed: Mar 30, 2011—May 1, 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.

Saturated Hydraulic Conductivity (Ksat)

Saturated Hydraulic Conductivity (Ksat)— Summary by Map Unit — State of Connecticut (CT600)				
Map unit symbol	**Map unit name**	**Rating (micrometers per second)**	**Acres in AOI**	**Percent of AOI**
3	Ridgebury, Leicester, and Whitman soils, 0 to 8 percent slopes, extremely stony	5.1044	3.9	4.2%
13	Walpole sandy loam, 0 to 3 percent slopes	40.6593	5.7	6.1%
21A	Ninigret and Tisbury soils, 0 to 5 percent slopes	34.7253	7.0	7.6%
38C	Hinckley loamy sand, 3 to 15 percent slopes	100.0000	1.1	1.2%
52C	Sutton fine sandy loam, 2 to 15 percent slopes, extremely stony	24.9231	5.2	5.5%
58C	Gloucester gravelly sandy loam, 8 to 15 percent slopes, very stony	93.0769	0.7	0.8%
61B	Canton and Charlton soils, 3 to 8 percent slopes, very stony	39.6703	16.1	17.3%
62C	Canton and Charlton soils, 3 to 15 percent slopes, extremely stony	39.6703	33.2	35.7%
73C	Charlton-Chatfield complex, 3 to 15 percent slopes, very rocky	21.5714	15.2	16.3%
73E	Charlton-Chatfield complex, 15 to 45 percent slopes, very rocky	21.5714	0.1	0.1%
75C	Hollis-Chatfield-Rock outcrop complex, 3 to 15 percent slopes	10.0139	3.0	3.2%
75E	Hollis-Chatfield-Rock outcrop complex, 15 to 45 percent slopes	10.0139	0.3	0.3%
103	Rippowam fine sandy loam	44.6703	1.5	1.6%
Totals for Area of Interest			**92.9**	**100.0%**

Description

Saturated hydraulic conductivity (Ksat) refers to the ease with which pores in a saturated soil transmit water. The estimates are expressed in terms of micrometers per second. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Saturated hydraulic conductivity is considered in the design of soil drainage systems and septic tank absorption fields.

For each soil layer, this attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

The numeric Ksat values have been grouped according to standard Ksat class limits.

Rating Options

Units of Measure: micrometers per second

Aggregation Method: Dominant Component

Component Percent Cutoff: *None Specified*

Tie-break Rule: Fastest

Interpret Nulls as Zero: No

Layer Options (Horizon Aggregation Method): Depth Range (Weighted Average)

Top Depth: 0

Bottom Depth: 36

Units of Measure: Inches

ATTACHMENT 2

JUNE 2016

NATURAL DIVERSITY DATABASE MAP

Natural Diversity Data Base Areas

KILLINGLY, CT

June 2016

State and Federal Listed Species & Significant Natural Communities

Town Boundary

NOTE: This map shows general locations of State and Federal Listed Species and Significant Natural Communities. Information on listed species is collected and compiled by the Natural Diversity Data Base (NDDB) from a number of data sources . Exact locations of species have been buffered to produce the general locations. Exact locations of species and communities occur somewhere in the shaded areas, not necessarily in the center. A new mapping format is being employed that more accurately models important riparian and aquatic areas and eliminates the need for the upstream/downstream searches required in previous versions.

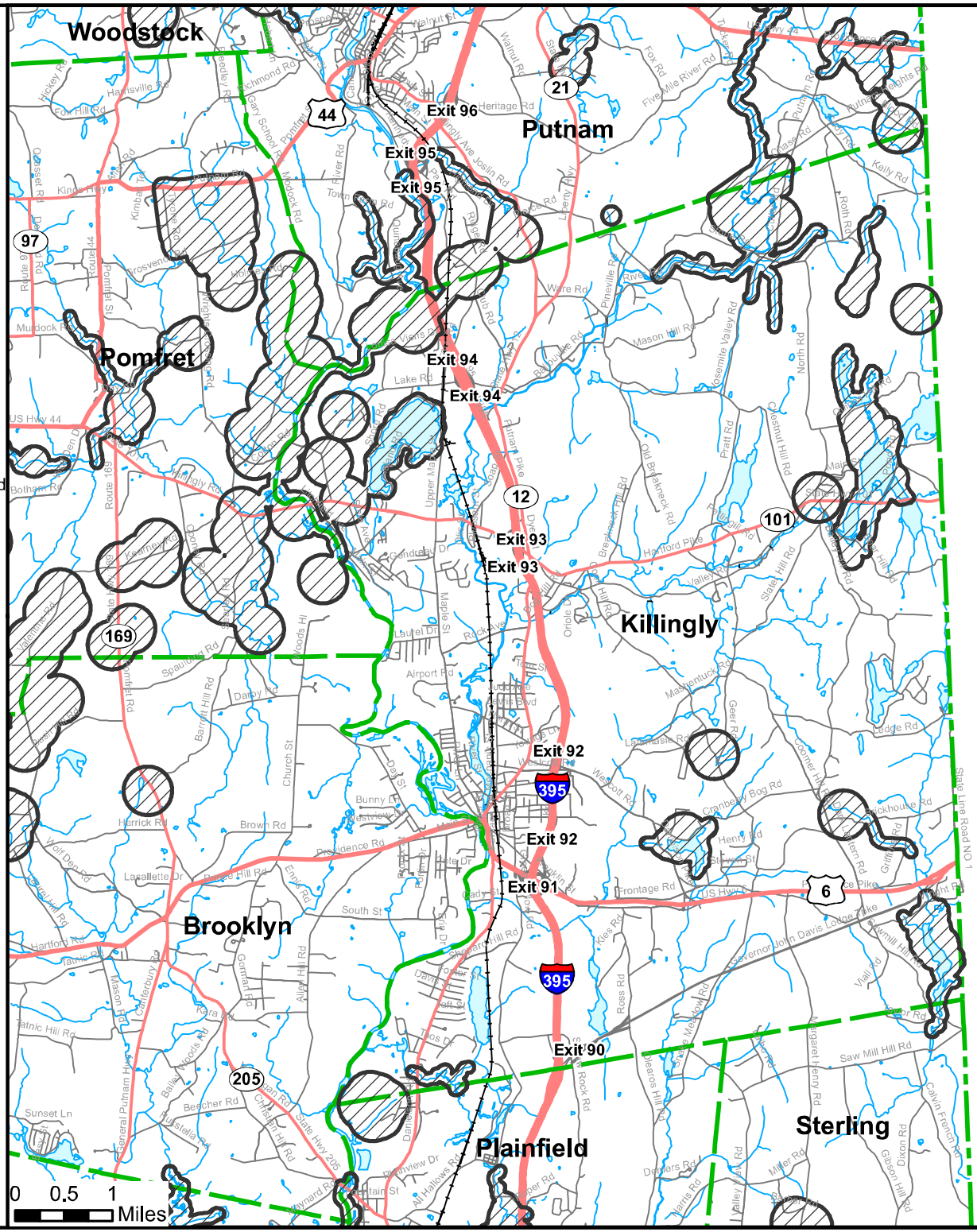
This map is intended for use as a preliminary screening tool for conducting a Natural Diversity Data Base Review Request. To use the map, locate the project boundaries and any additional affected areas. If the project is within a shaded area there may be a potential conflict with a listed species. For more information, complete a Request for Natural Diversity Data Base State Listed Species Review form (DEP-APP-007), and submit it to the NDDB along with the required maps and information. More detailed instructions are provided with the request form on our website.

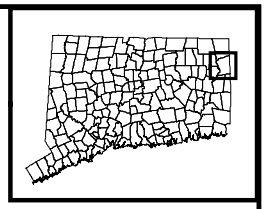
www.ct.gov/deep/nddbrequest

Use the CTECO Interactive Map Viewers at www.cteco.uconn.edu to more precisely search for and locate a site and to view aerial imagery with NDDB Areas.

QUESTIONS: Department of Energy and Environmental Protection (DEEP)
79 Elm St., Hartford CT 06106
Phone (860) 424-3011

Connecticut Department of Energy & Environmental Protection
Bureau of Natural Resources
Wildlife Division





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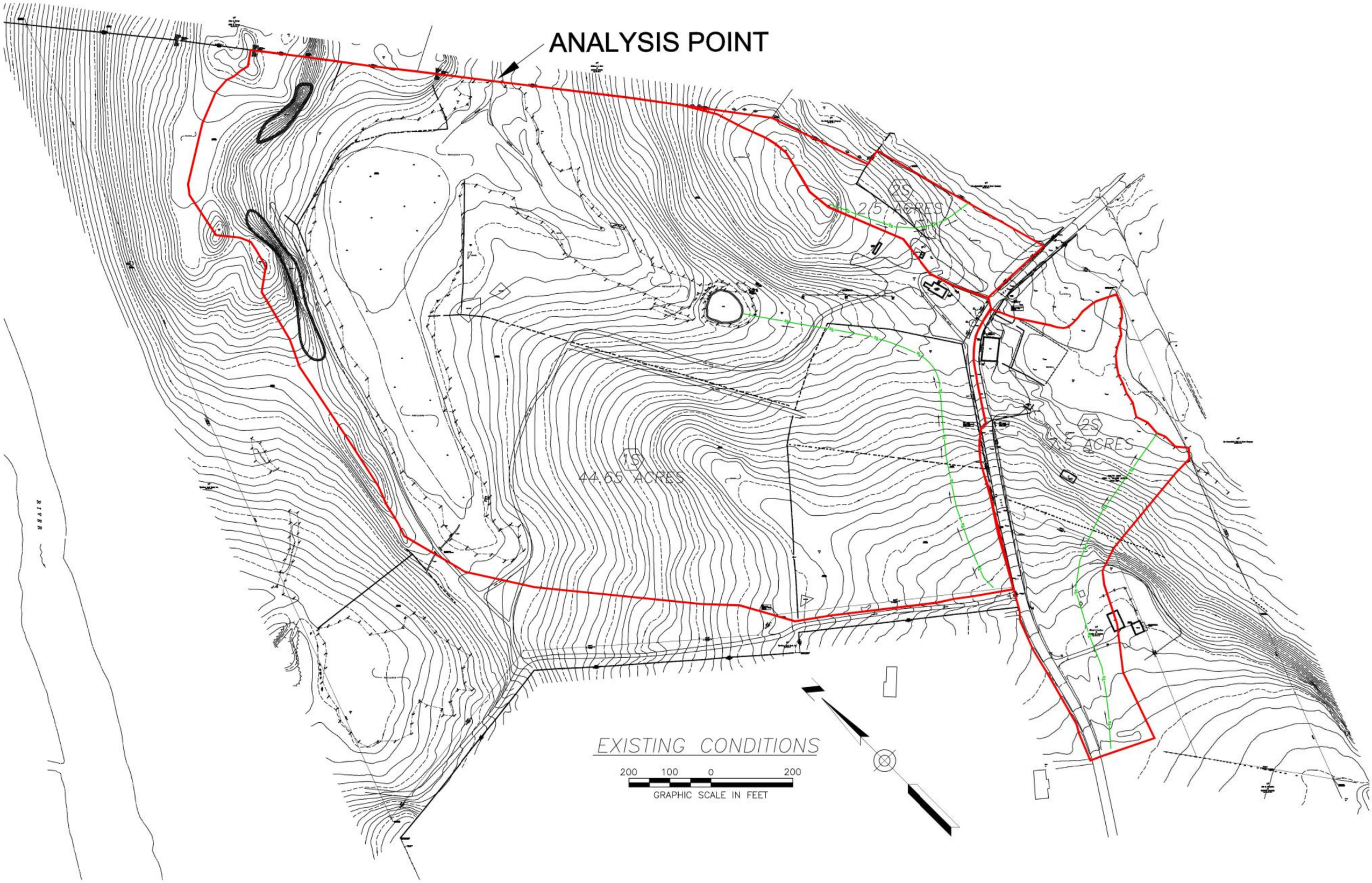
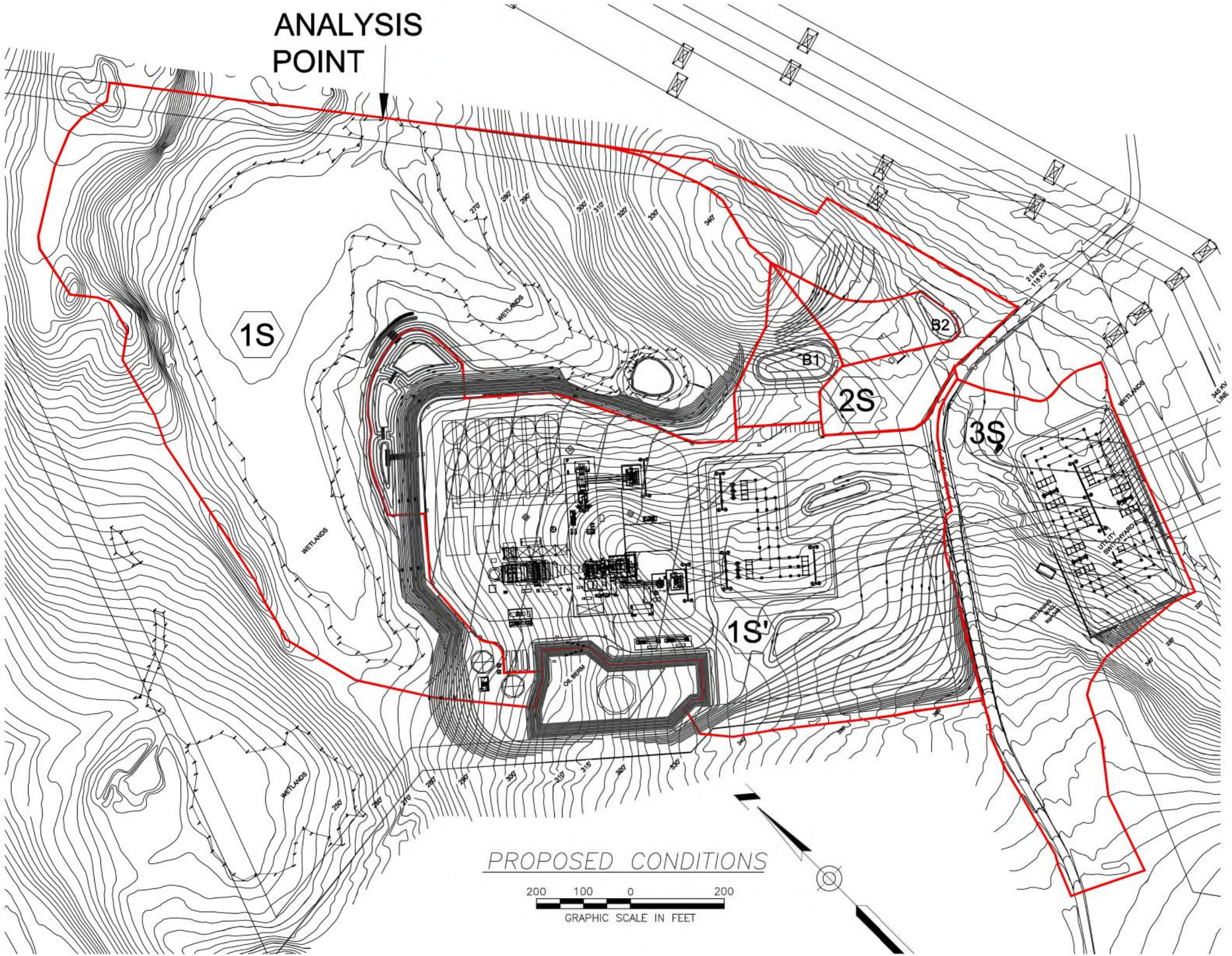
ATTACHMENT 3

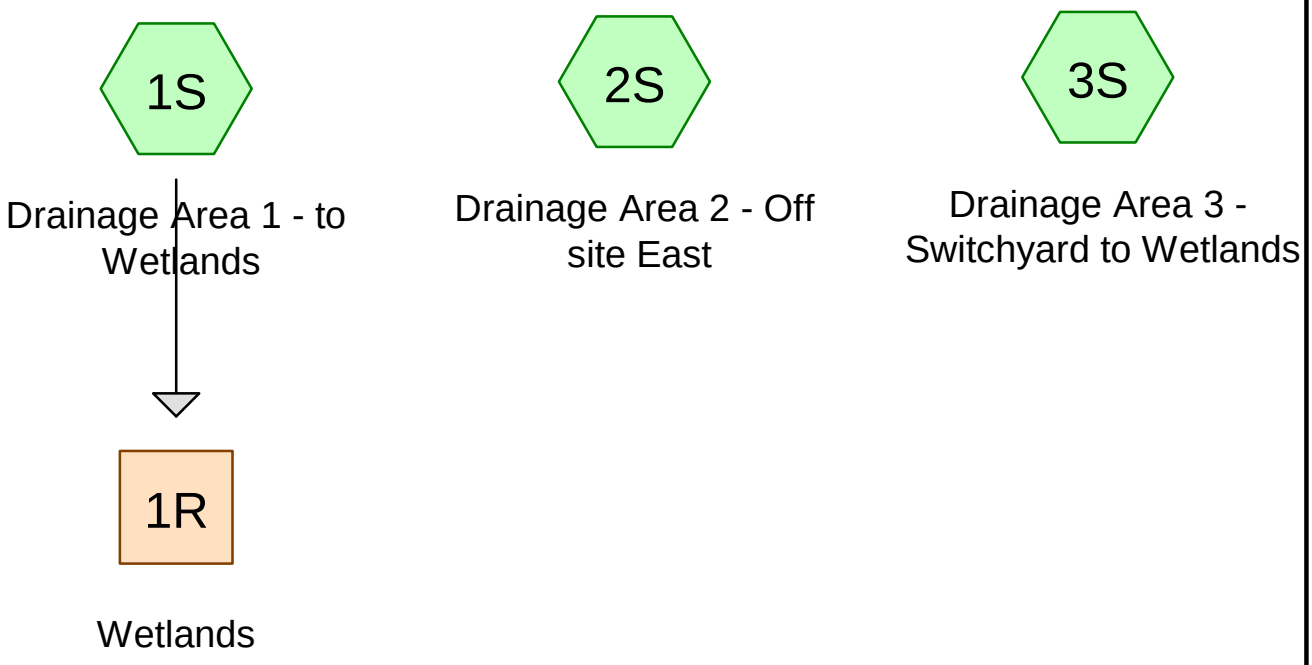
HydroCAD DRAINAGE CALCULATION SUMMARIES

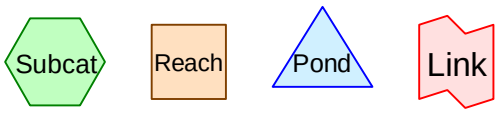
(With drainage area maps)


ANALYSIS POINT
1S
44.65 ACRES
2S
2.5 ACRES
2S
7.5 ACRES
RIVER
EXISTING CONDITIONS
200 100 0 200
GRAPHIC SCALE IN FEET


ANALYSIS POINT
1S
2S
3S
1S'
B1
B2
WETLANDS
WETLANDS
WETLANDS
WETLANDS
2 LINES 115 KV
345 KV LINE
UTILITY SWITCHYARD
OR RISER
PROPOSED CONDITIONS
200 100 0 200
GRAPHIC SCALE IN FEET

EXISTING CONDITIONS DRAINAGE COMPUTATIONS
2, 10 & 100-YEAR STORMS





Routing Diagram for Existing Drainage
Prepared by Microsoft, Printed 8/12/2016
HydroCAD® 10.00 s/n 07240 © 2011 HydroCAD Software Solutions LLC

Summary for Subcatchment 1S: Drainage Area 1 - to Wetlands

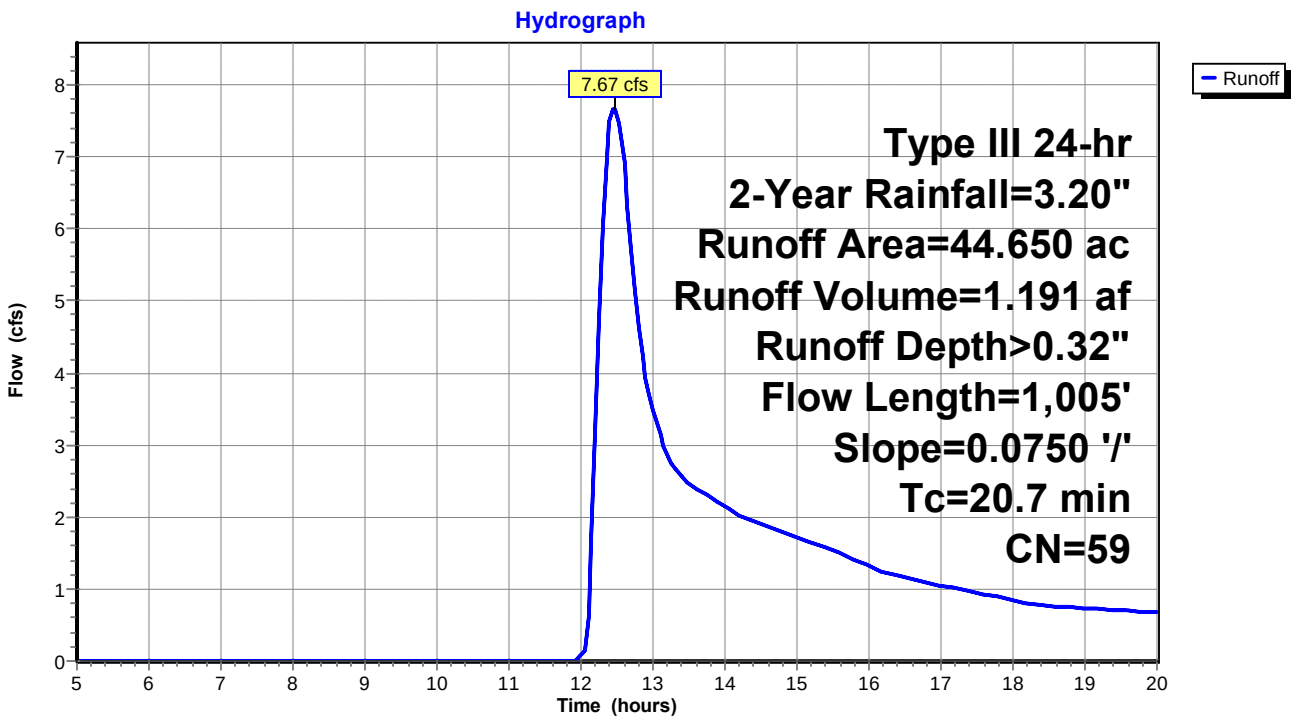
Runoff = 7.67 cfs @ 12.46 hrs, Volume= 1.191 af, Depth> 0.32"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.20"

	Area (ac)	CN	Description
	0.750	68	1 acre lots, 20% imp, HSG B
*	8.600	77	Woods, Good, HSG D (Wetlands)
	35.300	55	Woods, Good, HSG B
	44.650	59	Weighted Average
	44.500		99.66% Pervious Area
	0.150		0.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.7	1,005	0.0750	0.81		**Lag/CN Method, Tc-1**

Subcatchment 1S: Drainage Area 1 - to Wetlands



Summary for Subcatchment 2S: Drainage Area 2 - Off site East

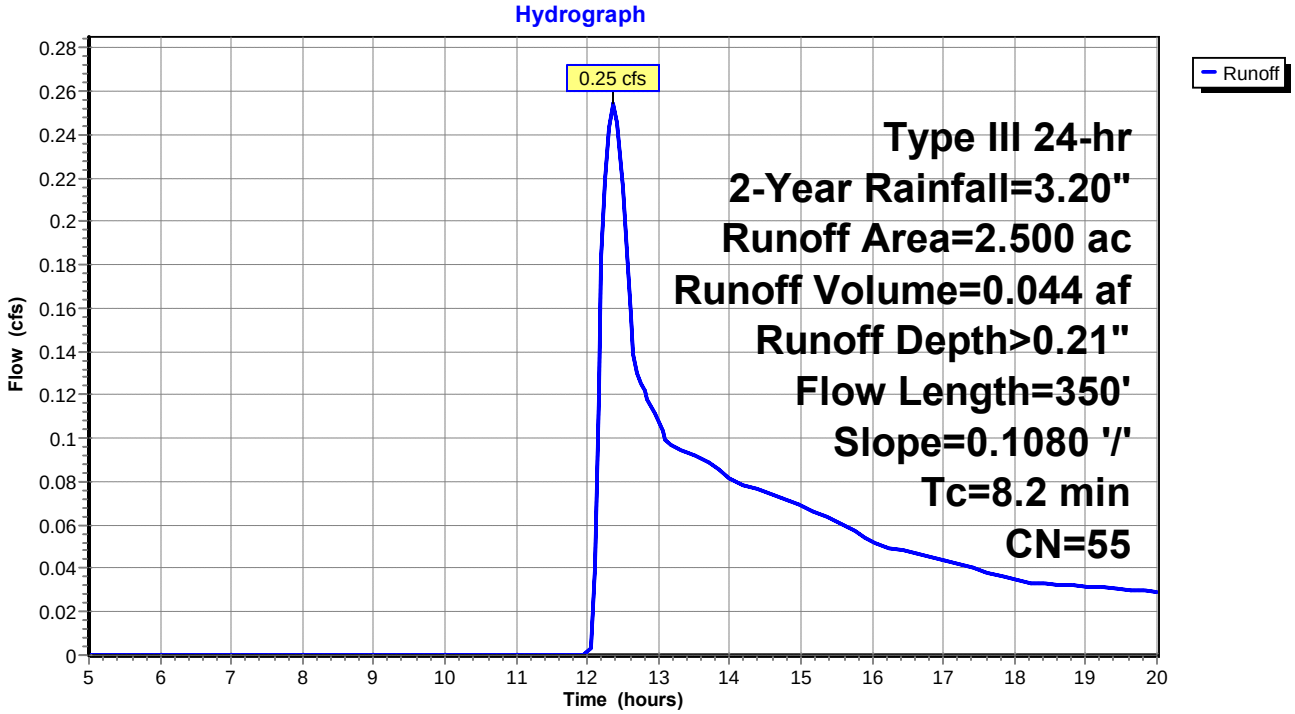
Runoff = 0.25 cfs @ 12.37 hrs, Volume= 0.044 af, Depth> 0.21"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.20"

Area (ac)	CN	Description
2.500	55	Woods, Good, HSG B
2.500		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	350	0.1080	0.71		**Lag/CN Method, Tc-2**

Subcatchment 2S: Drainage Area 2 - Off site East



Summary for Subcatchment 3S: Drainage Area 3 - Switchyard to Wetlands

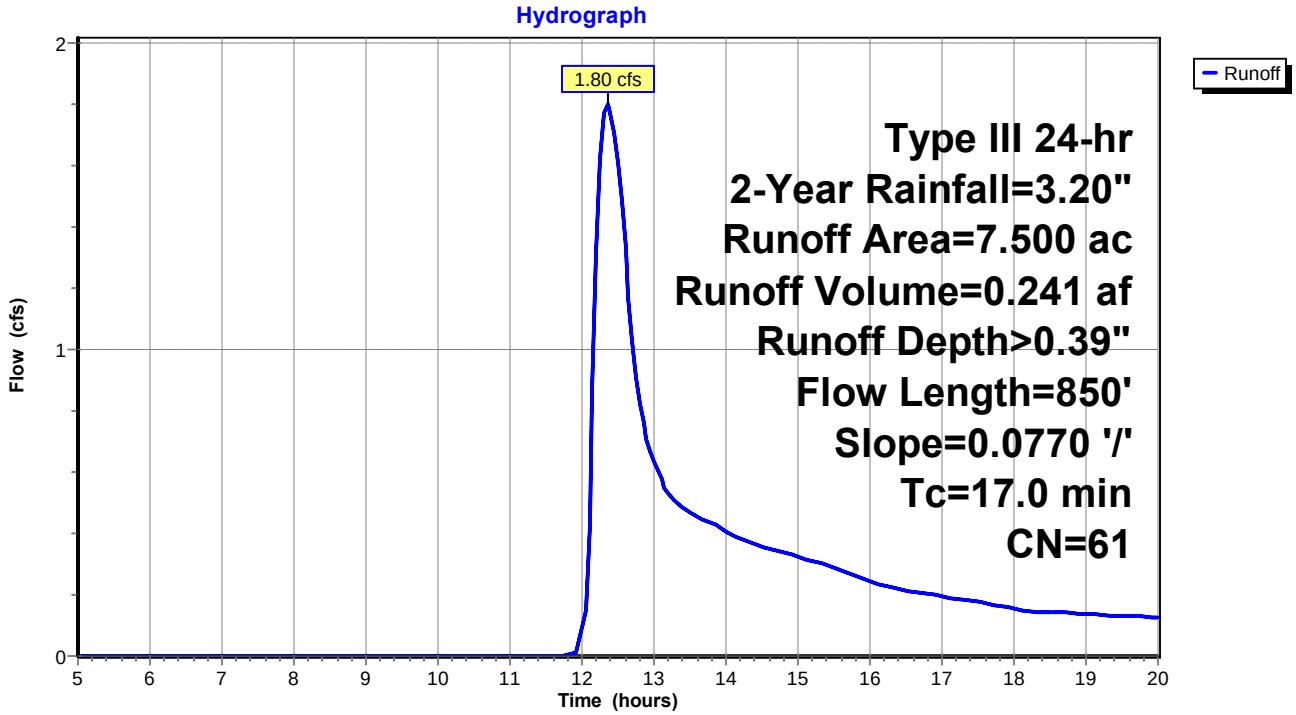
Runoff = 1.80 cfs @ 12.35 hrs, Volume= 0.241 af, Depth> 0.39"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.20"

	Area (ac)	CN	Description
*	0.900	98	Roof & Pavement
	1.000	58	Meadow, non-grazed, HSG B
	5.600	55	Woods, Good, HSG B
	7.500	61	Weighted Average
	6.600		88.00% Pervious Area
	0.900		12.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.0	850	0.0770	0.83		**Lag/CN Method, Tc-3**

Subcatchment 3S: Drainage Area 3 - Switchyard to Wetlands



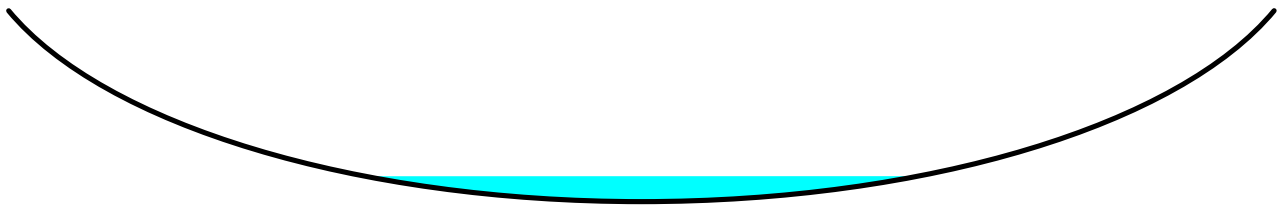
Summary for Reach 1R: Wetlands

Inflow Area = 44.650 ac, 0.34% Impervious, Inflow Depth > 0.32" for 2-Year event
Inflow = 7.67 cfs @ 12.46 hrs, Volume= 1.191 af
Outflow = 4.74 cfs @ 13.28 hrs, Volume= 1.110 af, Atten= 38%, Lag= 49.1 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.74 fps, Min. Travel Time= 29.3 min
Avg. Velocity = 0.52 fps, Avg. Travel Time= 42.0 min

Peak Storage= 8,349 cf @ 12.79 hrs
Average Depth at Peak Storage= 0.13'
Bank-Full Depth= 1.00' Flow Area= 133.3 sf, Capacity= 378.88 cfs

200.00' x 1.00' deep Parabolic Channel, n= 0.035
Length= 1,300.0' Slope= 0.0077 '/'
Inlet Invert= 274.00', Outlet Invert= 264.00'



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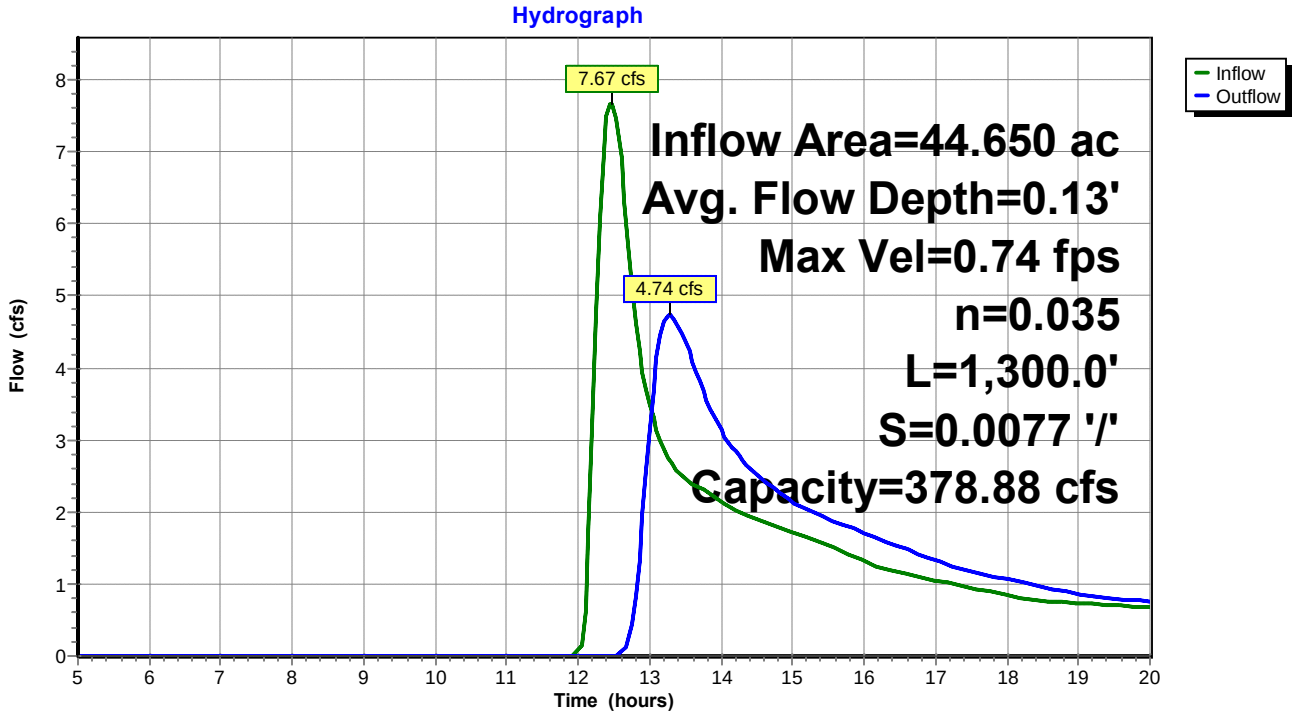
Reach 1R: Wetlands



Summary for Subcatchment 1S: Drainage Area 1 - to Wetlands

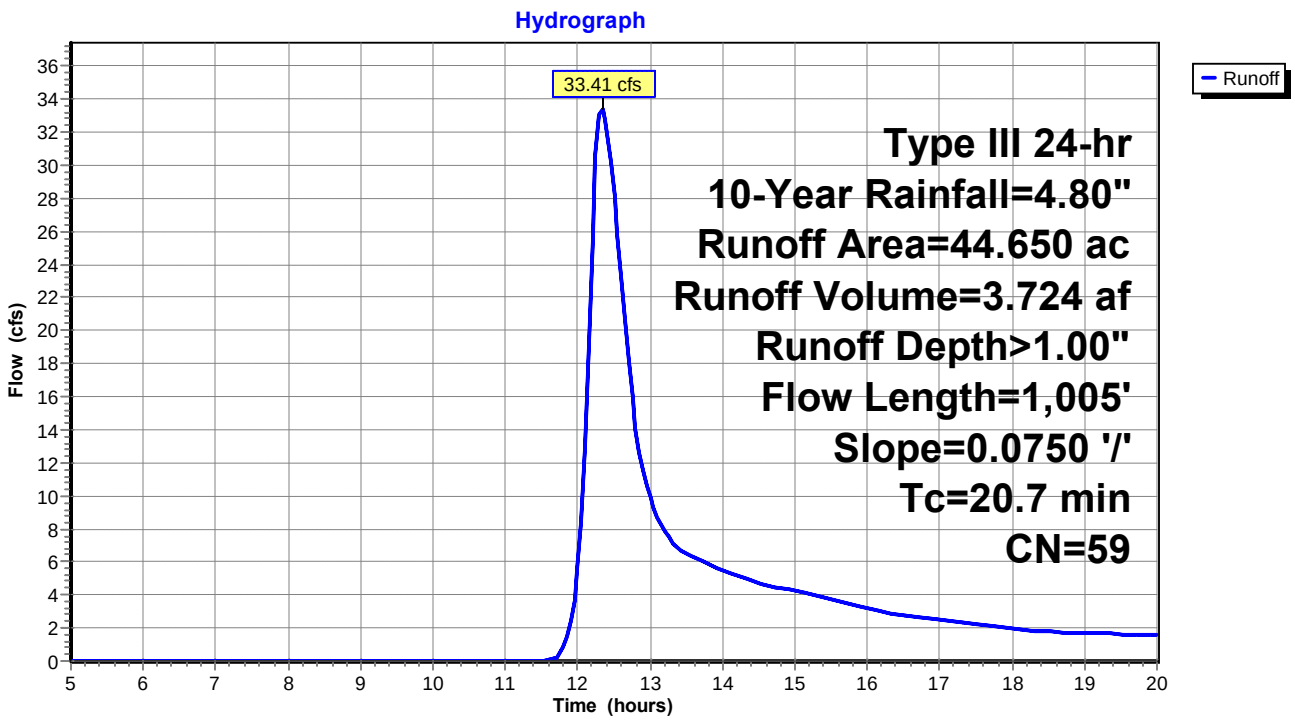
Runoff = 33.41 cfs @ 12.34 hrs, Volume= 3.724 af, Depth> 1.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (ac)	CN	Description
	0.750	68	1 acre lots, 20% imp, HSG B
*	8.600	77	Woods, Good, HSG D (Wetlands)
	35.300	55	Woods, Good, HSG B
	44.650	59	Weighted Average
	44.500		99.66% Pervious Area
	0.150		0.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.7	1,005	0.0750	0.81		**Lag/CN Method, Tc-1**

Subcatchment 1S: Drainage Area 1 - to Wetlands



Summary for Subcatchment 2S: Drainage Area 2 - Off site East

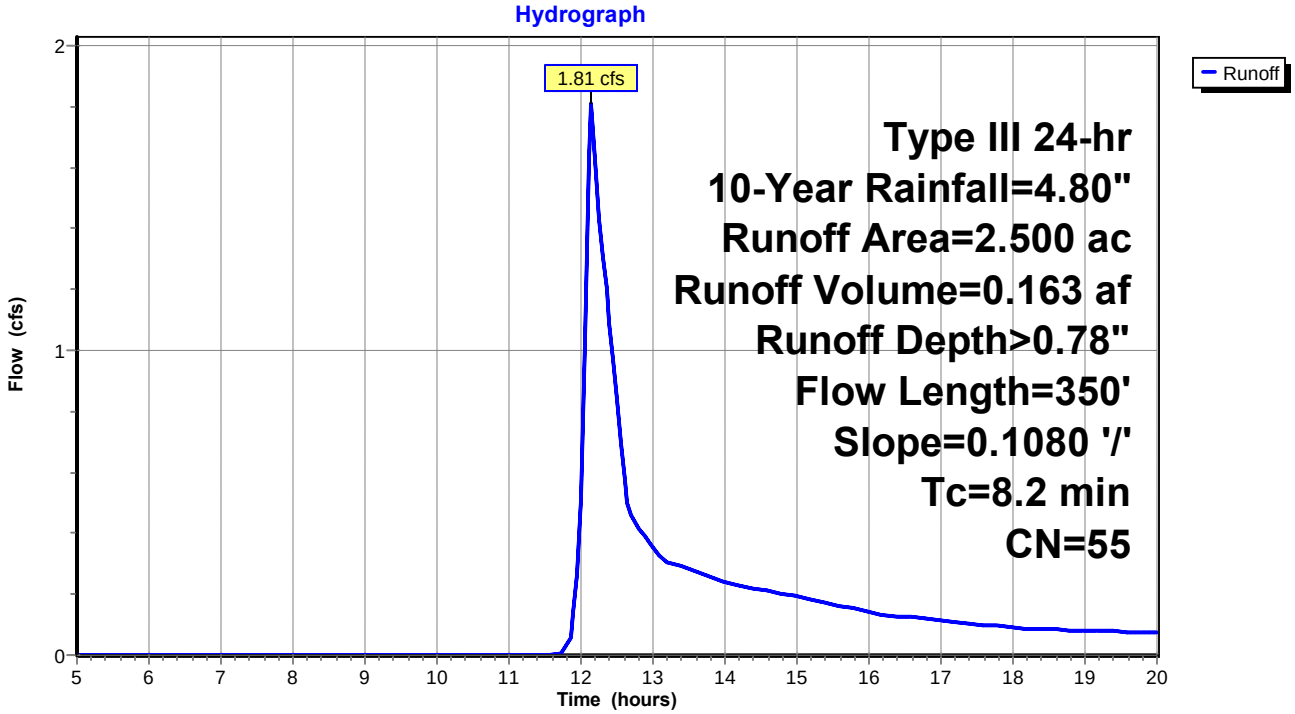
Runoff = 1.81 cfs @ 12.15 hrs, Volume= 0.163 af, Depth> 0.78"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description
2.500	55	Woods, Good, HSG B
2.500		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	350	0.1080	0.71		**Lag/CN Method, Tc-2**

