Town of Freetown

Application for Site Plan Review

Costa Solar

Freetown, Massachusetts
November 17, 2021

Applicant
Costa Solar, LLC
Attention: Adrian Ortlieb
Manager
PO Box 51794
Lafayette, LA 70505

Environmental Consultant
BRI Environmental
Attention: Dale Knapp
Principal
30 Danforth Street, Suite 213
Portland, ME 04101

Engineer
Krebs & Lansing
Attention: Ian Jewkes
Principal
164 Main Street, Suite 201
Colchester, VT 05446

November 18, 2021

Keven Desmarais
Planning Board Chairman
Town of Freetown
3 N. Main Street
PO Box 438
Assonet, MA 02702

Dear Keven,

On behalf of Ironwood Renewables, LLC (Ironwood), I want to formally initiate the Site Plan Review process for Costa Solar (Project). Costa Solar, LLC, a wholly owned subsidiary of Ironwood Renewables (Ironwood), is proposing to develop a distributed generation ground-mounted solar energy and battery storage facility on Costa Drive in Freetown. Biodiversity Research Institute, Inc. (BRI) has been engaged as the lead consultant to support the Project.

The Project is a 5-megawatt (MW AC) solar array that will deliver clean renewable energy to the local electrical grid, contributing to Massachusetts's renewable energy production goals and benefitting local energy consumers. The Project is proposed at the terminus of Costa Drive, on the property known as Tax Map 241, Lot 53, and Tax Map 247, Lot 6. This Site was selected due to its proximity to the transmission grid and the willingness of landowners.

Solar energy projects are low-impact in nature. The solar array panel racking system consists of steel piles driven or drilled into the ground to support the mounted panels and will not permanently impact or alter the land. Disturbed areas will be re-seeded with a wildlife/conservation seed mix to create a meadow buffer beneath the solar panels. When the useful life of the Project ends, it will be decommissioned, including grading and re-vegetation of the Site, which would be returned to a natural state. The Site would then be suitable for other uses and would not bear any permanent impact or alteration from the Project.

We look forward to continuing the conversation with the Town of Freetown throughout the Site Plan Review process. If you have any questions, please do not hesitate to contact me at (207) 631-9134 or by email at dale.knapp@BRIenvironmental.org.

Sincerely,

Dale F. Knapp, CSS, LSE, CEP, PWS
Principal, BRI Environmental

PLANNING BOARD
TOWN OF FREETOWN, MASSACHUSETTS
FORM SPR - APPLICATION FOR SITE PLAN REVIEW

<u>Checklist for Applicants:</u>

The following must be included with all applications for site plan review:

☒ 1) Three copies of this form, a copy of the deed to the property, and if the application is submitted by anyone other than the owner, a letter signed in the presence of a notary public authorizing the applicant to act on their behalf.

☒ 2) 12 copies of the plan prepared in accordance with the Town of Freetown Subdivision Rules and Regulations and the Town of Freetown Site Plan Review Regulations. <u>All plan copies must be folded.</u>

☒3) An application fee according to the fee schedule payable to the Town of Freetown. Applicant shall also be responsible for costs associated with advertising and certified mailing of public hearing notices.

☒4) A PDF electronic file of the plan on a CD including any drainage calculations, Development Impact Statements, or Traffic Studies.

☒5) A Municipal Lien Certificate

☒6) A certified abutters list from the Town of Freetown Board of Assessors.

☐7) Engineering Review deposit

☒ 8) Zoning Determination from the Zoning Enforcement Officer/Building Commissioner

To the Town Clerk of the Town of Freetown Massachusetts:

The undersigned hereby submits the accompanying Special Permit Application and supporting documents for Special Permit Approval under the Rules and Regulations of the Planning Board adopted hereunder.

1. Applicant: Costa Solar, LLC c/o Ironwood Renewables, LLC Tel: 337-412-9199

   Address: PO Box 51794, Lafayette, LA 70505

2. Agent: ~~Attorney:~~ BRI Environmental Tel: 207-631-9134

   Address: 30 Danforth Street, Suite 213, Portland, ME 04101

3. Owner: Michael & Karen Costa; the Estate of Anthony N Costa Tel: 202-664-0445

Address: 5226 Townsend Ave, Los Angeles, CA 90041

4. Designer: Krebs and Lansing Consulting Engineers, Inc. Tel: 802-878-0375

Address: 164 Main Street, Suite 201, Colchester, VT 05446

5. Plan Entitled: Costa Solar

6. Plan Dated: November 17, 2021

7. Project Location: Costa Drive, Freetown, MA (currently Map 247 Lot 6, and Map 241 Lot 53)

Address: 5 Costa Drive, Freetown; and 0 Rear Costa Drive, Freetown

8. Assessor Map/Parcel No. 241/53 and 247/6 Zoning District: Residential (241-53) and General Use (247-6)

9. Lot Area: 14.8 acres (241/53) and 36 acres (247/6) Number of Lots Proposed: 3 (Form C previously submitted)

Total Acreage of Tract 30.5 (LOD) Total Percentage of Lot Coverage Proposed: See Attachment 2

10. Total Square Footage of Existing Structures: 0

Total Square Footage of Proposed Structures: 39,200 sq. ft. (241-53) and 296,700 sq. ft. (247-6)

Combined Square Footage of Existing and Proposed Structures: Same as "Proposed," above

11. Total Number of Parking Spaces (Existing): 0

Total Number of Regular Parking Spaces Proposed: 0

Total Number of Handicapped Parking Spaces Proposed: 0

Total Number of Spaces for Deliveries Proposed: 0

12. Detailed Description of Project (use additional pages as added) See Attachment 2

13. Deed of Property Recorded in Fall River Registry of Deeds in Plan Book
Page Date Acquired .
Fall River Registry of Deeds:
Lot 241-53: Book 2482 / Page 237, acquired May 26, 1992
Lot 247-6: Book 8520 / Page 60, acquired August 13, 2014

14. Estimated Cost of Construction: $15.9M Type: ☒ new ☐ reconstruction ☐ alteration

15. Application Fee – based on fee schedule: $500 (plus technical review deposit, to be determined)

To: Board of Health, Conservation Commission, Planning/Land Use Administrator, Building Inspector, Highway Department, Fire Department, and Police Department.

According to the Special Permit Regulations in the Town of Freetown Protective By-Laws, you have the option to examine and to make recommendations on this plan and to submit your report to the Planning Board office on or before ______________________ (35 days from date of transmittal by the Town Clerk). Recommendations may be indicated directly on the attached plan or on separate cover.

The property owner of record should be present when submitting plans for the Planning Board's consideration. If the owner is not present, he or she shall be represented by an authorized agent with a notarized letter of authorization. All plans must be prepared and endorsed by a Professional Land Surveyor, licensed in the Commonwealth of Massachusetts.

Owner's signature and address if not the applicant or applicant's authorization if not the owner

Michael J. Costa Michael J. Costa (Nov 15, 2021 09:36 PST)	5226 Townsend Ave, Los Angeles, CA 90041
Owner's Signature	**Owner's Address**
Michael J. Costa	202-664-0445
Owner's Printed Name	**Owner's Phone Number**
Adrian Ortlieb	PO Box 51794, Lafayette, LA 70505
Applicant's Signature	**Applicant's Address**
Costa Solar, LLC c/o Ironwood Renewables, LLC	337-889-3460
Applicant's Printed Name	**Applicant's Phone Number**
adrian.ortlieb@ironwoodenergy.com	mjcosta@sbcglobal.net
Applicant's E-Mail Address	**Owner's E-Mail Address**

COMMONWEALTH OF MASSACHUSETTS See attached Agent Authorization

Bristol,SS ______________, 20____

On this __________ day of __________, 2021 , before me, the undersigned Notary Public, personally

appeared ____ and

proved to me through satisfactory evidence of identification, which is____________________, to be the person whose name is signed on the preceding or attached document, and acknowledged to me that they signed it voluntarily for its stated purpose.

____
Notary Public
My Commission Expires:

Date Received by Town Clerk:

RECEIVED BY TOWN CLERK

DATE: ______________________

TIME ______________________

SIGNATURE ______________________

Michael J. Costa and Karen C. Costa, and Michael J. Costa,
Executor for the Estate of Anthony N. Costa
5226 Townsend Ave.
Los Angeles, CA 90041

July 1, 2021

TO WHOM IT MAY CONCERN:

Please be advised that Ironwood Renewables, LLC, with an office at 128 Demanade Boulevard, Suite 200, Lafayette, LA 70503, is hereby authorized to submit to the Town of Freetown, and any other entities of appropriate jurisdiction any and all Applications, with supporting documentation, necessary to obtain all of the grants, permits, and licenses necessary to develop an approximately 7.5 megawatt Direct Current ground-mounted, solar photovoltaic panel array on a 20-acre portion of Assessors Map 241. Lot 53 and Map 247, Lot 6 which is located on 0 Braley Road and 0 Costa Drive in Freetown, Massachusetts.

Such submissions shall include, but not limited to, (i) a Notice of Intent to the Conservation Commission, and (ii) a Form C application for approval of definitive subdivision plan to the Planning Board.

Michael J. Costa Executor for the Estate of Anthony N. Costa

By: ________________________

Michael J. Costa, Executor

THE COMMONWEALTH OF MASSACHUSETTS

Bristol, SS

On this 2ND day of July 2021, before me, the undersigned notary public, personally appeared Michael J. Costa of 5226 Townsend Ave Los Angeles, CA 90041, personally known it me/proved to me through satisfactory evidence of identification to be the person whose name is signed on the preceding or attached document, and acknowledge to me that he signed it voluntarily for its stated purpose as his free act and deed.

EDWIN MELKONIAN
COMM.# 2268873
NOTARY PUBLIC - CALIFORNIA
LOS ANGELES COUNTY
My Comm. Expires Nov. 30, 2022
MM12
THE GREAT SEAL OF THE STATE OF CALIFORNIA EUREKA

____
Notary Public
My Commission Expires: 11/30/2022

IRONWOOD RENEWABLES

Agent Authorization

This form hereby authorizes Biodiversity Research Institute, Inc., to perform development related activities and represent Ironwood Renewables, LLC as the agent in support of all municipal, state, and federal permitting activities and submittals for solar project development activities in Massachusetts. Any communication with the municipalities and agencies required in the performance of these development related activities to act on behalf of Ironwood Renewables, LLC is hereby authorized.

By Adrian Ortlieb

Name Adrian Ortlieb

Title Manager

Date November 15, 2021

TABLE OF CONTENTS

Attachment 1

Deeds

BK 2482 PG 237
06/04/92 12:35 DOC. 9766

86 Braley Rd., Freetown

FIDUCIARY DEED

I, JOHN B. COSTA, Executor under the will of JOHN N. COSTA, Bristol County Probate Court Docket No. 85P1335, by power conferred by the statutes of the Commonwealth of Massachusetts, with no specific power of the court, since more than one year has elapsed from the time of my qualification as the fiduciary, and there being no claims outstanding against the estate of JOHN N. COSTA,

do hereby, and for consideration of the terms of the Will of JOHN N. COSTA, the only beneficiary therof being the grantee herein named, said terms being good consideration, and not for and/or receipt of any monetary consideration or other consideration to me by the grantee or others paid or agreed to be paid,

grant and convey by this Executor's Deed, to ANTHONY N. COSTA, 86 BRALEY ROAD, EAST FREETOWN, MASSACHUSETTS,

the land, with all of the buildings and improvements thereon, situated at 86 BRALEY ROAD, EAST FREETOWN, MASSACHUSETTS, bounded and described as follows:

BEGINNING at the Northeas corner of the land to be conveyed, at a point in the Westerly line of Braley Road, and aat the Southeasterly corner of land now or formerly of Albert Morse; thence running

SOUTHERLY 86° 45' WEST in line with said Morse land, and land now or formerly of Shubael G. Howland, One-thousand, Seven-hundred, Sixty-five (1765.) feet, more or less, to the location of a right of way of Old Colony Railroad or its successors and assigns; thence running across said railroad propety location and still in line with said Howland land,

in the same direction as above set forth, One-thousand Six-hundred Twelve (1612.) feet, more or less, to "Fall Brook" so-called; thence running

SOUTHERLY in line with said Fall Brook, about One-thousand (1000.) feet, mor or less to land now or formerly of Stephen Lawrence or Laurence; thence running

NORTH 87° 30' EAST, in line with said Lawrence land, One-thousand Seven-hundred Fifty-two (1752) feet, more or less to aforementioned railroad right-of-way or land, continuing in the same line across said railroad land, thence continuing and running still in line with said Laurence land One-thousand Five-hundred Sixty-five feet (1565) feet to the said Westerly line of Braley Road, thence running in the said Westerly line of Braley Road,

NORTH 3° WEST Thre-hundred (300) feet, thence continuing in said Westerly line of Braley Road,

NORTH 7° 15' WEST Three-hundred Fifty (350) feet; thence continuing in said Westerly line of Braley Road,

NORTH 3° 15' WEST, to the point of beginning.

BEING Lots A and B, on "Plan of Land, Freetown,Mass., Percy C. Peckham, Surveyor, Holbrook, Mass., June 18, 1931, Scale 1"=200 feet, Plan A.:, and Lots C and D on Plan entitled "Pland of Land, Freeteown, Mass., Percy C. Peckham, Surveyor, Holbrook, Mass., June 23, 1931, Scale 1"=200 feet, Plan B."