Subcatchment 2S: Drainage Area 2 - Off site East



Summary for Subcatchment 3S: Drainage Area 3 - Switchyard to Wetlands

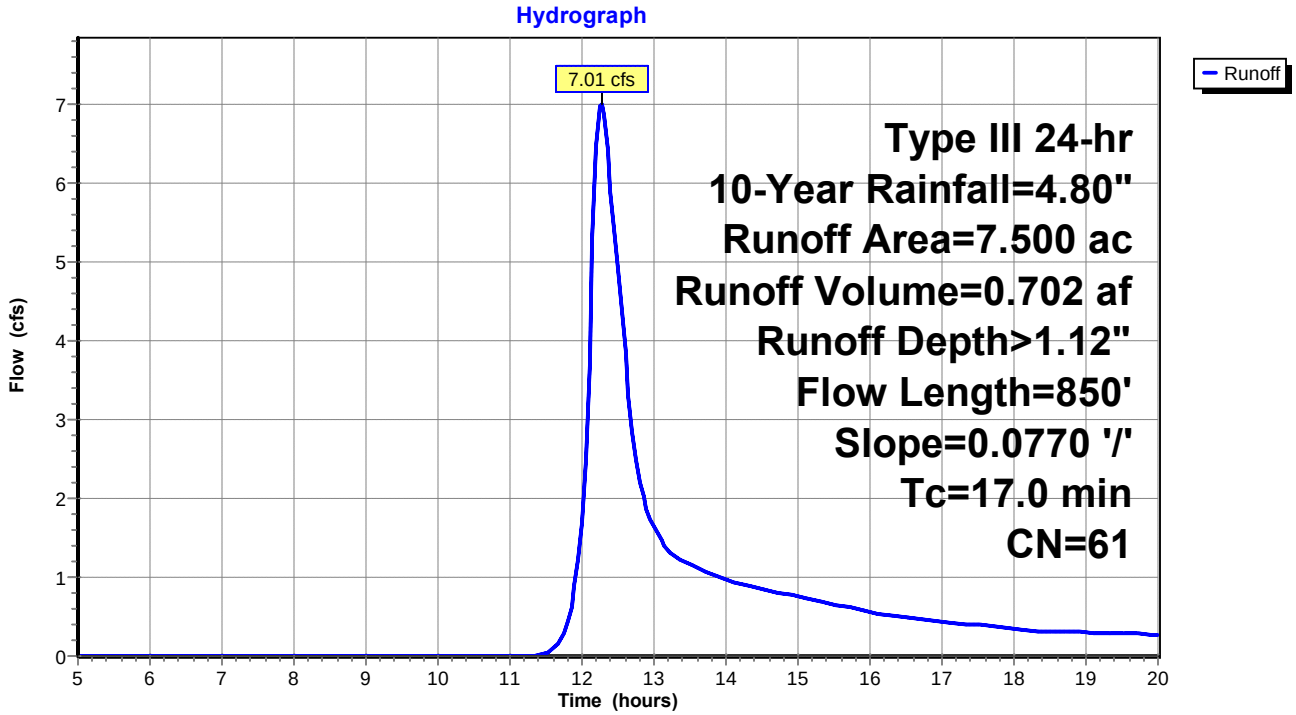
Runoff = 7.01 cfs @ 12.27 hrs, Volume= 0.702 af, Depth> 1.12"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (ac)	CN	Description
*	0.900	98	Roof & Pavement
	1.000	58	Meadow, non-grazed, HSG B
	5.600	55	Woods, Good, HSG B
	7.500	61	Weighted Average
	6.600		88.00% Pervious Area
	0.900		12.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.0	850	0.0770	0.83		**Lag/CN Method, Tc-3**

Subcatchment 3S: Drainage Area 3 - Switchyard to Wetlands



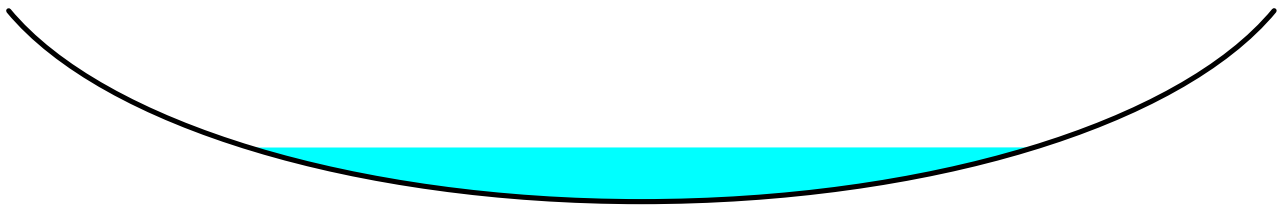
Summary for Reach 1R: Wetlands

Inflow Area = 44.650 ac, 0.34% Impervious, Inflow Depth > 1.00" for 10-Year event
Inflow = 33.41 cfs @ 12.34 hrs, Volume= 3.724 af
Outflow = 24.82 cfs @ 12.87 hrs, Volume= 3.594 af, Atten= 26%, Lag= 31.8 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.23 fps, Min. Travel Time= 17.6 min
Avg. Velocity = 0.69 fps, Avg. Travel Time= 31.5 min

Peak Storage= 26,286 cf @ 12.57 hrs
Average Depth at Peak Storage= 0.28'
Bank-Full Depth= 1.00' Flow Area= 133.3 sf, Capacity= 378.88 cfs

200.00' x 1.00' deep Parabolic Channel, n= 0.035
Length= 1,300.0' Slope= 0.0077 '/'
Inlet Invert= 274.00', Outlet Invert= 264.00'



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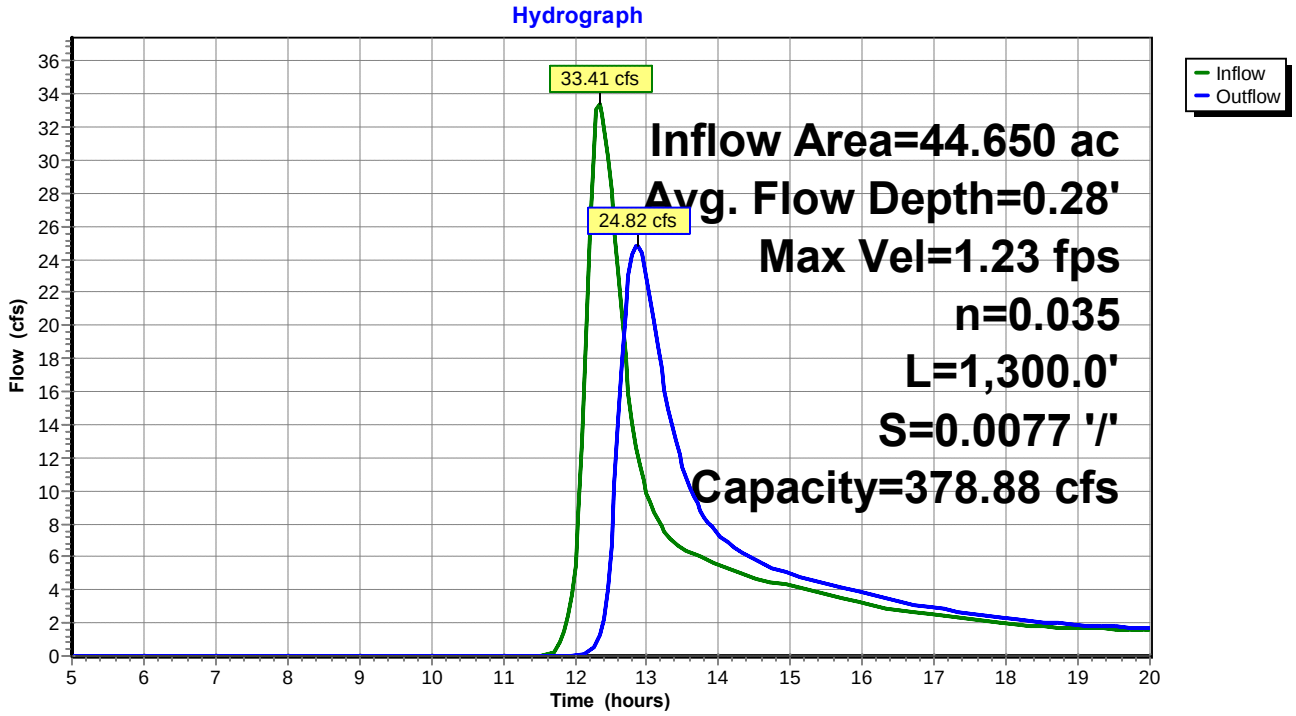
Reach 1R: Wetlands



Summary for Subcatchment 1S: Drainage Area 1 - to Wetlands

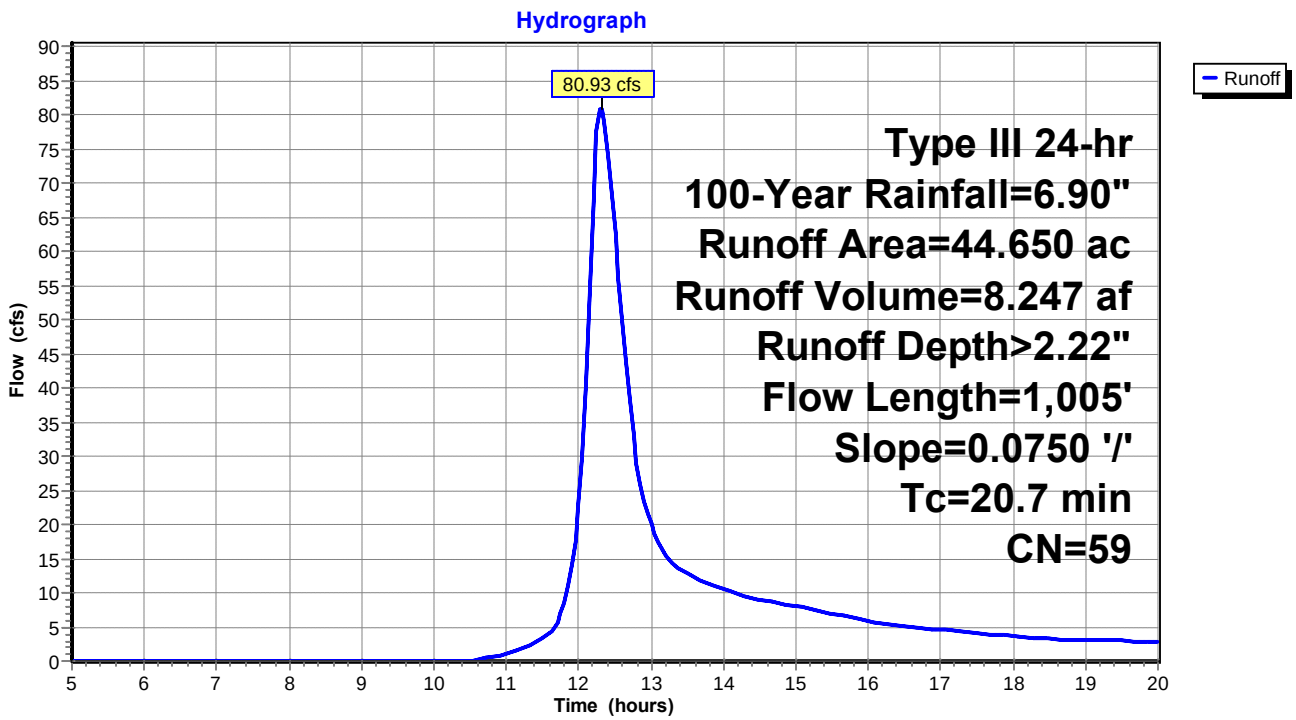
Runoff = 80.93 cfs @ 12.31 hrs, Volume= 8.247 af, Depth> 2.22"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.90"

	Area (ac)	CN	Description
	0.750	68	1 acre lots, 20% imp, HSG B
*	8.600	77	Woods, Good, HSG D (Wetlands)
	35.300	55	Woods, Good, HSG B
	44.650	59	Weighted Average
	44.500		99.66% Pervious Area
	0.150		0.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.7	1,005	0.0750	0.81		**Lag/CN Method, Tc-1**

Subcatchment 1S: Drainage Area 1 - to Wetlands



Summary for Subcatchment 2S: Drainage Area 2 - Off site East

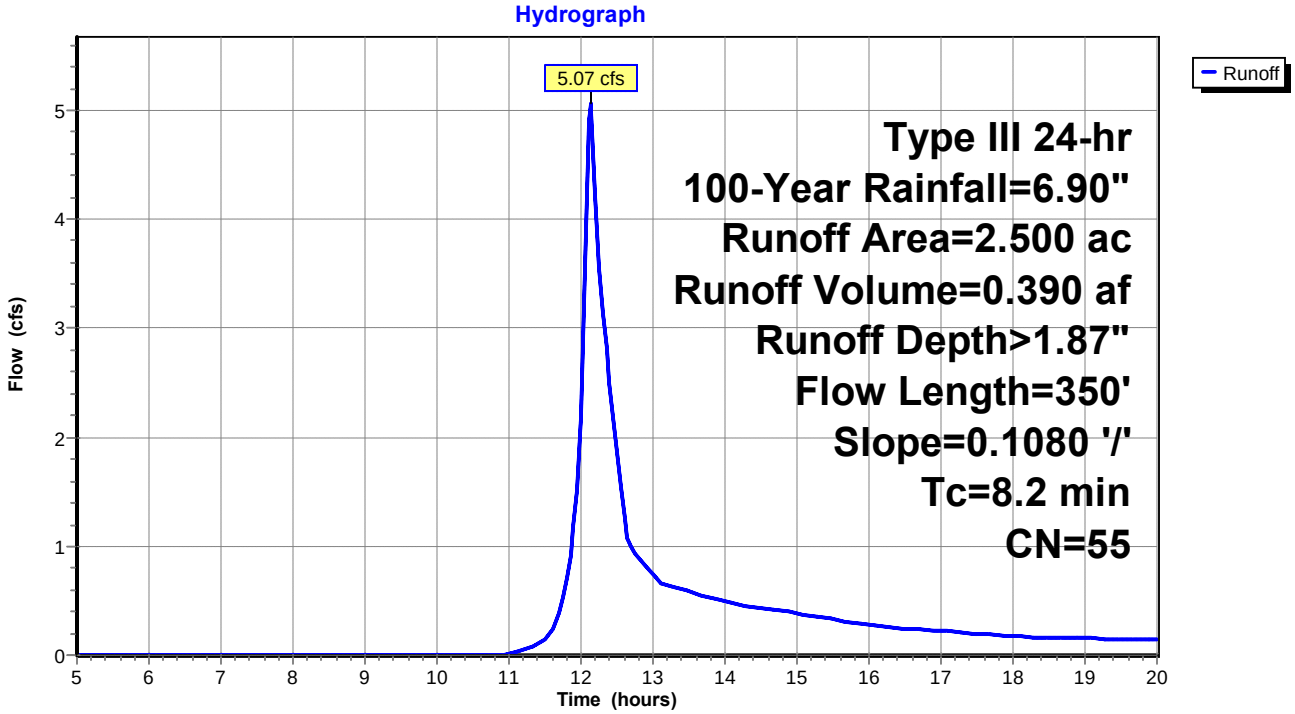
Runoff = 5.07 cfs @ 12.13 hrs, Volume= 0.390 af, Depth> 1.87"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.90"

Area (ac)	CN	Description
2.500	55	Woods, Good, HSG B
2.500		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.2	350	0.1080	0.71		**Lag/CN Method, Tc-2**

Subcatchment 2S: Drainage Area 2 - Off site East



Summary for Subcatchment 3S: Drainage Area 3 - Switchyard to Wetlands

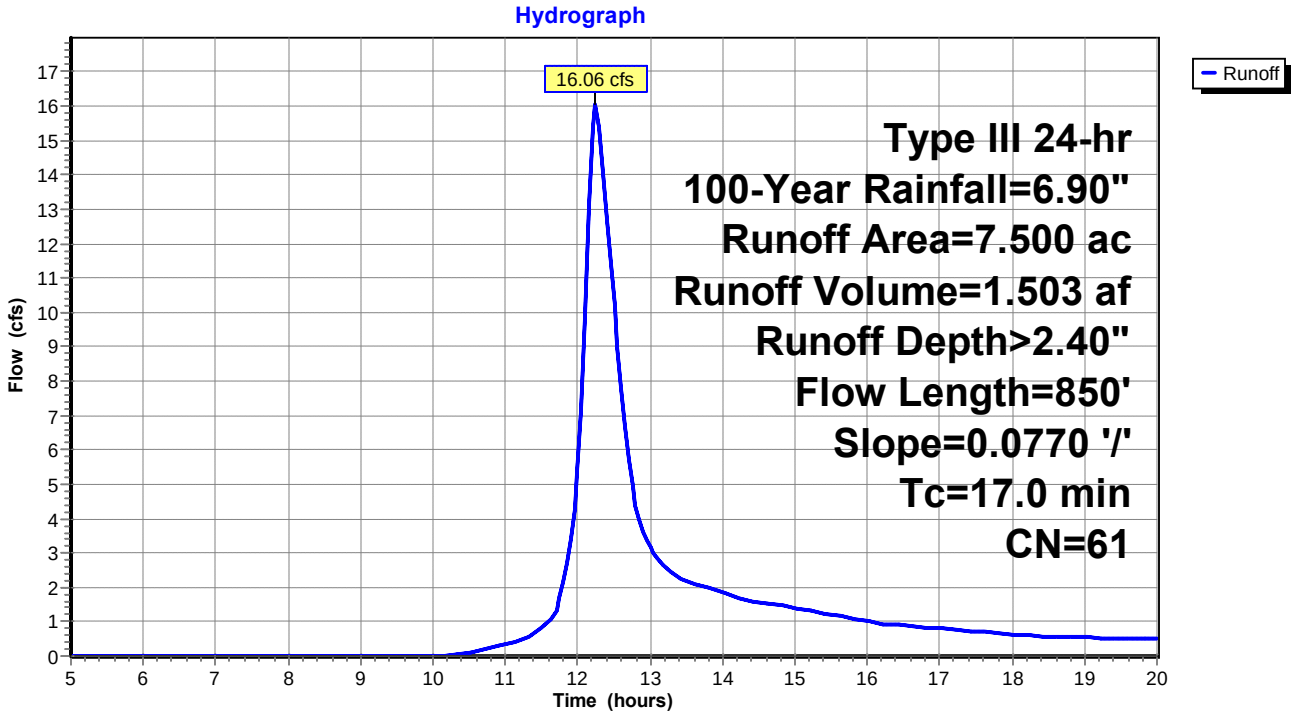
Runoff = 16.06 cfs @ 12.25 hrs, Volume= 1.503 af, Depth> 2.40"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.90"

	Area (ac)	CN	Description
*	0.900	98	Roof & Pavement
	1.000	58	Meadow, non-grazed, HSG B
	5.600	55	Woods, Good, HSG B
	7.500	61	Weighted Average
	6.600		88.00% Pervious Area
	0.900		12.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.0	850	0.0770	0.83		**Lag/CN Method, Tc-3**

Subcatchment 3S: Drainage Area 3 - Switchyard to Wetlands



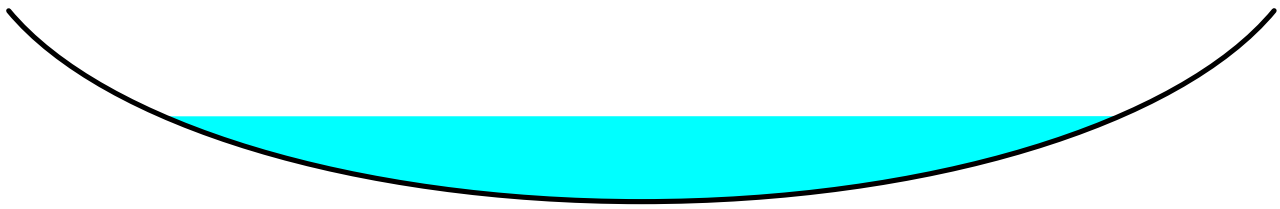
Summary for Reach 1R: Wetlands

Inflow Area = 44.650 ac, 0.34% Impervious, Inflow Depth > 2.22" for 100-Year event
Inflow = 80.93 cfs @ 12.31 hrs, Volume= 8.247 af
Outflow = 65.99 cfs @ 12.69 hrs, Volume= 8.057 af, Atten= 18%, Lag= 23.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.66 fps, Min. Travel Time= 13.0 min
Avg. Velocity = 0.80 fps, Avg. Travel Time= 27.0 min

Peak Storage= 51,844 cf @ 12.47 hrs
Average Depth at Peak Storage= 0.45'
Bank-Full Depth= 1.00' Flow Area= 133.3 sf, Capacity= 378.88 cfs

200.00' x 1.00' deep Parabolic Channel, n= 0.035
Length= 1,300.0' Slope= 0.0077 '/'
Inlet Invert= 274.00', Outlet Invert= 264.00'



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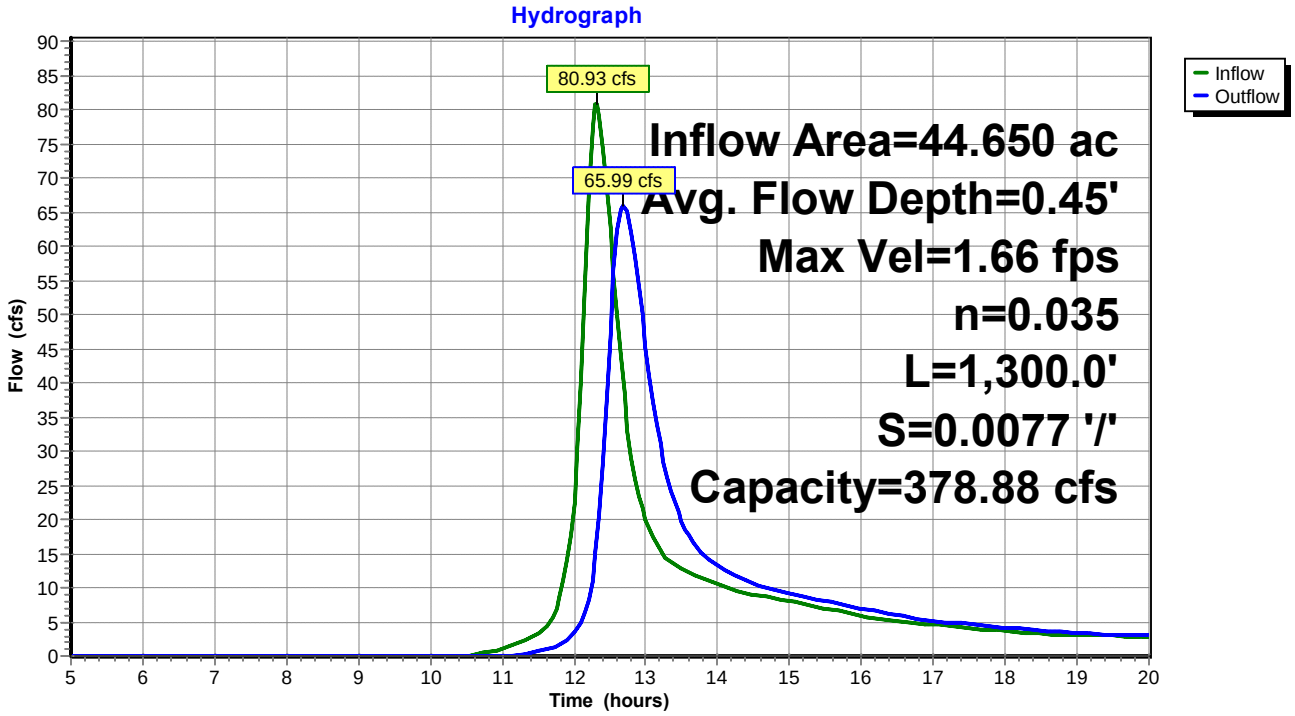
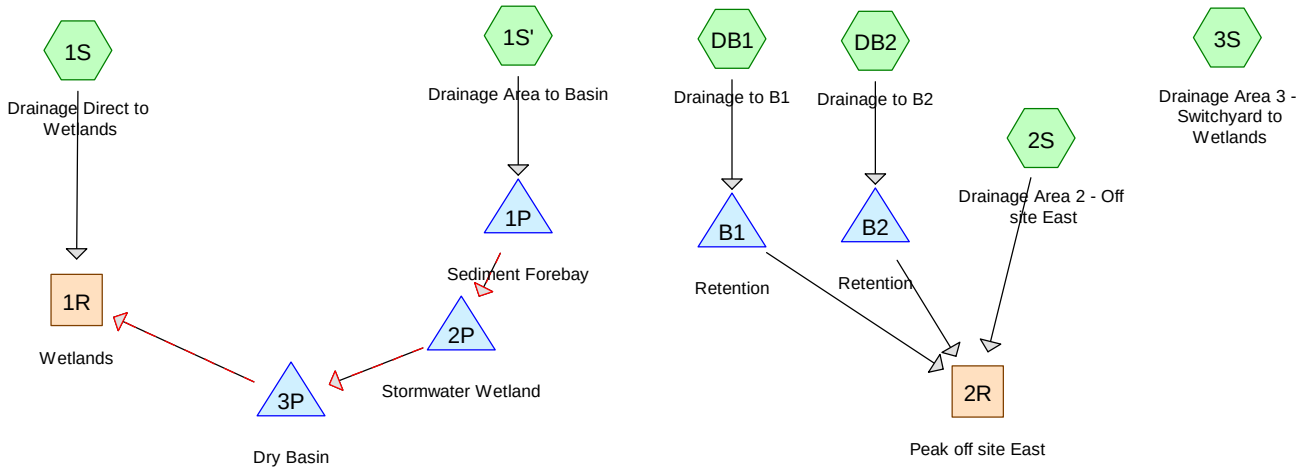
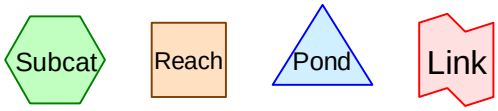
Reach 1R: Wetlands



PROPOSED CONDITIONS DRAINAGE COMPUTATIONS
2, 10 & 100-YEAR STORMS





Routing Diagram for Proposed Drainage
Prepared by Microsoft, Printed 8/12/2016
HydroCAD® 10.00 s/n 07240 © 2011 HydroCAD Software Solutions LLC

Summary for Subcatchment 1S: Drainage Direct to Wetlands

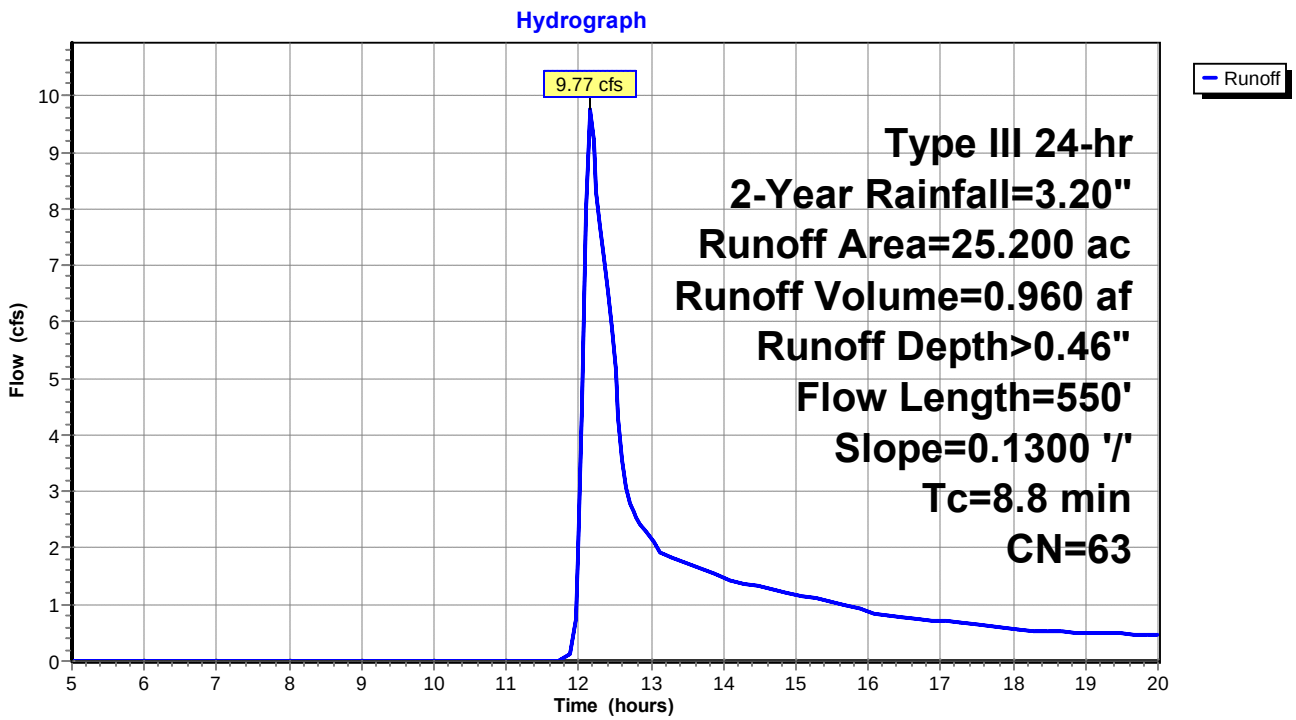
Runoff = 9.77 cfs @ 12.16 hrs, Volume= 0.960 af, Depth> 0.46"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.20"

	Area (ac)	CN	Description
	14.900	55	Woods, Good, HSG B
	8.600	77	Woods, Good, HSG D
	1.350	61	>75% Grass cover, Good, HSG B
*	0.350	72	Crushed Stone Surface, HSG B
	25.200	63	Weighted Average
	25.200		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.8	550	0.1300	1.05		**Lag/CN Method, Tc-1**

Subcatchment 1S: Drainage Direct to Wetlands



Summary for Subcatchment 1S': Drainage Area to Basin

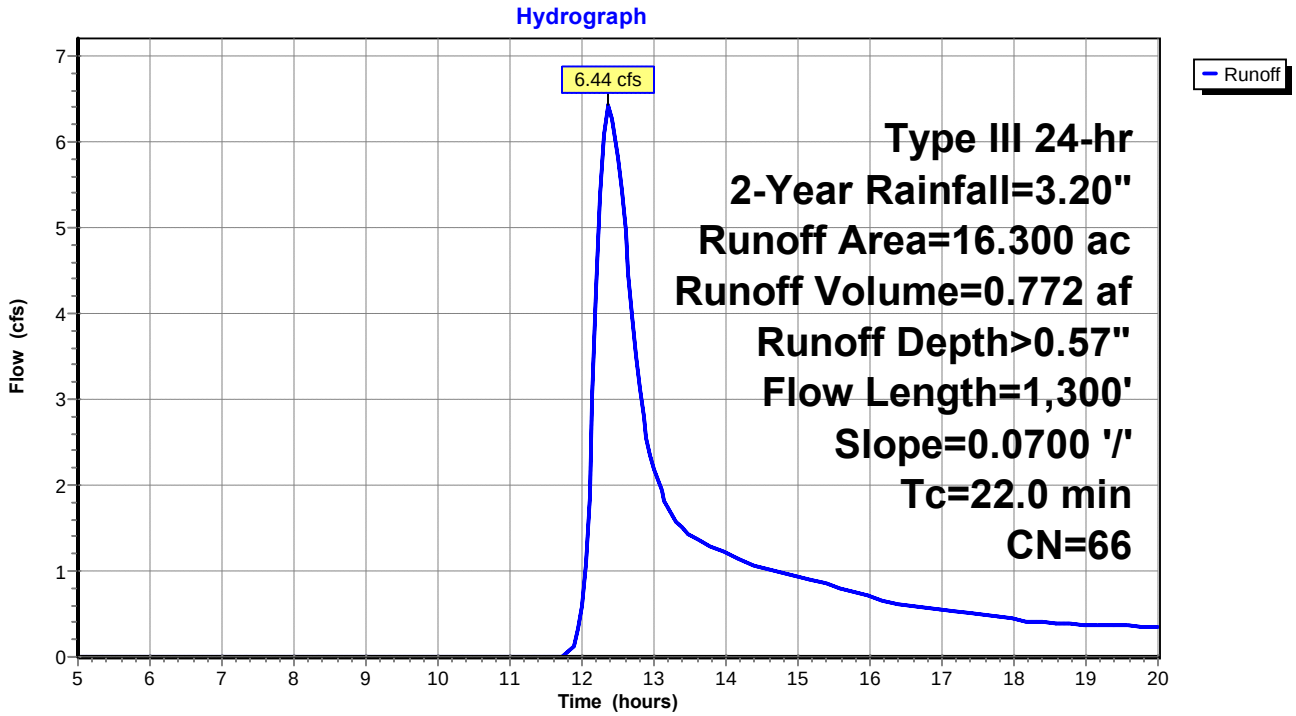
Runoff = 6.44 cfs @ 12.37 hrs, Volume= 0.772 af, Depth> 0.57"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.20"

	Area (ac)	CN	Description
*	6.400	65	Impervious roof & pavement
*	4.500	72	Crushed Stone surface, HSG B
	5.400	61	>75% Grass cover, Good, HSG B
	16.300	66	Weighted Average
	16.300		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.0	1,300	0.0700	0.99		**Lag/CN Method, Tc-1**

Subcatchment 1S': Drainage Area to Basin



Summary for Subcatchment 2S: Drainage Area 2 - Off site East

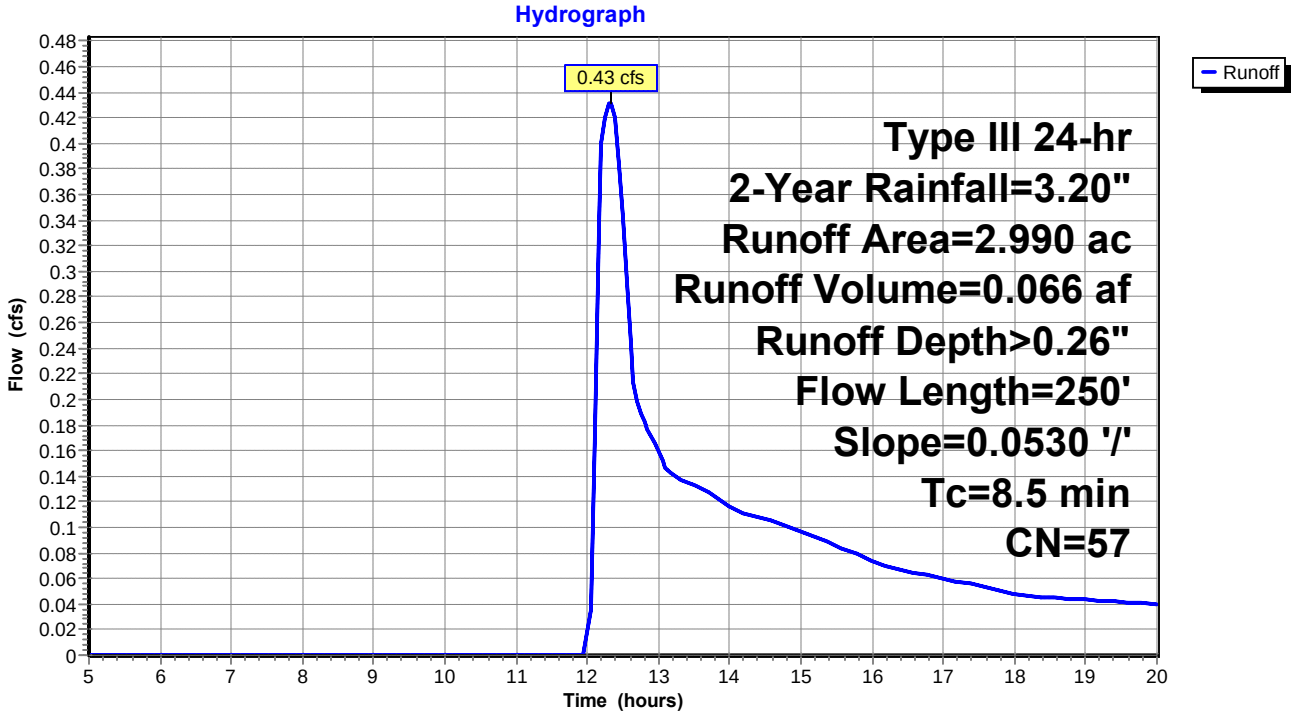
Runoff = 0.43 cfs @ 12.32 hrs, Volume= 0.066 af, Depth> 0.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.20"

Area (ac)	CN	Description
1.760	55	Woods, Good, HSG B
1.230	61	>75% Grass cover, Good, HSG B
2.990	57	Weighted Average
2.990		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.5	250	0.0530	0.49		**Lag/CN Method, Tc-2**

Subcatchment 2S: Drainage Area 2 - Off site East



Summary for Subcatchment 3S: Drainage Area 3 - Switchyard to Wetlands

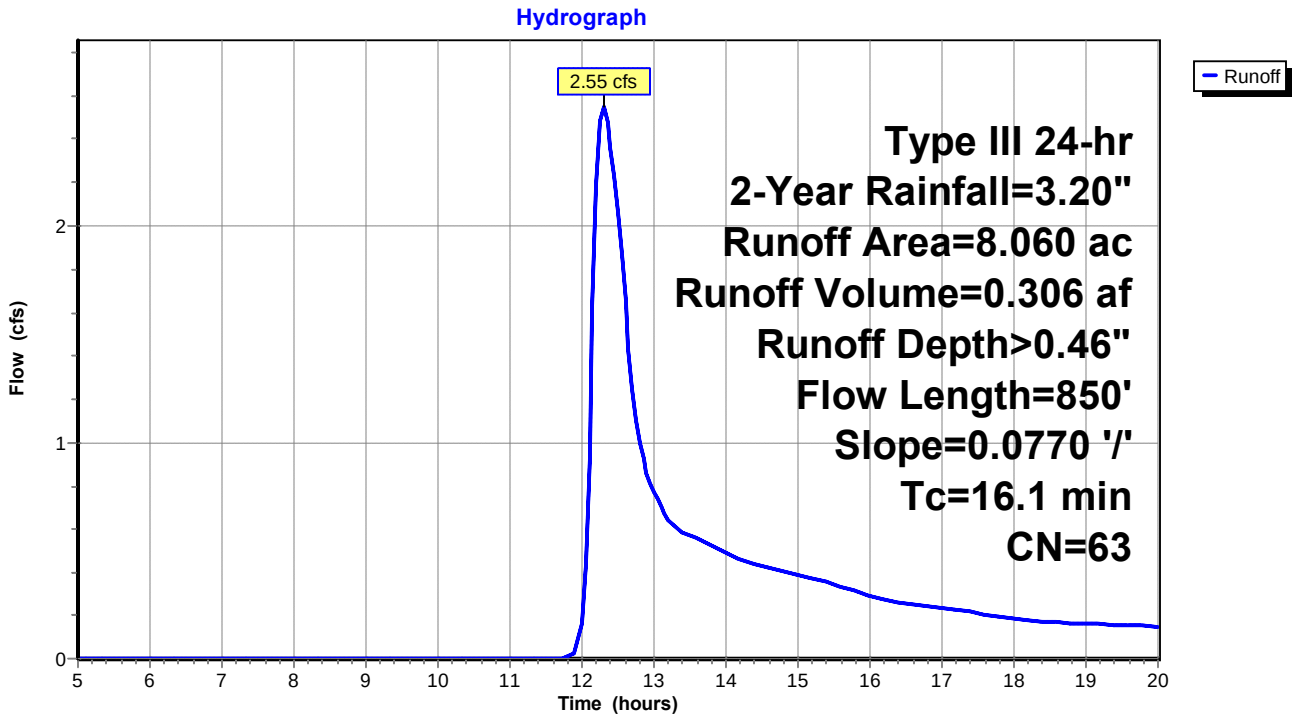
Runoff = 2.55 cfs @ 12.30 hrs, Volume= 0.306 af, Depth> 0.46"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.20"