BEING THE SAME PREMISES (with exceptions hereinafter noted) conveyed by deed dated April 4, 1939, by grantors Peter Costa and Olla Costa, and Paulino Neves and Mary Neves, all of Freetown, Massachusetts, to grantees John N. Costa and Mary P. Costa, husband and wife, as joint tenants; said deed being duly recorded at the Bristol County Fall River District Registry of Deeds, Book 433, Pages 371-372;

MARY P. COSTA (also sometimes known as MARIA COSTA OR MARIA P. COSTA, died on June 17, 1975; for purposes of reference, see Bristol County Probate Court Docket No. 176094, and the Commonwealth of Massachusetts, Dept. of Corporations and Taxation, Inheritance Tax Bureau, File No. 661076;

EXCEPTING THEREFROM, HOWEVER,

that portion of the hereinbefore described land conveyed by this instrument, the following parcels of land:

FIRST PARCEL EXCEPTED:

That portion of the premises described in and conveyed by deed of John N. Costa and Mary P. Costa, to Paulino Neves and Mary Neves, dated April 4, 1939, and recorded at Bristol County Fall River District Registry of Deeds, aat Book 433, Page 372; and

SECOND PARCEL EXCEPTED:

That portion of the premises described in and conveyed by deed of John N.Costa and Mary P. Costa, to Peter Costa and Olla Costa, dated April 4, 1939, and recorded at Bristol County Fall River District Registry of Deeds, at Book 433, Page 373;

THIRD PARCEL EXCEPTED:

That portion of the premises described in and conveyed by deed of JOHN N. COSTA and Mary P. Costa, to John B. Costa, dated August 29, 1955, and recorded at Bristol County Fall River Registry of Deedc, Book 637, Page 445;

FOURTH PARCEL EXCEPTED:

That portion of the premises and/or rights of way therein or thereon, conveyed by deed of John N. Costa and Mary P. Costa, to Peter Costa, et al, dated January 27, 1947, and recorded in the Bristol County Fall River District Registry of Deeds, Book 482, Page 380.

AND INTENDING TO CONVEY

All of the real property owned by John N. Costa, in the town of Freetown, however else it might be described, at the time of his death.

WITNESS my hand and seal this 26th day of May, 1992.

John B Costa
JOHN B. COSTA

The Commonwealth of Massachusetts

Bristol, ss. Fall River, May 26, 1992

Then personally appeared the above-named JOHN B. COSTA, and he acknowledged he foregoing instrument to be his free act and deed, before me.

Marilou D Legacy
Marilou D. Legacy
Notary Public
My commission expires May 1, 1998

ATTEST: FALL RIVER DISTRICT; Joseph E. Hanify Jr., Register

2

2014 00011077
Bk: 8520 Pg: 60 Doc: DEED
Page: 1 of 2 08/15/2014 09:41 AM

CORRECTIVE QUITCLAIM DEED

KNOW ALL MEN BY THESE PRESENTS:

That I, Anthony N. Costa, of East Freetown, Bristol County, Massachusetts, for consideration paid, and in full consideration of One Dollar ($1.00), grant to Michael John Costa and Karen Cipriano Costa, husband and wife as tenants by the entirety, of 5226 Townsend Avenue, Los Angeles, California 90041, with quitclaim covenants, thirty-six (36) acres, more or less, of undeveloped land in East Freetown, Bristol County, Massachusetts, bounded and described as follows:

Approximately thirty-six (36+/-) acres of undeveloped land, bounded to the north by land now or formerly of the Chipaway Corporation, to the west by the so-called Fall Brook, to the south by land now or formerly of the said Chipaway Corporation, by land now or formerly of Thomas Ferreira, and by land now or formerly of Andrew W. Brennan, and to the east by land now or formerly of of Conrail/CSX Railroad . Said land is shown with more particularity as "Anthony N. Costa (Remaining Land), 247-6, 36+/- acres" on a "Definitive Plan, John N. Costa Estate, Owner: Anthony N. Costa, 86 Braley Road, East Freetown, MA" dated November 15, 1996, revised April 3, 1997, drawn by Geodetic Engineering, Inc. of East Freetown, MA and filed in the Bristol County (Fall River District) Registry of Deeds (hereinafter the "Registry") in Plan Book 114, Page 13. Said land is also shown as "Remaining Land Map 247, Lot 6, 36+/- Acres" on an "Approval Not Required Plan of Land in Freetown, MA, Anthony N. Costa Conveying Lot D-1 to Larry S. Rose" dated February 24, 2005, drawn by the said Geodetic Engineering, Inc. and filed in said Registry in Plan Book 134, Page 73.

Together with a Right of Way over other land of the Grantor and over a Railroad Crossing allowing access to the Subject Land from Braley Road, and shown as "Existing Woods Road & Right of Way" on a "Modified Definitive Plan for John N. Costa Estate" dated August 22, 2002, drawn by the said Geodetic Engineering, Inc. and filed in said Registry in Plan Book 127, Page 44. Said Right of Way and Railroad Crossing is likewise shown on the Plans of Land filed in said Registry and referenced in the paragraph above.

For Title, see fiduciary deed to the Grantor herein from John B. Costa, executor under the will of John N. Costa dated May 26, 1992, recorded in said Registry in Book 2482, Page 237, of which the Subject Land is a part.

Property Address: Landlocked property west of CSX/Conrail railroad property to the rear of 86 Braley Road, East Freetown, MA 02702, and shown on Freetown Assessors' Map 247 as Lot 6.

This deed is intended to confirm and correct a deed from the Grantor herein to the Grantees herein dated February 23, 2014, recorded in said Registry in Book 8421, Page 337, wherein the Subject Premises was described only via the Freetown Assessors reference, and the Subject Land's rights in and to the Old Woods Road Right of Way and its Railroad Crossing were erroneously omitted.

IN WITNESS WHEREOF, I have hereunto set my hand and seal this 13th day of August, 2014.

Anthony N. Costa

Anthony N. Costa

COMMONWEALTH OF MASSACHUSETTS
BRISTOL, ss:

On this 13th day of August, 2014 before me, the undersigned notary public, personally appeared the above-named Anthony N. Costa, proved to me through satisfactory evidence of identification, ie: a Massachusetts driver's license, to be the person whose name is signed to the foregoing instrument, and acknowledged to me that he signed it voluntarily, for its stated purpose.

Ralph K. Mulford, III

Ralph K. Mulford, III
Notary Public
My Commission expires: 12/12/2014

RALPH K. MULFORD III
MY COMMISSION EXPIRES DEC. 12, 2014
COMMONWEALTH OF MASSACHUSETTS
NOTARY PUBLIC

Attachment 2

Detailed Description of Project

Detailed Description of Project

Introduction

Costa Solar, LLC is proposing the development of Costa Solar (Project), a utility scale ground-mounted solar energy generation facility located at 5 Costa Drive and 0 Rear Costa Drive in Freetown (Site). The Project will add 5 megawatts (AC) of clean, renewable energy to the local electrical grid.

The proposed Project includes an approximately 30.5-acre limit of disturbance and will require 28.5 acres of tree clearing. The Project includes a proposed 30-foot-wide private right of way, a road crossing that spans an intermittent stream, two separate fenced solar arrays, equipment pads, battery storage, a railroad crossing, and overhead equipment associated with interconnection to the utility infrastructure. The Site will be accessed near the western terminus of Costa Drive via a proposed access road that will located within the right of way.

Location

The Site currently consists of two undeveloped parcels: Map 241, Lot 53 (owned by the Estate of Anthony N. Costa), and Map 247, Lot 6 (owned by Michael and Karen Costa). The Project will use a right of way to cross railroad tracks (Map 253, Lot 30) that divide these two parcels. The Project team has submitted a Form C application for approval of a subdivision of the Project lots. Pending official designations from the Town of Freetown, this application will use the following placeholders when appropriate:

- Map 241-53 New Lot A (north of the proposed right of way)
- Map 241-53 New Lot B (south of the proposed right of way)
- Map 247-6 New Lot C (exclusive of the proposed right of way).

Project Parties

The applicant for this Project is Costa Solar, LLC, a wholly owned subsidiary of Ironwood Renewables, LLC (Ironwood). The address for Ironwood is PO Box 51794, Lafayette, LA 70505. Ironwood has engaged Biodiversity Research Institute (BRI) as the lead consultant in support of the Project. Dale Knapp at BRI can be reached at 207-631-9134, or at 30 Danforth Street, Suite 213, Portland, ME 04101. The properties involved in this Project are owned by Michael and Karen Costa, and by the Estate of Anthony N. Costa (with Michael Costa as executor). Michael Costa can be reached at 202-664-0445, or at 5226 Townsend Avenue, Los Angeles, CA 90041. A system installer has not yet been identified. Once an installer has been identified, the name and contact information will be shared with the Town of Freetown.

Total Percentage of Lot Coverage Proposed

Map 241 Lot 53 will have 6.1% coverage by structures (equipment and panels). Map 247 Lot 6 will have 18.9% coverage by structures (equipment and panels). Table 1 lists the proposed dimensions and coverage of each lot in more detail.

Table 1. Proposed Lot Dimensions and Coverage

Parcel	Address	Property Area (square feet)	Equipment Coverage (square feet)	Planimetric Solar Panel Coverage (square feet)	Total Lot Coverage by Panels and Equipment (square feet)	
241-53 (New Lot A)	5 Costa Drive	256,450	0	0	0	0.0%
241-53 (New Lot B)	5 Costa Drive	331,610	3,500	35,000	38,500	11.6%
241-53 (Right of Way)	5 Costa Drive	58,370	700	0	700	1.2%
247-6 (New Lot C)	0 Costa Drive	1,555,030	1,500	295,000	296,500	19.1%
247-6 (Right of Way)	0 Costa Drive	13,130	200	0	200	1.5%

Resource Areas and Impacts

The Project has been designed to avoid and minimize adverse impacts on the resource areas to the greatest extent practicable. A formal wetland delineation was performed at the Site in accordance with *Delineating Bordering Vegetated Wetlands Under the Massachusetts Wetlands Protection Act (1995*). The eastern parcel (Map 241, Lot 53) consists of several scrub-shrub and forested wetlands, an intermittent stream, and regenerating upland forest. The western parcel (Map 247, Lot 6) consists of several scrub-shrub and forested wetlands, a perennial stream along the western boundary, an intermittent stream along the southern boundary, and regenerating upland forest.

The Project proposes a total of 2,665 square feet of alteration to an area Bordering Vegetated Wetland (BVW), and 16 linear feet of Bank, to build a road crossing over an intermittent stream channel. Additionally, the Project proposes alteration within the buffer zones of the four BVWs and 41,940 square feet of alteration within the Riverfront Area.

The proposed alteration activities will be completed in accordance with the General Performance Standards listed in 310 CMR 10.55 by providing a greater than 1:1 ratio replication for the altered area. In accordance with 310 CMR 10.55(4)(a), the impacted BVW areas are presumed to be significant to the interests specified in 310 CMR 10.55(1). Approximately 2,700 square feet of BVW replication or replacement area will be provided as mitigation for the approximately 2,665 square feet of unavoidable impacts to BVW from the construction of the road crossing over the intermittent stream channel. A detailed wetland replication plan, construction details, and notes are provided in the attached Site Plans (**Attachment 3**).

The Project proposes to install an open bottom box culvert over the intermittent stream. Construction will include no work within the stream channel or to the existing Bank. Therefore, the Project as proposed should not impair the physical stability of the Bank. The proposed open bottom box culvert will not alter the dimensions of the existing channel and has been designed to have enough water carrying capacity for a 100-year 24-hour flood event. Therefore, the Project as proposed should not impair the water carrying capacity of the existing channel within the Bank.

Landscaping

The Project has been designed with the local character in mind. Existing vegetation will be maintained between the Site and abutting properties, which will visually screen the Project from residences and from the street. The Project proposes an agricultural-style wooden post fence to secure both of the solar arrays. A meadow buffer will be maintained beneath the solar panels, which will be planted with a wildlife/conservation seed mix. This mix consists of New England native varieties of grasses, wildflowers, and legumes, to encourage local pollinators and prevent erosion. Some tree clearing is unavoidable, in order to create space for and limit shading of solar panels. Tree clearing is minimized to only what is necessary for the Project. At the end of the life of the Project, equipment will be removed and the soil will be returned to a natural state suitable for other uses. See the Environmental Impact Assessment (**Attachment 4**) for more information about landscaping and natural buffers.

Circulation

After construction is complete, the traffic volume created by the Project will be minimal. For safety and security reasons the Site will be inaccessible to the public, and routine inspection and maintenance visits are expected no more than once per month. The access road, with its turnarounds and pullover lanes, will provide sufficient parking for routine maintenance and inspection visits. These features, along with a traffic circle in Lot 247-006, will reduce conflict points and traffic hazards within the Site. Manual swing gates on either side of the railroad tracks will ensure safety around the rail crossing. No parking areas or sidewalks are proposed. See the Parking Impact Assessment in **Attachment 4** for more information about expected circulation impacts.

Requested Documentation

The following requested documentation is attached:

- Municipal Lien Certificates for both Project lots: **Attachment 5**
- Lists of abutters for each Project lot, signed by the Assistant Assessor: **Attachment 6**
- Certificate of liability insurance: **Attachment 7**

Zoning district designations for the Project lots are shown on the Town Zoning Map, included in **Attachment 8**. An Application for Zoning Determination was submitted to the Building Commissioner on November 12, 2021. This application is also included in **Attachment 8**. The Project will share the outcome of this application with the Planning Board once it is available.

Electrical System Components

An electrical diagram of the Project installation and interconnection is included in **Attachment 9**. Additional documentation of typical system components is also included in **Attachment 9**, including photovoltaic modules and inverters. These models are representative of typical equipment that will be installed in this Project.

Surface Water Drainage

A Drainage Report was prepared by registered professional engineers at Krebs and Lansing, in accordance with the Massachusetts Department of Environmental Protection’s Stormwater Management Standards and Best Management Practices. This report is designed to ensure that post-development stormwater runoff will not exceed pre-development stormwater runoff for a 24-hour-duration 2-, 10-, 25-, or 100-year storm. See **Attachment 10** for the full reports, which include best management practices for both temporary construction-phase activity and long-term post-construction operations.

Vegetated meadow conditions beneath the solar arrays will treat stormwater created by the impervious equipment pads, solar panel supports, and fence posts. Slopes within the solar arrays are on average less than 8 percent, and all less than 25 percent. Vegetated buffers will be implemented along roadsides for the treatment of stormwater associated with the gravel access roads. The access roads will include runoff conveyance ditches that will protect the road surface and will transport stormwater to established meadow buffers for treatment. More information about drainage and stormwater management can be found in the Environmental Impact Assessment (**Attachment 4**) and the full Drainage Report (**Attachment 10**).

Building Location and Design

The Project is not located within a Natural Heritage & Endangered Species Program (NHESP) Estimated or Priority Habitat of Rare Species, and no vernal pools are known to be located on the Site. Visual impact will be minimized by a vegetated buffer surrounding the Project. The Project structures are similar to others in the area, as several solar projects have been installed to the north, east, and south of the proposed Site. Building materials are durable and expected to last the lifetime of the Project. Any damaged equipment will be repaired or replaced. For more information on design and local impact, see the Community Impact Assessment in **Attachment 4**.

Parking

The expected day-to-day traffic volume created by the Project will be minimal to non-existent. Maintenance and inspection personnel will be able park vehicles in the turnarounds and pullover lanes along the access road. These parking areas will be screened by the vegetated buffers that surround the Project. No additional parking areas are necessary. For more information, see *Circulation*, above, and the Traffic Impact Assessment in **Attachment 4**.

Lighting and Signs

Informational placards will be installed near entrance gates listing the Project owner and 24-hour emergency contact information for the Project. Means of emergency shutdown will be clearly marked. “No Trespassing” signs may be affixed to the Project fence. No other signage or advertising is proposed. No signs or placards will be illuminated and there will be no exterior lighting systems for the Project. Solar panels are specifically designed to absorb sunlight, rather than reflecting it, thereby minimizing glare.

Noise

Low levels of noise will be produced by Project equipment, such as electrical transformers and the battery bank. Noise-making equipment is located so as to minimize noise levels at property boundaries and occupied buildings, and should not unreasonably interfere with the use and enjoyment of nearby properties. For more information, see the Noise Impact Assessment in **Attachment 4**.

Maintenance

All Project equipment will be maintained via remote monitoring and periodic Site visits by a technician. Access ways, fences, landscaping, drainage, signage, and equipment will be kept in good condition. Damaged or defective equipment will be repaired or replaced, and vegetation will be maintained for visual buffering as well as stormwater treatment. An Operations and Maintenance Plan for stormwater features is included in the Drainage Report in **Attachment 10**. Site access will be maintained at a level acceptable to the Fire Chief.

Shading

The Project has been designed to avoid any shading from or shading of nearby structures or properties. The Project equipment will have a maximum height of 15 feet and has been located in areas that would not create shade impacts to nearby properties or structures. A tree line will be cleared to prevent shading from trees. Tree clearing will be limited to the minimum necessary to prevent shading.

Decommissioning and Financial Surety

The Project will be decommissioned within 150 days of the end of its operational life, or the expiration or termination of the land lease agreement. Costa Solar, LLC, or its successor, will be responsible for decommissioning activities, including removing the solar facility, disposing of waste, restoring the Project site, and periodically updating the form of surety. Costa Solar, LLC will fully fund the decommissioning of the Project at an estimated cost of $173,075. Financial assurance will be demonstrated through a performance bond, surety bond, irrevocable letter of credit, or other form acceptable to the Site Plan Review Authority. See **Attachment 11** for more information about decommissioning.

Requested Waivers

The Project team requests the following waivers:

Section II.B.3: *The plans shall be at a scale of one inch (1") equals forty feet (40'), or such other scale as the Planning Board may accept to show details clearly and adequately.*

- REASON: Due to the size of the Project, a scale of 1” to 40’ is not practical to fit the Project into a limited number of sheets. While the overall Site Plan is presented at 1” to 120’, specific portions and important details have been broken out at 1” to 20’ or 1” to 60’ for better legibility.

Section II.B.3.e: *The basement and first floor elevations of all existing buildings adjacent to the property.*

- REASON: A boundary survey has not been completed for the Project, so no basement and first-floor elevations were taken of existing adjacent buildings. Plans were drawn by a professional engineer licensed in the Commonwealth of Massachusetts.

Section II.B.3.f: *Location of all permanent monuments properly identified as to whether existing or proposed.*

- REASON: A boundary survey has not been completed for the Project, so no permanent monuments were identified. Plans were drawn by a professional engineer licensed in the Commonwealth of Massachusetts, and data was drawn from tax map information provided by the town.

Section II.B.3.n: *Size and location of existing and proposed water supply mains and their appurtenances, hydrants, sewer pipes and their appurtenances and/or sewage disposal systems including estimated water and sewer usage calculations.*

- REASON: The Project will not use any water or create any wastewater during operation, and does not need to be connected to Town water mains. Due to having no day-to-day on-site personnel, the Project does not require septic systems or sewage disposal.

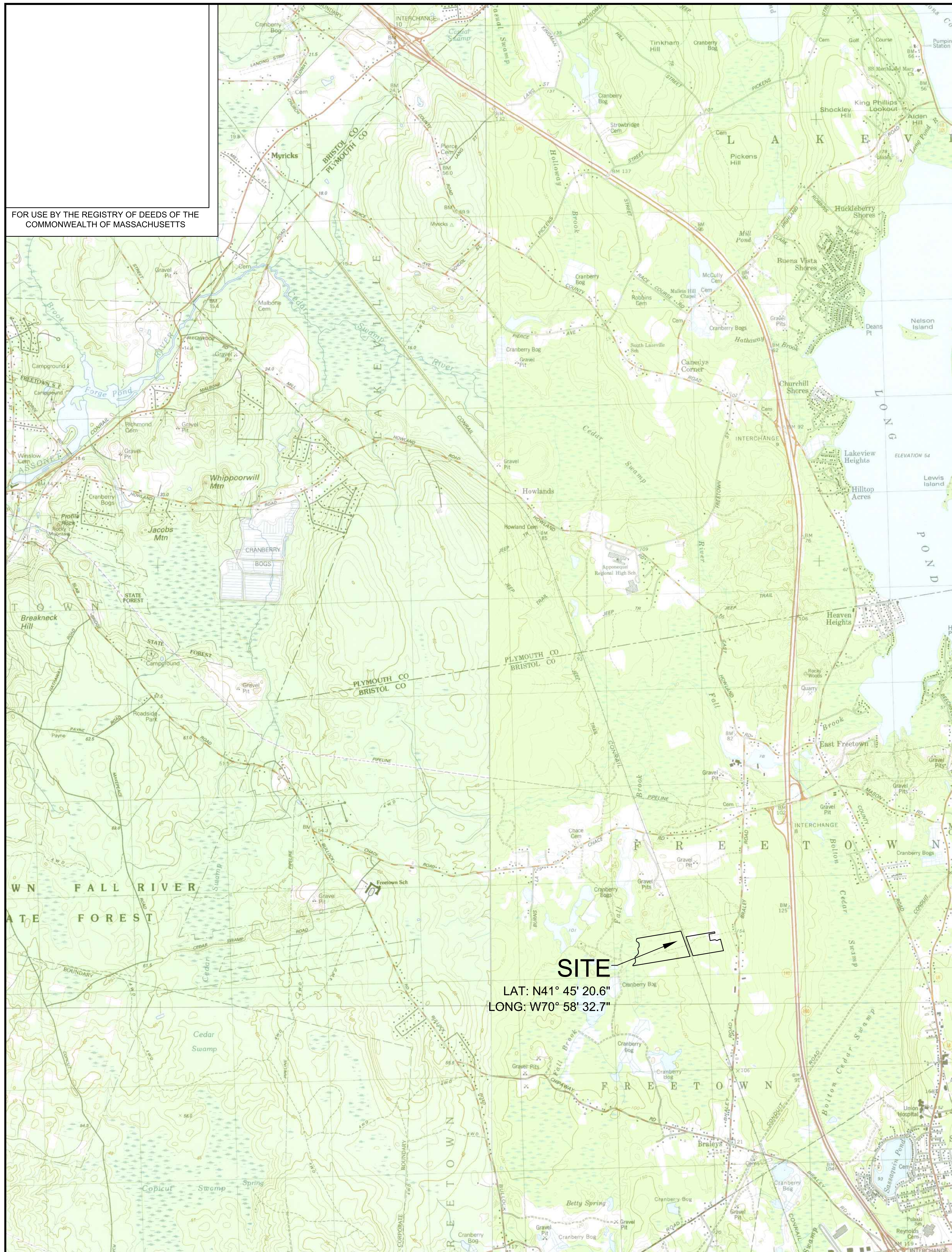
Form SPR: *A PDF electronic file of the plan on a CD.*

- REASON: The Project team has included a flash drive (thumb drive) rather than a CD, for easier transport and sharing.

Attachment 3

Site Plans

FOR USE BY THE REGISTRY OF DEEDS OF THE COMMONWEALTH OF MASSACHUSETTS



LOCUS MAP
SCALE: 1" = 2,000 FEET

COSTA SOLAR

SHEET INDEX:

SHEET NUMBER	SHEET TITLE	DRAWING DATE	REVISION DATE
C-0.00	COSTA SOLAR COVER PAGE PROPOSED SOLAR ARRAY	11/08/21	11/17/21
C-1.00	COSTA SOLAR OVERALL SITE PLAN PRELIMINARY SOLAR ARRAY	11/08/21	11/17/21
C-1.01	COSTA SOLAR EXISTING CONDITIONS	11/08/21	11/17/21
C-1.02	COSTA SOLAR CLEARING AND EROSION PREVENTION AND SEDIMENT CONTROL	11/08/21	11/17/21
C-1.03	COSTA SOLAR PROPOSED GRADING, ROAD INSTALLATION AND STORMWATER MANAGEMENT PLAN	11/08/21	11/17/21
C-1.04	COSTA SOLAR DETAILED SITE PLAN EASTERN PORTION OF SITE	11/08/21	11/17/21
C-1.05	COSTA SOLAR DETAILED SITE PLAN WESTERN PORTION OF SITE	11/08/21	11/17/21
C-1.06	COSTA SOLAR ROADWAY CROSS SECTIONS	11/17/21	-
C-3.00	COSTA SOLAR OPEN BOTTOM BOX CULVERT SPECIFICATIONS AND DETAILS	07/01/21	11/17/21
C-3.01	COSTA SOLAR DETAILS	07/01/21	11/17/21
C-3.02	COSTA SOLAR DETAILS	07/01/21	11/17/21
C-3.03	COSTA SOLAR DETAILS	11/08/21	11/17/21
C-3.04	COSTA SOLAR DETAILS	11/08/21	11/17/21

FREETOWN PLANNING BOARD APPROVAL

DATE

COSTA SOLAR
Costa Drive
Freetown, Massachusetts

IRONWOOD RENEWABLES

bri
BIODIVERSITY RESEARCH INSTITUTE

KREBS & LANSING CONSULTING ENGINEERS

ISSUED FOR PERMIT REVIEW
NOT FOR CONSTRUCTION

CIVIL ENGINEER:
Krebs and Lansing Consulting Engineers, Inc.
164 Main Street, Suite 201
Colchester, Vermont 05446

ENVIRONMENTAL:
BRI Environmental
30 Danforth Street, Suite 213
Portland, ME 04101

APPLICANT:
Costa Solar LLC
Ironwood Renewables, LLC c/o Adrian Ortlieb
P.O. Box 51794
Lafayette, LA 70505
(p) (337) 412-9199

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STAMP:
COMMONWEALTH OF MASSACHUSETTS
GREGORY T. DIXSON
CIVIL ENGINEER
No. 55649
REGISTERED PROFESSIONAL ENGINEER

REV. NO.	REVISIONS/COMMENTS	DATE
1.	Updates for Planning Board submission	11/17/21

DRAWING TITLE:
COSTA SOLAR COVER PAGE
PROPOSED SOLAR ARRAY

DATE of Issue: 11/08/2021
Drawn by: EJM/GTD
Checked by: GTD
Project No.: 21223
Scale: as noted
Drawing No.: C-0.00
Rev No.: 1

FOR USE BY THE REGISTRY OF DEEDS OF THE COMMONWEALTH OF MASSACHUSETTS

LEGEND

- APPROXIMATE PROPERTY LINES
- APPROXIMATE PROJECT PARCEL
- DELINEATED STEAMS
- DELINEATED WETLANDS
- ENVIRONMENTAL BUFFERS
- FEMA BASE FLOOD LIMIT OF 100 YEAR-24 HOUR STORM EVENT
- PROPOSED PERIMETER FENCING
- PROPOSED FIXED SOLAR PANEL RACKING
- PROPOSED OVERHEAD ELECTRIC LINE/POWER POLE
- PROPOSED UNDERGROUND POWER
- PROPOSED LIMIT OF DISTURBANCE (LOD)

NOTES:

1. THE PROJECT CONTRACTOR SHALL GIVE SEVEN (7) DAYS NOTICE TO PERTINENT TOWN DEPARTMENTS BEFORE COMMENCING WORK IN THE FIELD.
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8. THIS IS A PRELIMINARY DESIGN PLAN. FINAL DESIGN WILL BE MODIFIED TO MATCH EQUIPMENT PURCHASED AND POSSIBLE PERMIT CONSTRAINTS REVEALED DURING PROJECT'S REVIEW.