	Area (ac)	CN	Description
*	0.810	98	Roof & Pavement
	1.000	58	Meadow, non-grazed, HSG B
	4.650	55	Woods, Good, HSG B
*	1.600	72	Crushed stone surface
	8.060	63	Weighted Average
	7.250		89.95% Pervious Area
	0.810		10.05% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.1	850	0.0770	0.88		**Lag/CN Method, Tc-3**

Subcatchment 3S: Drainage Area 3 - Switchyard to Wetlands



Summary for Subcatchment DB1: Drainage to B1

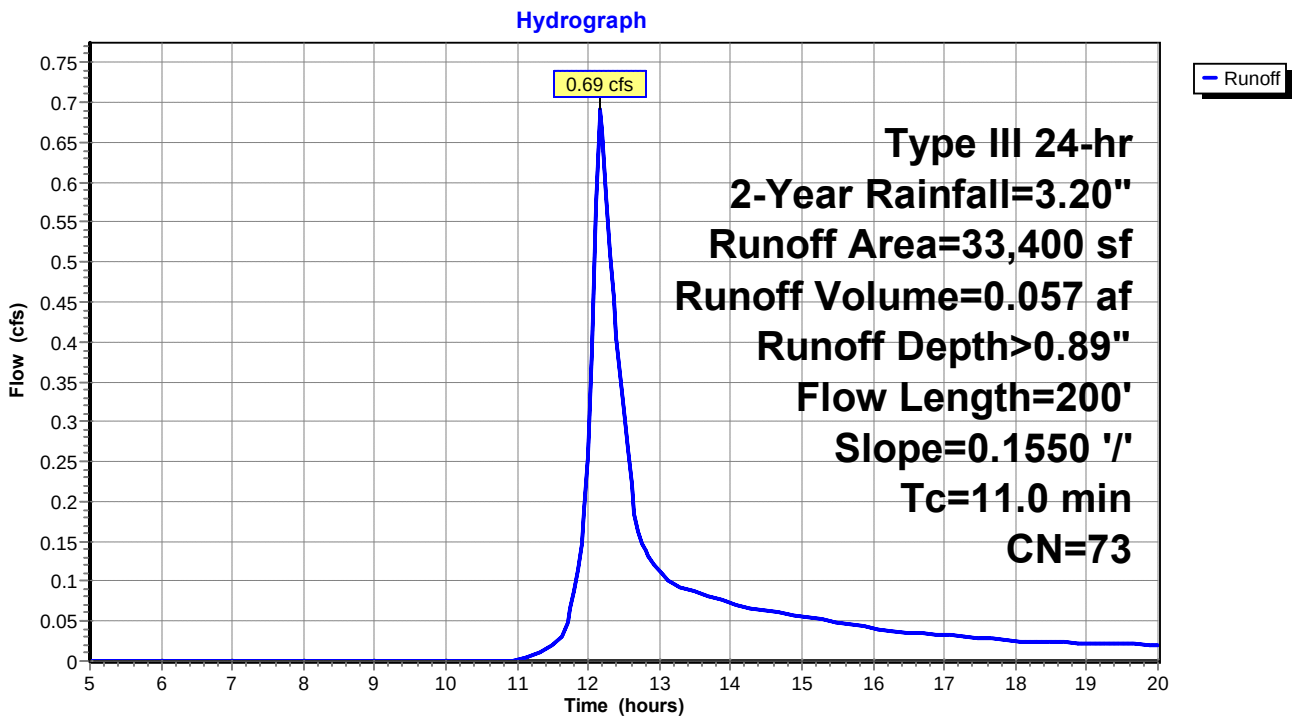
Runoff = 0.69 cfs @ 12.17 hrs, Volume= 0.057 af, Depth> 0.89"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.20"

Area (sf)	CN	Description
22,400	61	>75% Grass cover, Good, HSG B
11,000	98	Roofs, HSG B
33,400	73	Weighted Average
22,400		67.07% Pervious Area
11,000		32.93% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.0	200	0.1550	0.30		**Sheet Flow, Tc-DB-1** Grass: Dense n= 0.240 P2= 3.20"

Subcatchment DB1: Drainage to B1



Summary for Subcatchment DB2: Drainage to B2

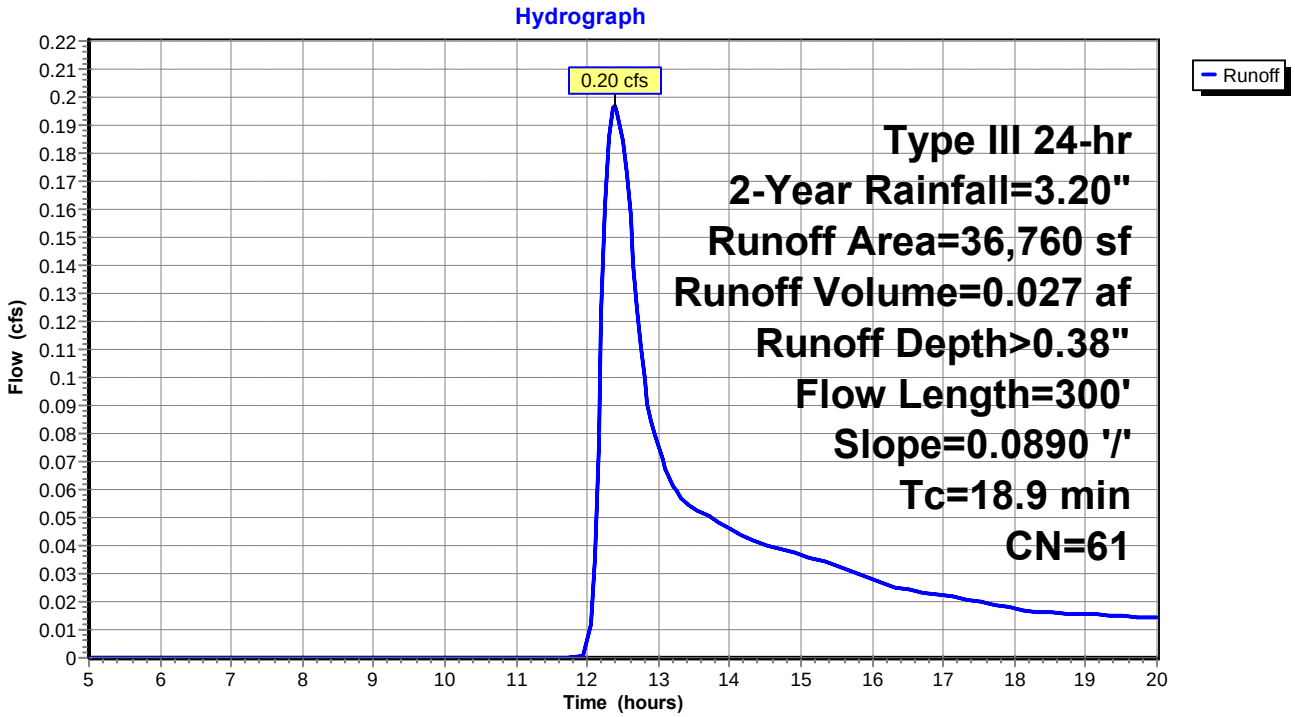
Runoff = 0.20 cfs @ 12.38 hrs, Volume= 0.027 af, Depth> 0.38"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.20"

Area (sf)	CN	Description
36,760	61	>75% Grass cover, Good, HSG B
36,760		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.9	300	0.0890	0.26		**Sheet Flow, Tc-DB2** Grass: Dense n= 0.240 P2= 3.20"

Subcatchment DB2: Drainage to B2



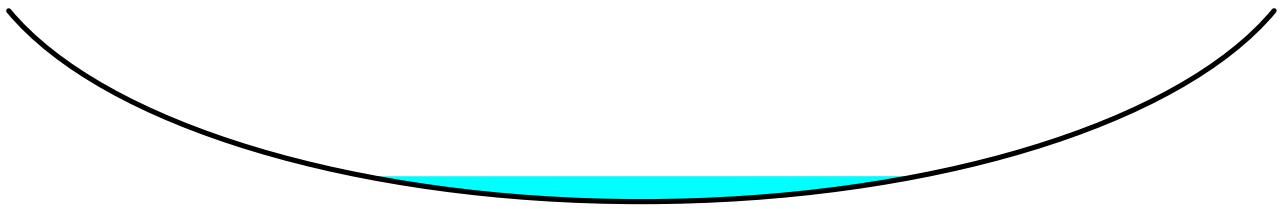
Summary for Reach 1R: Wetlands

Inflow Area = 41.500 ac, 0.00% Impervious, Inflow Depth > 0.28" for 2-Year event
Inflow = 9.77 cfs @ 12.16 hrs, Volume= 0.960 af
Outflow = 4.75 cfs @ 13.01 hrs, Volume= 0.900 af, Atten= 51%, Lag= 51.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.74 fps, Min. Travel Time= 29.3 min
Avg. Velocity = 0.47 fps, Avg. Travel Time= 45.7 min

Peak Storage= 8,370 cf @ 12.52 hrs
Average Depth at Peak Storage= 0.13'
Bank-Full Depth= 1.00' Flow Area= 133.3 sf, Capacity= 378.88 cfs

200.00' x 1.00' deep Parabolic Channel, n= 0.035
Length= 1,300.0' Slope= 0.0077 '/'
Inlet Invert= 274.00', Outlet Invert= 264.00'



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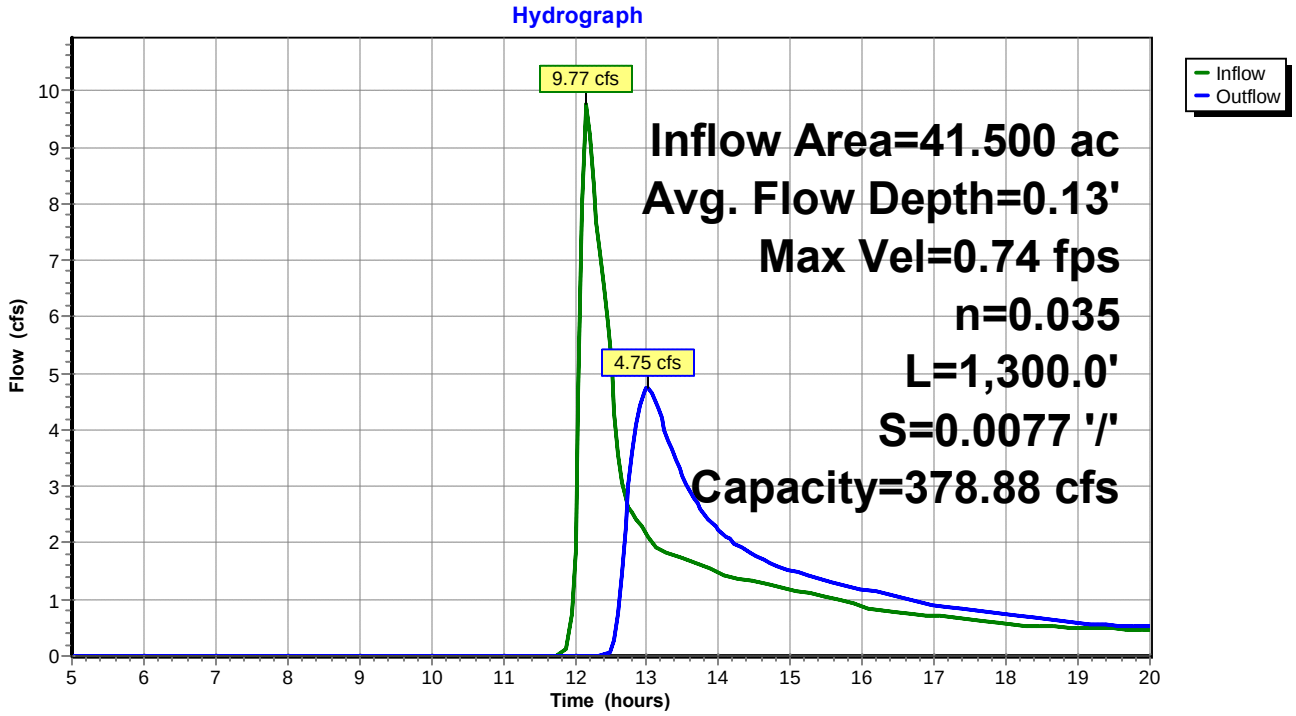
Reach 1R: Wetlands

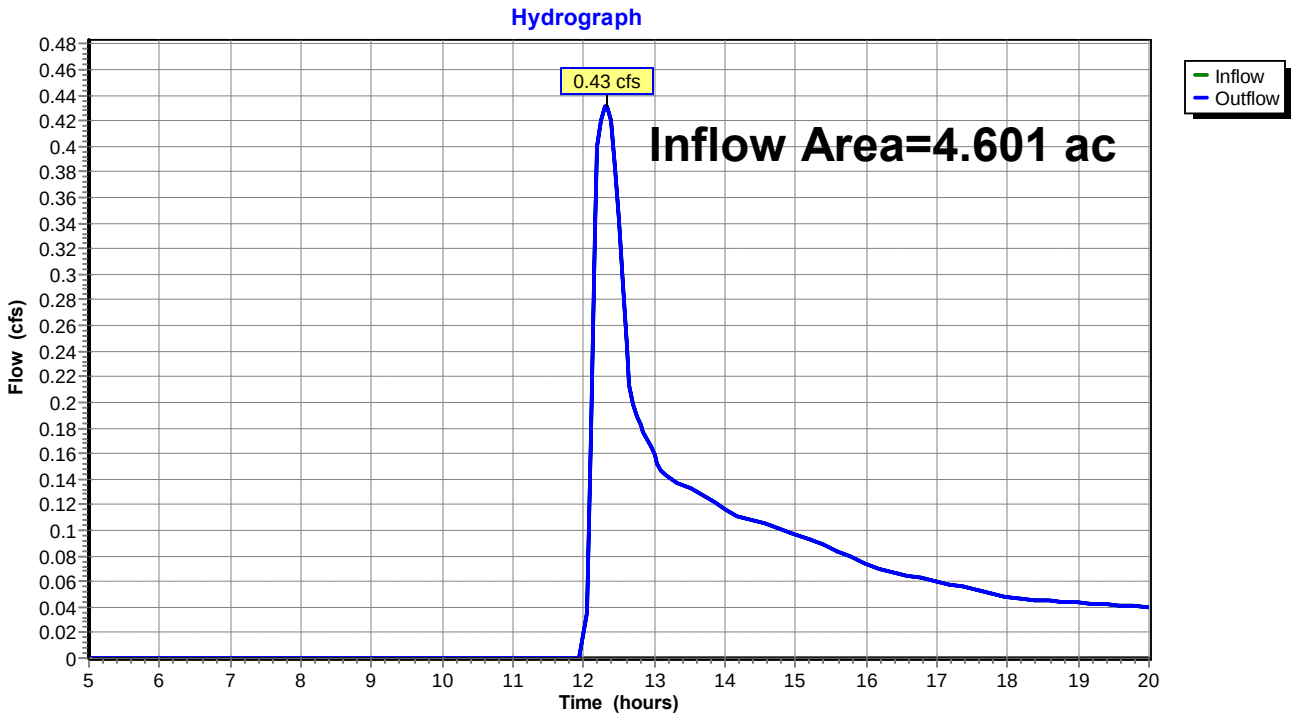


Summary for Reach 2R: Peak off site East

Inflow Area = 4.601 ac, 5.49% Impervious, Inflow Depth > 0.17" for 2-Year event
Inflow = 0.43 cfs @ 12.32 hrs, Volume= 0.066 af
Outflow = 0.43 cfs @ 12.32 hrs, Volume= 0.066 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach 2R: Peak off site East



Summary for Pond 1P: Sediment Forebay

Inflow Area =	16.300 ac,	0.00% Impervious,	Inflow Depth >	0.57"	for 2-Year event
Inflow =	6.44 cfs @	12.37 hrs,	Volume=	0.772 af	
Outflow =	4.80 cfs @	12.62 hrs,	Volume=	0.621 af,	Atten= 25%, Lag= 15.1 min
Primary =	4.80 cfs @	12.62 hrs,	Volume=	0.621 af	
Secondary =	0.00 cfs @	5.00 hrs,	Volume=	0.000 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 278.47' @ 12.62 hrs Surf.Area= 4,103 sf Storage= 8,076 cf

Plug-Flow detention time= 85.4 min calculated for 0.621 af (80% of inflow)
Center-of-Mass det. time= 32.6 min (883.8 - 851.2)

Volume	Invert	Avail.Storage	Storage Description
#1	275.00'	15,801 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

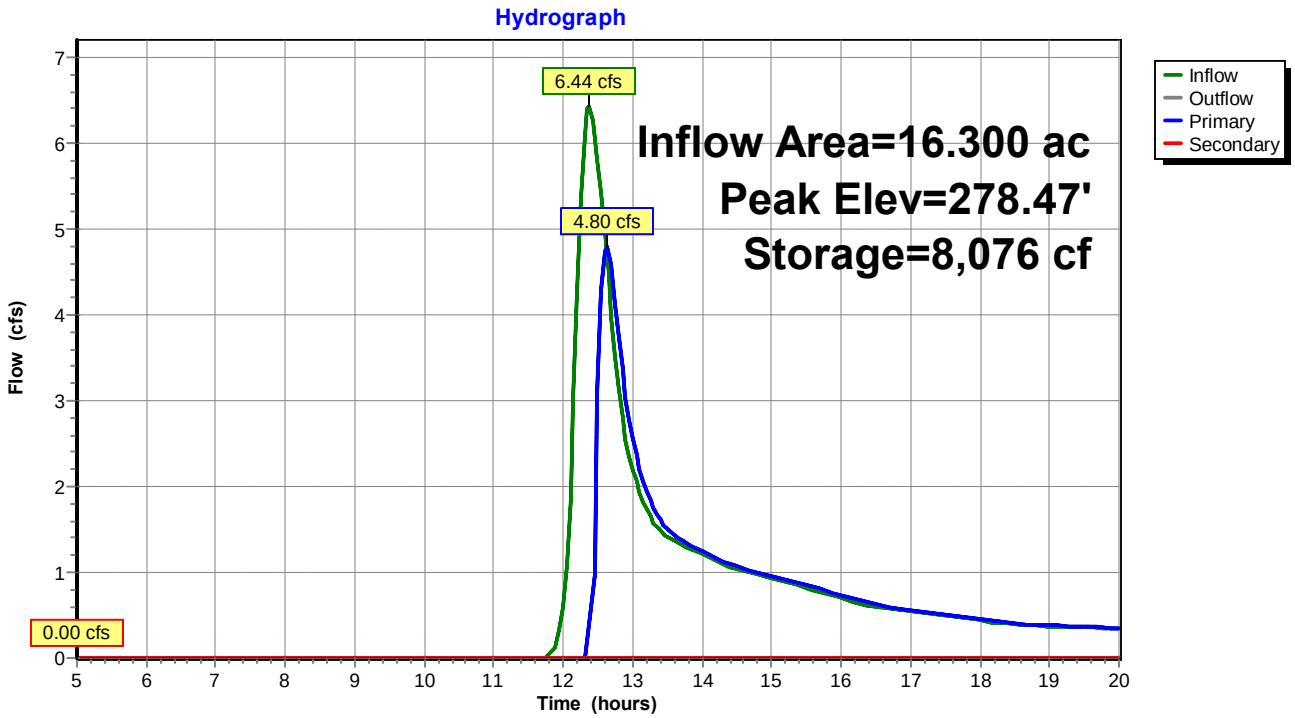
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
275.00	925	0	0
276.00	1,532	1,229	1,229
278.00	3,530	5,062	6,291
280.00	5,980	9,510	15,801

Device	Routing	Invert	Outlet Devices
#1	Secondary	279.50'	**24.0' long x 7.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.42 2.53 2.70 2.69 2.68 2.67 2.66 2.65 2.65 2.65 2.66 2.65 2.66 2.67 2.69 2.71 2.76
#2	Primary	278.00'	**84.0" W x 18.0" H Vert. Orifice/Grate** C= 0.400

Primary OutFlow Max=4.74 cfs @ 12.62 hrs HW=278.46' (Free Discharge)
└**2=Orifice/Grate** (Orifice Controls 4.74 cfs @ 1.46 fps)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=275.00' (Free Discharge)
└**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 1P: Sediment Forebay



Summary for Pond 2P: Stormwater Wetland

Inflow Area =	16.300 ac,	0.00% Impervious,	Inflow Depth >	0.46"	for 2-Year event
Inflow =	4.80 cfs @	12.62 hrs,	Volume=	0.621 af	
Outflow =	4.21 cfs @	12.75 hrs,	Volume=	0.587 af,	Atten= 12%, Lag= 7.4 min
Primary =	4.21 cfs @	12.75 hrs,	Volume=	0.587 af	
Secondary =	0.00 cfs @	5.00 hrs,	Volume=	0.000 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 276.93' @ 12.75 hrs Surf.Area= 2,906 sf Storage= 2,448 cf

Plug-Flow detention time= 27.3 min calculated for 0.587 af (95% of inflow)
Center-of-Mass det. time= 11.0 min (894.8 - 883.8)

Volume	Invert	Avail.Storage	Storage Description
#1	276.00'	15,825 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

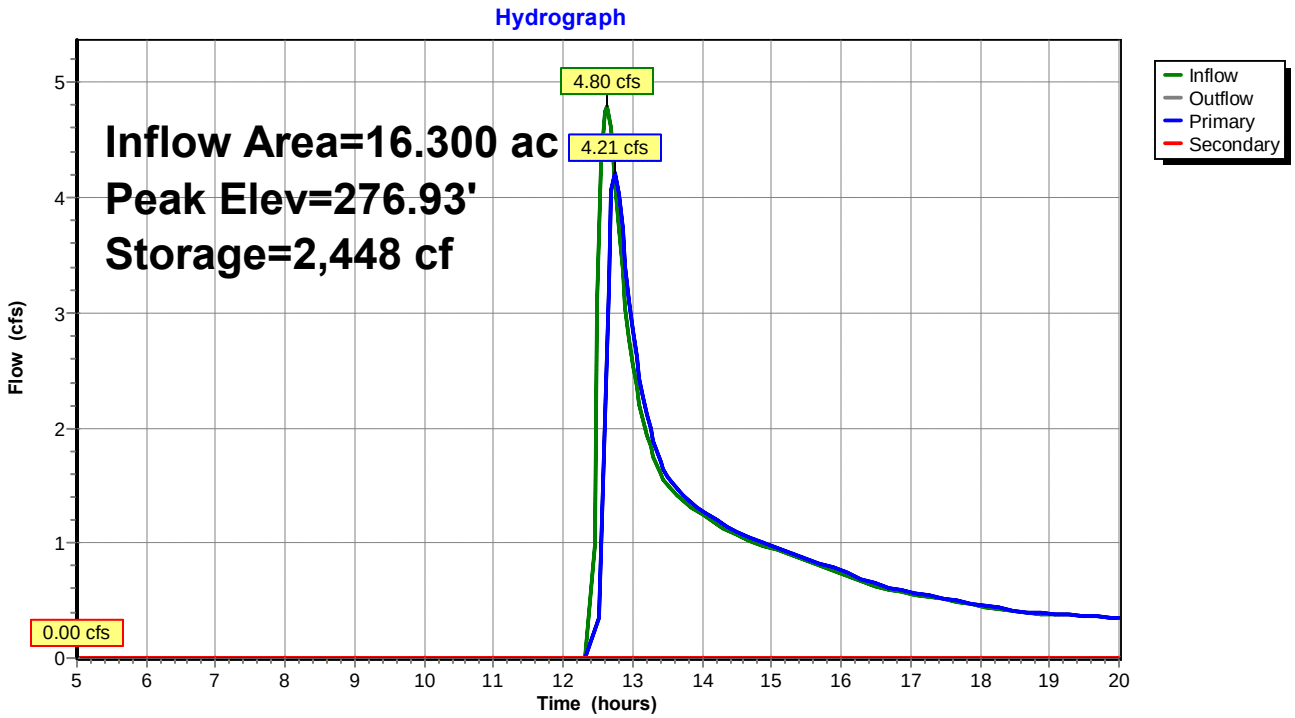
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
276.00	2,365	0	0
278.00	3,530	5,895	5,895
280.00	6,400	9,930	15,825

Device	Routing	Invert	Outlet Devices
#1	Secondary	279.50'	**24.0' long x 7.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.42 2.53 2.70 2.69 2.68 2.67 2.66 2.65 2.65 2.65 2.66 2.65 2.66 2.67 2.69 2.71 2.76
#2	Primary	276.50'	**84.0" W x 36.0" H Vert. Orifice/Grate** C= 0.400

Primary OutFlow Max=4.20 cfs @ 12.75 hrs HW=276.93' (Free Discharge)
└**2=Orifice/Grate** (Orifice Controls 4.20 cfs @ 1.40 fps)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=276.00' (Free Discharge)
└**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 2P: Stormwater Wetland



Summary for Pond 3P: Dry Basin

Inflow Area =	16.300 ac,	0.00% Impervious,	Inflow Depth >	0.43"	for 2-Year event
Inflow =	4.21 cfs @	12.75 hrs,	Volume=	0.587 af	
Outflow =	0.50 cfs @	17.69 hrs,	Volume=	0.289 af,	Atten= 88%, Lag= 296.7 min
Discarded =	0.50 cfs @	17.69 hrs,	Volume=	0.289 af	
Primary =	0.00 cfs @	5.00 hrs,	Volume=	0.000 af	
Secondary =	0.00 cfs @	5.00 hrs,	Volume=	0.000 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 276.80' @ 17.69 hrs Surf.Area= 7,675 sf Storage= 13,748 cf

Plug-Flow detention time= 192.8 min calculated for 0.288 af (49% of inflow)
Center-of-Mass det. time= 92.8 min (987.6 - 894.8)

Volume	Invert	Avail.Storage	Storage Description
#1	274.50'	44,586 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
274.50	4,205	0	0
275.00	4,780	2,246	2,246
276.00	6,750	5,765	8,011
278.00	9,075	15,825	23,836
280.00	11,675	20,750	44,586

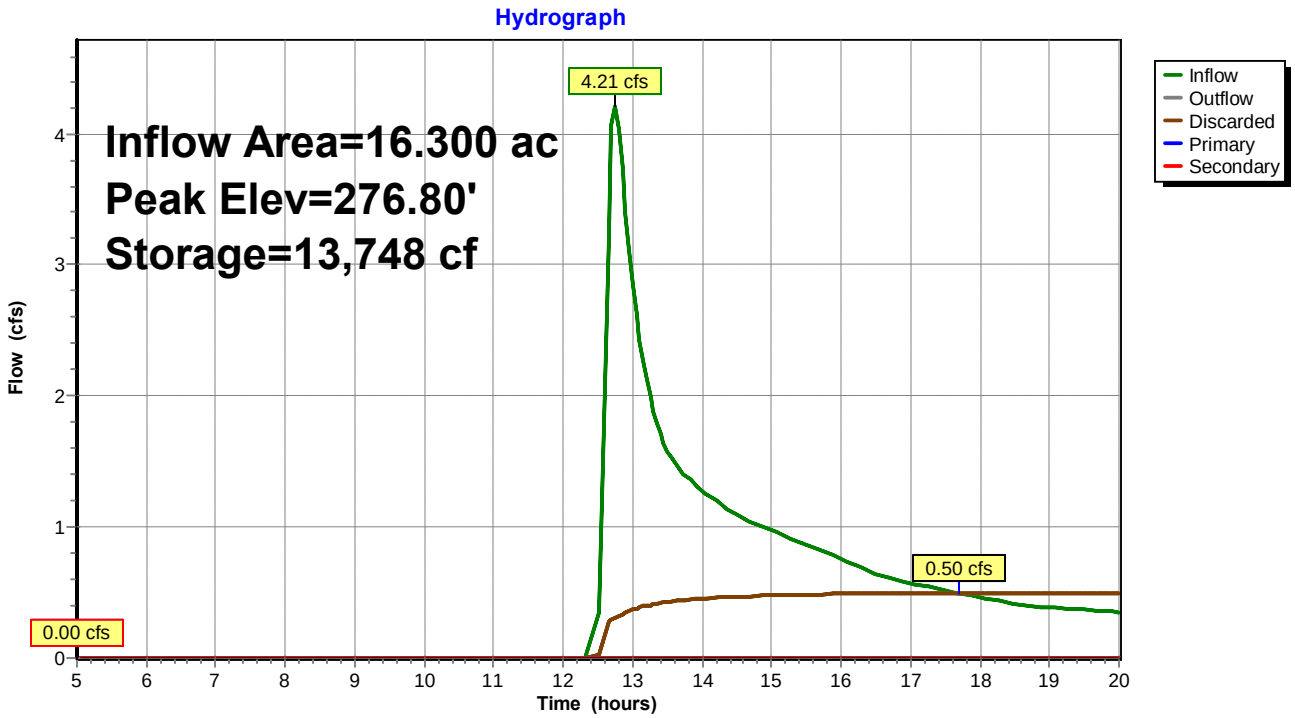
Device	Routing	Invert	Outlet Devices
#1	Secondary	279.00'	**16.0' long x 16.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Primary	277.00'	**6.0" Round Culvert** L= 28.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 277.00' / 275.00' S= 0.0714 '/' Cc= 0.900 n= 0.012, Flow Area= 0.20 sf
#3	Discarded	274.50'	**2.800 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.50 cfs @ 17.69 hrs HW=276.80' (Free Discharge)
└**3=Exfiltration** (Exfiltration Controls 0.50 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=274.50' (Free Discharge)
└**2=Culvert** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=274.50' (Free Discharge)
└**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 3P: Dry Basin



Summary for Pond B1: Retention

Inflow Area = 0.767 ac, 32.93% Impervious, Inflow Depth > 0.89" for 2-Year event
Inflow = 0.69 cfs @ 12.17 hrs, Volume= 0.057 af
Outflow = 0.29 cfs @ 12.53 hrs, Volume= 0.057 af, Atten= 59%, Lag= 21.7 min
Discarded = 0.29 cfs @ 12.53 hrs, Volume= 0.057 af
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 315.12' @ 12.53 hrs Surf.Area= 4,410 sf Storage= 464 cf

Plug-Flow detention time= 12.1 min calculated for 0.057 af (99% of inflow)
Center-of-Mass det. time= 11.1 min (835.7 - 824.6)

Volume	Invert	Avail.Storage	Storage Description
#1	315.00'	19,555 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

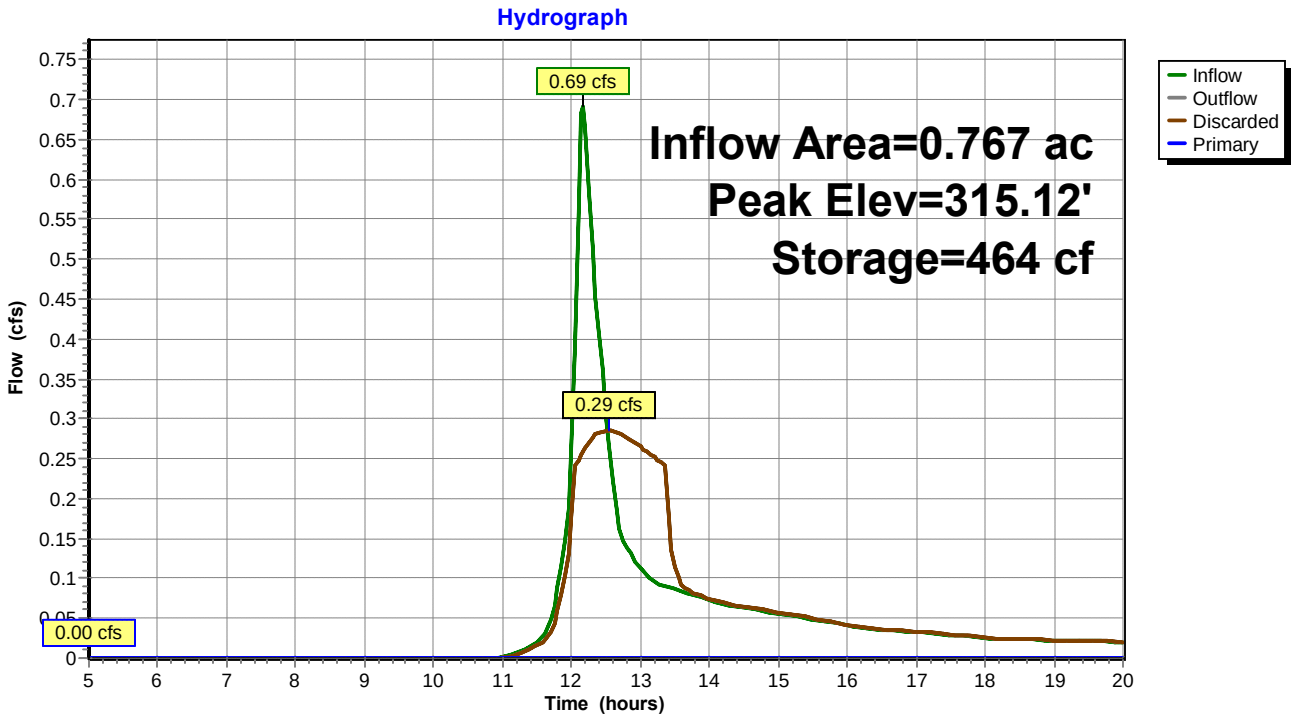
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
315.00	3,590	0	0
316.00	10,660	7,125	7,125
317.00	14,200	12,430	19,555

Device	Routing	Invert	Outlet Devices
#1	Primary	316.50'	**10.0' long x 20.0' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60
			Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Discarded	315.00'	**2.800 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.29 cfs @ 12.53 hrs HW=315.12' (Free Discharge)
└**2=Exfiltration** (Exfiltration Controls 0.29 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=315.00' (Free Discharge)
└**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond B1: Retention



Summary for Pond B2: Retention

Inflow Area =	0.844 ac,	0.00% Impervious,	Inflow Depth >	0.38"	for 2-Year event
Inflow =	0.20 cfs @	12.38 hrs,	Volume=	0.027 af	
Outflow =	0.19 cfs @	12.49 hrs,	Volume=	0.027 af,	Atten= 6%, Lag= 6.7 min
Discarded =	0.19 cfs @	12.49 hrs,	Volume=	0.027 af	
Primary =	0.00 cfs @	5.00 hrs,	Volume=	0.000 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 312.02' @ 12.49 hrs Surf.Area= 2,992 sf Storage= 57 cf

Plug-Flow detention time= 5.1 min calculated for 0.027 af (100% of inflow)
Center-of-Mass det. time= 3.9 min (869.8 - 865.9)

Volume	Invert	Avail.Storage	Storage Description
#1	312.00'	6,150 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

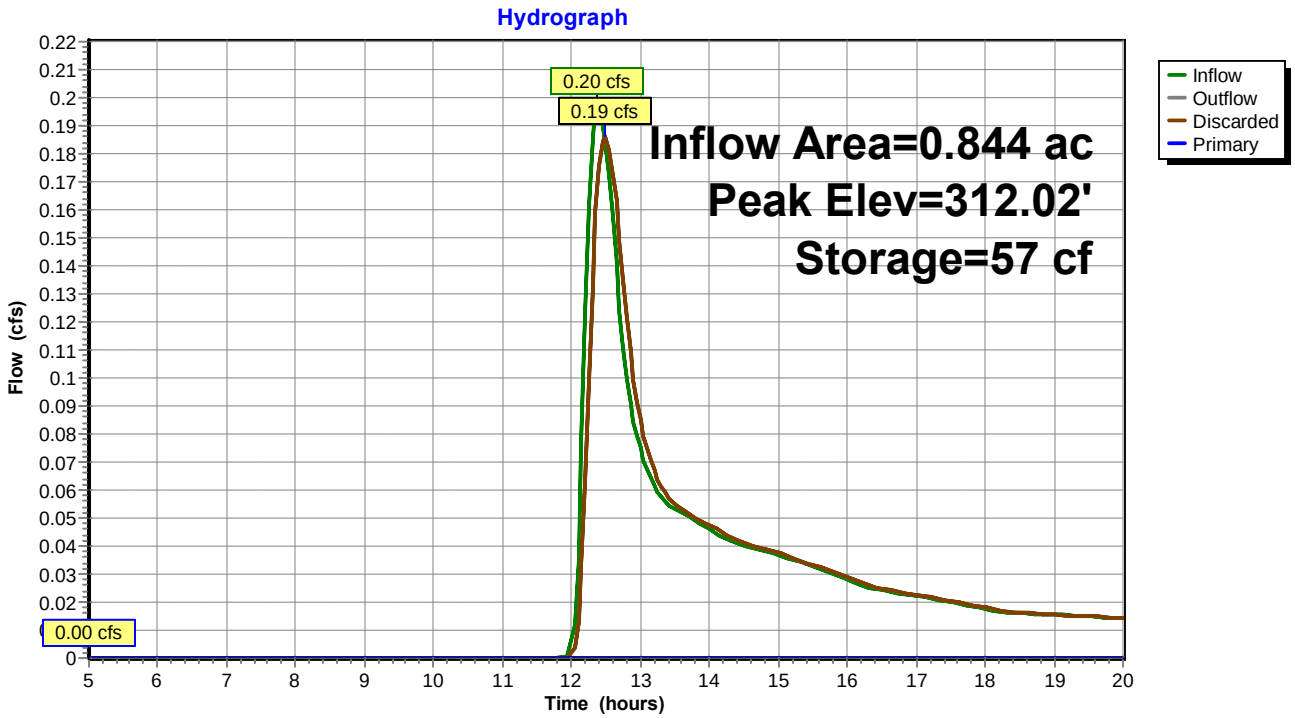
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
312.00	2,990	0	0
314.00	3,160	6,150	6,150

Device	Routing	Invert	Outlet Devices
#1	Primary	313.50'	**10.0' long x 20.0' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60
			Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Discarded	312.00'	**2.800 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.19 cfs @ 12.49 hrs HW=312.02' (Free Discharge)
↑└**2=Exfiltration** (Exfiltration Controls 0.19 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=312.00' (Free Discharge)
↑└**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond B2: Retention



Summary for Subcatchment 1S: Drainage Direct to Wetlands

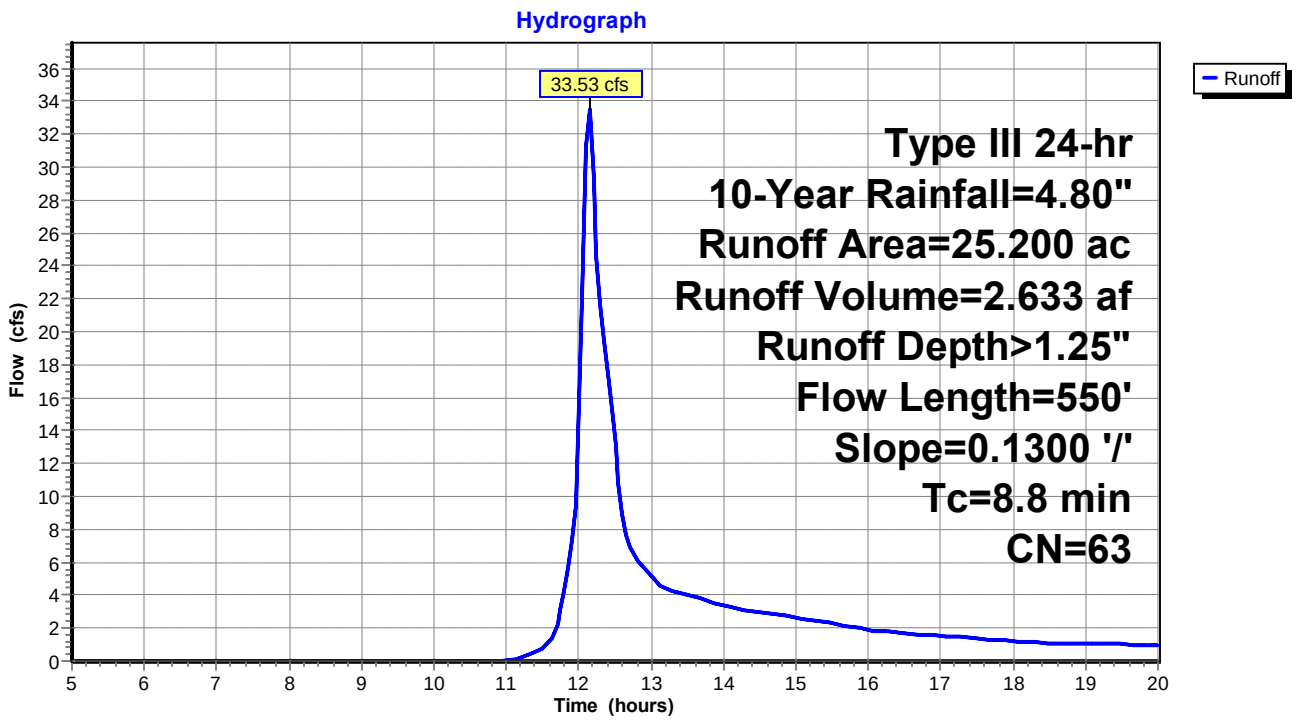
Runoff = 33.53 cfs @ 12.14 hrs, Volume= 2.633 af, Depth> 1.25"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (ac)	CN	Description
	14.900	55	Woods, Good, HSG B
	8.600	77	Woods, Good, HSG D
	1.350	61	>75% Grass cover, Good, HSG B
*	0.350	72	Crushed Stone Surface, HSG B
	25.200	63	Weighted Average
	25.200		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.8	550	0.1300	1.05		**Lag/CN Method, Tc-1**