PROJECT SPECIFICATIONS:

NUMBER OF MODULES: 13,896 (@520 PER PANEL)

DC OUTPUT: 7.23 MW

AC OUTPUT: 5.00 MW

DC/AC RATIO: 1.44

DESIGN: FIXED TILT @ 25° TILT

GCR: 0.476 (47.6%)

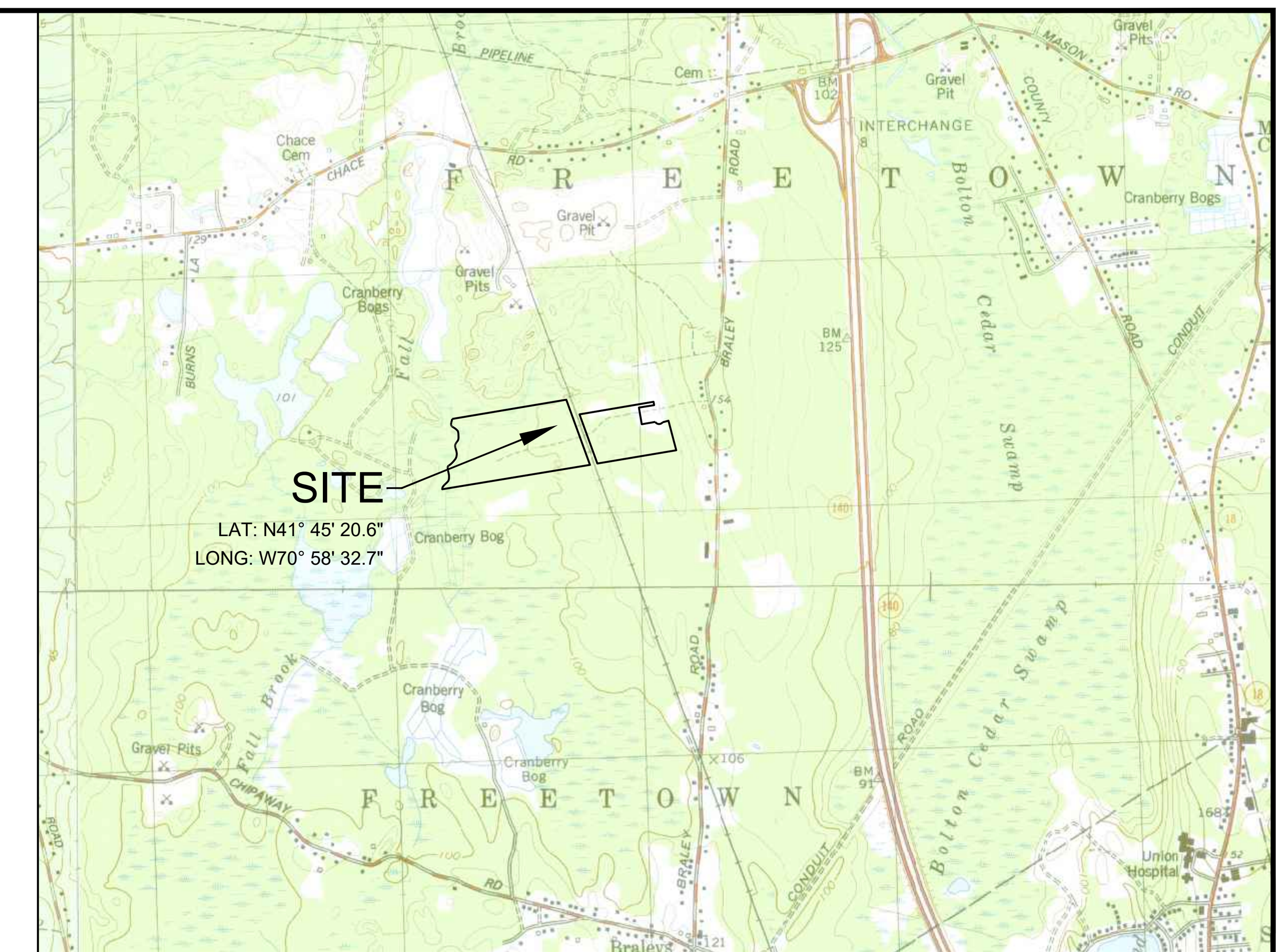
PROJECT CALCULATIONS

PROPOSED CLEARING
- ±28.6 ACRES

PROPOSED TOTAL DISTURBANCE
- ±30.5 ACRES

PROPOSED IMPERVIOUS AREA
- 1.52 ACRES (LIMITED PAVEMENT)

PROPOSED AREA WITHIN THE FENCE
- 19.8 ACRES

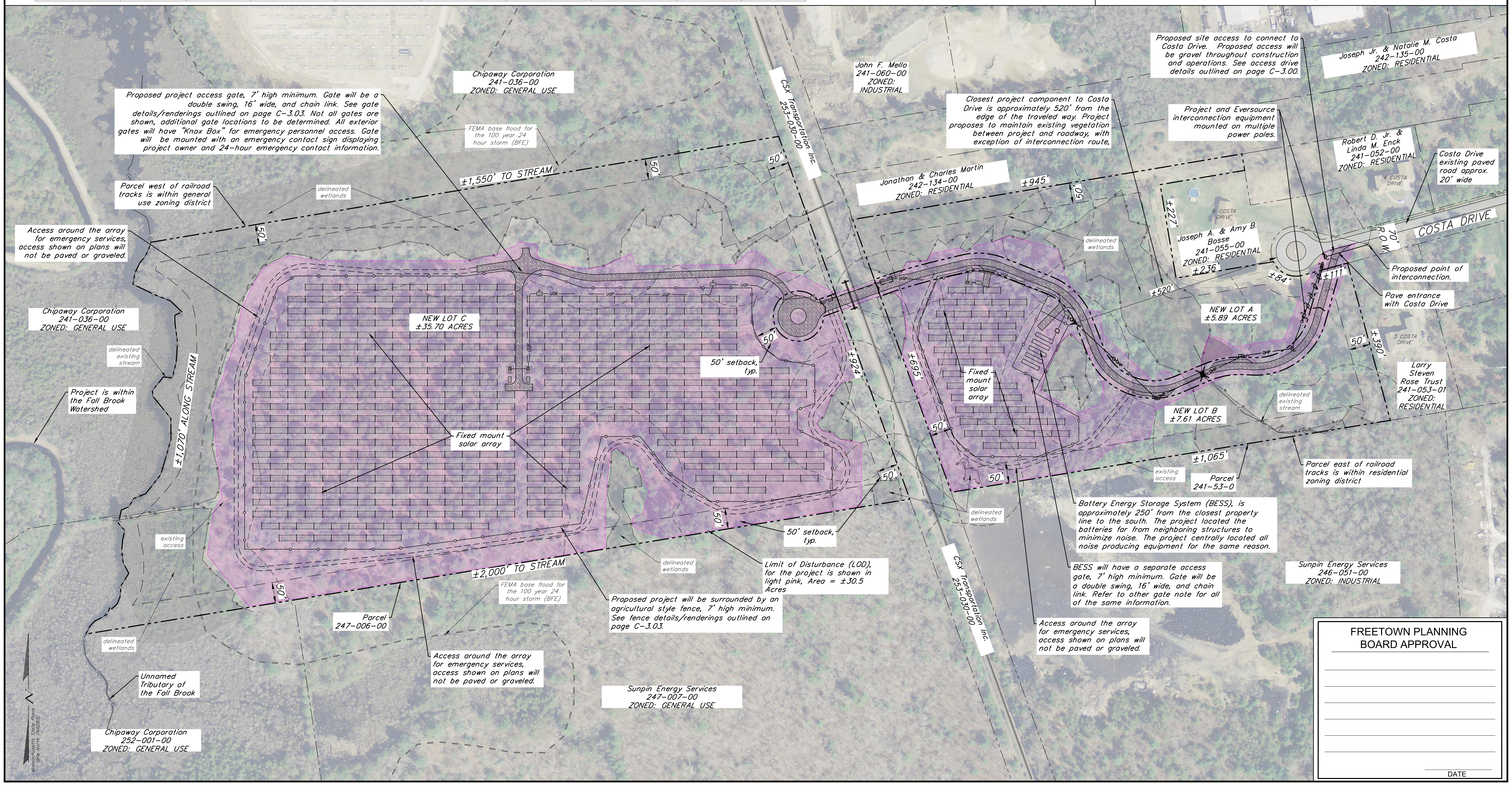


LOCUS MAP

SCALE: 1" =2,000'

ZONING INFORMATION BASED ON NEW PROPERTY LINES

PROPERTY ID	PROPERTY ADDRESS	ZONING DISTRICT	REQUIRES/PROPOSED AREA (S.F.)	REQUIRES/PROPOSED FRONTAGE (S.F.)	REQUIRES/PROPOSED FRONT SETBACK (FT.)	REQUIRES/PROPOSED SIDE SETBACK (FT.)	REQUIRES/PROPOSED REAR SETBACK (FT.)	WATER SUPPLY	FLOOD ZONE INFORMATION
241-53-0 (NEW LOT A)	5 COSTA DRIVE	RESIDENTIAL	70,000 / ±256,450	175 / 1,355	50 / 50	50(R) & 20(I) / 50	25 / 50	N/A	X - OUTSIDE
241-53-0 (NEW LOT B)	5 COSTA DRIVE	RESIDENTIAL	70,000 / ±331,610	175 / 1,420	50 / 50	50(R) & 20(I) / 50	25 / 50	N/A	X - OUTSIDE
247-6-0 (NEW LOT C)	0 COSTA DRIVE	GENERAL USE	70,000 / ±1,555,030	175 / 425	50 / 50	20 / 50	25 / 50	N/A	X - OUTSIDE



FREETOWN PLANNING BOARD APPROVAL

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COSTA SOLAR

Costa Drive
Freetown, Massachusetts

IRONWOOD RENEWABLES

bri BIODIVERSITY RESEARCH INSTITUTE

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STAMP:

COMMONWEALTH OF MASSACHUSETTS GREGORY T. DIXSON CIVIL ENGINEER No. 55649 REGISTERED PROFESSIONAL ENGINEER

0' 60' 120' 240' 360'
0" 1" 2" 3"
STANDARD GRAPHIC SCALE (1" = 120')
VALID WHEN PLOTTED ON 24" BY 36" MEDIA

REV. NO.	REVISIONS/COMMENTS	DATE
1.	Updates for Planning Board submission	11/17/21

DRAWING TITLE:

COSTA SOLAR OVERALL SITE PLAN PRELIMINARY SOLAR ARRAY

DATE of Issue: 11/08/2021

Drawn by: EJM/GTD Checked by: GTD

Project No.: 21223 Scale: 1" = 120'

Drawing No.: C-1.00 Rev No.: 1

FOR USE BY THE REGISTRY OF DEEDS OF THE COMMONWEALTH OF MASSACHUSETTS

LEGEND

- APPROXIMATE PROPERTY LINES
- APPROXIMATE PROJECT PARCEL
- DELINEATED STEAMS
- DELINEATED WETLANDS
- ENVIRONMENTAL BUFFERS
- FEMA BASE FLOOD LIMIT OF 100 YEAR-24 HOUR STORM EVENT
- PRE-CONSTRUCTION FLOW PATHS FOR TIME OF CONCENTRATION CALCULATIONS
- PRE-CONSTRUCTION WATERSHED LIMITS

NOTES:

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PROJECT CALCULATIONS

PROPOSED CLEARING
- ±28.6 ACRES

PROPOSED TOTAL DISTURBANCE
- ±30.5 ACRES

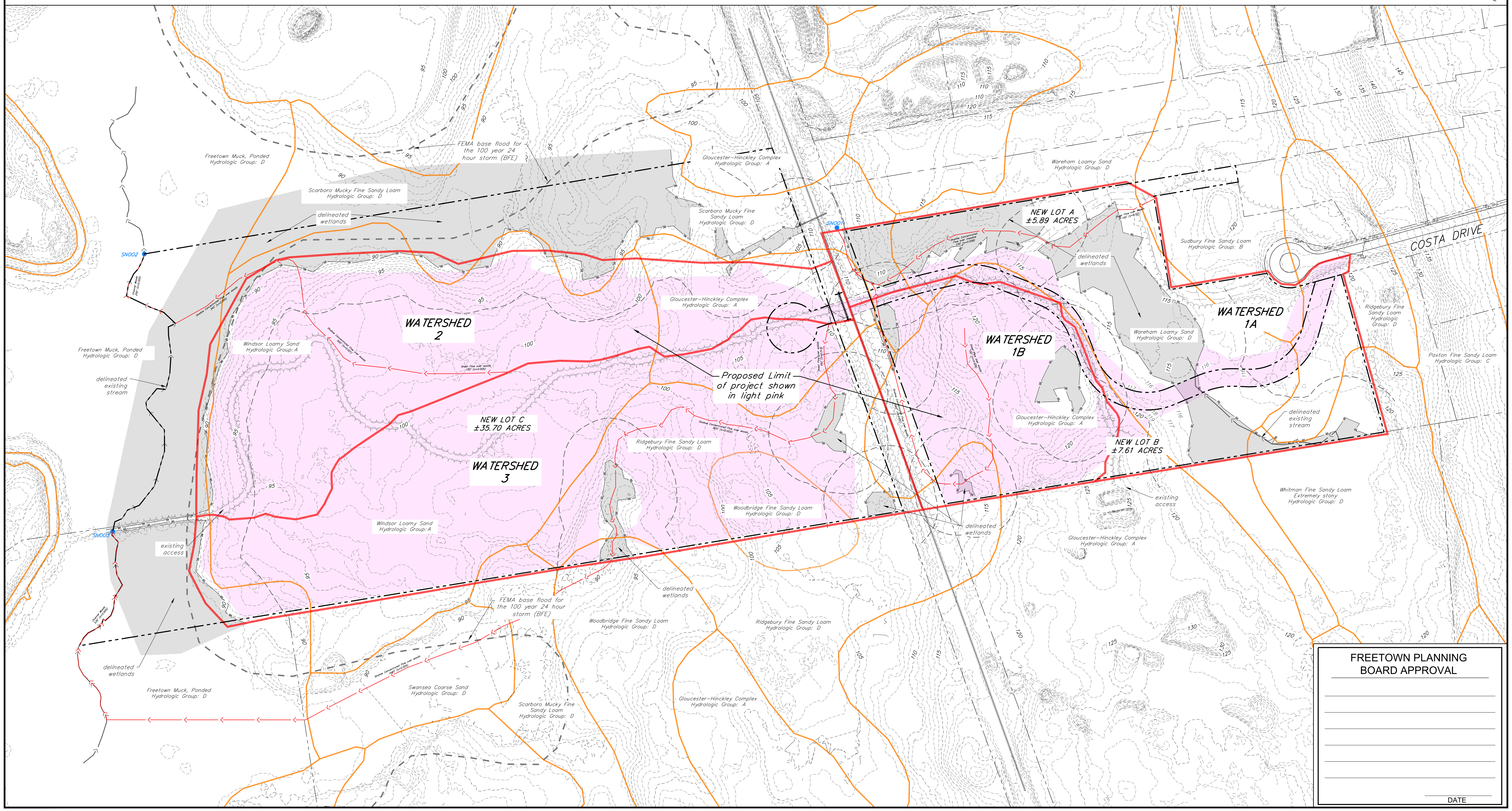
PROPOSED IMPERVIOUS AREA
- 1.52 ACRES (LIMITED PAVEMENT)

PROPOSED AREA WITHIN THE FENCE
- 19.8 ACRES

PRE-DEVELOPMENT PEAK FLOWS (CFS)

ANALYSIS POINT	2-YEAR 24-HOUR STORM EVENT	10-YEAR 24-HOUR STORM EVENT	25-YEAR 24-HOUR STORM EVENT	100-YEAR 24-HOUR STORM EVENT
SN001	4.71	10.56	14.97	22.69
SN002	0.00	0.06	0.27	1.10
SN003	0.45	2.58	4.71	8.79

Massachusetts State Plane Grid North (NAD83)



FREETOWN PLANNING BOARD APPROVAL

DATE

COSTA SOLAR

Costa Drive
Freetown, Massachusetts

IRONWOOD RENEWABLES

bri BIODIVERSITY RESEARCH INSTITUTE

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APPLICANT:
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Ironwood Renewables, LLC c/o Adrian Ortlieb
P.O. Box 51794
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COMMONWEALTH OF MASSACHUSETTS
GREGORY T. DIXSON
CIVIL ENGINEER
No. 55649
REGISTERED PROFESSIONAL ENGINEER

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0" 1" 2" 3"
STANDARD GRAPHIC SCALE (1" = 120')
VALID WHEN PLOTTED ON 24" BY 36" MEDIA

REV. NO.	REVISIONS/COMMENTS	DATE
1.	Updates for Planning Board submission	11/17/21

DRAWING TITLE:
COSTA SOLAR
EXISTING CONDITIONS

DATE of Issue: 11/08/2021
Drawn by: EJM/GTD
Checked by: GTD
Project No.: 21223
Scale: 1" = 120'
Drawing No.: C-1.01
Rev No.: 1

FOR USE BY THE REGISTRY OF DEEDS OF THE COMMONWEALTH OF MASSACHUSETTS

LEGEND

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- APPROXIMATE PROJECT PARCEL
- DELINEATED STEAMS
- DELINEATED WETLANDS
- ENVIRONMENTAL BUFFERS
- FEMA BASE FLOOD LIMIT OF 100 YEAR-24 HOUR STORM EVENT
- PROPOSED CLEARING LIMIT
- APPROXIMATE LIMIT OF DISTURBANCE (LOD)
- CLEARED AREAS
- PROPOSED EROSION PREVENTION AND SEDIMENT CONTROL SILT FENCE PERIMETER CONTROLS
- PERIMETER CONSTRUCTION BARRIER FENCE
- PROPOSED CONSTRUCTION STAGING AREA

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CLEARING NOTES:

1. ALL VEGETATION SHOWN IN LIGHT GREEN ON THIS PLAN WILL BE WILL BE CLEAR CUT. TOTAL AMOUNT OF CLEARING ±28.6 ACRES.
2. ALL AREAS WILL BE STUMPED AND GRUBBED. STUMPS WILL BE GROUND/CUT UP AND USE FOR EPSC. TREES MAY BE REMOVED FROM SITE (USED/SOLD). SMALLER TREES, SHRUBS AND BRANCHES WILL BE GROUND/CUT UP AND USED FOR EPSC.

PROJECT CALCULATIONS

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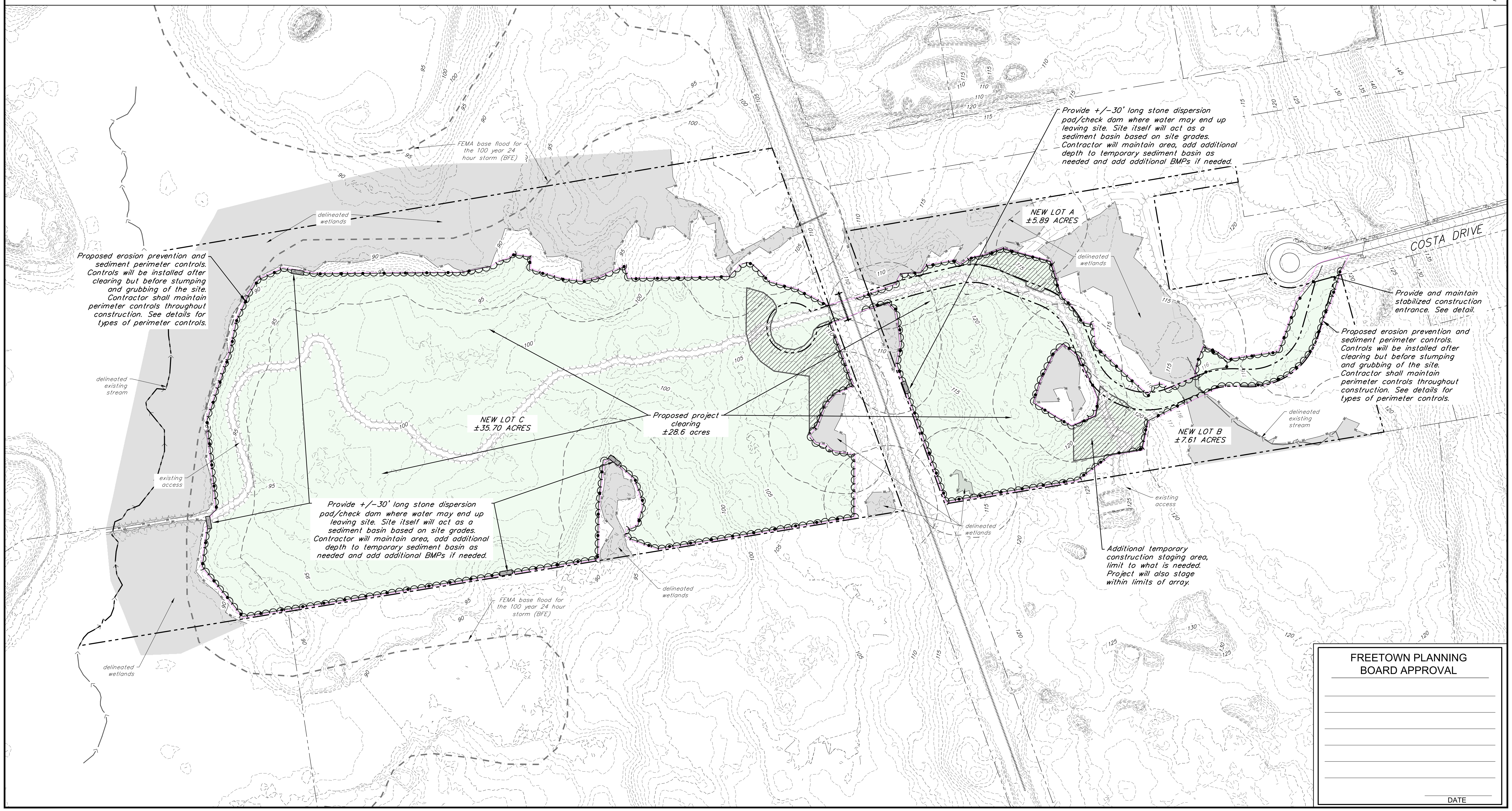
- ±28.6 ACRES

PROPOSED TOTAL DISTURBANCE
- ±30.5 ACRES

PROPOSED IMPERVIOUS AREA
- 1.52 ACRES (LIMITED PAVEMENT)

PROPOSED AREA WITHIN THE FENCE
- 19.8 ACRES

Massachusetts State Plane Grid North (NAD83)



FREETOWN PLANNING BOARD APPROVAL

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REV. NO.	REVISIONS/COMMENTS	DATE
1.	Updates for Planning Board submission	11/17/21

DRAWING TITLE:

COSTA SOLAR CLEARING AND EROSION PREVENTION AND SEDIMENT CONTROL

DATE of Issue: 11/08/2021
Drawn by: EJM/GTD Checked by: GTD
Project No.: 21223 Scale: 1" = 120'
Drawing No.: C-1.02 Rev No.: 1

FOR USE BY THE REGISTRY OF DEEDS OF THE COMMONWEALTH OF MASSACHUSETTS

LEGEND

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- DELINEATED WETLANDS
- ENVIRONMENTAL BUFFERS
- FEMA BASE FLOOD LIMIT OF 100 YEAR-24 HOUR STORM EVENT
- PROPOSED CLEARING LIMIT
- PROPOSED GRADE CONTOUR LINES (5 FOOT INTERVALS)
- PROPOSED GRADE CONTOUR LINES (1 FOOT INTERVALS)
- POST-CONSTRUCTION FLOW PATHS FOR TIME OF CONCENTRATION CALCULATIONS
- POST-CONSTRUCTION WATERSHED LIMITS

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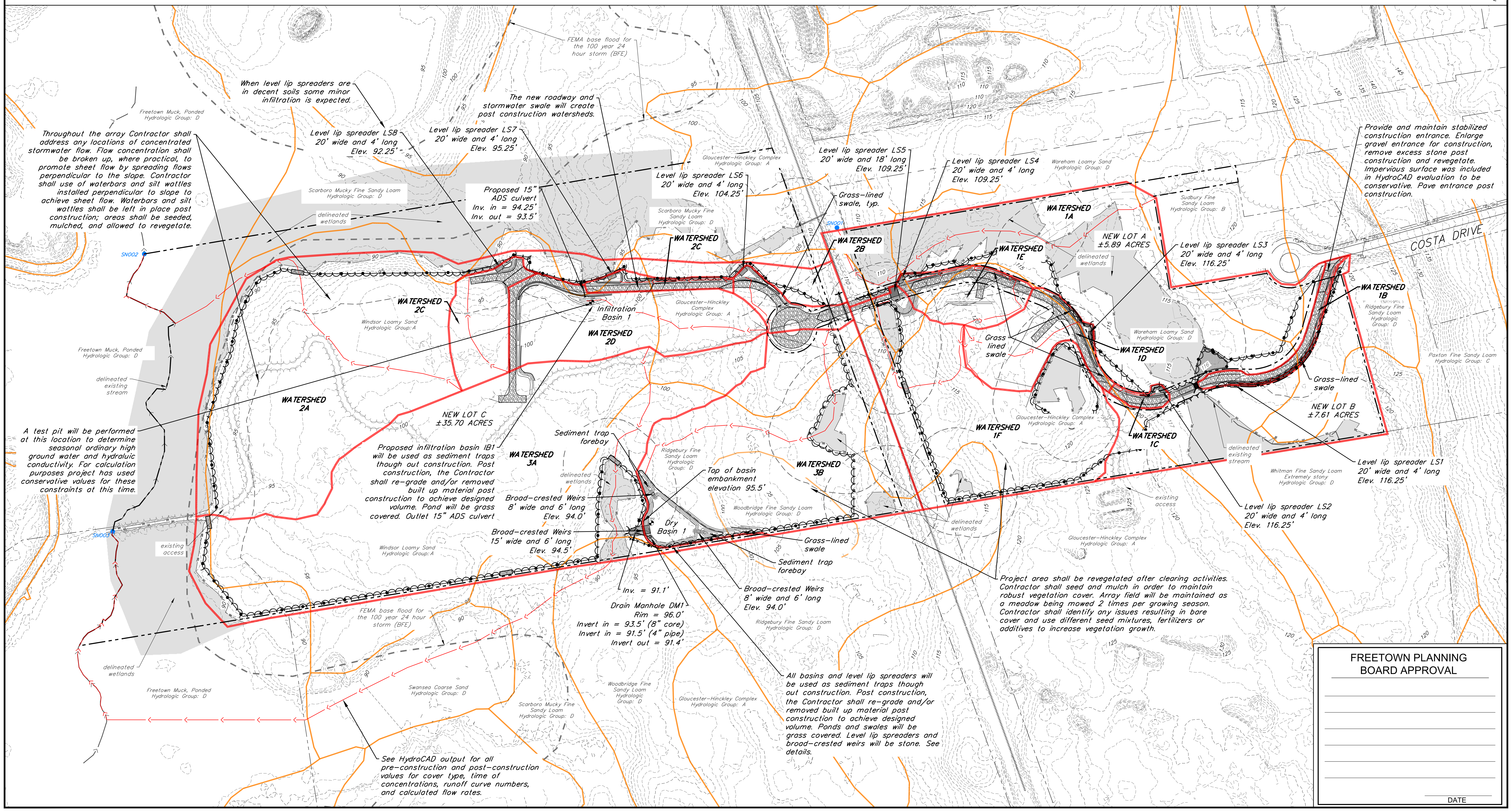
SN003	0.39	1.21	2.96	8.52

Massachusetts State Plane Grid North (NAD83)



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IRONWOOD RENEWABLES

BRI Biodiversity Research Institute

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REV. NO.	REVISIONS/COMMENTS	DATE
1.	Updates for Planning Board submission	11/17/21

DRAWING TITLE:

COSTA SOLAR PROPOSED GRADING, ROAD INSTALLATION AND STORMWATER MANAGEMENT PLAN

DATE of Issue: 11/08/2021

Drawn by: EJM/GTD	Checked by: GTD
Project No.: 21223	Scale: 1" = 120'
Drawing No.: C-1.03	Rev No.: 1

FOR USE BY THE REGISTRY OF DEEDS OF THE COMMONWEALTH OF MASSACHUSETTS

LEGEND

- APPROXIMATE PROPERTY LINES
- APPROXIMATE PROJECT PARCEL
- DELINEATED STEAMS
- DELINEATED WETLANDS
- ENVIRONMENTAL BUFFERS
- FEMA BASE FLOOD LIMIT OF 100 YEAR-24 HOUR STORM EVENT
- PROPOSED CLEARING LIMIT
- PROPOSED GRADE CONTOUR LINES (5 FOOT INTERVALS)
- PROPOSED GRADE CONTOUR LINES (1 FOOT INTERVALS)
- PROPOSED 16' GRAVEL ACCESS DRIVE
- PROPOSED PROJECT FENCE
- PROPOSED UNDERGROUND POWER
- PROPOSED OVERHEAD POWER
- PROPOSED FIXED SOLAR PANEL RACKING
- PROPOSED ELECTRIC EQUIPMENT
- PROPOSED CONSTRUCTION STAGING AREA

NOTES:

1. THE PROJECT CONTRACTOR SHALL GIVE SEVEN (7) DAYS NOTICE TO PERTINENT TOWN DEPARTMENTS BEFORE COMMENCING WORK IN THE FIELD.
2. ALL CONSTRUCTION SHALL CONFORM TO THE RULES AND REGULATIONS OF THE TOWN OF FREETOWN PLANNING BOARD AND HIGHWAY DEPARTMENT SPECIFICATIONS.
3. ASPECTS OF PLAN ARE APPROXIMATE AND DERIVED FROM AERIAL PHOTOGRAPHY.
4. THE HORIZONTAL COORDINATE SYSTEM IS BASED ON NAD83 MASSACHUSETTS STATE PLANE, MAINLAND ZONE (US SURVEY FEET). ELEVATIONS ARE BASED ON THE NAVD88 (US SURVEY FEET).
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8. THIS IS A PRELIMINARY DESIGN PLAN. FINAL DESIGN WILL BE MODIFIED TO MATCH EQUIPMENT PURCHASED AND POSSIBLE PERMIT CONSTRAINTS REVEALED DURING PROJECT'S REVIEW.