Subcatchment 1S: Drainage Direct to Wetlands



Summary for Subcatchment 1S': Drainage Area to Basin

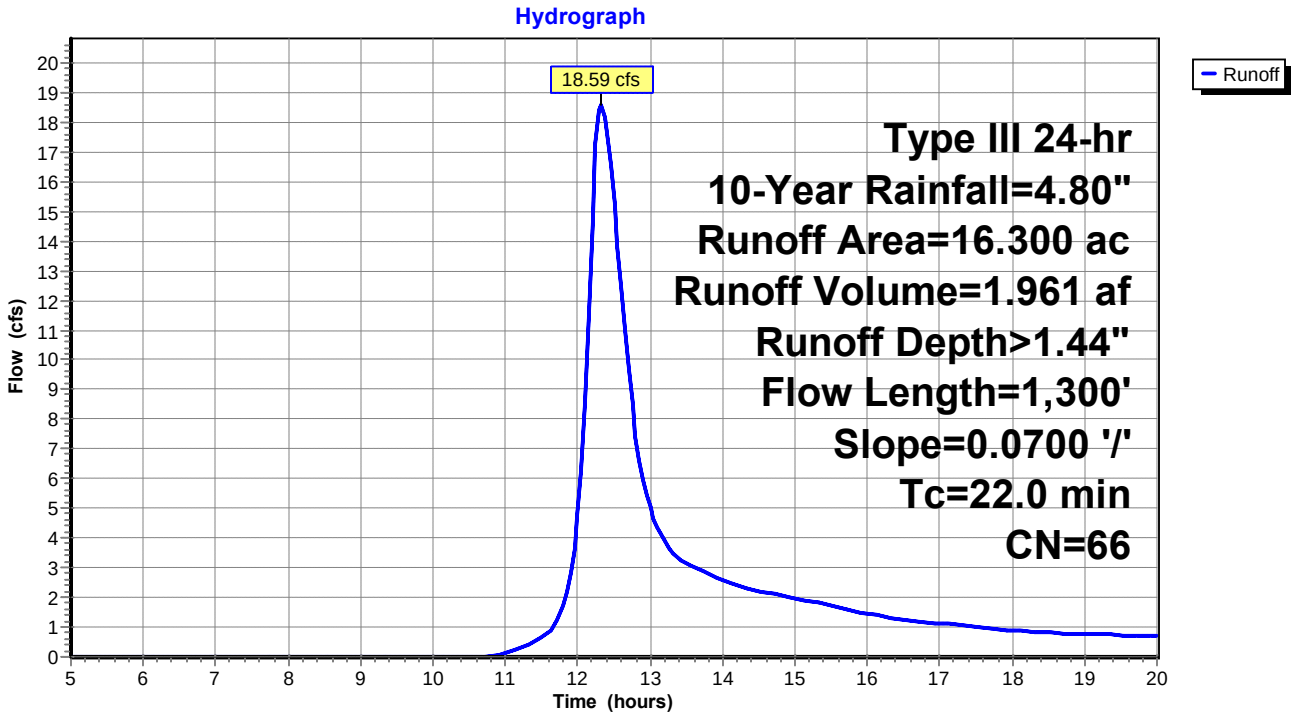
Runoff = 18.59 cfs @ 12.33 hrs, Volume= 1.961 af, Depth> 1.44"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (ac)	CN	Description
*	6.400	65	Impervious roof & pavement
*	4.500	72	Crushed Stone surface, HSG B
	5.400	61	>75% Grass cover, Good, HSG B
	16.300	66	Weighted Average
	16.300		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.0	1,300	0.0700	0.99		**Lag/CN Method, Tc-1**

Subcatchment 1S': Drainage Area to Basin



Summary for Subcatchment 2S: Drainage Area 2 - Off site East

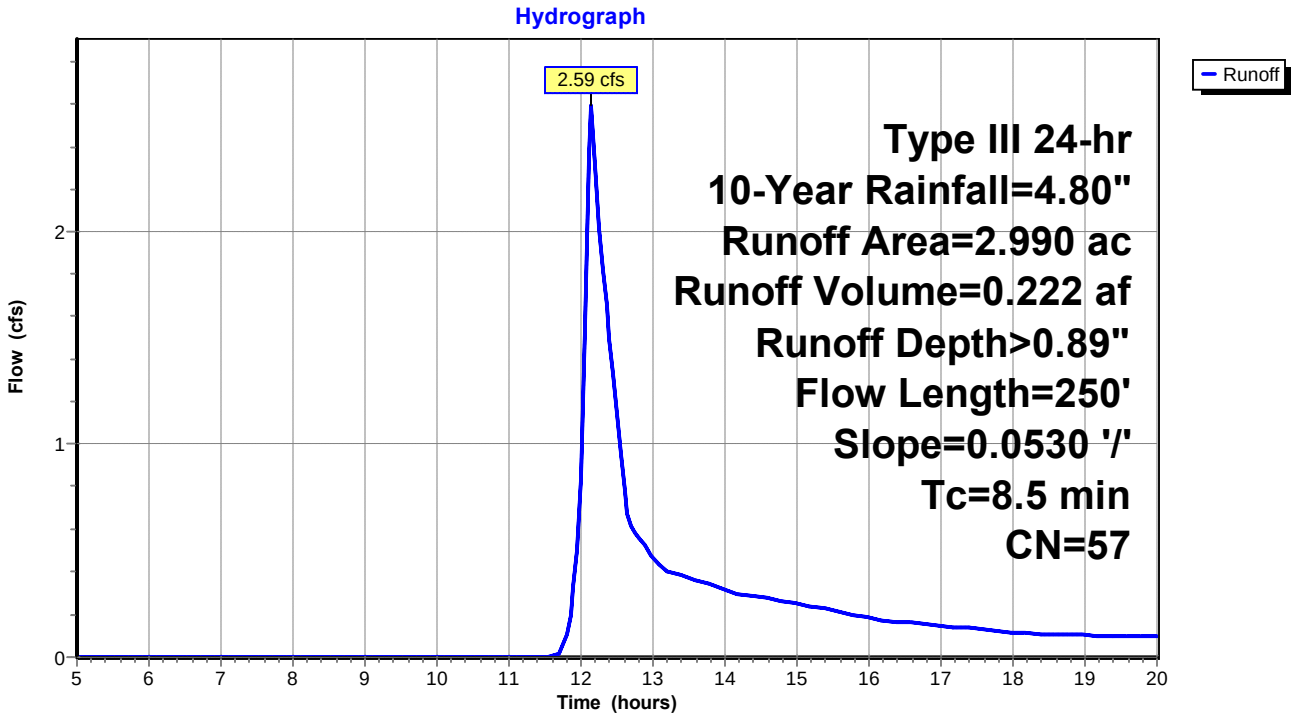
Runoff = 2.59 cfs @ 12.15 hrs, Volume= 0.222 af, Depth> 0.89"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (ac)	CN	Description
1.760	55	Woods, Good, HSG B
1.230	61	>75% Grass cover, Good, HSG B
2.990	57	Weighted Average
2.990		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.5	250	0.0530	0.49		**Lag/CN Method, Tc-2**

Subcatchment 2S: Drainage Area 2 - Off site East



Summary for Subcatchment 3S: Drainage Area 3 - Switchyard to Wetlands

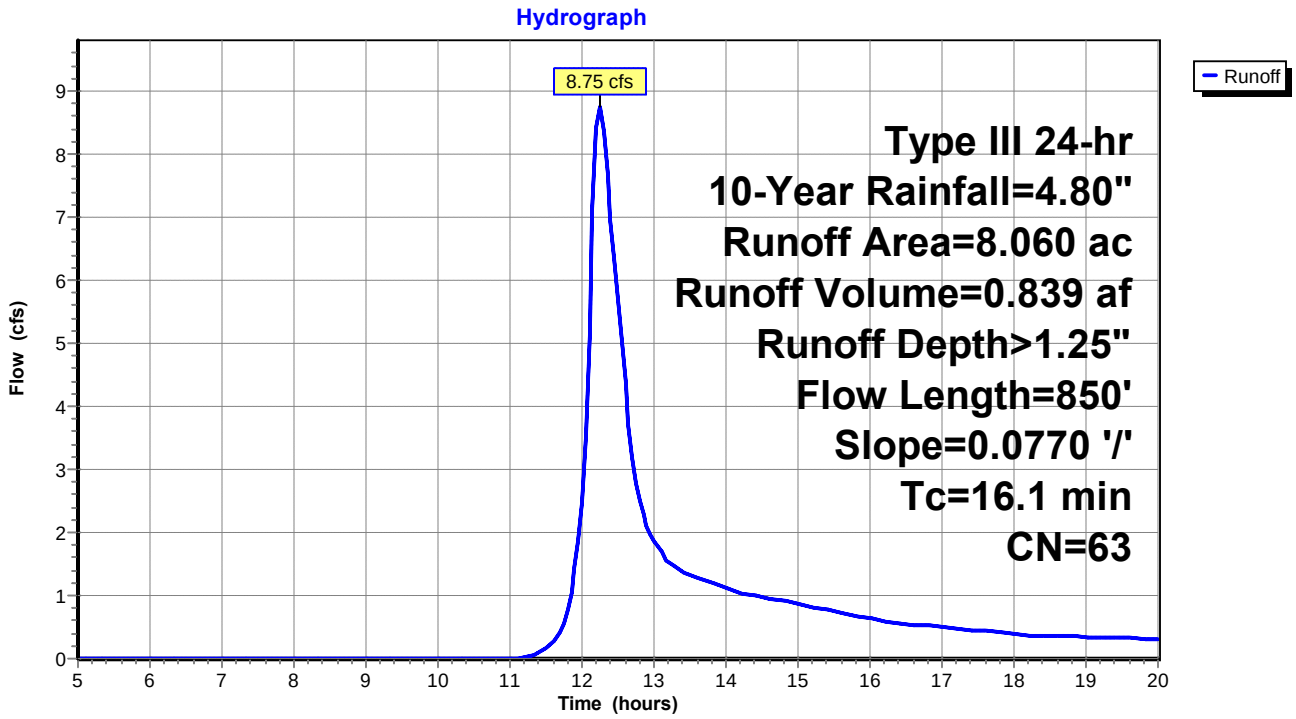
Runoff = 8.75 cfs @ 12.25 hrs, Volume= 0.839 af, Depth> 1.25"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

	Area (ac)	CN	Description
*	0.810	98	Roof & Pavement
	1.000	58	Meadow, non-grazed, HSG B
	4.650	55	Woods, Good, HSG B
*	1.600	72	Crushed stone surface
	8.060	63	Weighted Average
	7.250		89.95% Pervious Area
	0.810		10.05% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.1	850	0.0770	0.88		**Lag/CN Method, Tc-3**

Subcatchment 3S: Drainage Area 3 - Switchyard to Wetlands



Summary for Subcatchment DB1: Drainage to B1

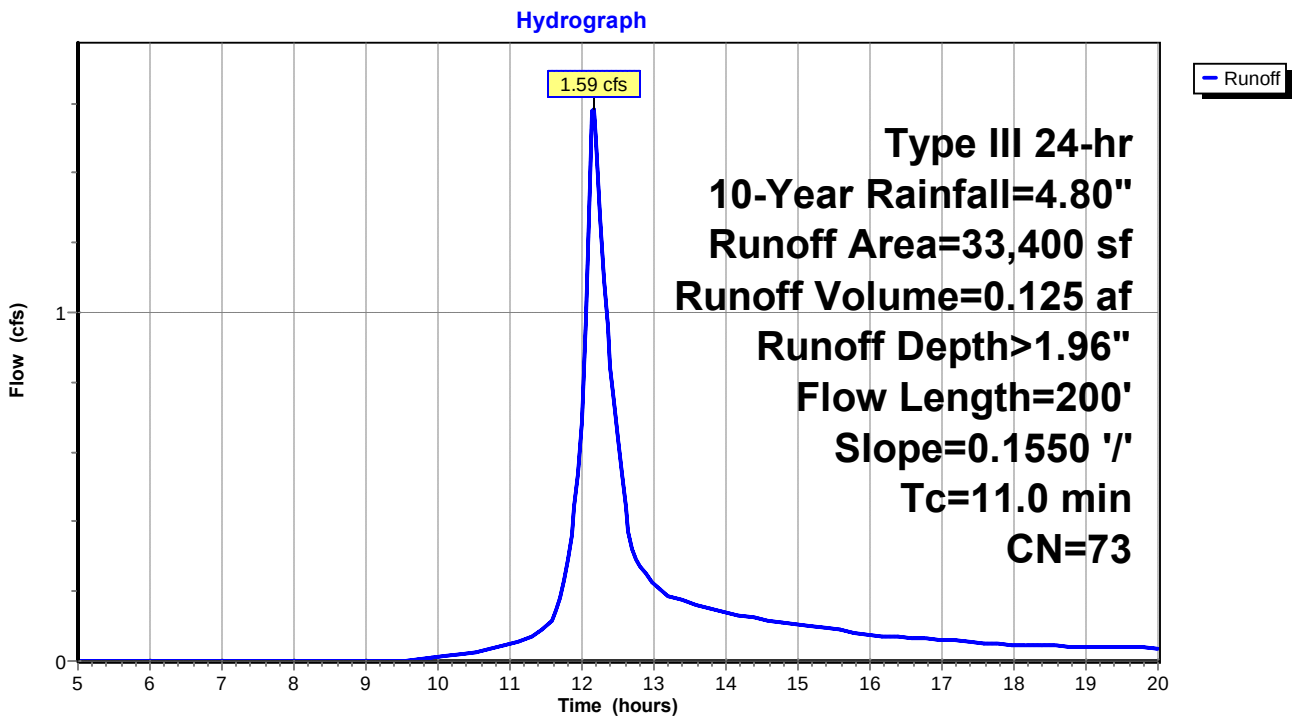
Runoff = 1.59 cfs @ 12.16 hrs, Volume= 0.125 af, Depth> 1.96"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (sf)	CN	Description
22,400	61	>75% Grass cover, Good, HSG B
11,000	98	Roofs, HSG B
33,400	73	Weighted Average
22,400		67.07% Pervious Area
11,000		32.93% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.0	200	0.1550	0.30		**Sheet Flow, Tc-DB-1** Grass: Dense n= 0.240 P2= 3.20"

Subcatchment DB1: Drainage to B1



Summary for Subcatchment DB2: Drainage to B2

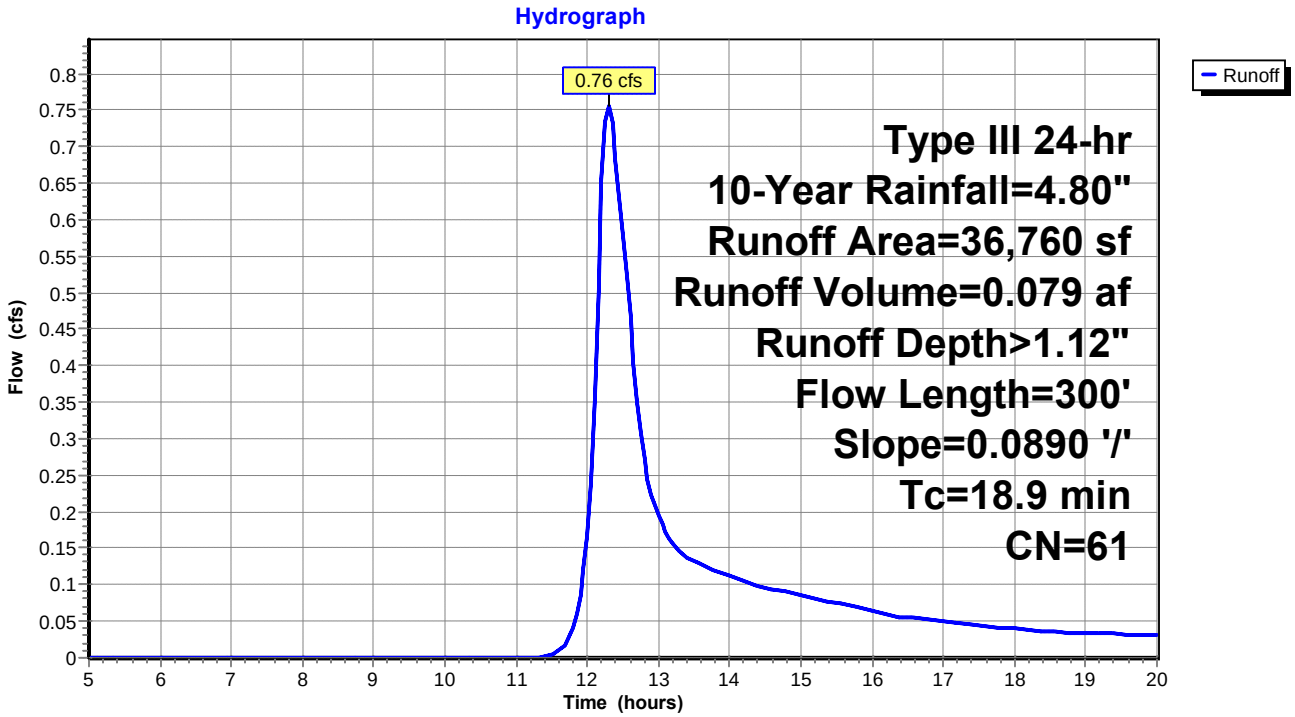
Runoff = 0.76 cfs @ 12.30 hrs, Volume= 0.079 af, Depth> 1.12"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.80"

Area (sf)	CN	Description
36,760	61	>75% Grass cover, Good, HSG B
36,760		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.9	300	0.0890	0.26		**Sheet Flow, Tc-DB2** Grass: Dense n= 0.240 P2= 3.20"

Subcatchment DB2: Drainage to B2



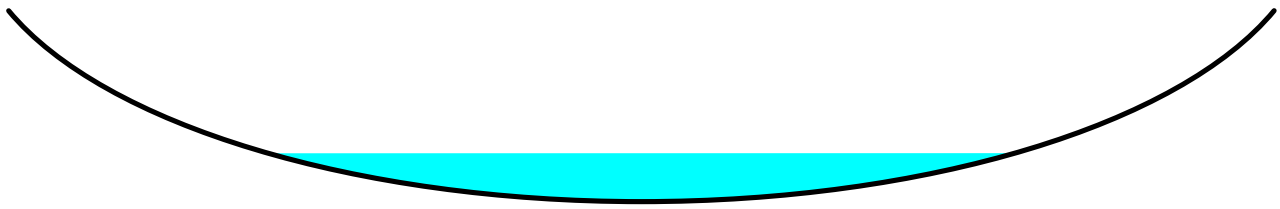
Summary for Reach 1R: Wetlands

Inflow Area = 41.500 ac, 0.00% Impervious, Inflow Depth > 0.98" for 10-Year event
Inflow = 33.53 cfs @ 12.14 hrs, Volume= 3.395 af
Outflow = 19.55 cfs @ 12.67 hrs, Volume= 3.251 af, Atten= 42%, Lag= 31.6 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.14 fps, Min. Travel Time= 19.0 min
Avg. Velocity = 0.66 fps, Avg. Travel Time= 32.9 min

Peak Storage= 22,300 cf @ 12.35 hrs
Average Depth at Peak Storage= 0.25'
Bank-Full Depth= 1.00' Flow Area= 133.3 sf, Capacity= 378.88 cfs

200.00' x 1.00' deep Parabolic Channel, n= 0.035
Length= 1,300.0' Slope= 0.0077 '/'
Inlet Invert= 274.00', Outlet Invert= 264.00'



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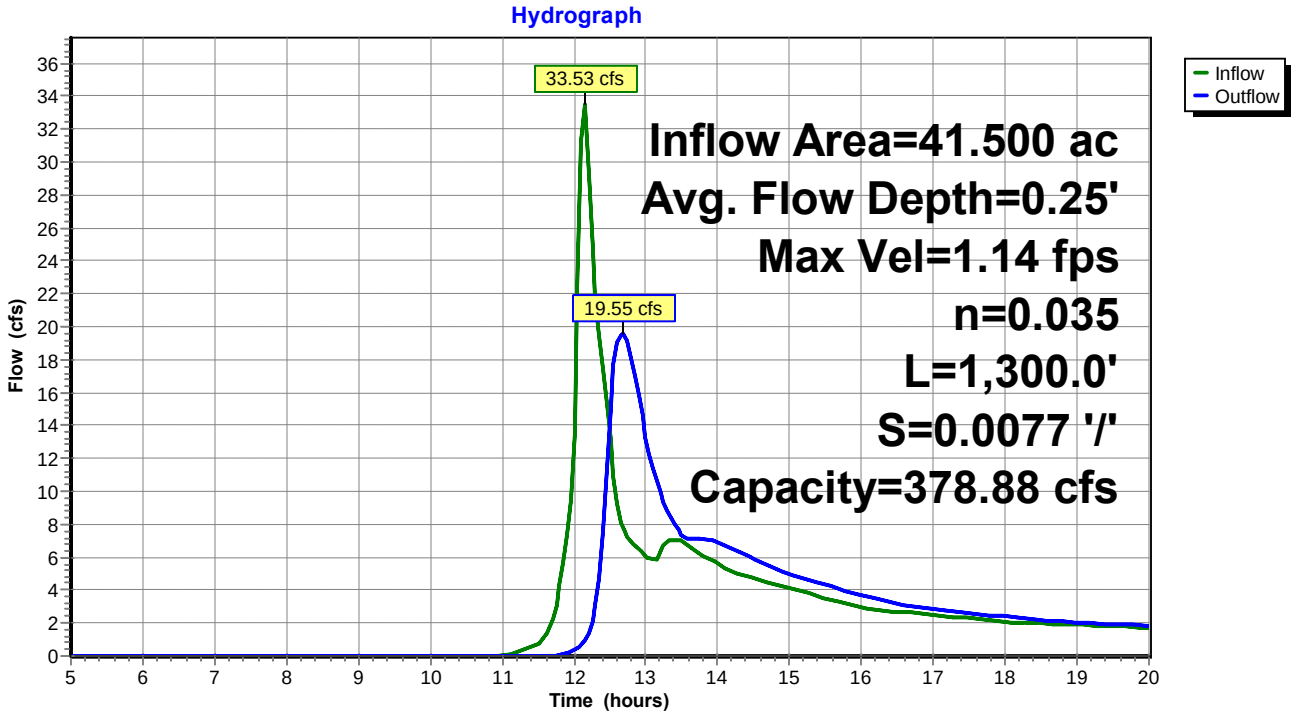
Reach 1R: Wetlands

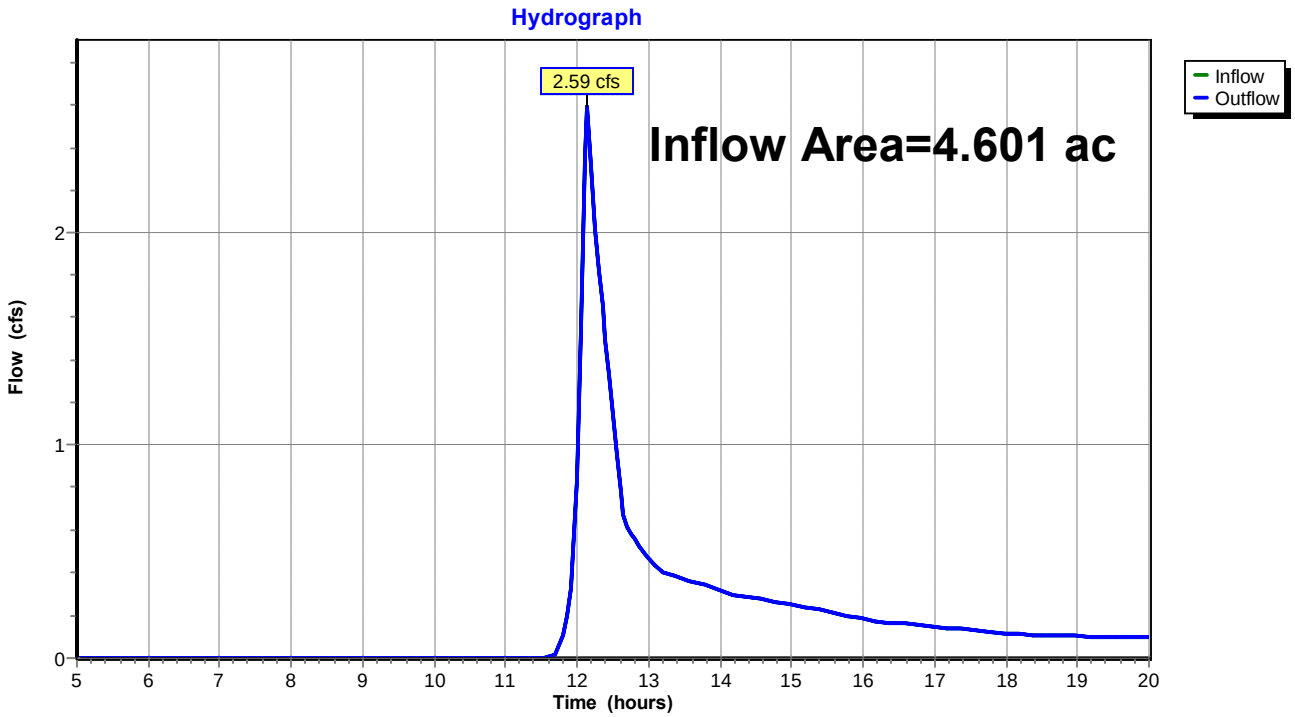


Summary for Reach 2R: Peak off site East

Inflow Area = 4.601 ac, 5.49% Impervious, Inflow Depth > 0.58" for 10-Year event
Inflow = 2.59 cfs @ 12.15 hrs, Volume= 0.222 af
Outflow = 2.59 cfs @ 12.15 hrs, Volume= 0.222 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach 2R: Peak off site East



Summary for Pond 1P: Sediment Forebay

Inflow Area = 16.300 ac, 0.00% Impervious, Inflow Depth > 1.44" for 10-Year event
Inflow = 18.59 cfs @ 12.33 hrs, Volume= 1.961 af
Outflow = 17.86 cfs @ 12.40 hrs, Volume= 1.806 af, Atten= 4%, Lag= 4.2 min
Primary = 17.86 cfs @ 12.40 hrs, Volume= 1.806 af
Secondary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 279.12' @ 12.40 hrs Surf.Area= 4,907 sf Storage= 11,034 cf

Plug-Flow detention time= 38.9 min calculated for 1.800 af (92% of inflow)
Center-of-Mass det. time= 13.9 min (843.3 - 829.4)

Volume	Invert	Avail.Storage	Storage Description
#1	275.00'	15,801 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

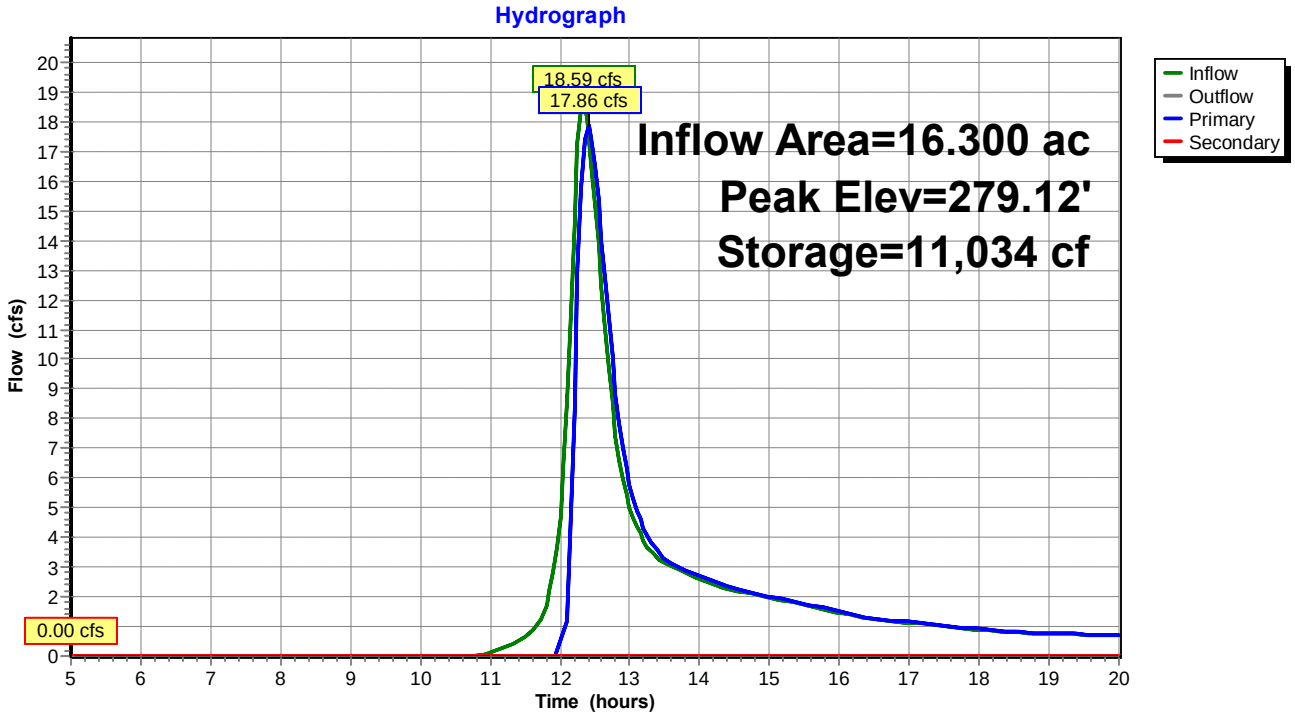
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
275.00	925	0	0
276.00	1,532	1,229	1,229
278.00	3,530	5,062	6,291
280.00	5,980	9,510	15,801

Device	Routing	Invert	Outlet Devices
#1	Secondary	279.50'	**24.0' long x 7.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.42 2.53 2.70 2.69 2.68 2.67 2.66 2.65 2.65 2.65 2.66 2.65 2.66 2.67 2.69 2.71 2.76
#2	Primary	278.00'	**84.0" W x 18.0" H Vert. Orifice/Grate** C= 0.400

Primary OutFlow Max=17.85 cfs @ 12.40 hrs HW=279.12' (Free Discharge)
└**2=Orifice/Grate** (Orifice Controls 17.85 cfs @ 2.27 fps)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=275.00' (Free Discharge)
└**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 1P: Sediment Forebay



Summary for Pond 2P: Stormwater Wetland

Inflow Area =	16.300 ac,	0.00% Impervious,	Inflow Depth >	1.33"	for 10-Year event
Inflow =	17.86 cfs @	12.40 hrs,	Volume=	1.806 af	
Outflow =	17.54 cfs @	12.45 hrs,	Volume=	1.769 af,	Atten= 2%, Lag= 2.9 min
Primary =	17.54 cfs @	12.45 hrs,	Volume=	1.769 af	
Secondary =	0.00 cfs @	5.00 hrs,	Volume=	0.000 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 277.61' @ 12.45 hrs Surf.Area= 3,303 sf Storage= 4,566 cf

Plug-Flow detention time= 12.2 min calculated for 1.769 af (98% of inflow)
Center-of-Mass det. time= 5.1 min (848.4 - 843.3)

Volume	Invert	Avail.Storage	Storage Description
#1	276.00'	15,825 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

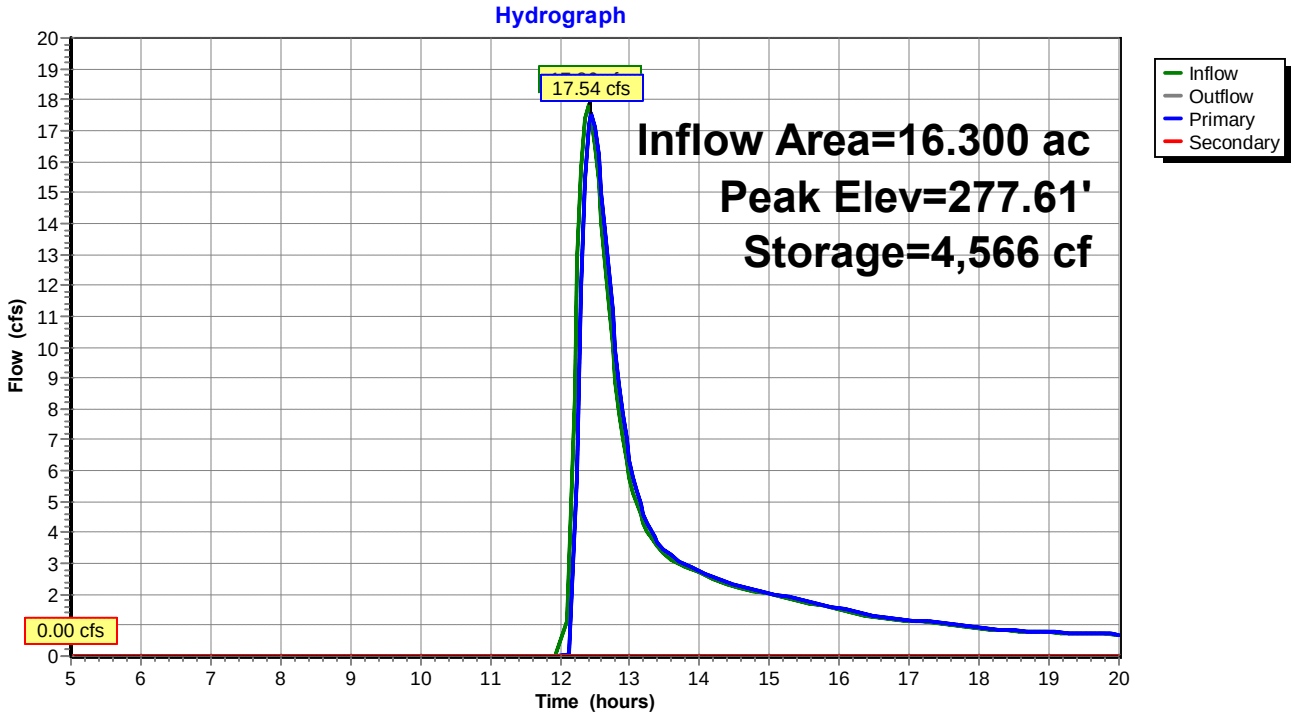
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
276.00	2,365	0	0
278.00	3,530	5,895	5,895
280.00	6,400	9,930	15,825

Device	Routing	Invert	Outlet Devices
#1	Secondary	279.50'	**24.0' long x 7.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.42 2.53 2.70 2.69 2.68 2.67 2.66 2.65 2.65 2.65 2.66 2.65 2.66 2.67 2.69 2.71 2.76
#2	Primary	276.50'	**84.0" W x 36.0" H Vert. Orifice/Grate** C= 0.400

Primary OutFlow Max=17.53 cfs @ 12.45 hrs HW=277.61' (Free Discharge)
└─**2=Orifice/Grate** (Orifice Controls 17.53 cfs @ 2.26 fps)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=276.00' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 2P: Stormwater Wetland



Summary for Pond 3P: Dry Basin

Inflow Area =	16.300 ac,	0.00% Impervious,	Inflow Depth >	1.30"	for 10-Year event
Inflow =	17.54 cfs @	12.45 hrs,	Volume=	1.769 af	
Outflow =	3.67 cfs @	13.41 hrs,	Volume=	1.178 af,	Atten= 79%, Lag= 58.0 min
Discarded =	0.68 cfs @	13.41 hrs,	Volume=	0.416 af	
Primary =	1.02 cfs @	13.41 hrs,	Volume=	0.569 af	
Secondary =	1.96 cfs @	13.41 hrs,	Volume=	0.193 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 279.13' @ 13.41 hrs Surf.Area= 10,540 sf Storage= 34,892 cf

Plug-Flow detention time= 174.1 min calculated for 1.174 af (66% of inflow)
Center-of-Mass det. time= 101.0 min (949.4 - 848.4)

Volume	Invert	Avail.Storage	Storage Description
#1	274.50'	44,586 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
274.50	4,205	0	0
275.00	4,780	2,246	2,246
276.00	6,750	5,765	8,011
278.00	9,075	15,825	23,836
280.00	11,675	20,750	44,586

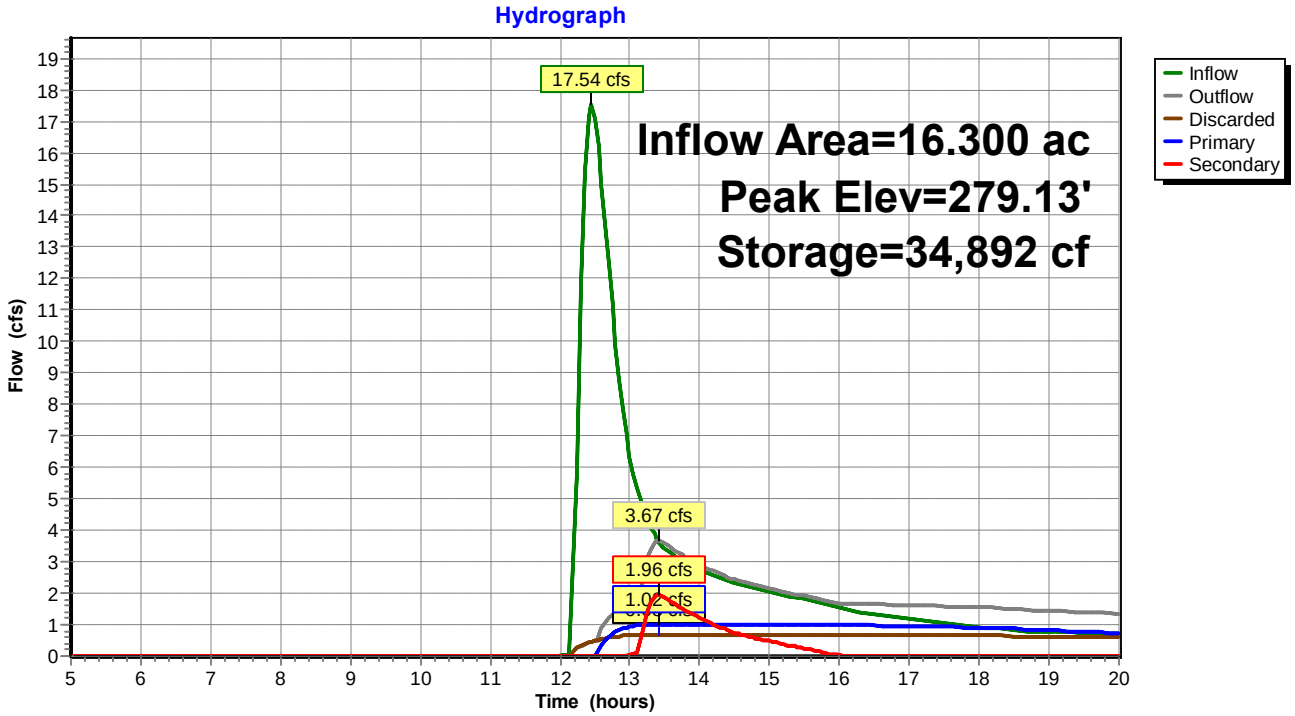
Device	Routing	Invert	Outlet Devices
#1	Secondary	279.00'	**16.0' long x 16.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Primary	277.00'	**6.0" Round Culvert** L= 28.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 277.00' / 275.00' S= 0.0714 '/' Cc= 0.900 n= 0.012, Flow Area= 0.20 sf
#3	Discarded	274.50'	**2.800 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.68 cfs @ 13.41 hrs HW=279.13' (Free Discharge)
└**3=Exfiltration** (Exfiltration Controls 0.68 cfs)

Primary OutFlow Max=1.02 cfs @ 13.41 hrs HW=279.13' (Free Discharge)
└**2=Culvert** (Inlet Controls 1.02 cfs @ 5.21 fps)

Secondary OutFlow Max=1.94 cfs @ 13.41 hrs HW=279.13' (Free Discharge)
└**1=Broad-Crested Rectangular Weir** (Weir Controls 1.94 cfs @ 0.95 fps)

Pond 3P: Dry Basin



Summary for Pond B1: Retention

Inflow Area = 0.767 ac, 32.93% Impervious, Inflow Depth > 1.96" for 10-Year event
Inflow = 1.59 cfs @ 12.16 hrs, Volume= 0.125 af
Outflow = 0.39 cfs @ 12.64 hrs, Volume= 0.125 af, Atten= 75%, Lag= 28.7 min
Discarded = 0.39 cfs @ 12.64 hrs, Volume= 0.125 af
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 315.35' @ 12.64 hrs Surf.Area= 6,030 sf Storage= 1,660 cf