PROJECT CALCULATIONS

PROPOSED CLEARING
- ±28.6 ACRES

PROPOSED TOTAL DISTURBANCE
- ±30.5 ACRES

PROPOSED IMPERVIOUS AREA
- 1.52 ACRES (LIMITED PAVEMENT)

PROPOSED AREA WITHIN THE FENCE
- 19.8 ACRES

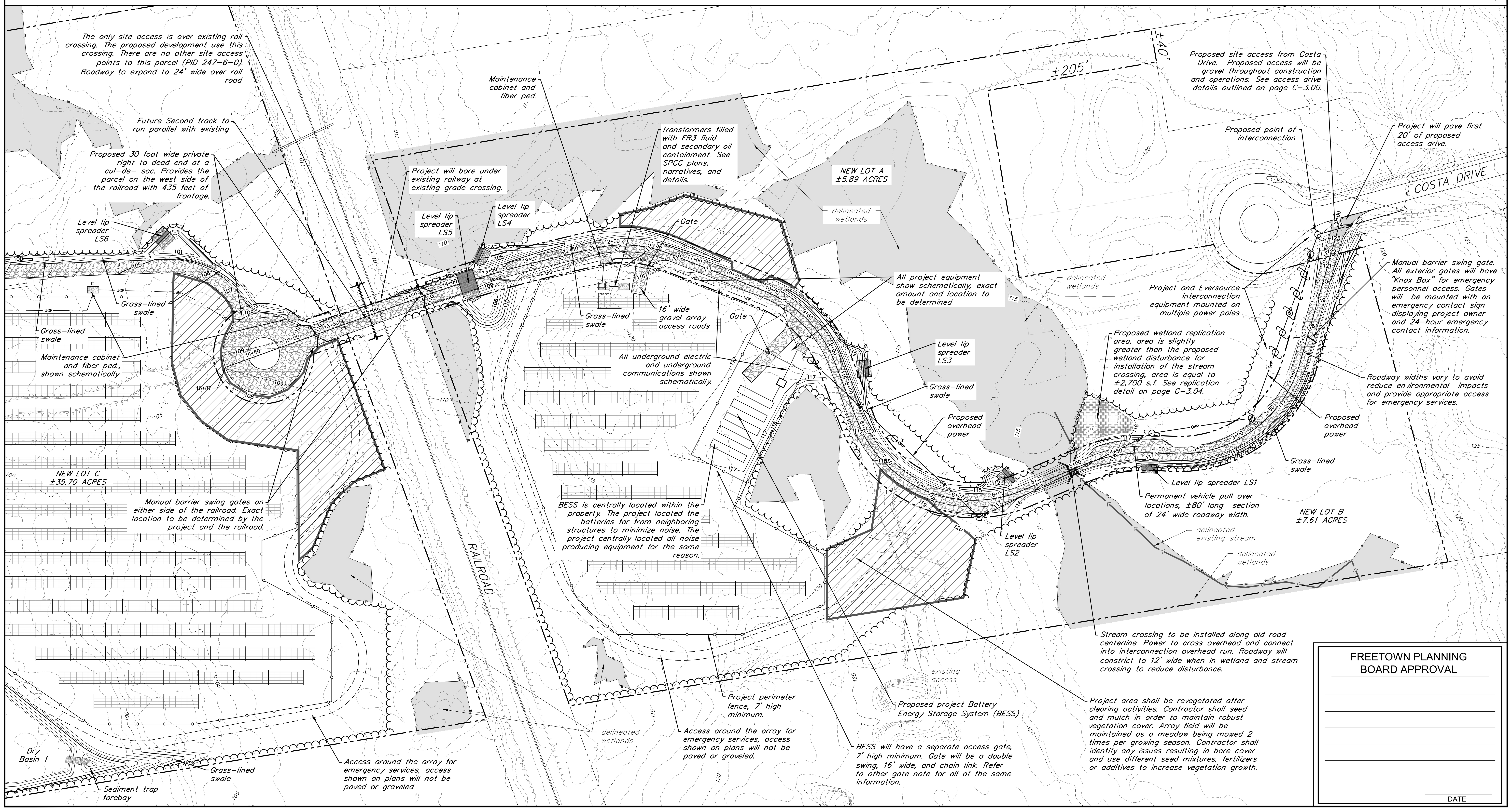
MAIN ROADWAY WIDTHS

APPROX. ROADWAY STATION	ROADWAY WIDTH (FEET)
0+00 to 3+80	16.0'
3+95 to 4+75	24.0'
4+90 to 5+75	12.0'
5+90 to 6+70	24.0'
6+85 to 13+50	16.0'
13+65 to END	24.0'

MAIN ROADWAY HORIZONTAL CURVE RADIUS

CURVE NO.	APPROX. ROADWAY STATION	℄ CURVE RADIUS (FEET)
C1	1+80 to 3+80	150.0'
C2	4+06 to 4+95	200.0'
C3	5+70 to 8+11	150.0'
C4	8+85 to 10+09	150.0'
C5	11+31 to 12+22	150.0'
C6	12+77 to 14+47	1,500.0'

Massachusetts State Plane Grid North (NAD83)



FREETOWN PLANNING BOARD APPROVAL

DATE

COSTA SOLAR

Costa Drive
Freetown, Massachusetts

IRONWOOD RENEWABLES

bri BIODIVERSITY RESEARCH INSTITUTE

KREBS & LANSING CONSULTING ENGINEERS

ISSUED FOR PERMIT REVIEW
NOT FOR CONSTRUCTION

CIVIL ENGINEER:
Krebs and Lansing Consulting Engineers, Inc.
164 Main Street, Suite 201
Colchester, Vermont 05446

ENVIRONMENTAL:
BRI Environmental
30 Danforth Street, Suite 213
Portland, ME 04101

APPLICANT:
Costa Solar LLC
Ironwood Renewables, LLC c/o Adrian Ortlieb
P.O. Box 51794
Lafayette, LA 70505
(p) (337) 412-9199

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STAMP:

COMMONWEALTH OF MASSACHUSETTS GREGORY T. DIXSON CIVIL ENGINEER No. 55649 REGISTERED PROFESSIONAL ENGINEER

0' 30' 60' 90' 120'
0" 1" 2" 3"
STANDARD GRAPHIC SCALE (1" = 120')
VALID WHEN PLOTTED ON 24" BY 36" MEDIA

REV. NO.	REVISIONS/COMMENTS	DATE
1.	Updates for Planning Board submission	11/17/21

DRAWING TITLE:

COSTA SOLAR DETAILED SITE PLAN EASTERN PORTION OF SITE

DATE of Issue: 11/08/2021
Drawn by: EJM/GTD Checked by: GTD
Project No.: 21223 Scale: 1" = 60'
Drawing No.: C-1.04 Rev No.: 1

FOR USE BY THE REGISTRY OF DEEDS OF THE COMMONWEALTH OF MASSACHUSETTS

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ARRAY ROADWAY WIDTHS

APPROX. ROADWAY STATION	ROADWAY WIDTH (FEET)
0+00 to 9+77	16.0'

ARRAY ROADWAY HORIZONTAL CURVE RADIUS

CURVE NO.	APPROX. ROADWAY STATION	℄ CURVE RADIUS (FEET)
C1	0+36 to 1+50	100.0'
C2	5+10 to 5+78	200.0'
C3	6+28 to 7+40	60.0'

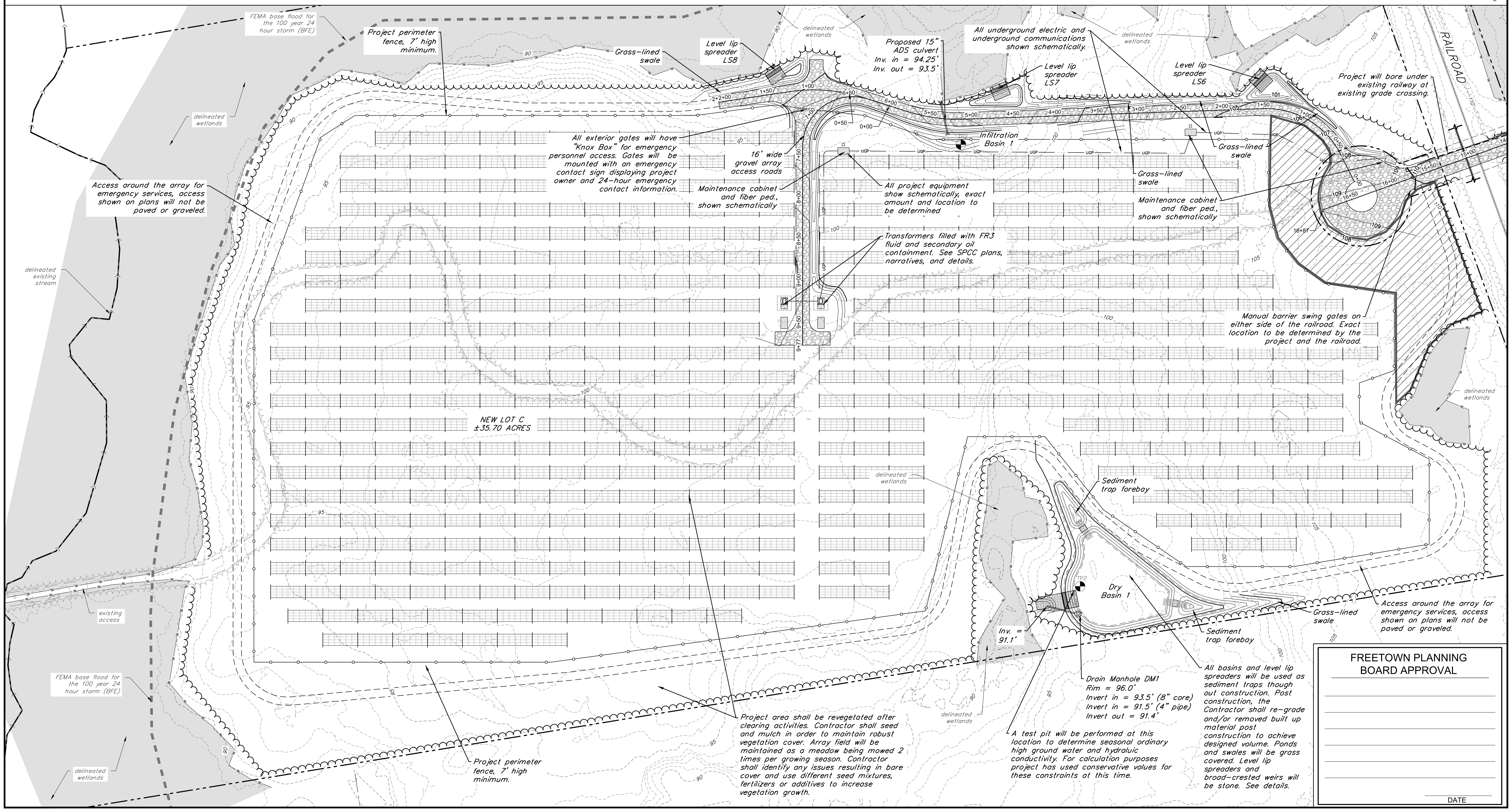
ARRAY SPUR ROADWAY WIDTHS

APPROX. ROADWAY STATION	ROADWAY WIDTH (FEET)
0+00 to 2+08	16.0'

ARRAY SPUR ROADWAY HORIZONTAL CURVE RADIUS

CURVE NO.	APPROX. ROADWAY STATION	℄ CURVE RADIUS (FEET)
C1	0+32 to 1+24	200.0'

Massachusetts State Plane Grid North (NAD83)



FREETOWN PLANNING BOARD APPROVAL

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Freetown, Massachusetts

IRONWOOD RENEWABLES

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GREGORY T. DIXSON
CIVIL ENGINEER
No. 55649
REGISTERED PROFESSIONAL ENGINEER

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0" 1" 2" 3"
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REV. NO.	REVISIONS/COMMENTS	DATE
1.	Updates for Planning Board submission	11/17/21

DRAWING TITLE:

COSTA SOLAR DETAILED SITE PLAN WESTERN PORTION OF SITE

DATE of Issue: 11/08/2021
Drawn by: EJM/GTD Checked by: GTD
Project No.: 21223 Scale: 1" = 60'
Drawing No.: C-1.05 Rev No.: 1

FOR USE BY THE REGISTRY OF DEEDS OF THE COMMONWEALTH OF MASSACHUSETTS

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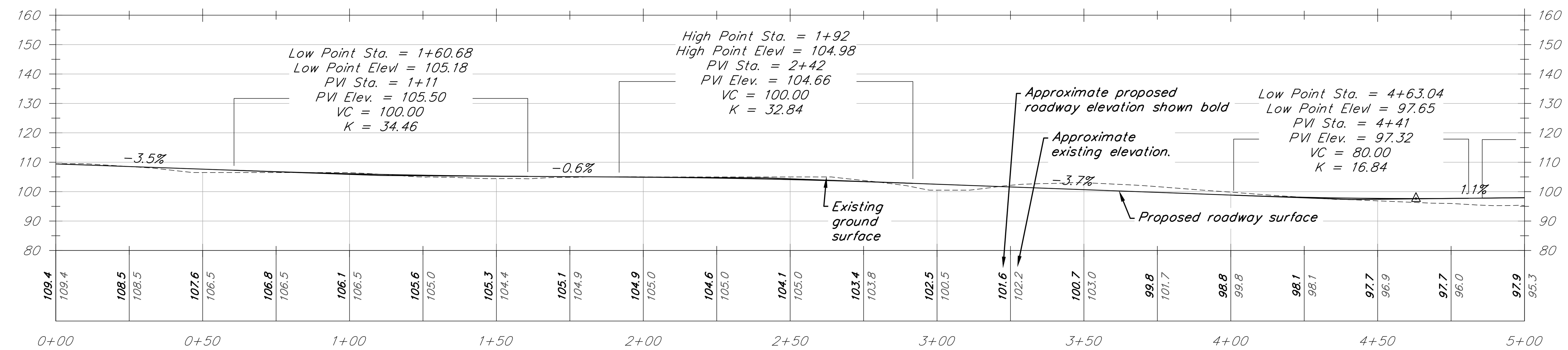
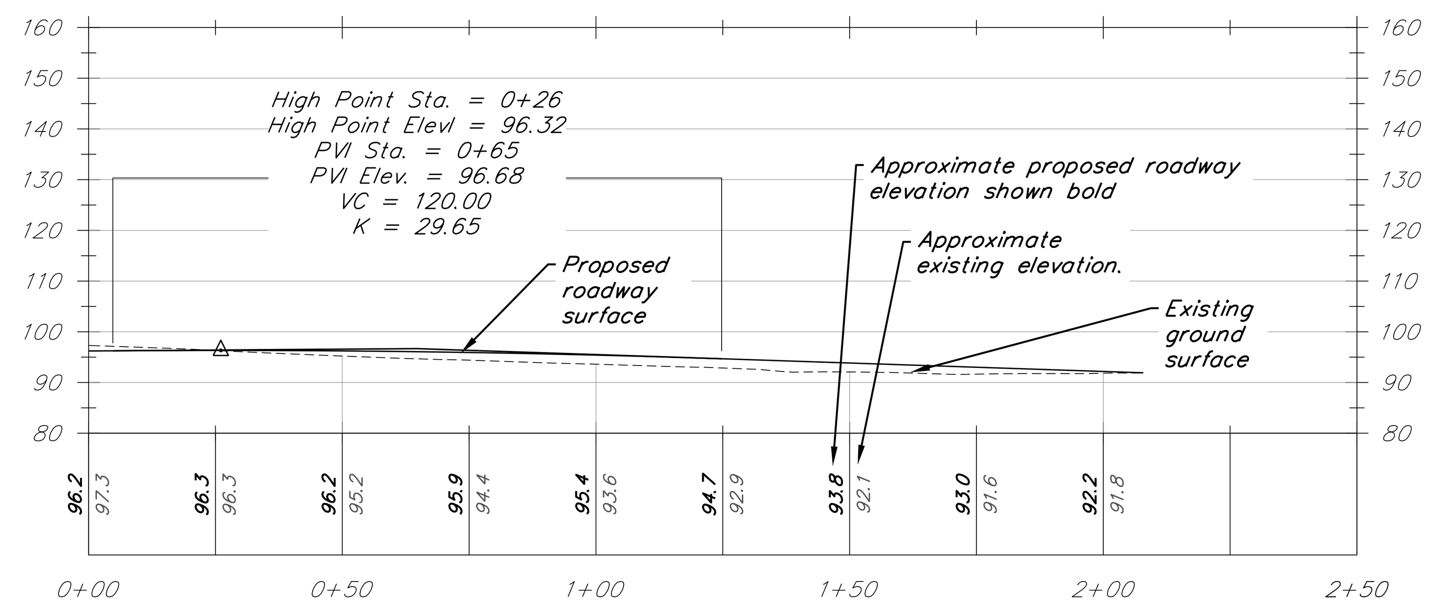


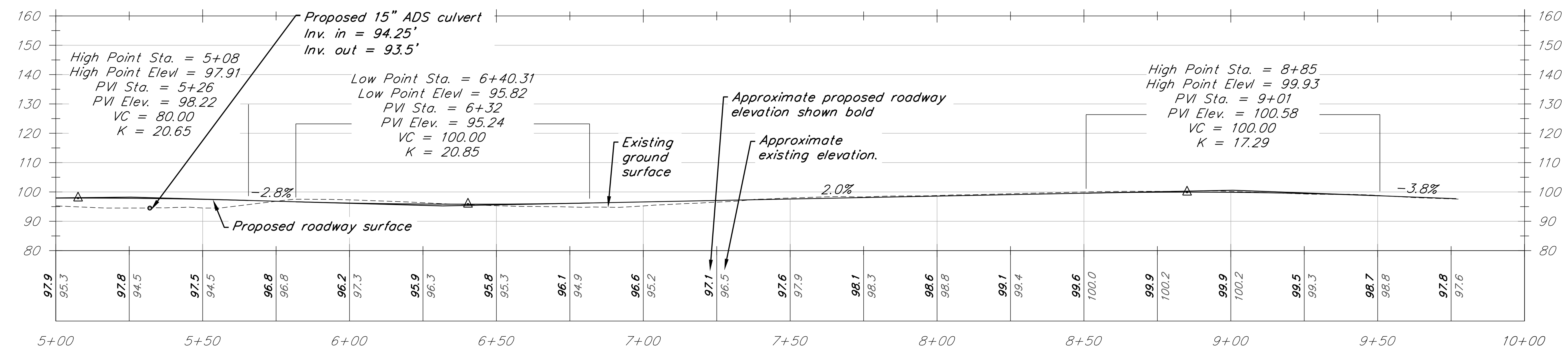
ARRAY ROADWAY CROSS SECTION - STATION 0+00 TO 5+00

HORIZONTAL AND VERTICAL SCALE: 1" = 30'



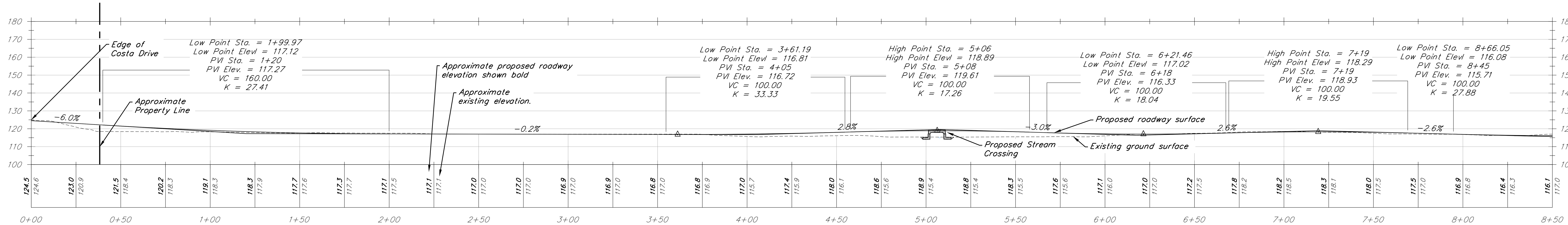
ARRAY SPUR ROADWAY CROSS SECTION - STATION 0+00 TO 2+50

HORIZONTAL AND VERTICAL SCALE: 1" = 30'



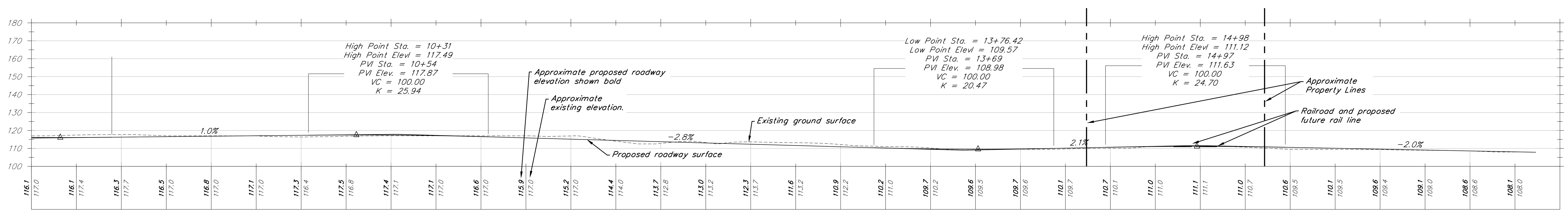
ARRAY ROADWAY CROSS SECTION - STATION 5+00 TO 10+00

HORIZONTAL AND VERTICAL SCALE: 1" = 30'



MAIN ROADWAY CROSS SECTION - STATION 0+00 TO 8+50

HORIZONTAL AND VERTICAL SCALE: 1" = 30'



MAIN ROADWAY CROSS SECTION - STATION 8+50 TO 17+00

HORIZONTAL AND VERTICAL SCALE: 1" = 30'

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GREGORY T. DIXSON
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0' 30' 60' 90' 120'
0" 1" 2" 3"
STANDARD GRAPHIC SCALE (1" = 120')
VALID WHEN PLOTTED ON 24" BY 36" MEDIA

REV. NO.	REVISIONS/COMMENTS	DATE
1.	Updates for Planning Board submission	11/16/21

DRAWING TITLE:

COSTA SOLAR ROADWAY CROSS SECTIONS

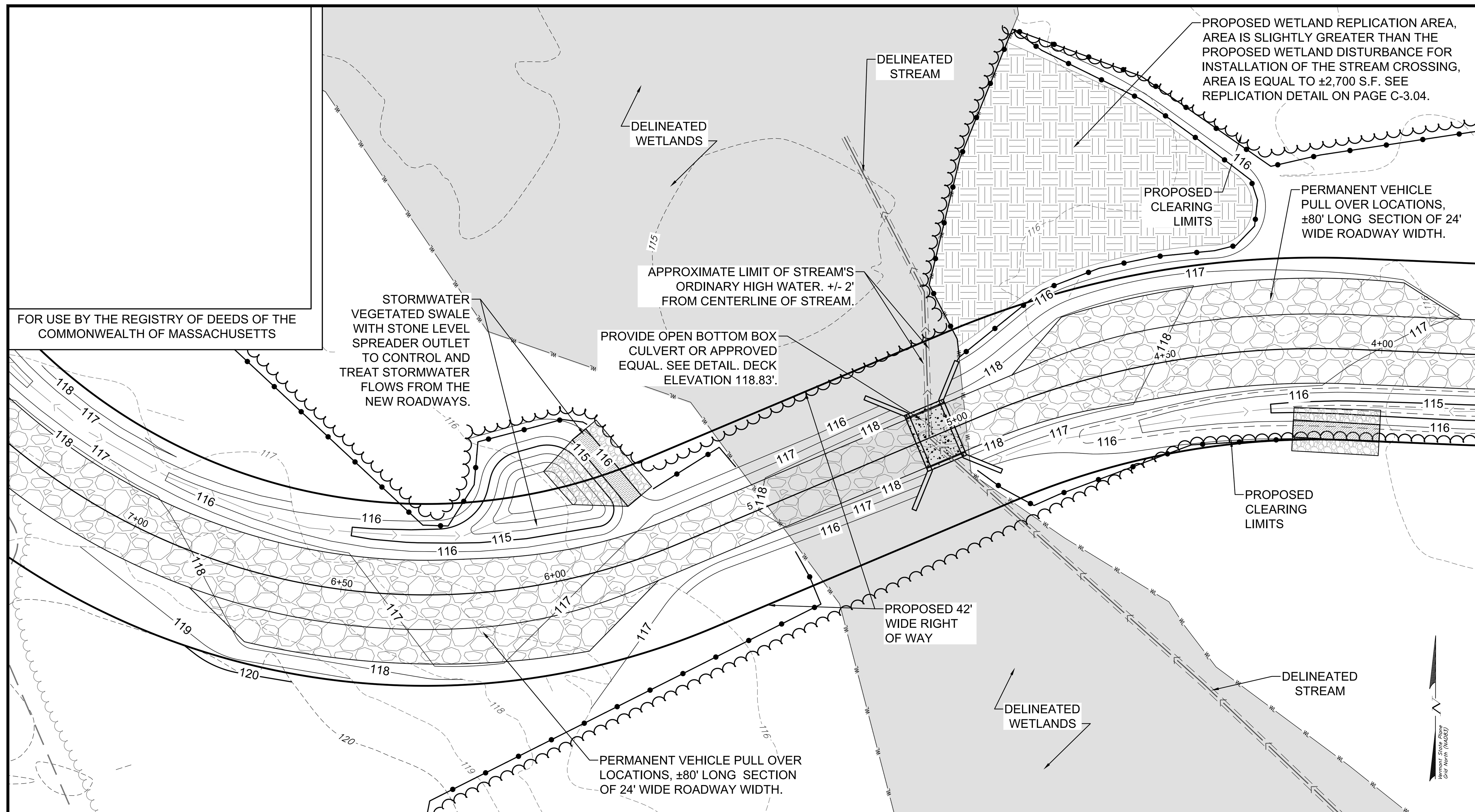
DATE of Issue: 11/17/2021

Drawn by: EJM/GTD — Checked by: GTD

Project No.: 21223 — Scale: 1" = 60'

Drawing No.: C-1.06 — Rev No.:

FOR USE BY THE REGISTRY OF DEEDS OF THE COMMONWEALTH OF MASSACHUSETTS

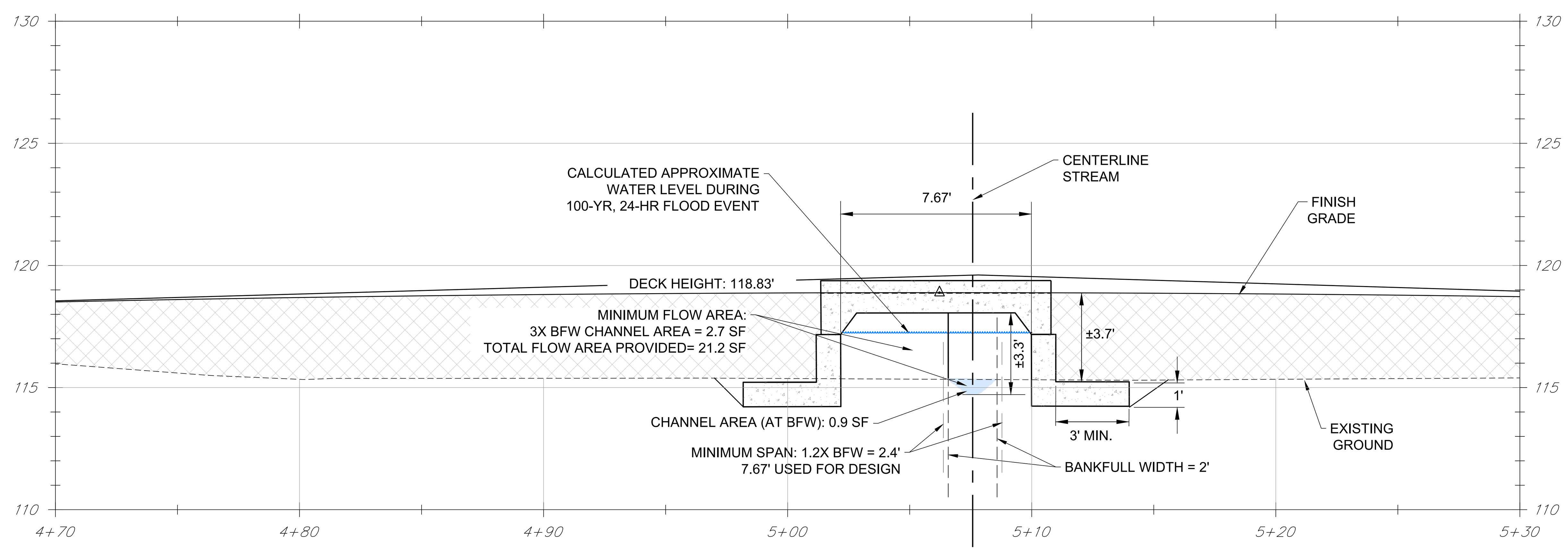


OPEN BOTTOM BOX CULVERT DETAIL PLAN

SCALE: 1" = 20'