Plug-Flow detention time= 35.6 min calculated for 0.125 af (100% of inflow)
Center-of-Mass det. time= 34.8 min (841.8 - 807.0)

Volume	Invert	Avail.Storage	Storage Description
#1	315.00'	19,555 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

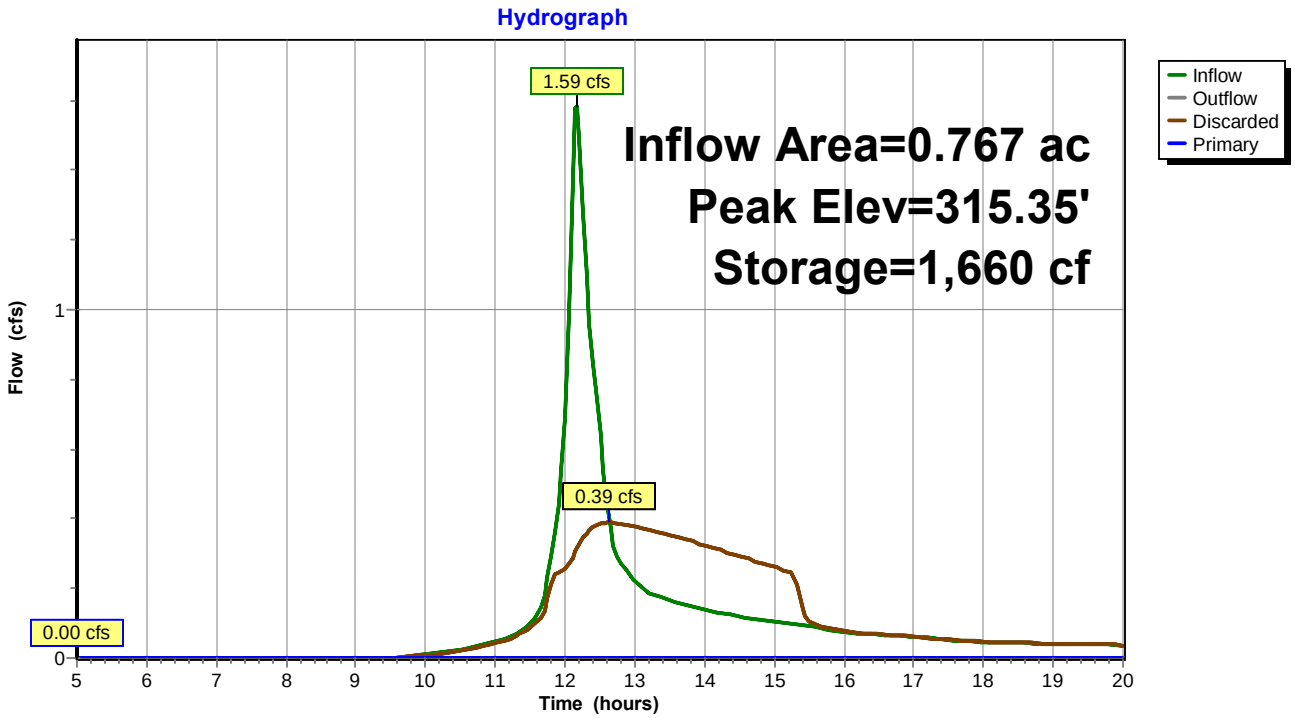
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
315.00	3,590	0	0
316.00	10,660	7,125	7,125
317.00	14,200	12,430	19,555

Device	Routing	Invert	Outlet Devices
#1	Primary	316.50'	**10.0' long x 20.0' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60
			Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Discarded	315.00'	**2.800 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.39 cfs @ 12.64 hrs HW=315.35' (Free Discharge)
└**2=Exfiltration** (Exfiltration Controls 0.39 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=315.00' (Free Discharge)
└**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond B1: Retention



Summary for Pond B2: Retention

Inflow Area =	0.844 ac,	0.00% Impervious,	Inflow Depth >	1.12"	for 10-Year event
Inflow =	0.76 cfs @	12.30 hrs,	Volume=	0.079 af	
Outflow =	0.20 cfs @	13.00 hrs,	Volume=	0.079 af,	Atten= 74%, Lag= 41.9 min
Discarded =	0.20 cfs @	13.00 hrs,	Volume=	0.079 af	
Primary =	0.00 cfs @	5.00 hrs,	Volume=	0.000 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 312.33' @ 13.00 hrs Surf.Area= 3,018 sf Storage= 977 cf

Plug-Flow detention time= 41.6 min calculated for 0.078 af (99% of inflow)
Center-of-Mass det. time= 40.4 min (878.1 - 837.7)

Volume	Invert	Avail.Storage	Storage Description
#1	312.00'	6,150 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

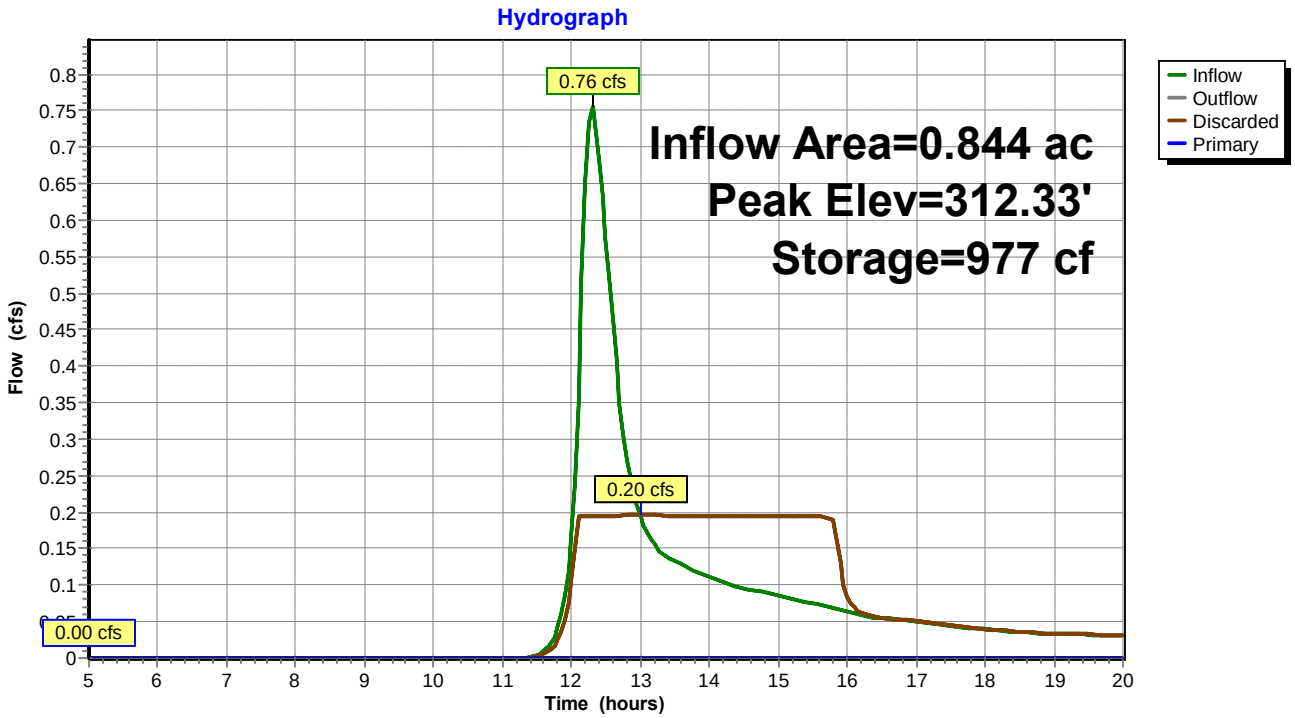
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
312.00	2,990	0	0
314.00	3,160	6,150	6,150

Device	Routing	Invert	Outlet Devices
#1	Primary	313.50'	**10.0' long x 20.0' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60
			Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Discarded	312.00'	**2.800 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.20 cfs @ 13.00 hrs HW=312.33' (Free Discharge)
↑└**2=Exfiltration** (Exfiltration Controls 0.20 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=312.00' (Free Discharge)
↑└**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond B2: Retention



Summary for Subcatchment 1S: Drainage Direct to Wetlands

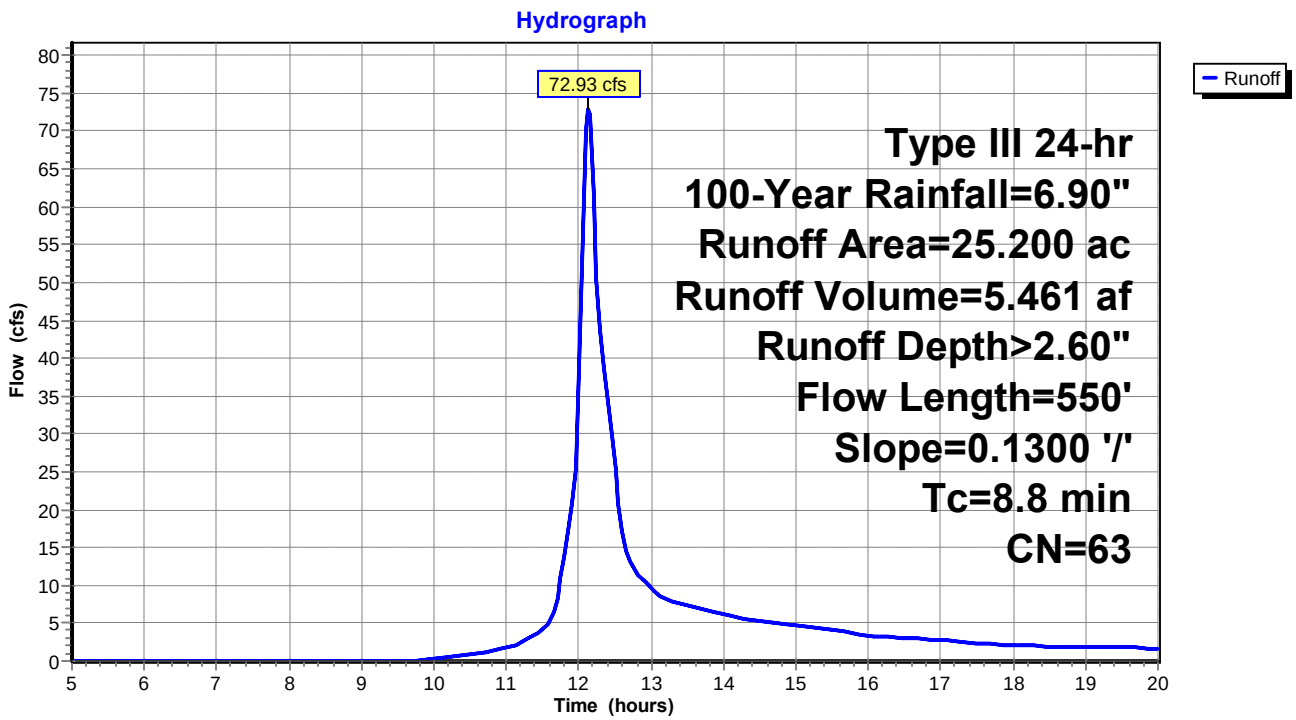
Runoff = 72.93 cfs @ 12.13 hrs, Volume= 5.461 af, Depth> 2.60"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.90"

	Area (ac)	CN	Description
	14.900	55	Woods, Good, HSG B
	8.600	77	Woods, Good, HSG D
	1.350	61	>75% Grass cover, Good, HSG B
*	0.350	72	Crushed Stone Surface, HSG B
	25.200	63	Weighted Average
	25.200		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.8	550	0.1300	1.05		**Lag/CN Method, Tc-1**

Subcatchment 1S: Drainage Direct to Wetlands



Summary for Subcatchment 1S': Drainage Area to Basin

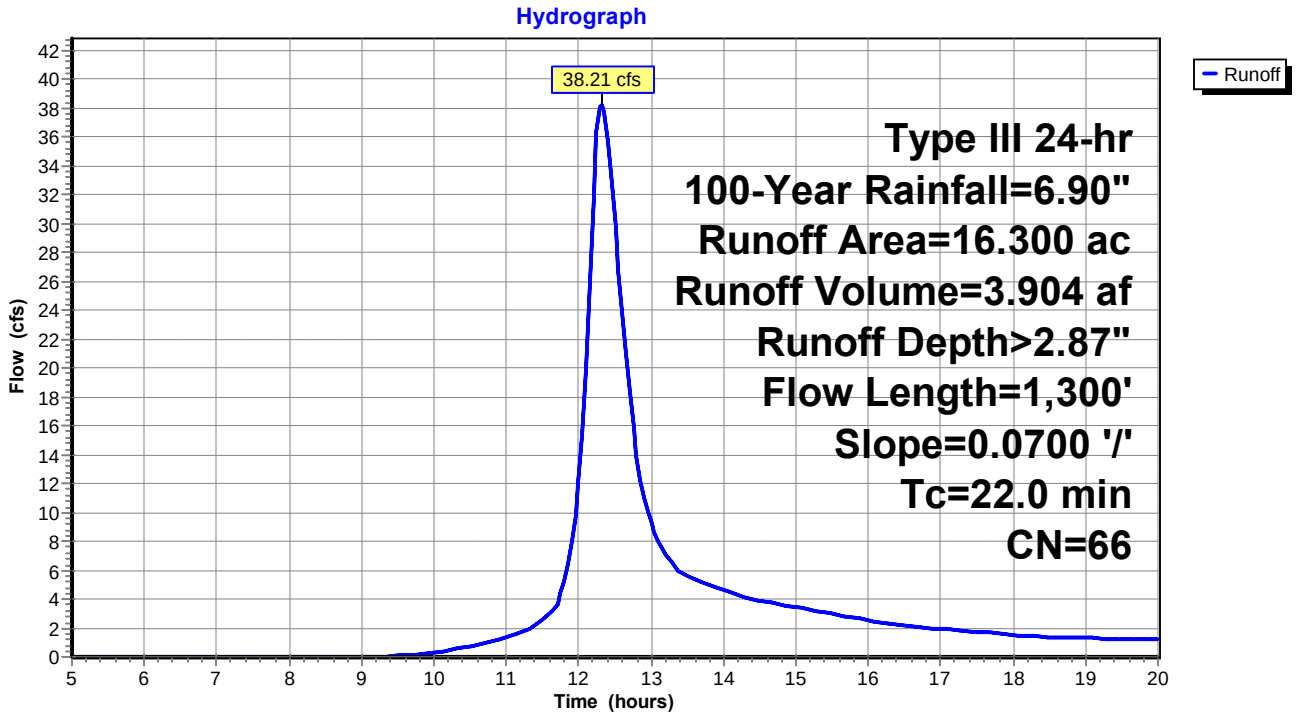
Runoff = 38.21 cfs @ 12.32 hrs, Volume= 3.904 af, Depth> 2.87"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.90"

	Area (ac)	CN	Description
*	6.400	65	Impervious roof & pavement
*	4.500	72	Crushed Stone surface, HSG B
	5.400	61	>75% Grass cover, Good, HSG B
	16.300	66	Weighted Average
	16.300		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.0	1,300	0.0700	0.99		**Lag/CN Method, Tc-1**

Subcatchment 1S': Drainage Area to Basin



Summary for Subcatchment 2S: Drainage Area 2 - Off site East

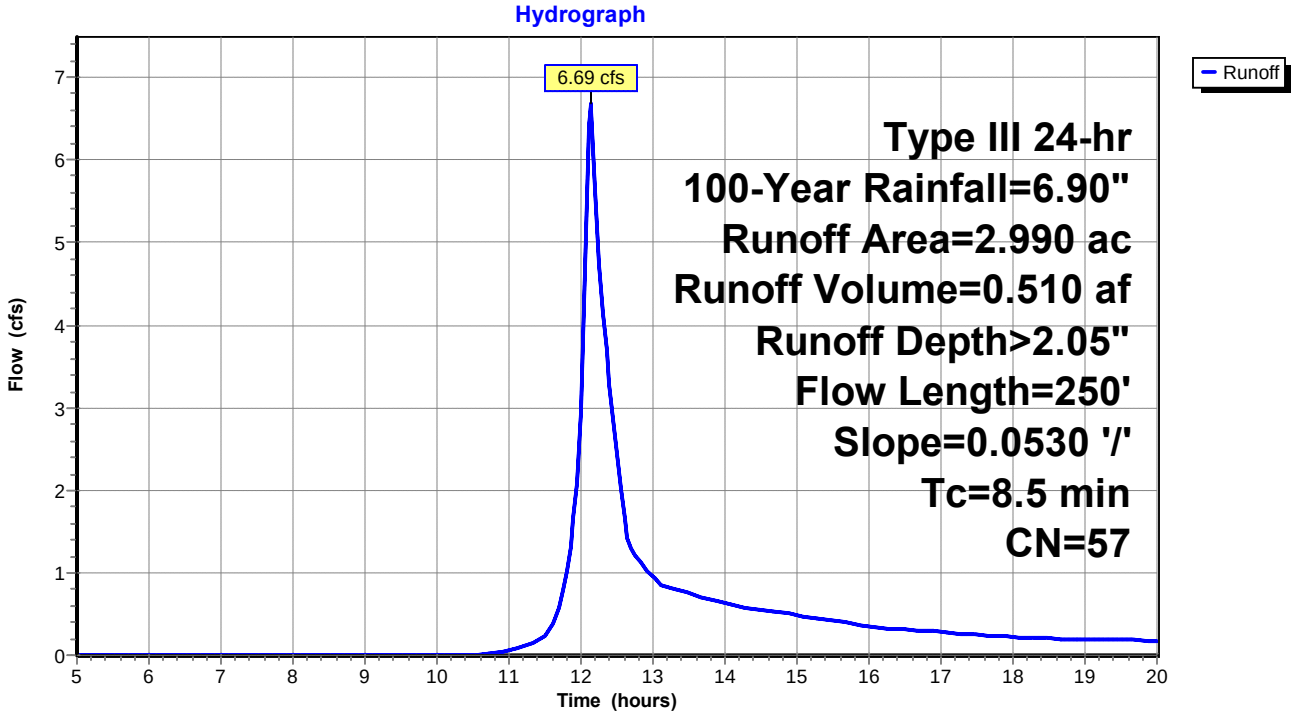
Runoff = 6.69 cfs @ 12.13 hrs, Volume= 0.510 af, Depth> 2.05"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.90"

Area (ac)	CN	Description
1.760	55	Woods, Good, HSG B
1.230	61	>75% Grass cover, Good, HSG B
2.990	57	Weighted Average
2.990		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.5	250	0.0530	0.49		**Lag/CN Method, Tc-2**

Subcatchment 2S: Drainage Area 2 - Off site East



Summary for Subcatchment 3S: Drainage Area 3 - Switchyard to Wetlands

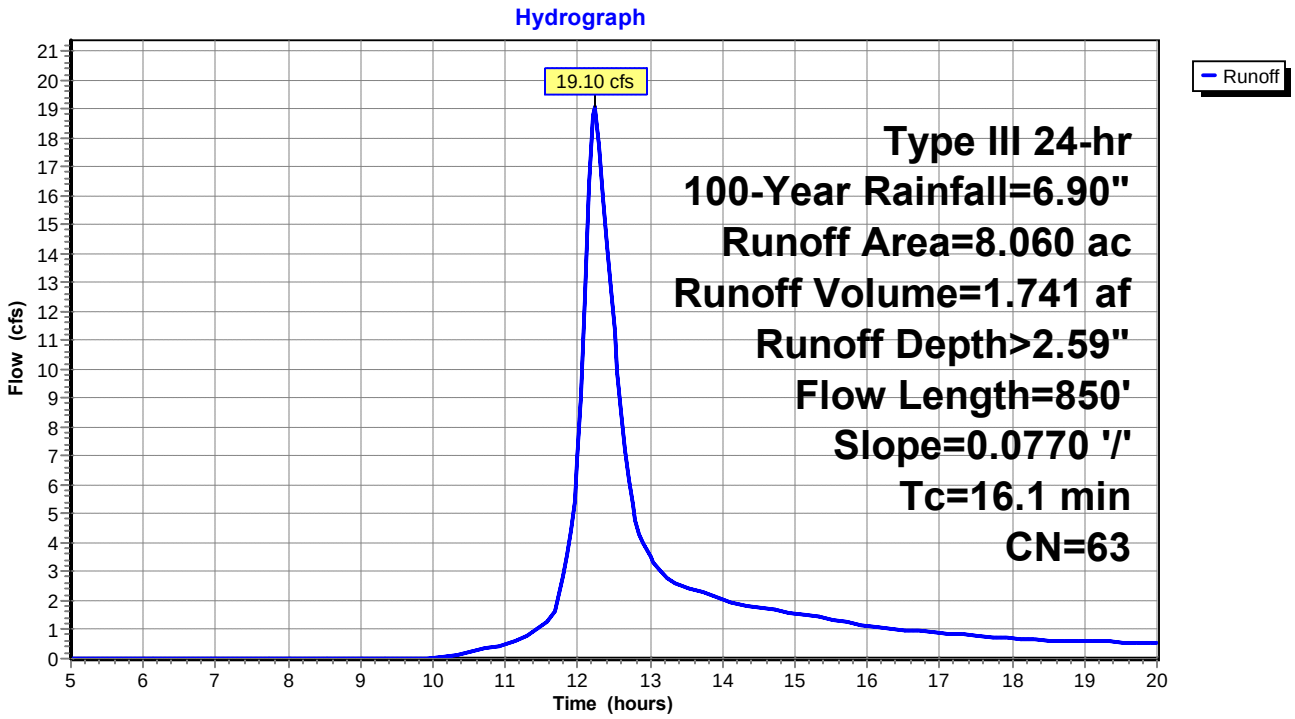
Runoff = 19.10 cfs @ 12.23 hrs, Volume= 1.741 af, Depth> 2.59"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.90"

	Area (ac)	CN	Description
*	0.810	98	Roof & Pavement
	1.000	58	Meadow, non-grazed, HSG B
	4.650	55	Woods, Good, HSG B
*	1.600	72	Crushed stone surface
	8.060	63	Weighted Average
	7.250		89.95% Pervious Area
	0.810		10.05% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.1	850	0.0770	0.88		**Lag/CN Method, Tc-3**

Subcatchment 3S: Drainage Area 3 - Switchyard to Wetlands



Summary for Subcatchment DB1: Drainage to B1

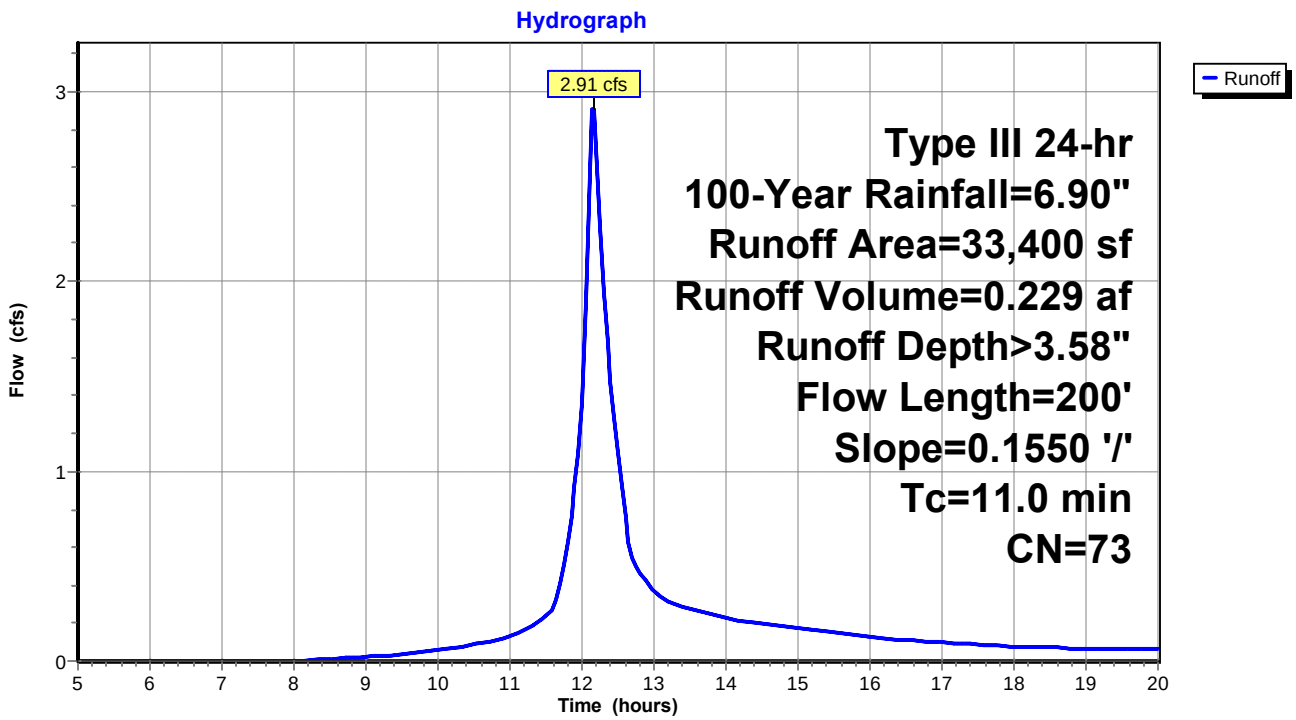
Runoff = 2.91 cfs @ 12.16 hrs, Volume= 0.229 af, Depth> 3.58"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.90"

Area (sf)	CN	Description
22,400	61	>75% Grass cover, Good, HSG B
11,000	98	Roofs, HSG B
33,400	73	Weighted Average
22,400		67.07% Pervious Area
11,000		32.93% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.0	200	0.1550	0.30		**Sheet Flow, Tc-DB-1** Grass: Dense n= 0.240 P2= 3.20"

Subcatchment DB1: Drainage to B1



Summary for Subcatchment DB2: Drainage to B2

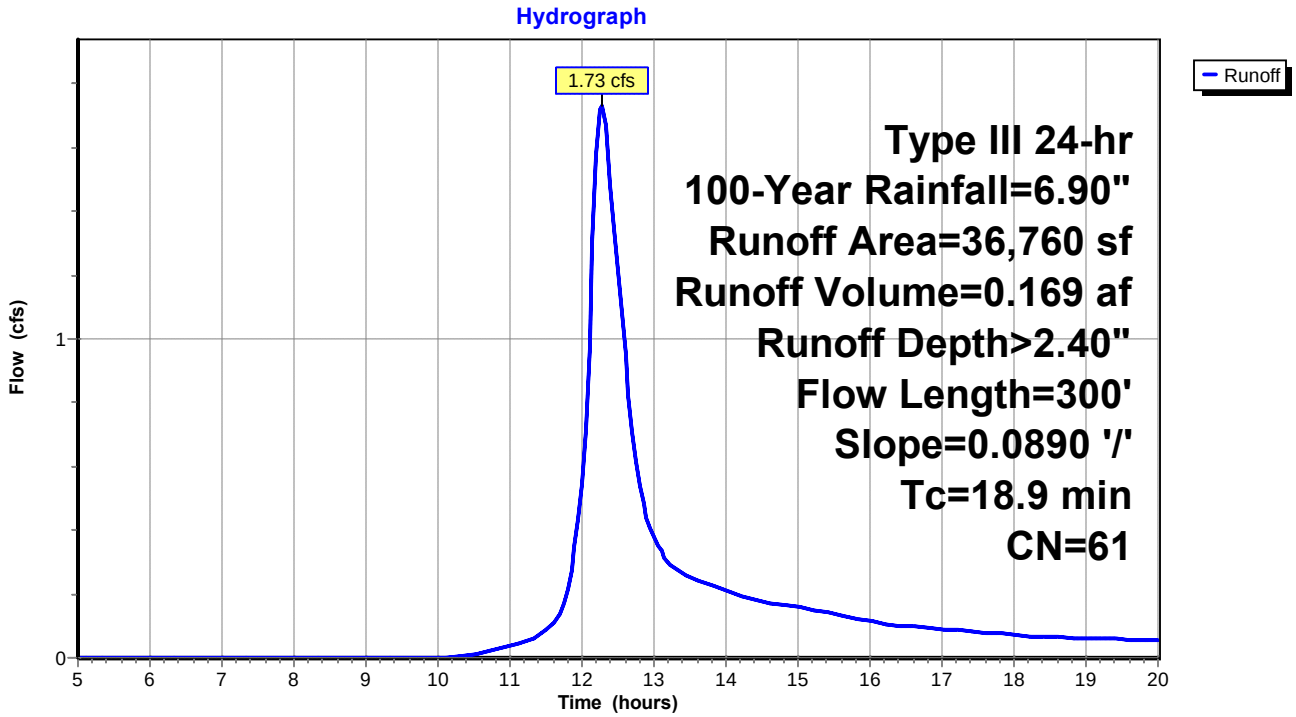
Runoff = 1.73 cfs @ 12.28 hrs, Volume= 0.169 af, Depth> 2.40"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.90"

Area (sf)	CN	Description
36,760	61	>75% Grass cover, Good, HSG B
36,760		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.9	300	0.0890	0.26		**Sheet Flow, Tc-DB2** Grass: Dense n= 0.240 P2= 3.20"

Subcatchment DB2: Drainage to B2



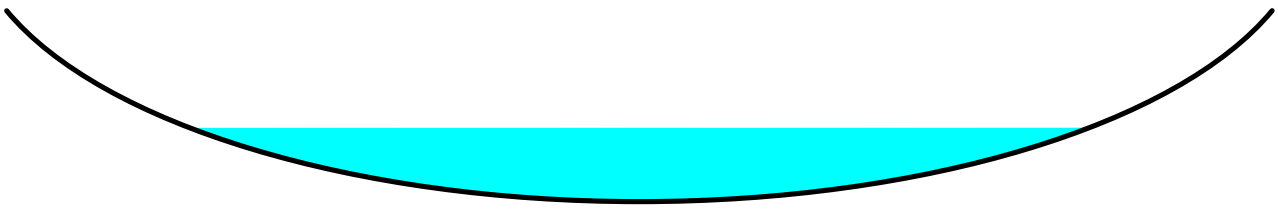
Summary for Reach 1R: Wetlands

Inflow Area = 41.500 ac, 0.00% Impervious, Inflow Depth > 2.31" for 100-Year event
Inflow = 72.93 cfs @ 12.13 hrs, Volume= 7.989 af
Outflow = 48.78 cfs @ 12.51 hrs, Volume= 7.805 af, Atten= 33%, Lag= 22.8 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.51 fps, Min. Travel Time= 14.3 min
Avg. Velocity = 0.77 fps, Avg. Travel Time= 28.0 min

Peak Storage= 42,055 cf @ 12.27 hrs
Average Depth at Peak Storage= 0.39'
Bank-Full Depth= 1.00' Flow Area= 133.3 sf, Capacity= 378.88 cfs

200.00' x 1.00' deep Parabolic Channel, n= 0.035
Length= 1,300.0' Slope= 0.0077 '/'
Inlet Invert= 274.00', Outlet Invert= 264.00'



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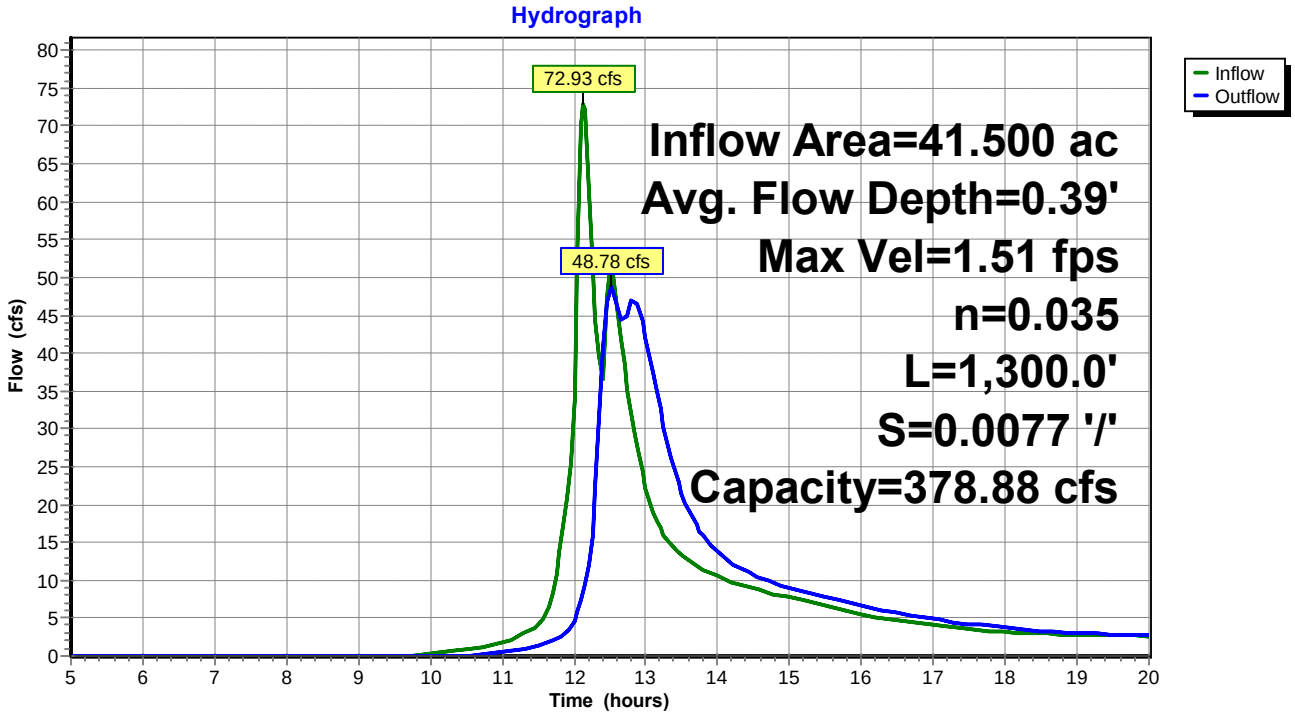
Reach 1R: Wetlands

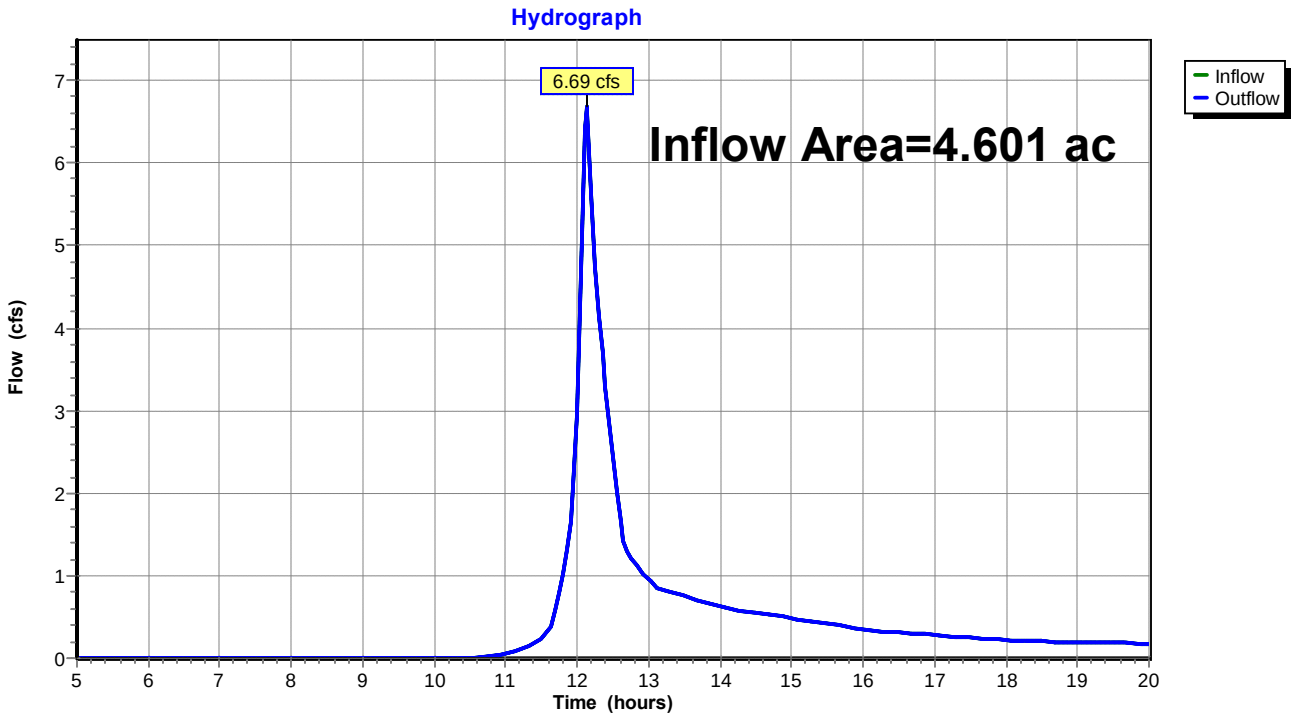


Summary for Reach 2R: Peak off site East

Inflow Area = 4.601 ac, 5.49% Impervious, Inflow Depth > 1.33" for 100-Year event
Inflow = 6.69 cfs @ 12.13 hrs, Volume= 0.510 af
Outflow = 6.69 cfs @ 12.13 hrs, Volume= 0.510 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Reach 2R: Peak off site East



Summary for Pond 1P: Sediment Forebay

Inflow Area =	16.300 ac,	0.00% Impervious,	Inflow Depth >	2.87"	for 100-Year event
Inflow =	38.21 cfs @	12.32 hrs,	Volume=	3.904 af	
Outflow =	37.87 cfs @	12.35 hrs,	Volume=	3.744 af,	Atten= 1%, Lag= 2.0 min
Primary =	32.11 cfs @	12.35 hrs,	Volume=	3.647 af	
Secondary =	5.76 cfs @	12.35 hrs,	Volume=	0.096 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 279.71' @ 12.35 hrs Surf.Area= 5,629 sf Storage= 14,135 cf

Plug-Flow detention time= 24.3 min calculated for 3.744 af (96% of inflow)
Center-of-Mass det. time= 10.0 min (824.3 - 814.3)

Volume	Invert	Avail.Storage	Storage Description
#1	275.00'	15,801 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

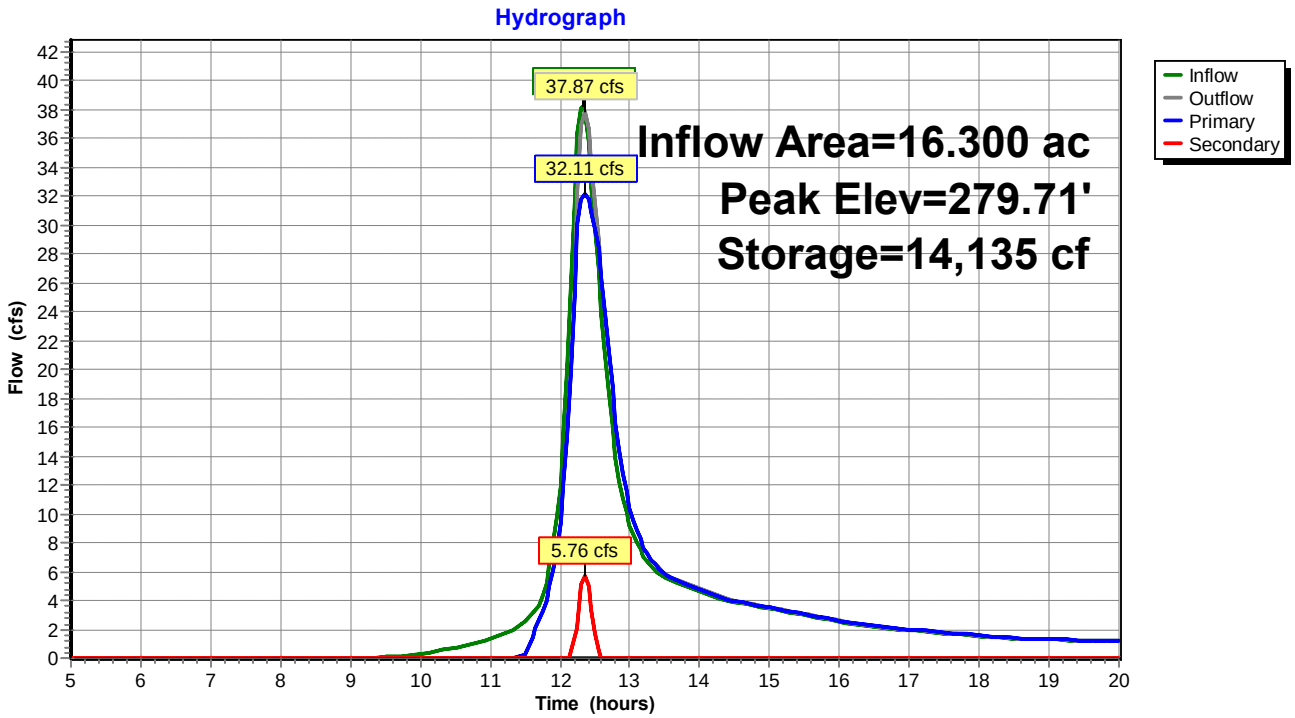
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
275.00	925	0	0
276.00	1,532	1,229	1,229
278.00	3,530	5,062	6,291
280.00	5,980	9,510	15,801

Device	Routing	Invert	Outlet Devices
#1	Secondary	279.50'	**24.0' long x 7.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.42 2.53 2.70 2.69 2.68 2.67 2.66 2.65 2.65 2.65 2.66 2.65 2.66 2.67 2.69 2.71 2.76
#2	Primary	278.00'	**84.0" W x 18.0" H Vert. Orifice/Grate** C= 0.400

Primary OutFlow Max=32.10 cfs @ 12.35 hrs HW=279.71' (Free Discharge)
└**2=Orifice/Grate** (Orifice Controls 32.10 cfs @ 3.06 fps)

Secondary OutFlow Max=5.70 cfs @ 12.35 hrs HW=279.71' (Free Discharge)
└**1=Broad-Crested Rectangular Weir** (Weir Controls 5.70 cfs @ 1.12 fps)

Pond 1P: Sediment Forebay



Summary for Pond 2P: Stormwater Wetland

Inflow Area =	16.300 ac,	0.00% Impervious,	Inflow Depth >	2.76"	for 100-Year event
Inflow =	37.87 cfs @	12.35 hrs,	Volume=	3.744 af	
Outflow =	37.17 cfs @	12.39 hrs,	Volume=	3.703 af,	Atten= 2%, Lag= 2.5 min
Primary =	37.17 cfs @	12.39 hrs,	Volume=	3.703 af	
Secondary =	0.00 cfs @	5.00 hrs,	Volume=	0.000 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 278.33' @ 12.39 hrs Surf.Area= 4,008 sf Storage= 7,149 cf

Plug-Flow detention time= 7.7 min calculated for 3.703 af (99% of inflow)
Center-of-Mass det. time= 3.8 min (828.1 - 824.3)

Volume	Invert	Avail.Storage	Storage Description
#1	276.00'	15,825 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

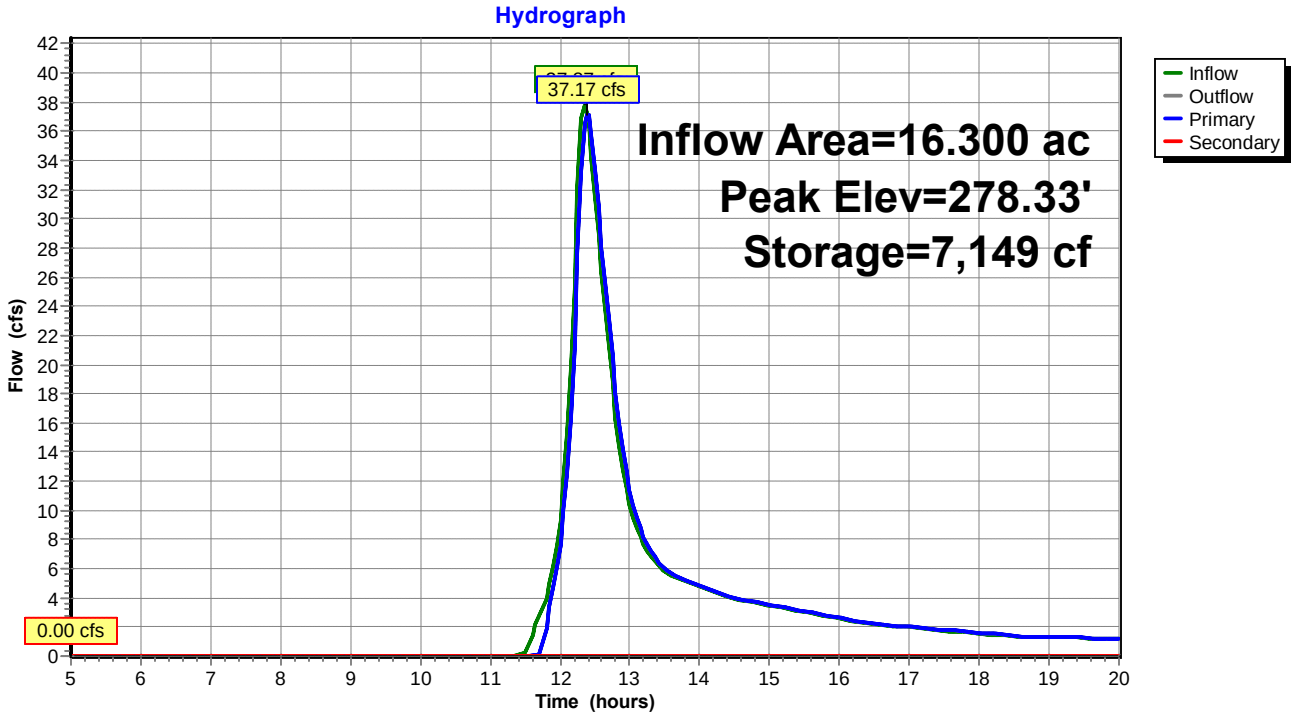
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
276.00	2,365	0	0
278.00	3,530	5,895	5,895
280.00	6,400	9,930	15,825

Device	Routing	Invert	Outlet Devices
#1	Secondary	279.50'	**24.0' long x 7.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.42 2.53 2.70 2.69 2.68 2.67 2.66 2.65 2.65 2.65 2.66 2.65 2.66 2.67 2.69 2.71 2.76
#2	Primary	276.50'	**84.0" W x 36.0" H Vert. Orifice/Grate** C= 0.400

Primary OutFlow Max=37.01 cfs @ 12.39 hrs HW=278.33' (Free Discharge)
└**2=Orifice/Grate** (Orifice Controls 37.01 cfs @ 2.89 fps)

Secondary OutFlow Max=0.00 cfs @ 5.00 hrs HW=276.00' (Free Discharge)
└**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 2P: Stormwater Wetland



Summary for Pond 3P: Dry Basin

Inflow Area =	16.300 ac,	0.00% Impervious,	Inflow Depth >	2.73"	for 100-Year event
Inflow =	37.17 cfs @	12.39 hrs,	Volume=	3.703 af	
Outflow =	30.41 cfs @	12.57 hrs,	Volume=	2.979 af,	Atten= 18%, Lag= 10.7 min
Discarded =	0.74 cfs @	12.57 hrs,	Volume=	0.451 af	
Primary =	1.18 cfs @	12.57 hrs,	Volume=	0.648 af	
Secondary =	28.49 cfs @	12.57 hrs,	Volume=	1.880 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 279.77' @ 12.57 hrs Surf.Area= 11,372 sf Storage= 41,903 cf

Plug-Flow detention time= 85.0 min calculated for 2.979 af (80% of inflow)
Center-of-Mass det. time= 34.4 min (862.5 - 828.1)

Volume	Invert	Avail.Storage	Storage Description
#1	274.50'	44,586 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
274.50	4,205	0	0
275.00	4,780	2,246	2,246
276.00	6,750	5,765	8,011
278.00	9,075	15,825	23,836
280.00	11,675	20,750	44,586

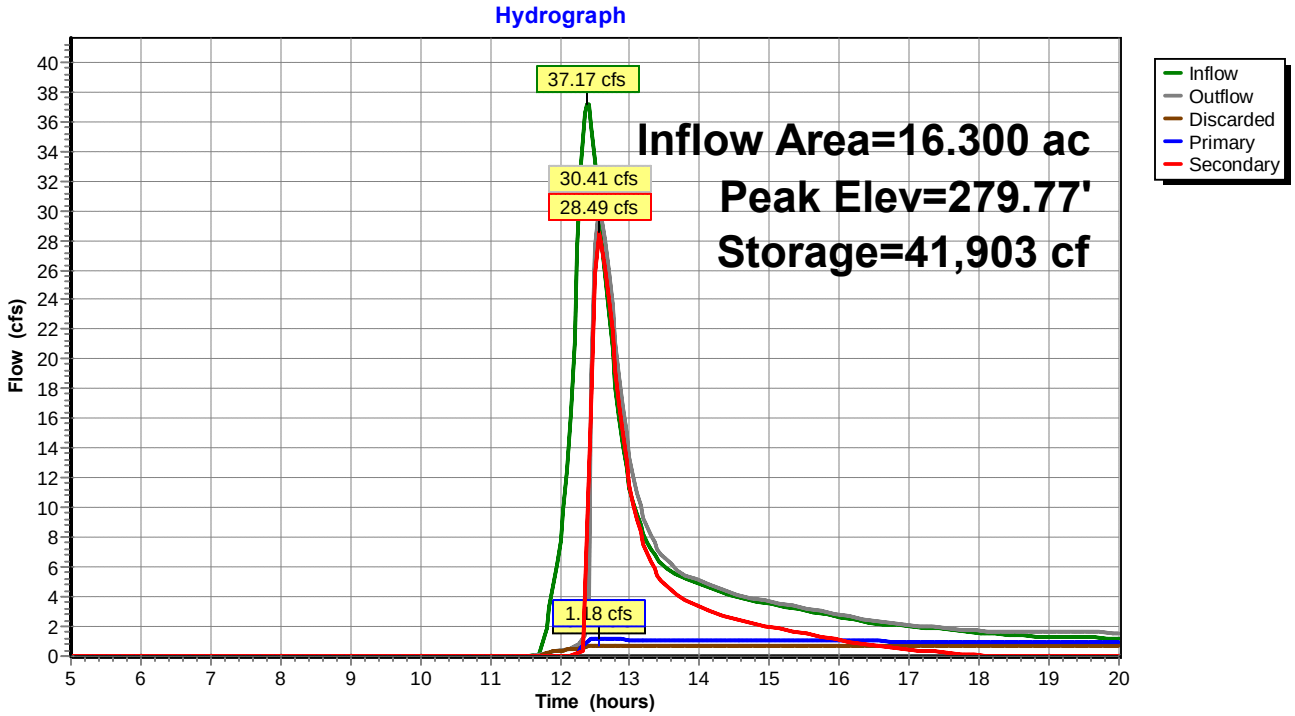
Device	Routing	Invert	Outlet Devices
#1	Secondary	279.00'	**16.0' long x 16.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Primary	277.00'	**6.0" Round Culvert** L= 28.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 277.00' / 275.00' S= 0.0714 '/' Cc= 0.900 n= 0.012, Flow Area= 0.20 sf
#3	Discarded	274.50'	**2.800 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.74 cfs @ 12.57 hrs HW=279.76' (Free Discharge)
└**3=Exfiltration** (Exfiltration Controls 0.74 cfs)

Primary OutFlow Max=1.18 cfs @ 12.57 hrs HW=279.76' (Free Discharge)
└**2=Culvert** (Inlet Controls 1.18 cfs @ 6.02 fps)

Secondary OutFlow Max=28.13 cfs @ 12.57 hrs HW=279.76' (Free Discharge)
└**1=Broad-Crested Rectangular Weir** (Weir Controls 28.13 cfs @ 2.31 fps)

Pond 3P: Dry Basin



Summary for Pond B1: Retention

Inflow Area = 0.767 ac, 32.93% Impervious, Inflow Depth > 3.58" for 100-Year event
Inflow = 2.91 cfs @ 12.16 hrs, Volume= 0.229 af
Outflow = 0.52 cfs @ 12.72 hrs, Volume= 0.229 af, Atten= 82%, Lag= 34.1 min
Discarded = 0.52 cfs @ 12.72 hrs, Volume= 0.229 af
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 315.63' @ 12.72 hrs Surf.Area= 8,065 sf Storage= 3,688 cf

Plug-Flow detention time= 67.8 min calculated for 0.228 af (99% of inflow)
Center-of-Mass det. time= 66.9 min (860.3 - 793.4)

Volume	Invert	Avail.Storage	Storage Description
#1	315.00'	19,555 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

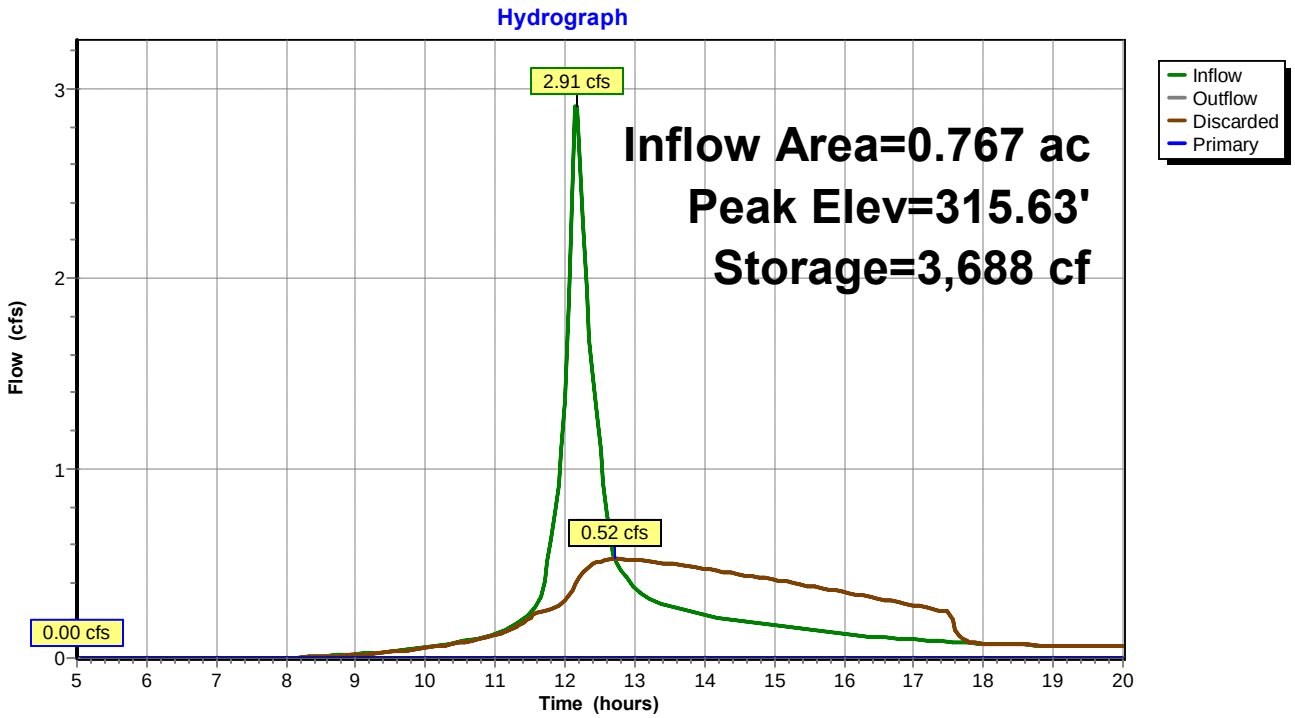
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
315.00	3,590	0	0
316.00	10,660	7,125	7,125
317.00	14,200	12,430	19,555

Device	Routing	Invert	Outlet Devices
#1	Primary	316.50'	**10.0' long x 20.0' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60
			Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Discarded	315.00'	**2.800 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.52 cfs @ 12.72 hrs HW=315.63' (Free Discharge)
└**2=Exfiltration** (Exfiltration Controls 0.52 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=315.00' (Free Discharge)
└**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond B1: Retention



Summary for Pond B2: Retention

Inflow Area =	0.844 ac,	0.00% Impervious,	Inflow Depth >	2.40"	for 100-Year event
Inflow =	1.73 cfs @	12.28 hrs,	Volume=	0.169 af	
Outflow =	0.20 cfs @	14.12 hrs,	Volume=	0.140 af,	Atten= 88%, Lag= 110.5 min
Discarded =	0.20 cfs @	14.12 hrs,	Volume=	0.140 af	
Primary =	0.00 cfs @	5.00 hrs,	Volume=	0.000 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 313.09' @ 14.12 hrs Surf.Area= 3,083 sf Storage= 3,319 cf

Plug-Flow detention time= 170.8 min calculated for 0.140 af (83% of inflow)
Center-of-Mass det. time= 123.5 min (944.1 - 820.6)

Volume	Invert	Avail.Storage	Storage Description
#1	312.00'	6,150 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

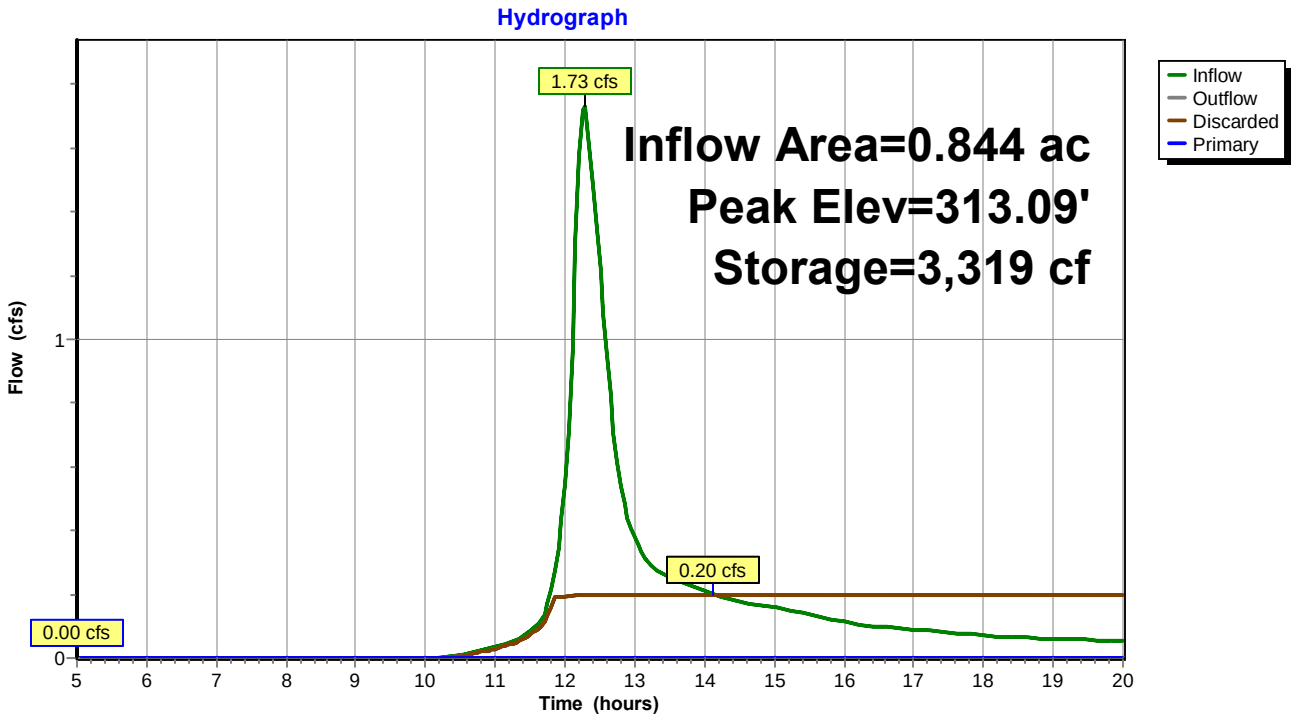
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
312.00	2,990	0	0
314.00	3,160	6,150	6,150

Device	Routing	Invert	Outlet Devices
#1	Primary	313.50'	**10.0' long x 20.0' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60
			Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Discarded	312.00'	**2.800 in/hr Exfiltration over Surface area**

Discarded OutFlow Max=0.20 cfs @ 14.12 hrs HW=313.09' (Free Discharge)
└**2=Exfiltration** (Exfiltration Controls 0.20 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=312.00' (Free Discharge)
└**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond B2: Retention



ATTACHMENT 4

WATER QUALITY BASIN CALCULATION

Water Quality Volume Requirements

Drainage Area to Basin = 16.3 Acres

Impervious Area = 6.4 Acres

% Impervious = 39.3%

WQV = 1ò (R) (A) / 12

R = 0.05 + 0.009 (I) = 0.05 + 0.009 (39.3) = 0.404

WQV = 1ò (0.404) (6.4) /12 = 0.215 Acre feet = 9,365 Cubic Feet

Total Provided

Sediment Forebay = 3,460 C.F.

Stormwater Wetland = 3,150 C.F.

Dry Basin = 14,190 C.F.

Total = 20,800 C.F.

Water Quality Flow (WQF)

Runoff Depth Q = WQV x 12ò per foot / DA = 0.215 x 12 / 16.3 = 0.16

Curve Number (CN) = 96

Ia = 0.083 (table 4-1)

Ia/P = Ia/1 = 0.083

q_u = 580 csm/in

WQF = (q_u)(A)*(Q) = (580)(.0255)(.16) = 2.36 CFS

*Square miles

ATTACHMENT 5

TEMPORARY SEDIMENTATION BASIN REQUIREMENTS

Temporary Sediment Trap Requirements

Per 5-11-5 / 5-11-25 of the 2002 CT guidelines for Soil & Erosion Control

Area	*DA (acres)*	*A (ton/acre/yr)*	*Tons per year*	*Density*	*Required Storage Volume (cubic feet)*
North	16.3	134	2184.2	85	**51,392.9**
South	5.2	134	696.8	85	**16,395.3**

Note: Individual sediment traps shall be field located after land clearing and prior to grading activities

ATTACHMENT 6

SAMPLE CONSTRUCTION STORMWATER INSPECTION REPORT

SEMI- ANNUAL STORMWATER COMPREHENSIVE SITE INSPECTION

Inspector:	
Date of Inspection:	
Weather Conditions:	

1. **Review the Stormwater Pollution Prevention Plan including the Site Map, Material Inventory/Potential Pollutants, Stormwater Control Measures, and Pollution Prevention Team Roster.**

Are there any changes? ☐ *Yes* ☐ *No*

If "Yes", note changes here and revise the Stormwater Pollution Prevention Plan as needed.

2. **Review visual and analytical Stormwater Monitoring Reports since last inspection.**

Are there any changes? ☐ *Yes* ☐ *No*

If "Yes", note changes here and revise the Stormwater Pollution Prevention Plan as needed.

3. **Review routine inspection reports and maintenance records, spill reports, etc. since last inspection.**

Are there any changes? ☐ *Yes* ☐ *No*

If "Yes", note changes here and revise the Stormwater Pollution Prevention Plan as needed.

Additional Comments:

I have discussed the results of this inspection with the Stormwater Pollution Prevention Team members.

Signature of Inspector **Date**

COMPREHENSIVE SITE INSPECTION (CSI)

CSI Date: _____/_____/_____
CSI Start Time: _____
CSI End Time: _____
CSI Conducted During Rainfall Event? YES or NO
Page ____ of ____

Stormwater Management Measures and Spill Response Equipment	Location	Inspection Points – Verify That Each of the Following Conditions is Acceptable.	Conditions Acceptable? (Check One)		Explanation of Unacceptable Conditions, Remedial Action(s) Taken, Date(s) of Remedial Action(s), and Other Comments
Spill Response Equipment	In bins near transfer station tipping floor and in trailer load out area	• Adequate amount of absorbent booms, pads, Speedi-Dri® present and easily accessible			
Erosion Control Measures	Throughout site	• Erosion control measures being used as necessary during site construction and repair work			
Drainage Structures – Catch Basins, Sedimentation Basins, Infiltration Basins Channels/Swales, Outfalls	Located throughout site, see site plans	• In good physical condition			
		• Clear of debris			
		• No visible sheen or floating scum			
		• No excessive sediment build-up			

Any Additional Comments or Observations: _____

_____

_____

_____

Name(s) of Inspector(s) and Organization(s): _____

Signature(s) of Inspector(s): _____ **Date:** _____

Connecticut Department of
Energy & Environmental Protection
Bureau of Materials Management & Compliance Assurance
Water Permitting & Enforcement Division

General Permit for the Discharge of Stormwater and Dewatering Wastewaters from Construction Activities, issued 8/21/13, effective 10/1/13
Stormwater Monitoring Report

SITE INFORMATION

Permittee: _____

Mailing Address: _____

Business Phone: _____ ext.: _____ Fax: _____

Contact Person: _____ Title: _____

Site Name: _____

Site Address: _____

Receiving Water (name, basin): _____

Stormwater Permit No. GSN_____

SAMPLING INFORMATION (Submit a separate form for each outfall)

Outfall Designation: _____ Date/Time Collected: _____

Outfall Location(s) (lat/lon or map link): _____

Person Collecting Sample: _____

Storm Magnitude (inches): _____ Storm Duration (hours): _____

Size of Disturbed Area at any time: _____

MONITORING RESULTS

Sample #	Parameter	Method	Results (units)	Laboratory (if applicable)
1	Turbidity			
2	Turbidity			
3	Turbidity			
4	Turbidity			

(provide an attachment if more than 4 samples were taken for this outfall) Avg =

STATEMENT OF ACKNOWLEDGMENT

I certify that the data reported on this document were prepared under my direction or supervision in accordance with the General Permit for the Discharge of Stormwater and Dewatering Wastewaters from Construction Activities. The information submitted is, to the best of my knowledge and belief, true, accurate and complete.

Authorized Official: _____

Signature: _____ Date: _____

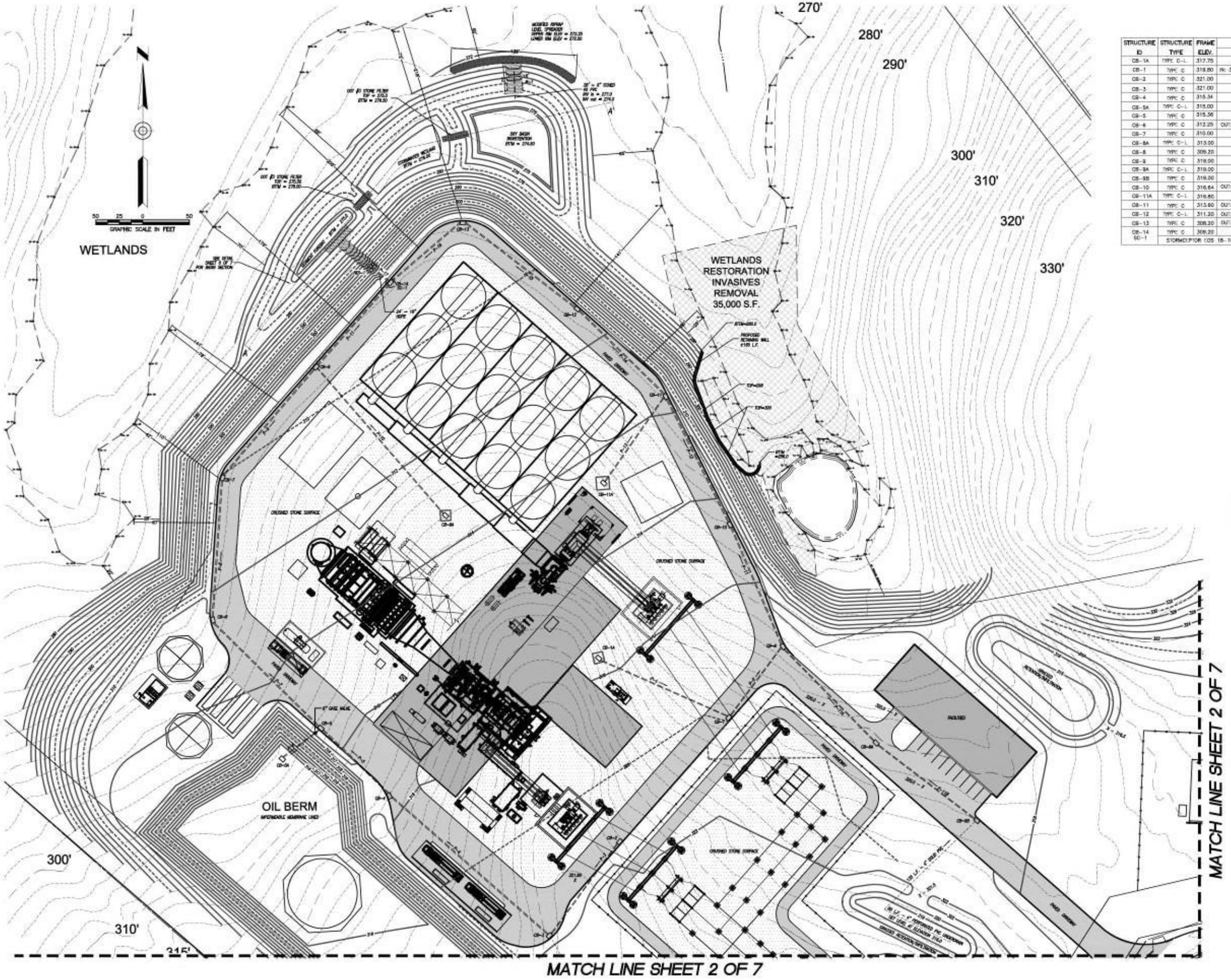
Please send completed form to:

DEPARTMENT OF ENERGY & ENVIRONMENTAL PROTECTION
BUREAU OF MATERIALS MANAGEMENT AND COMPLIANCE ASSURANCE
79 ELM STREET
HARTFORD, CT 06106-5127
ATTN: NEAL WILLIAMS

ATTACHMENT 7

GRADING PLANS, EROSION AND SEDIMENTATION CONTROL PLANS & DETAILS

SEPARATE ENCLOSURE



STORM DRAINAGE STRUCTURE SCHEDULE

STRUCTURE ID	STRUCTURE TYPE	FRAME ELEV.	PIPE INVERT ELEVATION N	S	E	W	SUMP
CB-1A	TYPE C-L	317.75		OUT: 313.25 (SE)			309.25
CB-1	TYPE C	319.80	IN: 311.71 (NW)		OUT: 311.61 (NE)		307.61
CB-2	TYPE C	321.00		OUT: 316.50 (SW)			312.50
CB-3	TYPE C	321.00			IN: 315.22 (NE)	OUT: 315.12 (NW)	311.12
CB-4	TYPE C	315.34			IN: 310.58 (SE)	OUT: 310.48 (NW)	306.48
CB-5A	TYPE C-L	315.00			OUT: 311.48 (NE)		307.48
CB-5	TYPE C	315.56		IN: 310.00 (SW)		OUT: 309.90 (NW)	305.90
CB-6	TYPE C	312.25	OUT: 307.30		IN: 307.40 (SE)		303.50
CB-7	TYPE C	310.00		IN: 305.50	OUT: 305.40 (NE)		301.40
CB-8A	TYPE C-L	313.00				OUT: 308.00 (NW)	305.00
CB-8	TYPE C	309.20		IN: 303.50 (SW)	IN: 303.50 (SE)	OUT: 303.40 (NW)	299.40
CB-9	TYPE C	318.00		IN: 310.69 (SW & SE)		OUT: 310.59 (NW)	308.59
CB-9A	TYPE C-L	319.00		IN: 313.59 (SE)		OUT: 313.49 (NW)	309.49
CB-9B	TYPE C	319.00				OUT: 314.79 (NW)	310.79
CB-10	TYPE C	316.64	OUT: 308.63	IN: 308.73			304.63
CB-11A	TYPE C-L	316.80			OUT: 312.80 (NE)		308.80
CB-11	TYPE C	313.60	OUT: 307.00	IN: 307.10		IN: 307.10	303.00
CB-12	TYPE C-L	311.20	OUT: 305.59	IN: 305.69			301.59
CB-13	TYPE C	308.20	OUT: 303.90 (NW)	IN: 303.80			299.50
CB-14 SD-1	TYPE C	309.20		IN: 301.00 (SW)	IN: 301.00 (NE)	OUT: 300.90 (NW)	295.90
	STORMCEPTOR COS 18-1000 OIL-GRIT SEPARATOR						

PIPE SCHEDULE

PIPE ID	OUTLET DIA. (IN.)	MATERIAL	LENGTH (FT.)	SLOPE (%)
P-1	12	HDPE	154	1.0%
P-2	12	HDPE	92	1.0%
P-3	12	HDPE	129	1.0%
P-4	15	HDPE	227	2.0%
P-5	15	HDPE	102	1.0%
P-6	8	D.I.P	50	1.0%
P-7	15	HDPE	165	1.52%
P-8	15	HDPE	153	1.17%
P-9	18	HDPE	156	1.22%
P-10	12	HDPE	211	2.6%
P-11	12	HDPE	141	1.5%
P-11A	15	HDPE	140	2.0%
P-11B	12	HDPE	130	1.0%
P-12	15	HDPE	153	1.0%
P-13	12	HDPE	114	5.0%
P-14	15	HDPE	131	1.0%
P-15	15	HDPE	152	1.3%
P-16	15	HDPE	100	2.5%
P-17	18	HDPE	24	3.8%
P-18	15	RCP	140	TBD

STRUCTURE ID	TYPE	INVERT ELEVATION
FES-1	FLARED END	300.00
W-1	OVERFLOW WEIR	277.00
FES-2	FLARED END	313.50

DATE	DESCRIPTION

REVISIONS

PROPOSED GRADING & DRAINAGE

PREPARED FOR

KILLINGLY ENERGY CENTER NTE ENERGY PROJECT

LAKE ROAD

KILLINGLY, CONNECTICUT

Killingly Engineering Associates
Civil Engineering & Surveying
134 Westcott Road
P.O. Box 421
Killingly, Connecticut 06241
(860) 779-7299
www.killinglyengineering.com

DATE: 06/30/2016	DRAWN: NET
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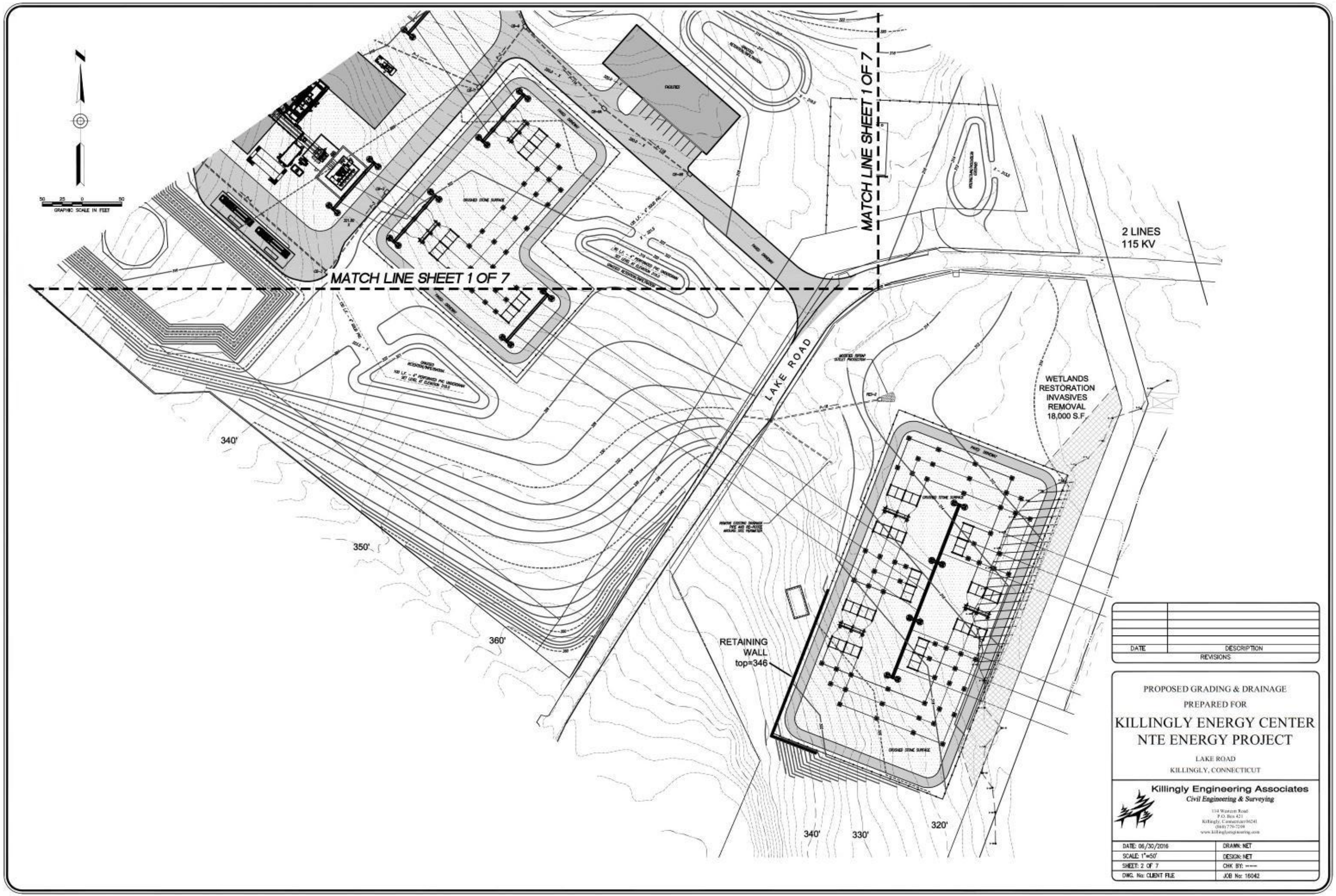
SHEET: 1 OF 7	CHK BY: ----
DWG. No: CLIENT FILE	JOB No: 16042


GRAPHIC SCALE IN FEET
MATCH LINE SHEET 1 OF 7
MATCH LINE SHEET 1 OF 7
2 LINES
115 KV
LAKE ROAD
WETLANDS
RESTORATION
INVASIVES
REMOVAL
18,000 S.F.
340'
350'
360'
RETAINING
WALL
top=346
340'
330'
320'
DATE
DESCRIPTION
REVISIONS
PROPOSED GRADING & DRAINAGE
PREPARED FOR
KILLINGLY ENERGY CENTER
NTE ENERGY PROJECT
LAKE ROAD
KILLINGLY, CONNECTICUT
Killingly Engineering Associates
Civil Engineering & Surveying
DATE: 06/30/2016
DRAWN: NET
SCALE: 1"=50'
DESIGN: NET
SHEET: 2 OF 7
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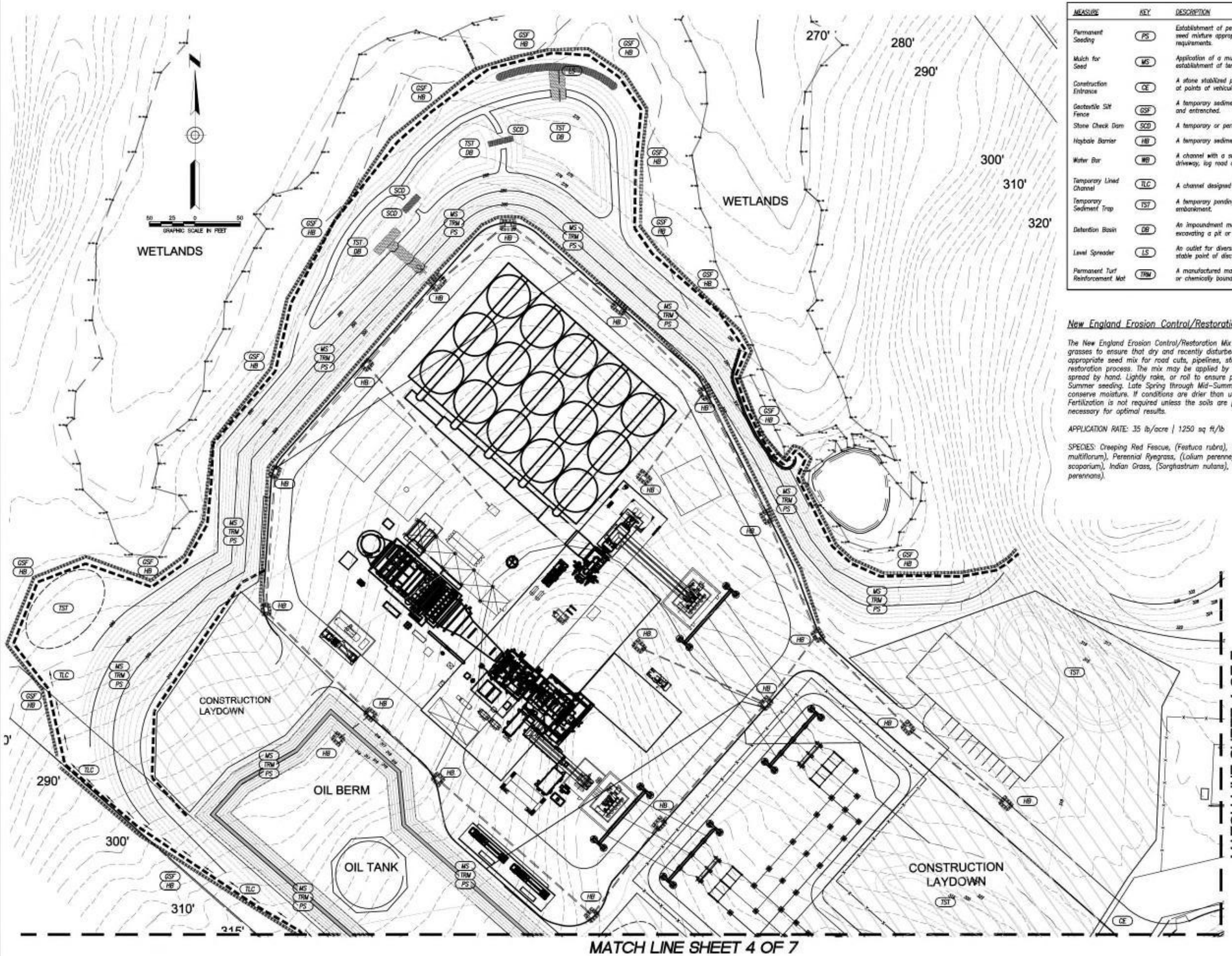
JOB No: 16042



MEASURE	KEY	DESCRIPTION
Permanent Seeding	PS	Establishment of permanent stand of grass and/or legumes by seeding and mulching exposed soils with a seed mixture appropriate for long term stabilization. See Erosion Control Narrative for seed mix requirements.
Mulch for Seed	MS	Application of a mulch that will protect the soil surface on a temporary basis and promote the establishment of temporary or permanent seedings.
Construction Entrance	CE	A stone stabilized pad sometimes associated with a mud rack, automotive spray, or other measures located at points of vehicular ingress and egress on a construction site.
Geotextile Silt Fence	GSF	A temporary sediment barrier consisting of a geotextile fabric pulled taut and attached to supporting posts and entrenched.
Stone Check Dam	SCD	A temporary or permanent stone dam placed across a drainageway.
Hybale Barrier	HB	A temporary sediment barrier consisting of a row of entrenched and anchored bales of hay or straw.
Water Bar	WB	A channel with a supporting berm on the down slope side constructed across a construction access road, driveway, log road or other access way.
Temporary Lined Channel	TLC	A channel designed to convey flows on a short term basis and lined with an erosion resistant covering.
Temporary Sediment Trap	TST	A temporary ponding area with a stone outlet formed by excavation and/or constructing an earthen embankment.
Detention Basin	DB	An impoundment made by constructing a dam or an embankment (embankment detention basin) or by excavating a pit or dugout (excavated detention basin).
Level Spreader	LS	An outlet for diversions and other water conveyances consisting of an excavated depression with a broad stable point of discharge constructed at zero grade across a slope
Permanent Turf Reinforcement Mat	TRM	A manufactured mat composed of non-biodegradable polymer or synthetic fibers mechanically, structurally, or chemically bound to form a continuous matrix.

New England Erosion Control/Restoration Mix

The New England Erosion Control/Restoration Mix For Dry Sites provides an appropriate selection of native and naturalized grasses to ensure that dry and recently disturbed sites will be quickly revegetated and the soil surface stabilized. It is an appropriate seed mix for road cuts, pipelines, steeper slopes, and areas requiring quick cover during the ecological restoration process. The mix may be applied by hydro-seeding, by mechanical spreader, or on small sites it can be spread by hand. Lightly rake, or roll to ensure proper soil-seed contact. Best results are obtained with a Spring or late Summer seeding. Late Spring through Mid-Summer seeding will benefit from a light mulching of weed-free straw to conserve moisture. If conditions are drier than usual, watering will be required.
Fertilization is not required unless the soils are particularly infertile. Preparation of a clean weed free seed bed is necessary for optimal results.

APPLICATION RATE: 35 lb/acre | 1250 sq ft/lb

SPECIES: Creeping Red Fescue, (Festuca rubra), Canada Wild Rye, (Elymus canadensis), Annual Ryegrass, (Lolium multiflorum), Perennial Ryegrass, (Lolium perenne), Blue Grama, (Bouteloua gracilis), Little Bluestem, (Schizachyrium scoparium), Indian Grass, (Sorghastrum nutans), Rough Bentgrass, (Agrostis scabra), Upland Bentgrass, (Agrostis perennans).

NOTES:

1. CONTRUCTION LAYDOWN AND STAGING AREAS SHALL BE RE-ESTABLISHED AS GREEN AREAS AT THE TERMINATION OF CONSTRUCTION. PORTIONS MAY BE ESTABLISHED AS OVERFLOW OR EMERGENCY PARKING WITH GRASS PAVE OR AN ENGINEER APPROVED TURF REINFORCEMENT OPTION.
2. TURF REINFORCEMENT MAT ON FILL AND CUT SLOPES SHALL BE ERONET C-125 LONG-TERM PHOTODEGRADABLE DOUBLE-NET BLANKET OR APPROVED EQUAL.
3. SEED MIX ON SLOPES SHALL BE NEW ENGLAND EROSION CONTROL RESTORATION MIX DISTRIBUTED BY NEW ENGLAND WETLANDS PLANTS, INC. APPLY AT A RATE OF 35 POUNDS PER ACRE AND SUPPLEMENT WITH 5% ANNUAL RYE GRASS (BY WEIGHT) AT TIME OF APPLICATION.

DATE	DESCRIPTION

REVISIONS

EROSION AND SEDIMENTATION CONTROL PLAN

PREPARED FOR

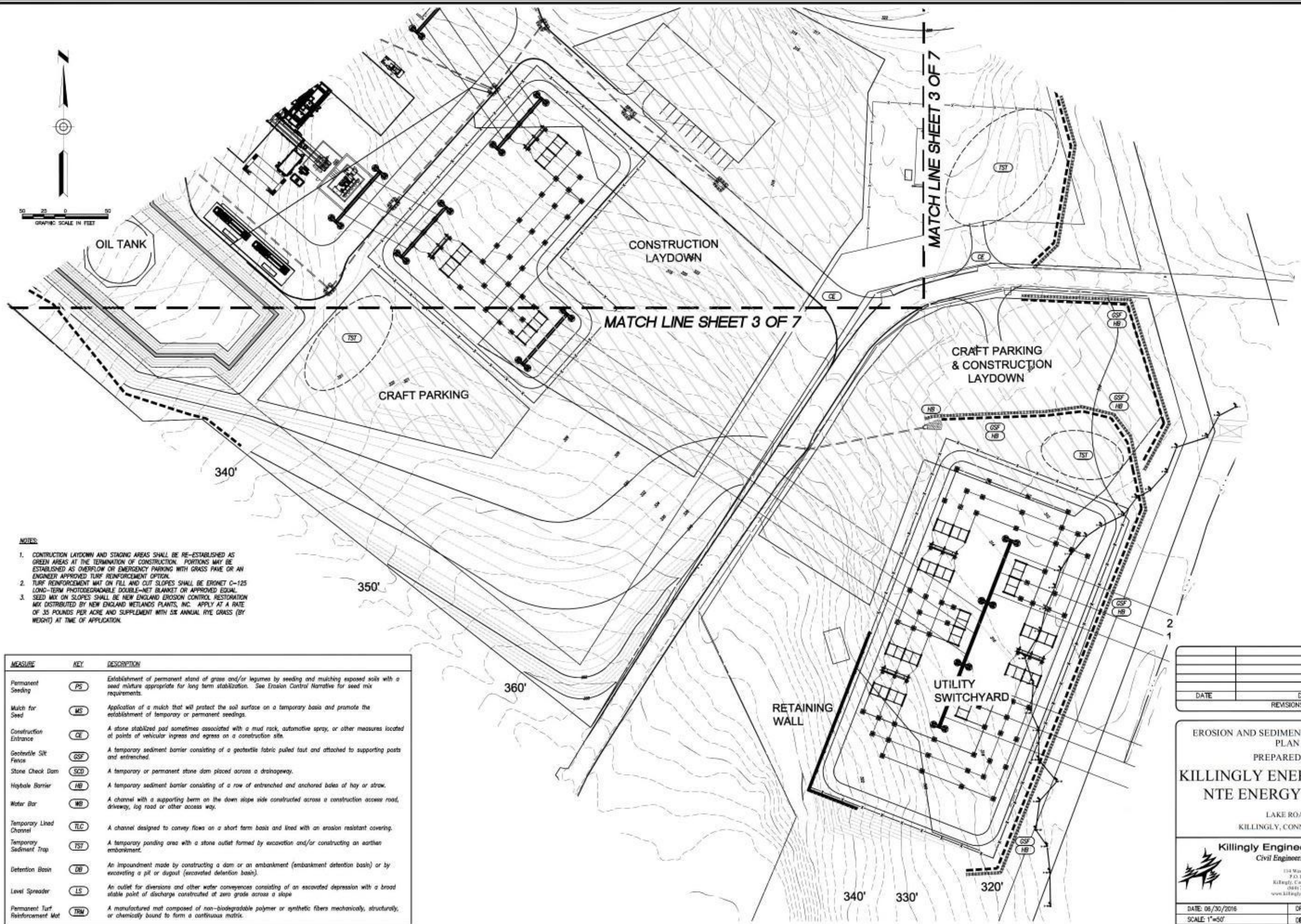
KILLINGLY ENERGY CENTER NTE ENERGY PROJECT

LAKE ROAD

KILLINGLY, CONNECTICUT

Killingly Engineering Associates
Civil Engineering & Surveying

DATE: 06/30/2016	DRAWN: NET
SCALE: 1"=50'	DESIGN: NET
SHEET: 3 OF 7	CHK BY: ----
DWG. No: CLIENT FILE	JOB No: 16042



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DATE	DESCRIPTION

REVISIONS

EROSION AND SEDIMENTATION CONTROL PLAN

PREPARED FOR

KILLINGLY ENERGY CENTER NTE ENERGY PROJECT

LAKE ROAD

KILLINGLY, CONNECTICUT

Killingly Engineering Associates
Civil Engineering & Surveying
134 Westcott Road
P.O. Box 421
Killingly, Connecticut 06241
(860) 779-7299
www.killinglyengineering.com

DATE: 08/30/2016	DRAWN: NET
SCALE: 1"=50'	DESIGN: NET
SHEET: 4 OF 7	CHK BY: ----
DWG. No: CLIENT FILE	JOB No: 16042

EROSION AND SEDIMENT CONTROL PLAN:

REFERENCE IS MADE TO:

1. Connecticut Guidelines for Soil Erosion and Sediment Control 2002 (2002 Guidelines).
2. NRCS WSS (Web Soil Survey)

DEVELOPMENT CONTROL PLAN:

1. Development of the site will be performed by the Contractor, who will be responsible for the installation and maintenance of erosion and sediment control measures required throughout construction.
2. The sedimentation control mechanisms shall remain in place from start of PutnamKillingly will be notified when sediment and erosion control structures are initially in place. Any additional soil & erosion control measures requested by the Town or its agent, shall be installed immediately. Once the proposed development, seeding and planting have been completed, the representative shall again be notified to inspect the site. The control measures will not be removed until this inspection is complete.
3. All stripping is to be confined to the immediate construction area. Topsoil shall be stockpiled so that slopes do not exceed 2 to 1. A hay bale sediment barrier is to surround each stockpile and a temporary vegetative cover shall be provided.
4. Dust control will be accomplished by spraying with water. The application of calcium chloride is not permitted adjacent to wetland resource areas or within 100' of these areas.
5. The proposed planting schedule is to be adhered to during the planting of disturbed areas throughout the proposed construction site.
6. Final stabilization of the site is to follow the procedures outlined in "Permanent Vegetative Cover". If necessary a temporary vegetative cover is to be provided until a permanent cover can be applied.

SILT FENCE INSTALLATION AND MAINTENANCE:

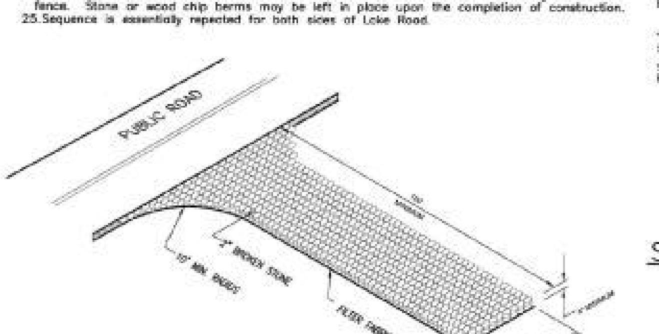
1. Dig a 6" deep trench on the uphill side of the barrier location.
2. Position the posts on the downhill side of the barrier and drive the posts 1.5 feet into the ground.
3. Lay the bottom 6" of the fabric in the trench to prevent undermining and backfill.
4. Inspect and repair barrier after heavy rainfall.
5. Inspections will be made at least once per week and within 24 hours of the end of a storm with a rainfall amount of 0.5 inch or greater to determine maintenance needs.
6. Sediment deposits are to be removed when they reach a height of 1 foot behind the barrier or half the height of the barrier and are to be deposited in an area which is not regulated by the inland wetlands commission.
7. Replace or repair the fence within 24 hours of observed failure. Failure of the fence has occurred when sediment fails to be retained by the fence because:
- the fence has been overtopped, undercut or bypassed by runoff water,
- the fence has been moved out of position (knocked over), or
- the geotextile has decomposed or been damaged.

HAY BALE INSTALLATION AND MAINTENANCE:

1. Bales shall be placed as shown on the plans with the ends of the bales tightly abutting each other.
2. Each bale shall be securely anchored with at least 2 stakes and gaps between bales shall be wedged with straw to prevent water from passing between the bales.
3. Inspect bales at least once per week and within 24 hours of the end of a storm with a rainfall amount of 0.5 inches or greater to determine maintenance needs.
4. Remove sediment behind the bales when it reaches half the height of the bale and deposit in an area which is not regulated by the Inland Wetlands Commission.
5. Replace or repair the barrier within 24 hours of observed failure. Failure of the barrier has occurred when sediment fails to be retained by the barrier because:
- the barrier has been overtopped, undercut or bypassed by runoff water.
- the barrier has been moved out of position, or
- the hay bales have deteriorated or been damaged.

SEQUENCE OF CONSTRUCTION

1. Flag the limits of construction disturbance necessary to facilitate the pre-construction meeting.
2. Contact Call Before You Dig at 1-800-922-4455 to mark out existing utilities.
3. Hold the pre-construction meeting.
4. Install the anti-tracking construction entrance.
5. Cut trees within the defined clearing limits and remove cut wood. Chip brush, branches and small trees and stockpile chips for use on site for erosion and sedimentation control.
6. Install perimeter erosion and sedimentation controls.
7. Remove stumps and transport off site. No stumps shall be buried on site.
8. Remove topsoil and grade construction staging and laydown area. Install crushed stone or rolled gravel surface and grade to provide positive drainage to perimeter of laydown area. Construct temporary sediment basin and install perimeter erosion controls in accordance with plans.
9. Strip and stockpile topsoil within the footprint of the construction phase area. Install perimeter erosion and sedimentation controls around stockpiles.
10. Make required cuts and fills and construct proposed retaining wall as fills are being placed adjacent to wetlands area.
11. Establish the subgrade for topsoil areas, buildings, perimeter roadway and parking areas. Bench buildings to a subgrade and allow for sufficient area around building footprints for construction activities.
12. Begin building and equipment construction.
13. Install surface water controls such as temporary sedimentation basins, diversions, and stone or wood chip dikes and insure that discharge locations are stable. Engineer shall evaluate unstable conditions for recommended alternatives prior to installing surface controls.
14. Construct Stormwater basin, outlet and outlet protection and utilize basin as a temporary sedimentation basin during construction. Plug low level outlet until all areas on site have been stabilized and basin vegetation is established.
15. Install all utilities and drainage systems to within 5' of the buildings and facilities or as modified by the site engineer for specific site conditions.
16. Prepare sub-base, slopes, parking areas, shoulder areas, access roads and any additional areas of disturbance for final grading.
17. Install topsoil on fill and cut slopes, seed disturbed areas and install erosion control fabric to protect against runoff erosion or raindrop impact.
18. Install and compact processed aggregate for pavement areas.
19. Install crushed stone surfaces where call for on the design plans.
20. Place remaining topsoil where required and complete perimeter landscaping. Fine grade, rake, seed and mulch to within 2' of curbs or paved areas.
21. Upon substantial completion of the building(s) and plant equipment areas, complete the balance of the site work and stabilization of remaining disturbed areas. Install first course of paving.
22. When all other work has been completed, repair and sweep all paved areas for final course of paving. Inspect drainage system and stormwater basin and remove accumulated sediment.
23. Install final course of pavement and unplug low level outlet from stormwater basin.
24. After site is stabilized, remove all erosion and sedimentation controls such as geotextile silt fence. Stone or wood chip berms may be left in place upon the completion of construction.
25. Sequence is essentially repeated for both sides of Lake Road.



ANTI-TRACKING PAD

NOT TO SCALE

EROSION AND SEDIMENT CONTROL NARRATIVE:

PRINCIPLES OF EROSION AND SEDIMENT CONTROL

The primary function of erosion and sediment controls is to absorb erosional energies and reduce runoff velocities that force the detachment and transport of soil and/or encourage the deposition of eroded soil particles before they reach any sensitive area.

KEEP LAND DISTURBANCE TO A MINIMUM

The more land that is in vegetative cover, the more surface water will infiltrate into the soil, thus minimizing stormwater runoff and potential erosion. Keeping land disturbance to a minimum not only involves minimizing the extent of exposure at any one time, but also the duration of exposure. Phasing, sequencing and construction scheduling are interrelated. Phasing divides a large project into distinct sections where construction work over a specific area occurs over distinct periods of time and each phase is not dependent upon a subsequent phase in order to be functional. A sequence is the order in which construction activities are to occur during any particular phase. A sequence should be developed on the premise of "first things first" and "last things last" with proper attention given to the inclusion of adequate erosion and sediment control measures. A construction schedule is a sequence with time lines applied to it and should address the potential overlap of actions in a sequence which may be in conflict with each other.

- Limit areas of clearing and grading. Protect natural vegetation from construction equipment with fencing, tree armoring, and retaining walls or tree wells.
- Route traffic patterns within the site to avoid existing or newly planted vegetation.
- Phase construction so that areas which are actively being developed at any one time are minimized and only that area under construction is exposed. Clear only those areas essential for construction.
- Sequence the construction of storm drainage systems so that they are operational as soon as possible during construction. Ensure all outlets are stable before outletting storm drainage flow into them.
- Schedule construction so that final grading and stabilization is completed as soon as possible.

SLOW THE FLOW

Detachment and transport of eroded soil must be kept to a minimum by absorbing and reducing the erosive energy of water. The erosive energy of water increases as the volume and velocity of runoff increases. The volume and velocity of runoff increases during development as a result of reduced infiltration rates caused by the removal of existing vegetation, removal of topsoil, compaction of soil and the construction of impervious surfaces.

- Use diversions, stone dikes, silt fences and similar measures to break flow lines and dissipate storm water energy.
- Avoid diverting one drainage system into another without calculating the potential for downstream flooding or erosion.

KEEP CLEAN RUNOFF SEPARATED

Clean runoff should be kept separated from sediment laden water and should not be directed over disturbed areas without additional controls. Additionally, prevent the mixing of clean off-site generated runoff with sediment laden runoff generated on-site until after adequate filtration of on-site waters has occurred.

- Segregate construction waters from clean water.
- Divert site runoff to keep it isolated from wetlands, watercourses and drainage ways that flow through or near the development until the sediment in that runoff is trapped or detained.

REDUCE ON SITE POTENTIAL INTERNALLY AND INSTALL PERIMETER CONTROLS

While it may seem less complicated to collect all waters to one point of discharge for treatment and just install a perimeter control, it can be more effective to apply internal controls to many small sub-drainage basins within the site. By reducing sediment loading from within the site, the chance of perimeter control failure and the potential off-site damage that it can cause is reduced. It is generally more expensive to correct off-site damage than it is to install proper internal controls.

- Control erosion and sedimentation in the smallest drainage area possible. It is easier to control erosion than to contend with sediment after it has been carried downstream and deposited in unwanted areas.
- Direct runoff from small disturbed areas to adjoining undisturbed vegetated areas to reduce the potential for concentrated flows and increase settlement and filtering of sediments.
- Concentrated runoff from development should be safely conveyed to stable outlets using rip rapped channels, waterways, diversions, storm drains or similar measures.
- Determine the need for sediment basins. Sediment basins are required on larger developments where major grading is planned and where it is impossible or impractical to control erosion at the source. Sediment basins are needed on large and small sites when sensitive areas such as wetlands, watercourses, and streets would be impacted by off-site sediment deposition. Do not locate sediment basins in wetlands or permanent or intermittent watercourses. Sediment basins should be located to intercept runoff prior to its entry into the wetland or watercourse.
- Grade and landscape around buildings and septic systems to divert water away from them.

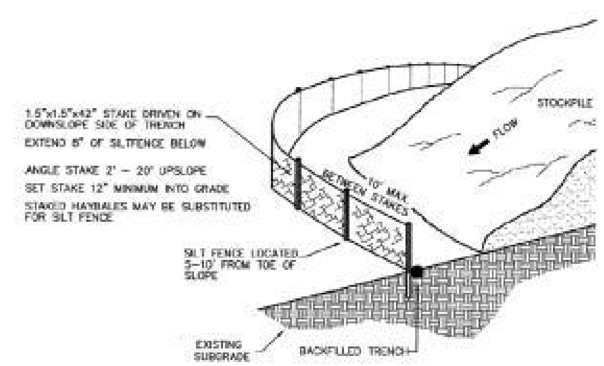
1.5"x1.5"x42" STAKE DRIVEN ON DOWNSLOPE SIDE OF TRENCH

EXTEND 8" OF SILTFENCE BELOW

ANGLE STAKE 2' - 20" UPSLOPE

SET STAKE 12" MINIMUM INTO GRADE

STAKED HAYBALES MAY BE SUBSTITUTED FOR SILT FENCE



SILT FENCE @ TOE OF SLOPE APPLICATION

NOT TO SCALE

TEMPORARY VEGETATIVE COVER:

SEED SELECTION

Grass species shall be appropriate for the season and site conditions. Appropriate species are outlined in Figure TS-2 in the 2002 Guidelines.

TIMING CONSIDERATIONS

Seed with a temporary seed mixture within 7 days after the suspension of grading work in disturbed areas where the suspension of work is expected to be more than 30 days but less than 1 year.

SITE PREPARATION

Install needed erosion control measures such as diversions, grade stabilization structures, sediment basins and grassed waterways.

Grade according to plans and allow for the use of appropriate equipment for seedbed preparation, seeding, mulch application, and mulch anchoring.

SEEDBED PREPARATION

Loosen the soil to a depth of 3-4 inches with a slightly roughened surface. If the area has been recently loosened or disturbed, no further roughening is required. Soil preparation can be accomplished by tracking with a bulldozer, discing, harrowing, raking or dragging with a section of chain link fence. Avoid excessive compaction of the surface by equipment traveling back and forth over the surface. If the slope is tracked, the cleat marks shall be perpendicular to the anticipated direction of the flow of surface water.

If soil testing is not practical or feasible on small or variable sites, or where timing is critical, fertilizer may be applied at the rate of 300 pounds per acre or 7.5 pounds per 1,000 square feet of 10-10-10 or equivalent. Additionally, lime may be applied using rates given in Figure TS-1 in the 2002 Guidelines.

SEEDING

Apply seed uniformly by hand cyclone seeder, drill, cultipacker type seeder or hydroseeder at a minimum rate for the selected species. Increase seeding rates by 10% when hydroseeding.

MULCHING

Temporary seedings made during optimum seeding dates shall be mulched according to the recommendations in the 2002 Guidelines. When seeding outside of the recommended dates, increase the application of mulch to provide 95%-100% coverage.

MAINTENANCE

Inspect seeded area at least once a week and within 24 hours of the end of a storm with a rainfall amount of 0.5 inch or greater for seed and mulch movement and rill erosion.

Where seed has moved or where soil erosion has occurred, determine the cause of the failure. Repair eroded areas and install additional controls if required to prevent reoccurrence of erosion.

Continue inspections until the grasses are firmly established. Grasses shall not be considered established until a ground cover is achieved which is mature enough to control soil erosion and to survive severe weather conditions (approximately 80% vegetative cover).

Figure TS-2 Temporary Seeding Rates and Dates

Species[4]	Seeding Rates (pounds) per acre	Seeding Rates (pounds) per 1000 sq.ft.	Optimum Seed Depth[2] (inches)	Optimum Seeding Dates	Plant Characteristics
Annual ryegrass (Lolium multiflorum)	40	1.0	0.5		May be added to mixes. Will mow out of most stands.
Perennial ryegrass (Lolium perenne)	40	1.0	0.5		Use for winter cover. Tolerates cold and low moisture.
Winter Rye (Secale cereale)	120	3.0	1.0		Quick germination and heavy spring growth. Dies back in June with little regrowth.
Oats (Avena sativa)	86	2.0	1.0		In northern CT will winter kill with the first killing frost and may through out the state in severe winters.
Winter Wheat (Triticum aestivum)	120	3.0	1.0		Quick germination with moderate growth. Dies back in June with no regrowth.
Millet (Echinochloa crusgalli)	20	0.5	1.0		Warm season small grain, dies with frost in September.
Sudangrass (Sorghum sudanense)	30	0.7	1.0		Tolerates warm temperatures and droughty conditions.
Buckwheat (Fagopyrum esculentum)	15	0.4	1.0		Hardy plant that will reseed itself and is good as a green manure crop.
Weeping lovegrass (Eragrostis curvula)	5	0.2	0.25		Warm season perennial. May bunch. Tolerates hot, dry slopes, and acidic soils. Excellent nurse crop. Usually [illegible]
DOT all Purpose Mix[3]	150	3.4	0.5		Suitable for all conditions.

[1] May be planted throughout summer if soil moisture is adequate or can be irrigated. Fall seeding may be extended 15 days in the coastal towns.
[2] Seed at twice the indicated depth for sandy soils.
[3] See Permanent Seeding Figure PS-3 for seeding mixture requirements.
[4] Listed species may be used in combinations to obtain a broader time spectrum. If used in combination, reduce each species planting rate by 30% of that listed.

Figure PS-2 Selecting Seed Mix to Match Need

Area To Be Seeded	Mixture Number: Mowing Desired	Mixture Number: Mowing Not Required
BORROW AREAS, ROADSIDES, DIKES, LEVEES, POND BANKS AND OTHER SLOPES AND BANKS		
A) Well or excessively drained soil[2]	1,2,3,4,5 or 6	5 or 7, 8, 9, 10, 11, 12, 16, 22
B) Somewhat poorly drained soils[2]	2	5, 6
C) Variable drainage soils[2]	2	5, 6, 11
DRAINAGE DITCH AND CHANNEL BANKS		
A) Well or excessively drained soils[2]	1, 4, 5, or 6	5, 10, 11, 13
B) Somewhat poorly drained soils[2]	2	
C) Variable drainage soils[2]	2	
DIVERSIONS		
A) Well or excessively drained soils[2]	2, 3 or 4	9, 10, 11
B) Somewhat poorly drained soils[2]	2	
C) Variable drainage soils[2]	2	
EFFLUENT DISPOSAL		5 or 6
GRAVEL PITS[3]		26, 27, 28
GULLIED AND ERODED AREAS		3, 4, 5, 8, 14, 11, 12
MINESPOIL & WASTE, AND OTHER SPOIL BANKS (If toxic substances & physical properties not limiting)		13, 16, 17, 18, 26, 27, 28
SHORELINES (Fluctuating water levels)		5 or 6
SKI SLOPES		6, 10
SOD WATERWAYS AND SPILLWAYS	1, 2, 3, 4, 6, 7, or 8	1, 2, 3, 4, 6, 7, or 8
SUNNY RECREATION AREAS (Picnic areas and playgrounds or driving and archery ranges, nature trails)	1, 2 or 23	
CAMPING AND PARKING, NATURE TRAILS (Shaded)	81, 21 or 23	
SAND DUNES (Blowing sand)	25	
WOODLAND ACCESS ROADS, SKID TRAILS AND LOG YARDING AREAS		9, 10, 16, 22, 26
LAWNS AND HIGH MAINTENANCE AREAS	1, 19, 21 or 29	

[1] The numbers following in these columns refer to seed mixtures in Figure PS-3. Mixes for shady areas are in bold italics print (including mixes 20 through 24).
[2] See county soil survey for drainage class. Soil surveys are available from the County Soil and Water Conservation District Office.
[3] Use mix 26 when soil passing a 200 mesh sieve is less than 15% of total weight. Use mix 26 & 27 when soil passing a 200 mesh sieve is between 15 and 20% of total weight. Use mix 26, 27 & 28 when soil passing a 200 mesh sieve is above 20% of total weight.

PERMANENT VEGETATIVE COVER:

Refer to Figure PS-2, Permanent Seeding Measure in the 2002 Guidelines for specific applications and details related to the installation and maintenance of a permanent vegetative cover. In general, the following sequence of operations shall apply:

1. Topsoil will be replaced once the excavation and grading has been completed. Topsoil will be spread at a minimum compacted depth of 4".
2. Once the topsoil has been spread, all stones 2" or larger in any dimension will be removed as well as debris.
3. Apply agricultural ground limestone at a rate of 2 tons per acre or 100 lbs. per 1000 s.f. Apply 10-10-10 fertilizer or equivalent at a rate of 300 lbs. per acre or 7.5 lbs. per 1000 s.f. Work lime and fertilizer into the soil to a depth of 4".
4. Inspect seedbed before seeding. If traffic has compacted the soil, retill compacted areas.
5. Apply the chosen grass seed mix. The recommended seeding dates are: April 1 to June 15 & August 15 - October 1.
6. Following seeding, firm seedbed with a roller. Mulch immediately following seeding. If a permanent vegetative stand cannot be established by September 30, apply a temporary cover on the topsoil such as netting, mat or organic mulch.

Figure PS-3 Seed Mixtures for Permanent Seeding

No.	Seed Mixture (Variety)[1]	Lbs/Acre	Lbs/1,000 Sq.Ft.
1[5]	Kentucky Bluegrass Creeping Red Fescue (Pennlawn, Wintergreen) Perennial Ryegrass (Pennfine, Manhattan)	20 20 5 Total 45	.45 .45 .10 1.00
2[5]	Creeping Red Fescue (Pennlawn, Wintergreen) Redtop (Streaker, Common) Tall Fescue (Kentucky 31) or Smooth Bromegrass (Saratoga, Lincoln)	20 2 20 Total 42	.45 .05 .45 .95
3[5]	Creeping Red Fescue (Pennlawn, Wintergreen) Birdsfoot Trefoil (Empire, Viking) with inoculant[1] Tall Fescue (Kentucky 31) or Smooth Bromegrass (Saratoga, Lincoln)	20 8 20 Total 48	.45 .20 .45 1.10
4[5]	Creeping Red Fescue (Pennlawn, Wintergreen) or Tall Fescue (Kentucky 31) Redtop (Streaker, Common) Birdsfoot Trefoil (Empire, Viking) with inoculant[1]	20 2 8 Total 30	.45 .05 .20 .70
5[5]	White Clover Perennial Rye Grass	10 2 Total 12	.25 .05 .30
6[5]	Creeping Red Fescue Redtop (Streaker, Common) Perennial Rye Grass	20 2 20 Total 42	.50 .05 .50 1.05
7[5]	Smooth Bromegrass (Saratoga, Lincoln) Perennial Ryegrass (Pennfine, Manhattan) Bird's-foot Trefoil (Empire, Viking) with inoculant[1]	15 5 10 Total 30	.35 .10 .25 .70
8[6]	Switchgrass (Blackwell, Shelter, Cave-in-rock) Weeping lovegrass Little Bluestem (Blaze, Aldous, Camper)	10[2] 3 10[2] Total 23	.25 .07 .25 .57
9[5]	Creeping Red Fescue (Pennlawn, Wintergreen) Crown Vetch (Chemung, Penngift) with inoculant[1] (or Flatpea (Lathco) with inoculant[1]) Tall Fescue (Kentucky 31) or Smooth Bromegrass (Saratoga, Lincoln) Redtop (Streaker, Common)	10 15 (30) 15 2 Total 42 (or 57)	.25 .35 (.75) .35 .05 1.00 (or 1.40)
10[5]	Creeping Red Fescue (Pennlawn, Wintergreen) Redtop (Streaker, Common) Crown Vetch (Chemung, Penngift) with inoculant[1] (or Flatpea (Lathco) with inoculant[1])	20 2 15 (30) Total 37 (or 52)	.45 .05 .35 (.75) .85 (or 1.25)
11[5]	Bird's-foot Trefoil (Empire, Viking) with inoculant[1] Crown Vetch (Chemung, Penngift) with inoculant[1] Creeping Red Fescue (Pennlawn, Wintergreen) or Tall Fescue (Kentucky 31)	8 15	.20 .35

Figure PS-3 Seed Mixtures for Permanent Seeding (con't)

No.	Seed Mixture (Variety)[1]	Lbs/Acre	Lbs/1,000 Sq.Ft.
12[6]	Switchgrass (Blackwell, Shelter, Cave-in-rock) Perennial Ryegrass (Pennfine, Manhattan) Crown Vetch (Chemung, Penngift) with inoculant[1]	10 5 25 Total 45	.25 .10 .55 1.05
13[6]	Crown Vetch (Chemung, Penngift) with inoculant[1] (or Flatpea (Lathco) with inoculant[1]) Switchgrass (Blackwell, Shelter, Cave-in-rock) Perennial Ryegrass (Pennfine, Manhattan)	10 (30) 5 5 Total 20 (or 40)	.25 (.75) .10 .10 .45 (or .95)
14[5]	Crown Vetch (Chemung, Penngift) with inoculant[1] (or Flatpea (Lathco) with inoculant[1]) Perennial Ryegrass (Pennfine, Manhattan)	15 (30) 10 Total 25 (or 40)	.35 (.75) .25 .60 (or 1.00)
15[6]	Switchgrass (Blackwell, Shelter, Cave-in-rock) Big Bluestem (Niagara, Kaw) or Little Bluestem (Blaze, Aldous, Camper) Perennial Ryegrass (Pennfine, Manhattan) Birdsfoot Trefoil (Empire, Viking) with inoculant[1]	5[2] 5[2] 5 5 Total 20	.10 .10 .10 .10 .40
16[5]	Tall Fescue (Kentucky 31) Flatpea (Lathco) with inoculant[1]	20 30 Total 50	.45 .75 1.20
17[6]	Deer Tongue (Tioga) with inoculant[1] Birdsfoot Trefoil (Empire, Viking) with inoculant[1] Perennial Ryegrass (Pennfine, Manhattan)	10[2] 8 3 Total 21	.25 .20 .07 .52
18[6]	Deer Tongue (Tioga) with inoculant[1] Crown Vetch (Chemung, Penngift) with inoculant[1] Perennial Ryegrass (Pennfine, Manhattan)	10[2] 15 3 Total 28	.25 .35 .07 .67
19[5]	Chewings Fescue Hard Fescue Colonial Bentgrass Birds-foot Trefoil (Empire, Viking) Perennial Ryegrass	35 30 1 10 20 Total 100	.80 .70 .03 .20 .50 2.50
20[4]	[illegible]		
21[5]	Creeping Red Fescue (Pennlawn, Wintergreen)	Total 60	1.35
22[5]	Creeping Red Fescue (Pennlawn, Wintergreen) Tall Fescue (Kentucky 31)	40 20 Total 60	.90 .45 1.35
23[5]	Creeping Red Fescue (Pennlawn, Wintergreen) Flatpea (Lathco) with inoculant[1]	15 30 Total 45	.35 .75 1.00
24[5]	Tall Fescue (Kentucky 31)	Total 150	3.60

Figure PS-3 Seed Mixtures for Permanent Seeding (con't)

No.	Seed Mixture (Variety)[1]	Lbs/Acre	Lbs/1,000 Sq.Ft.
25[6]	American Beachgrass (Cape)	58,500 culms/acre	1,343 culms/100 sq. ft.
26[6]	Switchgrass (Blackwell, Shelter, Cave-in-rock) Big Bluestem (Niagara, Kaw) Little Bluestem (Blaze, Aldous, Camper) Sand Lovegrass (NE-27, Bend) Bird's-foot Trefoil (Empire Viking)	4.0 4.0 2.0 1.5 2.0 Total 13.5	.10 .10 .05 .03 .05 .33
27[5]	Flatpea (Lathco) Perennial Pea (Lathco) Crown Vetch (Chemung, Penngift) Tall Fescue (Kentucky 31)	10 2 10 2 Total 24	.20 .05 .20 .20 .65
28[5]	Orchardgrass (Pennlate, Sav, Potomac) Tall Fescue (Kentucky 31) Redtop (Streaker, Common) Birds-foot Trefoil (Empire Viking)	5 10 2 5 Total 22	.10 .20 .05 .10 .45
29	Turf Type Tall Fescue (Bonanza, Mustang, Rebel II, Spartan, Jaguar) or Perennial Rye ("Fiesta 2000" mix, Pinnacle II, Blazer II, and Dasher III)	175 to 250	6 to 8

[1] Use proper inoculant for legume seeds, use four times recommended rate when hydroseeding.
[2] Use Pure Live Seed (PLS) = % Germination X % Purity / 100
EXAMPLE: Common Bermuda seed with 75% germination and 80% purity: [illegible]
[3] DOT All purpose mix.
[4] Wild flower seed containing New England Aster, Baby's Breath, Black Eye Susan, Catchfly, Dwarf Columbine, Purple Coneflower, Lance-leaved Coreopsis, Cornflower, Ox eye Daisy, Dame's Rocket, Scarlet Flax, Foxglove, Gaillardia, Rocky Larkspur, Spanish Lokopsis, Corn Poppy, Spurred Snapdragon, Wallflower and/or Yarrow may be added to any seed mix given. Most seed suppliers carry a wild flower mixture that is suitable for the Northeast and contains a variety of both annual and perennial flowers. Seeding rates for the specific mixture should be followed.
[5] Considered to be a cool season mix.
[6] Considered to be a warm season mix.

DATE	DESCRIPTION
REVISIONS	

EROSION AND SEIMENTATION CONTROL NARRATIVE AND DETAILS

PREPARED FOR

KILLINGLY ENERGY CENTER NTE ENERGY PROJECT

LAKE ROAD

KILLINGLY, CONNECTICUT

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DATE: 06/30/2016	DRAWN: NET
SCALE: 1"=50'	DESIGN: NET
SHEET: 5 OF 7	CHK BY: ---
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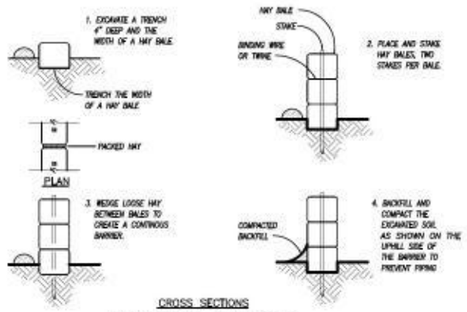
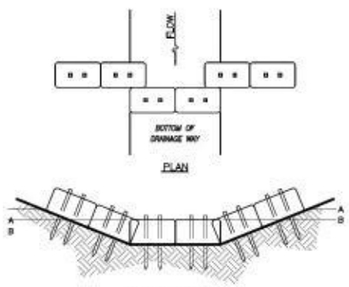


CROSS SECTIONS

HAYBALE BARRIER

NOT TO SCALE



CROSS SECTION

HAYBALE CHECK DAM

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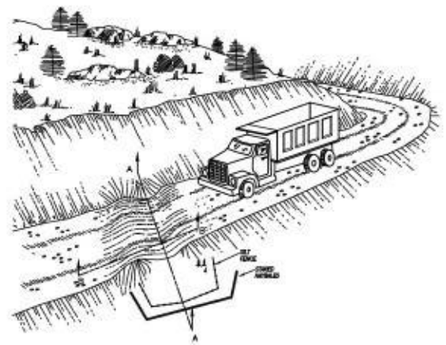

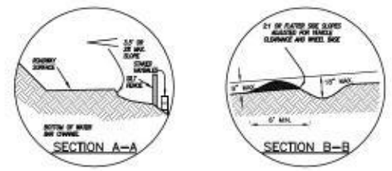

WATER BAR DETAIL

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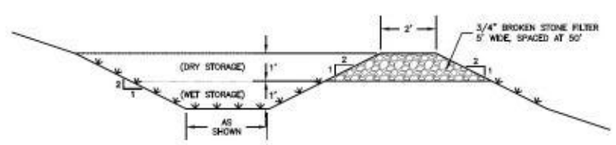
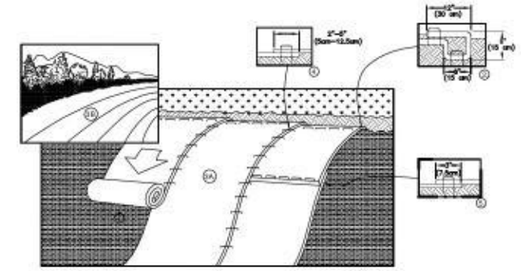


TEMPORARY SEDIMENTATION BASIN

NOT TO SCALE

NOTES:

1. Inspect the BASIN at least once a week (preferably twice) and after rainfall events of 0.5" or greater.
2. Remove sediment when deposits reach approximately 1/2 the height of the weir. Sediment shall be deposited in an area which is not regulated by the Inland Wetlands Commission.
3. Replace or repair within 24-hours of observed failure. Failure may include:
   - Overtopping, undercutting or bypassed by runoff water.
   - Stone filter has been moved or knocked over.



1. PREPARE SOIL BEFORE INSTALLING BLANKETS, INCLUDING ANY NECESSARY APPLICATION OF LIME, FERTILIZER, AND SEED. NOTE: WHEN USING CELL-O-SEED DO NOT SEED PREPARED AREA. CELL-O-SEED MUST BE INSTALLED WITH PAPER SIDE DOWN.
2. BEGIN AT THE TOP OF THE SLOPE BY ANCHORING THE BLANKET IN A 6" (15cm) DEEP X 6" (15cm) WIDE TRENCH WITH APPROXIMATELY 12" (30cm) OF BLANKET EXTENDED BEYOND THE UP-SLOPE PORTION OF THE TRENCH. ANCHOR THE BLANKET WITH A ROW OF STAPLES/STAKES APPROXIMATELY 12" (30cm) APART IN THE BOTTOM OF THE TRENCH. BACKFILL AND COMPACT THE TRENCH AFTER STAPLING. APPLY SEED TO COMPACTED SOIL AND FOLD REMAINING 12" (30cm) PORTION OF BLANKET BACK OVER SEED AND COMPACTED SOIL. SECURE BLANKET OVER COMPACTED SOIL WITH A ROW OF STAPLES/STAKES SPACED APPROXIMATELY 12" (30cm) APART ACROSS THE WIDTH OF THE BLANKET.
3. ROLL THE BLANKETS (A.) DOWN OR (B.) HORIZONTALLY ACROSS THE SLOPE. BLANKETS WILL UNROLL WITH APPROPRIATE SIDE AGAINST THE SOIL SURFACE. ALL BLANKETS MUST BE SECURELY FASTENED TO SOIL SURFACE BY PLACING STAPLES/STAKES IN APPROPRIATE LOCATIONS AS SHOWN IN THE STAPLE PATTERN GUIDE. WHEN USING OPTIONAL DOT SYSTEM", STAPLES/STAKES SHOULD BE PLACED THROUGH EACH OF THE COLORED DOTS CORRESPONDING TO THE APPROPRIATE STAPLE PATTERN.
4. THE EDGES OF PARALLEL BLANKETS MUST BE STAPLED WITH APPROXIMATELY 2"–5" (5cm–12.5cm) OVERLAP DEPENDING ON BLANKET TYPE. TO ENSURE PROPER SEAM ALIGNMENT, PLACE THE EDGE OF THE OVERLAPPING BLANKET (BLANKET BEING INSTALLED ON TOP) EVEN WITH THE COLORED SEAM STITCH ON THE PREVIOUSLY INSTALLED BLANKET.
5. CONSECUTIVE BLANKETS SPLICED DOWN THE SLOPE MUST BE PLACED END OVER END (SHINGLE STYLE) WITH AN APPROXIMATE 3" (7.5cm) OVERLAP. STAPLE THROUGH OVERLAPPED AREA, APPROXIMATELY 12" (30cm) APART ACROSS ENTIRE BLANKET WIDTH.

NOTES:

1. IN LOOSE SOIL CONDITIONS, THE USE OF STAPLE OR STAKE LENGTHS GREATER THAN 6" (15cm) MAY BE NECESSARY TO PROPERLY SECURE THE BLANKETS.
2. TURF REINFORCEMENT MAT SHALL BE NORTH AMERICAN GREEN ECONET C-125 LONG TERM PHOTODEGRADABLE BLANKET OR APPROVED EQUIVALENT.

TURF REINFORCEMENT MAT INSTALLATION

NOT TO SCALE

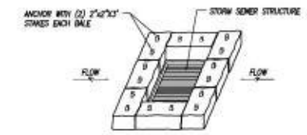
WETLAND SEED MIX FOR WET BASIN/STORMWATER WETLAND

The New England Wetmix (Wetland Seed Mix) contains a wide variety of native seeds that are suitable for most wetland restoration sites that are not permanently flooded. All species are best suited to moist ground as found in most wet meadows, scrub shrub, or forested wetland restoration areas. The mix is well suited for detention basin borders and the bottom of detention basins not generally under standing water. The seeds will not germinate under inundated conditions. If planted during the fall months, the seed mix will germinate the following spring. During the first season of growth, several species will produce seeds while other species will produce seeds after the second growing season. Not all species will grow in all wetland situations. This mix is comprised of the wetland species most likely to grow in created/restored wetlands and should produce more than 75% ground cover in two full growing seasons.

The wetland seeds in this mix can be sown by hand, with a hand-held spreader, or hydro-seeded on large or hard to reach sites. Lightly rake to insure good seed-to-soil contact. Seeding can take place on frozen soil, as the freezing and thawing weather of late fall and late winter will work the seed into the soil. If spring conditions are drier than usual watering may be required. If sowing during the summer months supplemental watering will likely be required until germination. A light mulch of clean, weed free straw is recommended.

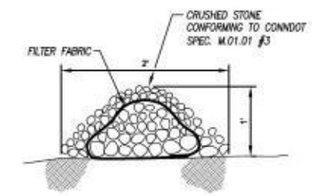
APPLICATION RATE: 1 LB/2500 sq. ft

SPECIES: Fox Sedge, (Carex vulpinoidea), Lurid Sedge, (Carex lurida), Blunt Broom Sedge, (Carex scoparia), Sensitive Fern, (Onoclea sensibilis), Blue Vervain, (Verbena hastata), Hop Sedge, (Carex lupulina), Green Bulrush, (Scirpus atrovirens), Nodding Bur Marigold, (Bidens cer-nua), Bristly Sedge, (Carex comosa), Fringed Sedge, (Carex crinita), American Mannagrass, (Glyceria grandis), Wool Grass, (Scirpus cyperinus), Soft Rush, (Juncus effusus), Spotted Joe Pye Weed, (Eupatorium maculatum), Boneset, (Eupatorium perfoliatum), Mud Plantain, (Alisma subcordatum), New England Aster, (Aster novae-angliae), Rattlesnake Grass, (Glyceria canadensis), Purplestem aster (Aster puniceus), Soft Stem Bulrush, (Scirpus validus), Blueflag (Iris versicolor), Swamp Milkweed, (Asclepias incarnata), Monkey Flower, (Mimulus ringens). The functionality of each mix will remain unchanged, although mix composition may vary during the year.



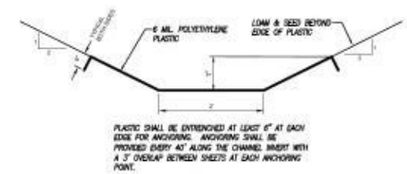
HAYBALE INSTALLATION AT CATCH BASIN

NOT TO SCALE



STONE CHECK DAM

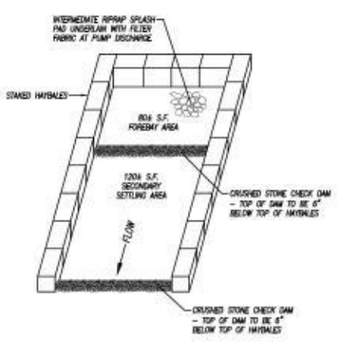
NOT TO SCALE



PLASTIC SHALL BE ENTRENCHED AT LEAST 6" AT EACH EDGE FOR ANCHORING. ANCHORING SHALL BE PROVIDED EVERY 40' ALONG THE CHANNEL. INSERT WITH A 3' OVERLAP BETWEEN SHEETS AT EACH ANCHORING POINT.

TEMPORARY LINED CHANNEL

NOT TO SCALE

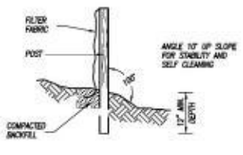


PUMPING OUTLET BASIN

NOT TO SCALE

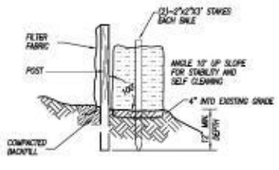
NOTES:

1.) TO BE USED IN THE EVENT THAT CUTOFF TRENCH DEWATERING IS REQUIRED
2.) LOCATE BASINS OUTSIDE OF WETLANDS UPLAND REVIEW AREAS



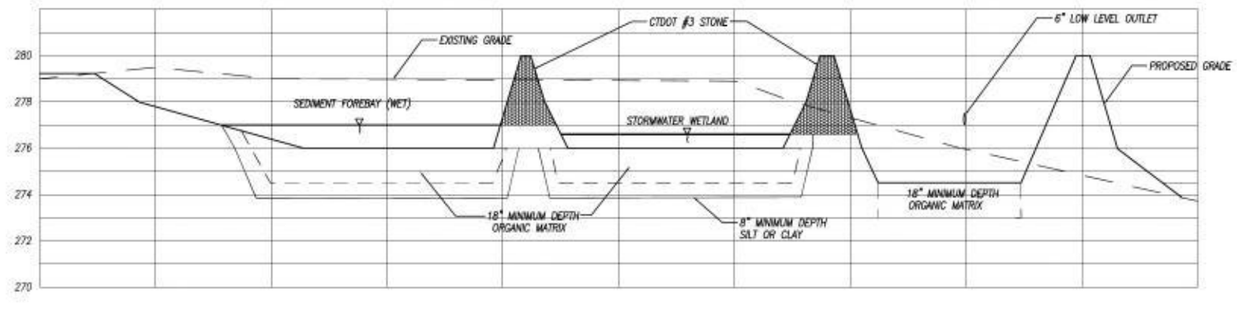
SILT FENCE

NOT TO SCALE



SILT FENCE – BACKED WITH HAYBALES

NOT TO SCALE



SECTION THROUGH DETENTION/WATER QUALITY BASIN

DATE	DESCRIPTION

REVISIONS

EROSION AND SEDIMENTATION CONTROL DETAILS

PREPARED FOR

KILLINGLY ENERGY CENTER NTE ENERGY PROJECT

LAKE ROAD

KILLINGLY, CONNECTICUT

Killingly Engineering Associates
Civil Engineering & Surveying
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P.O. Box 421
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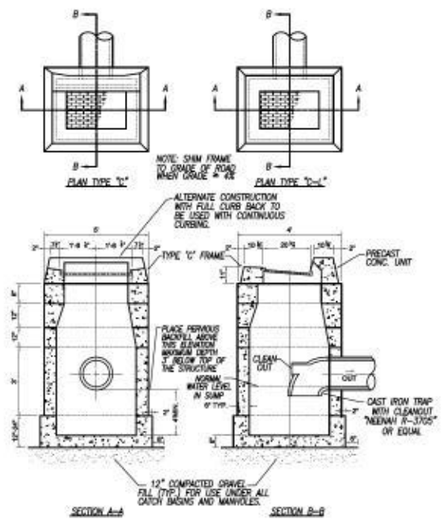
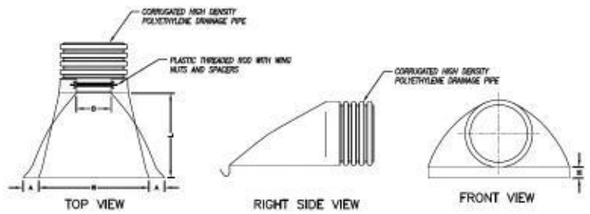
DATE: 06/30/2016	DRAWN: NET
SCALE: 1"=50'	DESIGN: NET
SHEET: 6 OF 7	CHK BY: ----
DWG. No: CLIENT FILE	JOB No: 16042



HOODED CATCH BASIN DETAIL

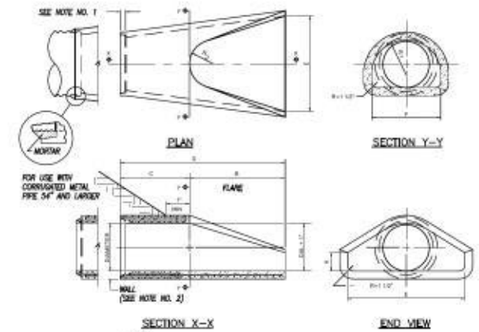
NOT TO SCALE



PIPE SIZE (IN)	A (IN)	B (IN, MAX)	H (IN)	L (IN)	W (IN)
12	6.50	10.00	6.50	25.00	29.00
15	6.50	10.00	6.50	25.00	29.00
18	7.50	15.00	6.50	32.00	35.00
24	7.50	18.00	6.50	36.00	45.00
30	7.50	12.00	8.60	58.00	63.00
36	7.50	25.00	8.60	58.00	63.00

FLARED END DETAIL

NOT TO SCALE

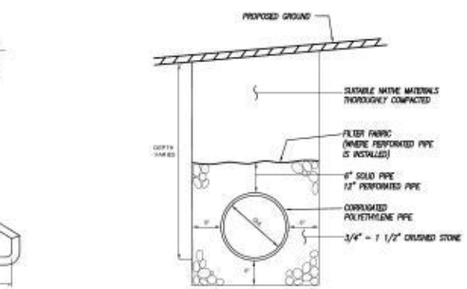


NOTE:
1. JOINTS SHALL BE TONGUE AND GROOVE OR BELL AND SPIGOT AS REQUIRED TO CONFORM TO PIPE INSTALLED
2. WALL THICKNESS SHALL CONFORM TO PIPE THICKNESS

DIMENSIONS FOR REINFORCED CONCRETE CULVERT END									FLARED REINFORCEMENT (NO. LENGTH REQ'D IN MIDDLE OF WALL)	
DIA.	A	B	C	D	E	F	R_1	R_2	HORIZ. BARS AT 6" CTS. NO. 10 W.R.	VERTICAL BARS AT 6" CTS. NO. 10 W.R.
12"	4"	2'-0"	4'-0 3/8"	6'-0 3/8"	2'-0"	1'-1 15/16"	1'-0 1/4"	9"	0.049	0.049
15"	4"	2'-0"	3'-10"	6'-0"	2'-0"	2'-0 5/16"	1'-0 1/2"	1'-1"	0.054	0.054
18"	9"	2'-0"	3'-10"	6'-0"	2'-0"	2'-0"	1'-0 1/2"	1'-6"	0.060	0.060
21"	9"	2'-11"	3'-2"	6'-0"	2'-0"	2'-2 1/2"	1'-0"	1'-7"	0.069	0.069
24"	9 1/2"	3'-7 1/2"	2'-6"	6'-1 1/2"	4'-0"	2'-8 3/16"	1'-4 15/16"	1'-2"	0.072	0.072
30"	1'-0"	4'-6"	1'-7 3/4"	6'-1 3/4"	6'-0"	3'-1"	1'-8 1/2"	1'-0"	0.084	0.084
36"	1'-0"	5'-0"	0'-10 3/4"	6'-1 3/4"	6'-0"	3'-11 15/16"	2'-0 5/16"	1'-0"	0.099	0.099
42"	1'-6"	5'-0"	2'-11"	6'-2"	6'-0"	4'-5 7/8"	2'-3 1/2"	1'-11"	0.108	0.108
48"	2'-0"	5'-0"	3'-2"	6'-2"	7'-0"	4'-8 1/2"	2'-4 1/2"	1'-11"	0.132	0.132
54"	2'-0"	5'-0"	3'-11"	6'-4"	7'-0"	5'-0 1/2"	2'-9 1/2"	2'-2"	0.132	0.132
60"	2'-6"	5'-0"	3'-2"	6'-2"	8'-0"	6'-0 1/2"	3'-6 11/16"	2'-2"	0.144	0.144

CULVERT END

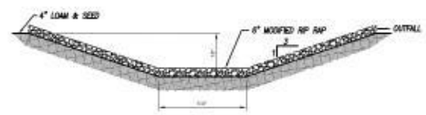
NOT TO SCALE



DRAINAGE PIPE INSTALLATION DETAIL

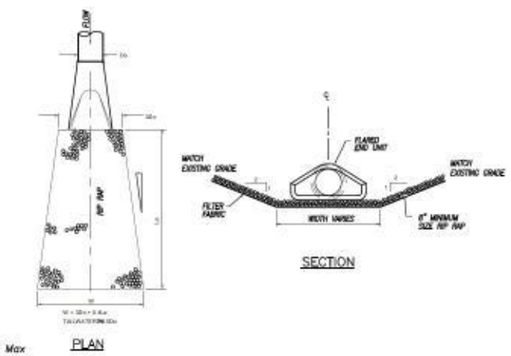
NOT TO SCALE

NOTE: PROVIDE WATER TIGHT GASKETED PIPE FOR INSTALLATIONS IN FILL SLOPES



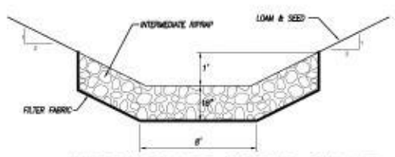
SECTION THROUGH LEVEL SPREADER

NOT TO SCALE



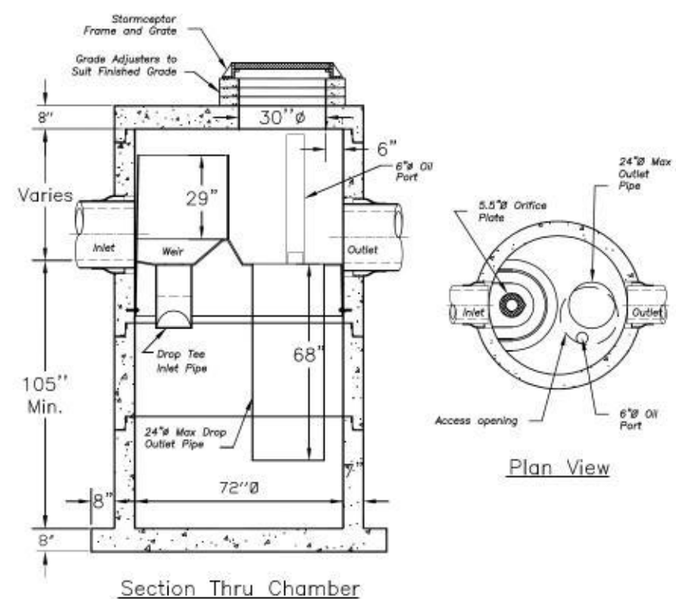
RIP RAP OUTFALL

NOT TO SCALE

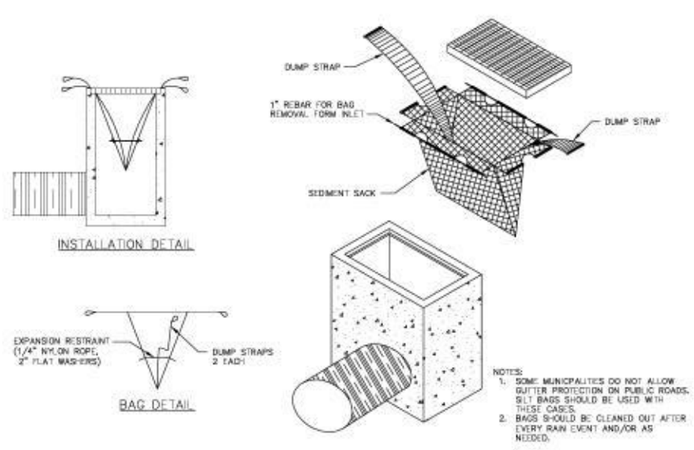


INTERMEDIATE RIPRAP SWALE

NOT TO SCALE



EOS 18-1000 Precast Concrete Stormceptor
(1000 U.S. Gallon Oil Capacity)



NOTES:
1. SOME MUNICIPALITIES DO NOT ALLOW GUTTER PROTECTION ON PUBLIC ROADS. SILT BAGS SHOULD BE USED WITH THESE CASES.
2. BAGS SHOULD BE CLEANED OUT AFTER EVERY RAIN EVENT AND/OR AS NEEDED.

SILTBAG INLET SEDIMENT CONTROL DEVICE

NOT TO SCALE

MAY BE USED IN LIEU OF OR IN COMBINATION WITH STAKED HAYBALES

DATE	DESCRIPTION

REVISIONS

STORMWATER CONSTRUCTION DETAILS

PREPARED FOR

KILLINGLY ENERGY CENTER NTE ENERGY PROJECT

LAKE ROAD

KILLINGLY, CONNECTICUT

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DATE: 06/30/2016	DRAWN: NET
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SHEET: 7 OF 7	CHK BY: ----
DWG. No: CLIENT FILE	JOB No: 16042

APPENDIX E – WETLAND INFORMATION

E-1 Wetland Report: Proposed Conditions
E-2 Wetland Report: Existing Conditions

APPENDIX E-1 – WETLAND REPORT: PROPOSED CONDITIONS

WETLAND REPORT: PROPOSED CONDITIONS

KILLINGLY ENERGY CENTER

LAKE ROAD, KILLINGLY, CONNECTICUT

August 2016

Killingly Energy Center
an NTE Energy Project

REMA

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Attachment A	Figures
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Attachment C	Functions & Values Assessment: Rationales

1.0 INTRODUCTION

NTE Connecticut, LLC (NTE) plans to develop the Killingly Energy Center (KEC), an approximately 550-megawatt combined cycle electric generating facility and related electrical interconnection switchyard on an approximately 73-acre site in Killingly, Connecticut (the KEC Site). Approximately 63 acres north of Lake Road will be the location of the generating facility (the Generating Facility Site), and the approximately 10-acre parcel south of Lake Road (the Switchyard Site) will be the location of the associated utility switchyard.

This *Wetland Report: Proposed Conditions* provides an analysis and discussion by Rema Ecological Services, LLC (REMA) of potential short-term and long-term impacts on the KEC Site's regulated wetlands and watercourses, and upon the functions and values provided by them. This report also discusses the proposed mitigation strategies that avoid, minimize, and offset direct and indirect wetland and watercourse impacts.

The regulated wetlands and watercourses referred to in this report have been described and characterized in *Wetland Report: Existing Conditions*, published in July, 2016. The reader should refer to that report for information regarding these resources' soils, hydrology, inventoried flora and fauna, landscape-setting, and past land-uses. The *Wetland Report: Existing Conditions* also includes an extensive photo-record of the regulated resources. *Wetland Report: Proposed Conditions* provides additional information, including annotated figures (specifically, Figure 2 of Attachment A, which depicts the various wetland units); annotated photographs to illustrate points made herein (Attachment B), and the basis for the wetland functions and values assessment (see Section 3.0 and Attachment C).

Additional site visits have been conducted by REMA staff since the last site visit (June 13, 2016) documented in the *Wetland Report: Existing Conditions*. Some of these visits were specifically targeting the proposed wetland impact area and the stormwater discharge area discussed in this report, while others were conducted as part of an ongoing effort to complete natural resource and ecological inventories for the KEC Site. Since June 13, 2016 REMA staff visited the KEC Site an additional six times, logging an additional 32 hours in the field. The last site visit covered in this document was conducted on July 28, 2016.

2.0 PROJECT OVERVIEW

The KEC Site encompasses approximately 73 acres of land in Killingly, Connecticut. Of this acreage, the approximately 63-acre Generating Facility Site is located north and northwest of Lake Road, while approximately 10-acre Switchyard Site is located to the south and southeast of Lake Road. The KEC Site is located west of Alexander Lake and Interstate 395, and few hundred feet south and east of the Quinebaug River (see Figure 1, Attachment A). An Eversource electric right-of-way abuts the KEC Site to the southeast.

In all, approximately 10.95 acres of regulated wetlands occur within the KEC Site's 73 acres (i.e., 15% of the total acreage). The central wetlands on the Generating Facility Site (i.e., Wetland Units A1, A2, and A3), which are the subject of much of the analysis and discussion in this report, are roughly 8.5 acres in size (see Figure 2, Attachment A). At the Switchyard Site, Wetland Unit D is about 0.51 acres, but this wetland unit extends offsite to the east within the Eversource electric right-of-way.

At the Generating Facility Site, the proposal calls for the disturbance of about 24 acres of uplands in association with KEC's construction. No direct wetland impacts are proposed on the Generating Facility Site. Earthwork will be required to create the level surface that will contain the various components of the generating facility, such as the turbine building; the air-cooled condenser; the administration, warehouse and water treatment buildings; the fuel oil tank and containment berm; and the generator step-up transformers and related electrical equipment. At the Switchyard Site, proposed development will result in the disturbance of approximately 4 acres of land, including a direct wetland impact of approximately 12,500 square feet upon Wetland Unit D.

At both the Generating Facility and Switchyard Sites, impervious surfaces have been minimized to the extent practicable. Of the combined 28 acres of land disturbance, only 6.84 acres will be impervious (i.e., 24.4%), while the balance will be pervious crushed stone surfaces that will allow significant infiltration of rainfall into the ground and the local groundwater regimes, which in part feed wetland/watercourse hydrology. At the Generating Facility Site, runoff generated on impervious surfaces will be handled through a piped stormwater management system (SMS) that includes a best management practice (BMP)-rich, treatment train that will renovate stormwater to such

a high degree that no impacts to the water quality of receiving waters (i.e., wetlands and watercourses), including the Quinebaug River, are expected.

From the inception of the KEC project, REMA has been involved with guiding the development team regarding potential impacts to the regulated resources. Even following the initial site reconnaissance in February 2016, and preliminary assessment of resource quality and sensitivity, REMA developed a set of minimum guidelines that would be met in order to avoid and minimize wetland and watercourse impacts. These guidelines encompassed wetland hydrology, surface water quality, special aquatic habitats (e.g., vernal pool habitats), wetland setbacks and buffer zones, and required mitigation for direct and indirect wetland impacts. An iterative process was followed, continually being informed as additional baseline data were gathered, and the development configuration and mitigation strategies were progressively adjusted, until all of the initial guidelines were met or exceeded.

3.0 WETLAND FUNCTION & VALUES ASSESSMENT

Functions and values were assessed for each of the major wetland units at the site, using the United States Army Corps of Engineers (USACE) Highway Methodology or the *Descriptive pproach*. This methodology was published in 1995 and amended in 1998. It has much in common with other assessment methodologies in use in the northeastern United States. To summarize, after a thorough and detailed wetland inventory and characterization has been completed, each wetland's properties are briefly outlined on the cover page and compared with lists of numbered rationales for each of 14 functions and values. The rationale lists are attached (Attachment C), and the columns to the left indicated whether they are applicable [(Y) or not (N]), and explanatory notes are added. The bottom of the sheet describes the overall conclusion for each wetland unit, as to whether the function/value is a *principal* function/value (P), *present* to some degree (Y), or *absent* (N).

The four evaluation units for the KEC Site include the three headwaters riparian corridors, located on the Generating Facility Site that flow northerly towards the Quinebaug River. Wetland Unit A1/A2 is easternmost, and includes the man-made pond (A1) at the southern end. Wetland Unit A3 is the broad, central corridor, which is joined by Wetland Unit A2, where the two seasonal streams join to form one stream that outlets the site at its eastern boundary. This stream flows approximately 1,800 feet

offsite, before discharging to the Quinebaug River. Wetland Unit B is westernmost and includes an embedded vernal pool habitat, with an outlet seasonal watercourse. At the Switchyard Site, east of Lake Road, Wetland Unit D was evaluated. This is also the only wetland associated with KEC that will be directly impacted.

3.1 Groundwater Recharge/Discharge

This is a *principal* function for all three stream corridors, but not for Wetland D, a seasonally saturated shrub swamp/wet meadow complex. In Wetlands A1 and A2 multiple seepage areas discharge groundwater, providing baseflow for the seasonal streams. This is consistent with a "groundwater slope" hydrogeomorphic setting, as indicated on the wetland inventory and characterization forms. In Wetland B as well, shallow groundwater is discharged at the base of a slope into a low-lying saturated wetland and a vernal pool habitat. The stream in Wetland A3 intercepts the sub-regional groundwater table in shallow sandy glacial outwash. Groundwater recharge is seasonally important in all of the wetlands, when the water table drops and precipitation and snow melt infiltrates.

3.2 Floodflow Alteration (Storage and Desynchroni ation)

This is a *principal* value for three of the evaluated wetlands. The man-made pond in Wetland A1 and the pool in Wetland B are rarely full to capacity and serve to hold floodwaters back, as do multiple smaller depressions along the broad Wetland A3 corridor. During large storm events, floodwaters can also overtop the stream channels and spread out onto the stream terraces. The outlet of Wetland A3 through a topographical restriction and gap in a stone wall would act to hold back floodwaters during an infrequent storm event (e.g., 25-year storm). Only Wetland Unit D (WD; on-site section), without a watercourse, has more limited flood storage value.[1] The functional value is *present* but not appreciably, even taking into account the balance of the wetland area, which occurs offsite to the east within the electric transmission right-of-way. However, there is effective infiltration, above the water table, on level, sandy terrain within Wetland Unit D. The primary manner in which the entire KEC Site

[1] The overall wetland unit, of which Wetland Unit D is a small part, extends off-site into the Eversource electric transmission right-of-way. The overall wetland has a restricted outlet at Lake Road, where a ditched seasonal watercourse is culverted under the roadway.

helps prevent flooding under existing conditions is the high proportion of infiltrated precipitation, slowly discharged as seepage, or used directly by transpiring vegetation.

3.3 Fish and Shellfish Habitat

The USACE methodology includes separate criteria for freshwater and marine fish and shellfish habitat. They are both addressed in this section.

Freshwater fish and shellfish habitat is lacking in all the wetlands except the man-made pond (Wetland A1), where it is *present*. This pond supports a population of small-mouth bass. None of the three streams are perennial, nor is the western vernal pool, though the presence of two-lined salamanders, case caddisflies, and other aquatic invertebrates indicates semi-perennial flow.[2] Wetland Unit D has no fisheries function as open water is lacking.

The marine fish and shellfish habitat function relates to the extent to which wetlands support marine and estuarine ecosystems, that is, whether anadromous fish can breed in the headwaters streams. Downriver dams without fish ladders along the Quinebaug and Willimantic Rivers preclude anadromous fish migration. However, each of the three shaded streams contribute to downgradient fisheries function and to marine and estuarine function, by exporting fine particulate leaf litter and cold water of high quality, in particular with a very low nutrient load. The USACE assessment methodology does not allow the assessor to make this point in the summaries for these functions, just as a comment.

3.4 Sediment/Toxicant/Pathogen Retention

Potential is high for this function, based on multiple rationales, such as dense vegetation, at least during the growing season. However, currently *opportunity* is very low; offsite pollution sources are lacking except potentially for several small farm dumps, and some minimal road/trail runoff (for Wetland Units B and D). The function is rated *present*, but not principal.

[2] Due to the "moderate drought" experienced in May through July of 2016, only the uppermost sections of the seasonal watercourses in Wetlands A2 and A3 were found flowing in late July 2016, still supported by baseflow. There was no flow at the outlet stream for Wetland B. Work done earlier in the spring served to characterize these areas during higher-flow conditions.

3.5 Nutrient Removal/Retention/Transformation

Potential is high for this function, but *opportunity* is very low; dense vegetation is present throughout all of the evaluated wetland units for nutrient uptake, and diffuse, intermittently saturated wetland boundaries are well suited to denitrification. Wetlands do not receive excessive nutrient loading from sources such as partially treated septic leachate and runoff from over-fertilized lawns. Nutrient concentrations were very low in all the water samples tested (see Attachment D in the July 2016 *Wetland Report: Existing Conditions*), indicating that natural nutrient sources are not an issue, though the expected early spring algal blooms were triggered by the abrupt release of nutrients from plant tissues decomposed over the winter. The algae are transformed via the food chain into amphibian and fish biomass, and utilized by higher plants as the growing season progresses.

3.6 Production Export

This function encompasses processes related to the food web and to breakdown of organic matter in aquatic systems. It also covers harvest of forest products. It is a *principal* function for the three northeastern riparian wetland units, which have diverse flora and fauna, complex food web interactions, and export of plant detritus via streams, both tree leaves and twigs, and sedge/grass leaves. However, a portion of the detritus simply settles to the substrate, especially in the low gradient A3 stream, adding to the organic soil. Wetland D lacks a flowing stream. This function is *present* here but not appreciably. The wetland's shrub thicket is dominated by invasive shrub species eaten by very few herbivorous insects, or deer. However, the wet meadow portions of this wetland, and also the locust and black cherry trees nearby, support an active food web and pollinators.

3.7 Sediment/Shoreline Stabili ation

This function is *present* in the three wetlands that are associated with a seasonal watercourse (e.g., A1/A2, A3, and B), but not Wetland Unit D. This function considers the effectiveness of a wetland to stabilize stream banks and shorelines (e.g., of ponds and lakes) against erosion. In Wetland Units A3 and B, the seasonal streams are low-gradient, well protected by wide and well vegetated wetland terraces, and flows along the stream channels would not be erosive. In Wetland Unit A2, the upper portion of

the seasonal watercourse, just below the pond outlet (i.e., Wetland Unit A1), has a higher gradient and shows some minimal evidence of bank erosion. However, it is still well protected by vegetation growing on or near the banks.

3. Wildlife Habitat

The wildlife habitat function relates to the ecological integrity of the wetlands within the site's landscape setting. Because the site is surrounded by a high proportion of forest, wetland-dependent or wetland-associated fauna includes species such as barred owl (*Strix varia*), Louisiana waterthrush (*Parkesia matacilla*), broad winged hawk (*uteo platypterus*), pickerel frog (*Lithobates palustris*), gray tree frog (*yla versicolor*), and wood frog (*Lithobates sylvaticus*), as well as diverse *Lepidopterans*. Habitat includes a variety of cover types and hydrologic regimes. It is suitable for the insect populations needed as prey for wildlife species diversity as expected for wetlands in this landscape, and this function is *principal* for the three riparian corridors. It is also a *principal* function for Wetland D, again because the rural landscape supports less common species like prairie warbler, indigo bunting, and milk snake. However, the assessment methodology evaluates the entire wetland ecologic unit, which in the case of Wetland D, is mostly off-site. Furthermore, the resolution of the methodology does not allow an assessment of the level to which a small portion of a wetland contributes to the overall assessment rating. The on-site portion of Wetland D is transitional in nature, and contains patches of dense invasive vegetation. Therefore, it does contribute greatly to the wildlife habitat function of the overall wetland unit.

3.9 Endangered Species Habitat

One Connecticut *Species of Special Concern*, the broad-winged hawk, was observed by REMA at the site. The sightings were on separate days and in separate areas. One sighting was at the Switchyard Site, within the deciduous forest to the southwest of Wetland D, while the other was just off-site, about 80 to 100 feet to the west of the Generating Facility Site's western property boundary, again in predominately deciduous forest. Broad-winged hawks are often observed within wetlands and riparian areas, feeding on a variety of prey: small birds, amphibians, and a variety of insects, and they are typically found in large blocks of unfragmented habitat, such as that at this site and its environs. However, they are not considered wetland-dependent, and no indication of nesting was encountered within any of the site's wetlands.

An acoustic bat survey was conducted by Tetra Tech wildlife biologists, targeting the federally and state-listed northern long-eared bat (*Myotis septentrionalis*) (NLEB). While NLEB was not detected, several other bat species were detected as potentially foraging or roosting at the site. Of the five bat species detected, four species – the eastern red bat (*Lasiurus borealis*), hoary bat (*Lasiurus cinereus*), silver-haired bat (*Lasionycteris noctivagans*), and little brown bat (*Myotis lucifugus*) – are "listed" in Connecticut. Of these four species, two are considered to be wetland-dependent based on feeding and roosting behavior (Whitlock et al. 1994).[3] These are the little brown bat ("Threatened"), and the silver-haired bat ("Special Concern.")

Therefore, this function is *present* for the wetlands at the Generating Facility Site, but absent for Wetland Unit D, at the Switchyard Site.

It should be noted that *Lepidopteran* surveys were conducted, based on documented presence in the site vicinity, for two "listed" moths and one "listed" butterfly (see Invertebrate Survey submitted separately). None of the targeted species were observed. Moreover, these moths and butterfly are not considered wetland-dependent.

3.10 Human Use Values

Human Use Values are comprised of assessment rationales (9) Recreation, (10) Educational/Scientific Value, (11) Uniqueness/Heritage, and (12) Visual Quality/Aesthetics. The suitability of the KEC Site for human use, as a site for *recreation,* environmental *education*, and for *aesthetic* enjoyment is assessed by overlapping sets of rationales. Key characteristics include access to the general public and parking for vehicles and school buses (currently lacking), safety, and accessibility. Although only a few informal paths traverse the site, the terrain is mostly walkable with low density understory, such that *recreational value* is *present*. For example, the terrain bordering Wetland Unit A3 is an open forest floor with a bed of deep pine/hemlock needles. The exception is Wetland Unit B, with dense ground-layer vegetation, and mucky footing, so this wetland unit received a lower rating for the human use values. Right-of-way management makes the meadow cover type of Wetland Unit D accessible, but the shrub thicket is too dense for recreational use. This

[3] Whitlock A. L., N. M. Jarman, and J. S. Larson. 1994. WEThings: Wetland Habitat Indicators for NonGame Species. Wetland-Dependent Amphibians, Reptiles, and Mammals of New England. Volume II. The Environmental Institute. University of Massachusetts.

functional value is *present* here mostly because of the off-site section and the maintained access trail that traverses through the Eversource electric transmission right-of-way.

Per established aesthetics principles, the views of the pond (Wetland Unit A1) and the emergent marsh inclusions in Wetland Units A1 and A3 are classified as very good. A notable 4-foot diameter oak, and contrasting, adjacent cliff faces also confer *aesthetic value*, contributing to a "*principal*" rating for Wetland Unit A3. The fact that rare species potentially use the wetlands at the Generating Facility Site increases the *educational scientific value* but not enough for a principal rating.

All the human use values are integrated for the "*Uniqueness and Heritage" value*; its high standards are not met in any of the wetlands evaluated.

4.0 OVERVIEW OF POTENTIAL WETLAND & WATERCOURSE IMPACTS

4.1 Direct Wetland Impacts

According to the site plans developed for KEC, *direct* wetland impacts are limited to 12,500 square feet, which represents 2.62% of the wetlands within the KEC Site's 73 acres.

The area to be impacted is part of Wetland Unit D, the on-site portion of a larger wetland area that extends easterly into the Eversource electric transmission right-of-way (see Figure 3, and Photos 1 and 2, Attachments A and B). The impact area consists of both scrub-shrub and emergent wetland cover types, has poorly drained to somewhat poorly drained soils, and a seasonally saturated hydrologic regime.

The emergent cover type is a wet meadow dominated by goldenrods (*Solidago* spp.), sensitive fern (*noclea sensibilis*), cinnamon fern (*smunda cinnamomea*), sedges (*Carex* sp.), and other forbs (see Photo 3). The scrub-shrub cover type includes saplings of red maple (*cer rubrum*), gray birch (*etula populifolia*), and white pine (*Pinus strobus*), but also fox grape (*itis labrusca*) and invasives such as autumn olive (*Eleagnus umbellata*) and glossy buckthorn (*Frangula alnus*) (see Photo 4). The presence of fox grape and autumn olive indicates that this area is transitional in nature, more moist than wet in habit, yet still a regulated or jurisdictional wetland.

The overall wetland unit, including off-site sections is roughly 5.6 acres in size (see Figure 3), and consists of the same matrix of emergent and scrub-shrub cover types, which are maintained within the electric transmission right-of-way. Therefore, the loss of 0.287 acres of a similar cover type is not a significant taking that would compromise the ecological integrity or functionality of the entire wetland unit. Moreover, as will be discussed in a following section, proposed mitigation in the form of wetland creation, restoration, and enhancement will more than offset the proposed wetland impact. Finally, as discussed in Section 4.2.5, the wetland functions and values provided by the overall wetland will not be impacted as a result. This wetland will continue to provide these functions and values assessed under existing conditions in the post-construction phase.

Alternative layouts for the utility Switchyard Site were considered during the planning process, in an effort to avoid any direct wetland impacts. However, the Switchyard Site's constraints and Eversource's required specifications for the utility switchyard did not allow complete avoidance (see further discussion in Section 5.0).

4.2 Indirect Wetland Impacts

ndirect or secondary impacts to a wetland or watercourse can occur as a result of activities outside of wetlands or watercourses. Such impacts can be *short term* or *long term*, and are typically associated with erosion and sedimentation, mostly during the construction period, the removal or disturbance of vegetation in upland areas but adjacent to wetlands or watercourses, the alteration of wetland hydrology or the flow regime of a watercourse, and the discharge of degraded surface water or groundwater, which may adversely impact the water quality of the regulated resources.

The potential for any of these indirect impacts to occur at the site as a result of the proposal depends on the regulated resources themselves, their sensitivity, and their ecological and physical characteristics. These potential impacts are discussed below.

4.2.1 Erosion and Sedimentation

If not properly controlled, the potential for soil erosion and subsequent deposition in wetlands or watercourses exists at construction sites that involve soil disturbance. At this site, the risk, or the potential for adverse impacts, from erosion and sedimentation