0' 20' 40' 60'
0" 1" 2" 3"

PLAN STANDARD GRAPHIC SCALE (1" = 20') VALID WHEN PLOTTED ON 24" BY 36" MEDIA



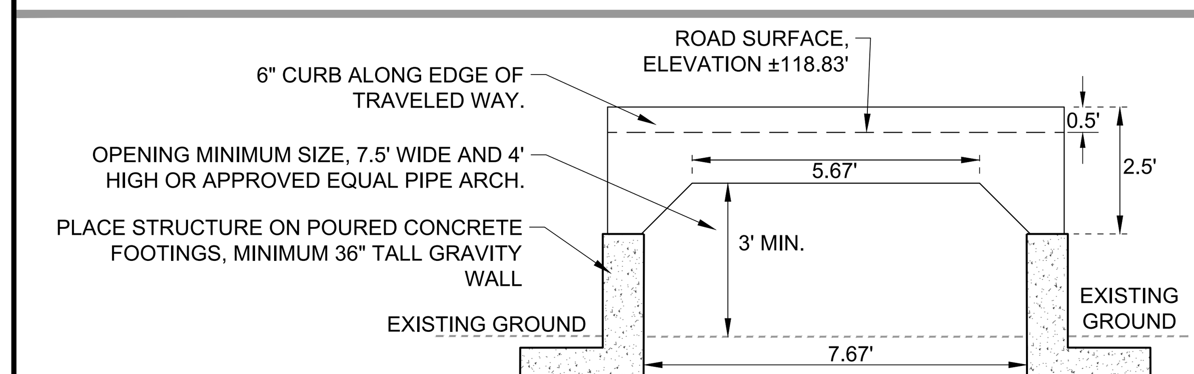
OPEN BOTTOM BOX CULVERT DETAIL PROFILE

HORIZONTAL AND VERTICAL SCALE: 1" = 4'

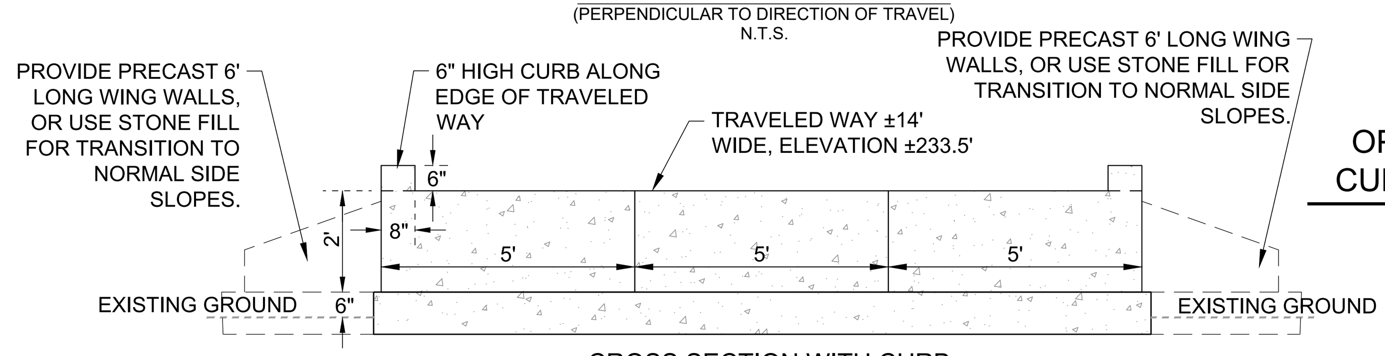
0' 2' 4' 8' 12'
0" 1" 2" 3"

PROFILE STANDARD GRAPHIC SCALE (1" = 4') VALID WHEN PLOTTED ON 24" BY 36" MEDIA

100 YR, 24HR FLOOD EVENT
PEAK RUNOFF: ±39.5 CFS
AVG. CHANNEL SLOPE: 1.0%
FLOW DEPTH: 2.0 FT
FLOW VELOCITY: 2.8 FT/S



PROFILE VIEW
(PERPENDICULAR TO DIRECTION OF TRAVEL)
N.T.S.



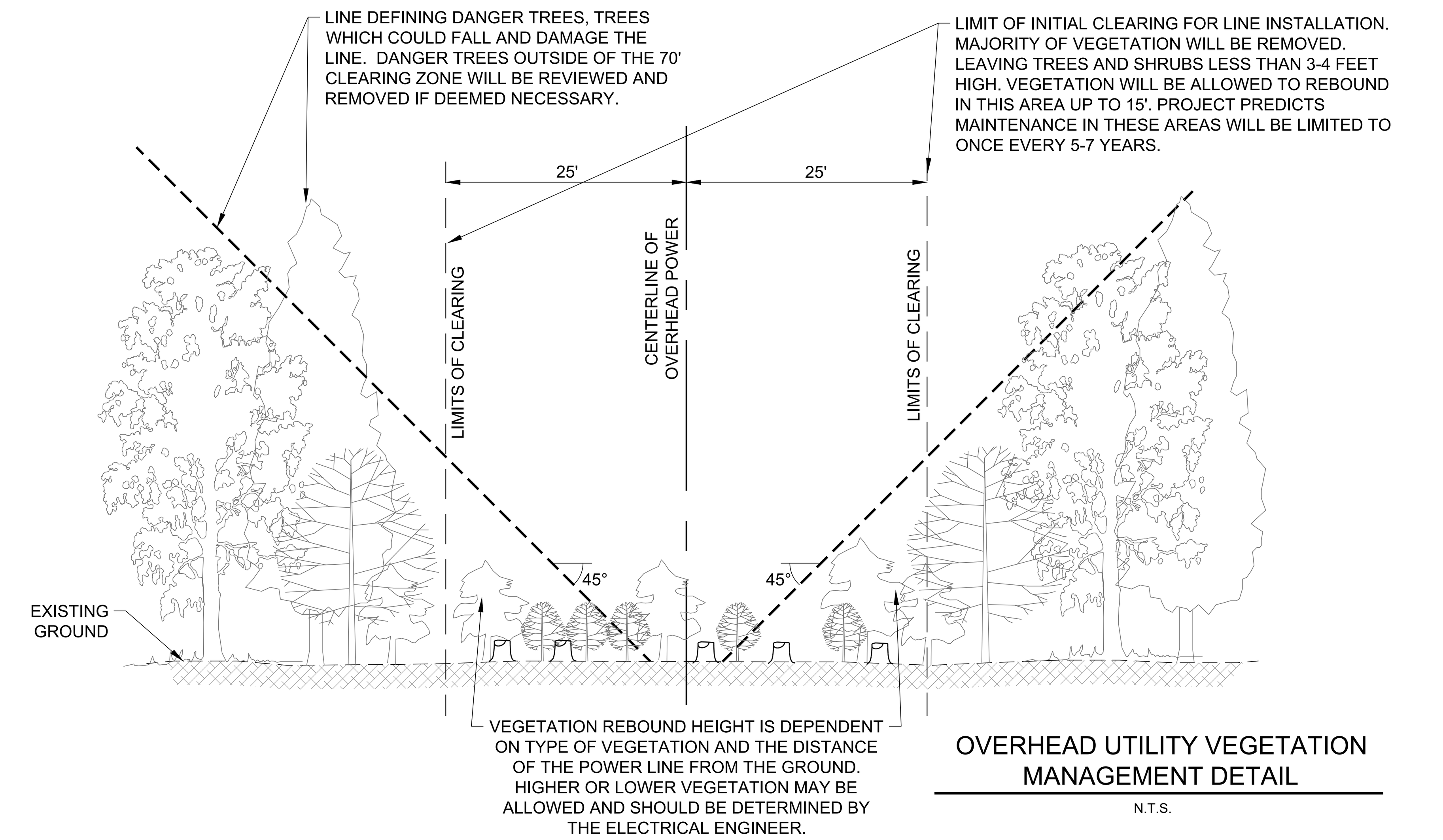
CROSS SECTION WITH CURB
(ALONG DIRECTION OF TRAVEL)
N.T.S.

NOTES

1. WETLAND CROSSING SHALL USE OPEN BOTTOM BOX CULVERT, OPENING SHALL BE MINIMUM 7.67' WIDE, 3' HIGH, OR APPROVED EQUAL. STRUCTURE SHALL SIT CONCRETE FOUNDATION TO BE DESIGNED, SHOWN SCHEMATICALLY IN THESE PLANS.
2. STRUCTURE WILL BE EVALUATED BY A STRUCTURAL ENGINEER AND SHOULD BE DESIGNED FOR H20 LOADING, CAPABLE OF HANDLING ALL CONSTRUCTION EQUIPMENT AND EMERGENCY VEHICLES.

OPEN BOTTOM BOX CULVERT SCHEMATIC

N.T.S.



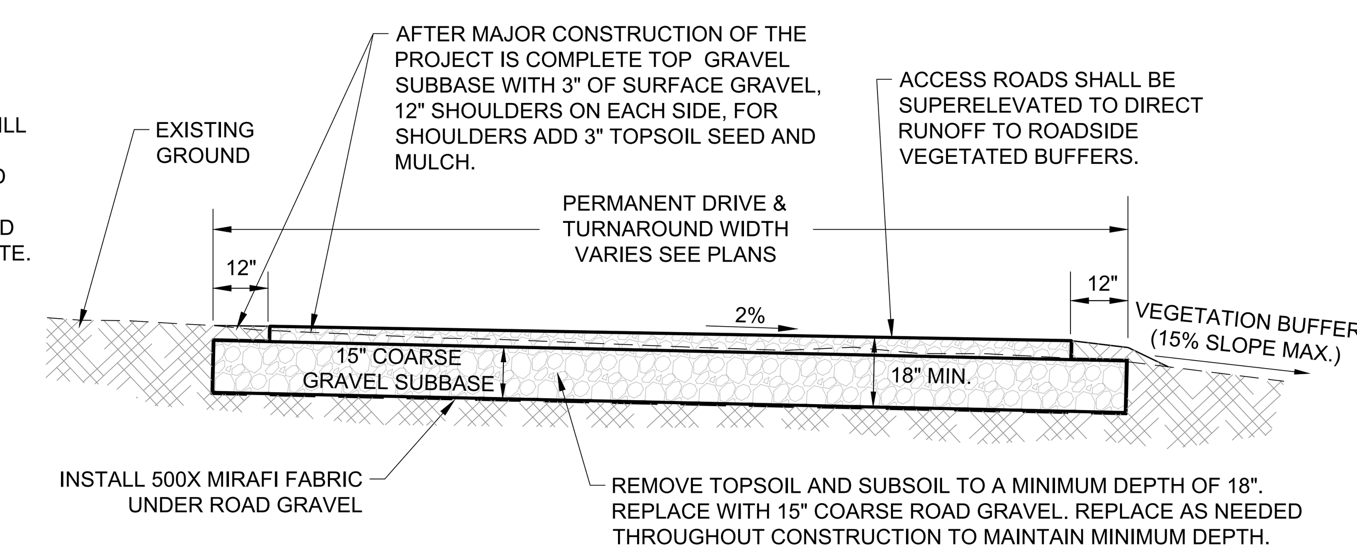
OVERHEAD UTILITY VEGETATION MANAGEMENT DETAIL

N.T.S.

CONSTRUCTION NOTES

1. THE METHODS AND MATERIALS OF CONSTRUCTION SHALL BE IN CONFORMANCE WITH ALL PERMITS AND APPROVALS ISSUED FOR THE PROJECT. IN CASE OF CONFLICT, THE MORE STRINGENT SPECIFICATION SHALL APPLY AS DIRECTED BY ENGINEER. ALL WORK SHALL BE DONE IN A WORKMANLIKE MANNER AND COMPLETED IN THE TIME SPECIFIED BY OWNER.
2. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ALL WORK AND MATERIALS SHOWN AND REQUIRED TO MAKE THE JOB COMPLETE. THESE DRAWINGS DO NOT SHOW EVERY FITTING OR APPURTENANCE. MATERIALS SHALL BE AS SPECIFIED ON THE DRAWINGS. MANUFACTURER'S PRODUCT SPECIFICATIONS SHALL BE SUBMITTED FOR ALL MATERIALS TO THE ENGINEER FOR APPROVAL PRIOR TO INSTALLATION.
3. THE LOCATION AND SIZE OF EXISTING UNDERGROUND UTILITIES IS NOT WARRANTED TO BE EXACT OR COMPLETE. THE CONTRACTOR SHALL FIELD LOCATE ALL UTILITIES AND SHALL CONTACT THE AFFECTED UTILITY COMPANY, THE ENGINEER AND THE TOWN PRIOR TO MAKING ANY HOOK UPS. THE CONTRACTOR SHALL BE SOLELY RESPONSIBLE FOR ALL EXISTING UTILITIES AND THEIR UNINTERRUPTED SERVICES. ALL OFF-SITE BACKFILL, SHEETING AND SHORING, DEWATERING, CLEARING AND GRUBBING, EROSION CONTROL, DUST CONTROL, TRAFFIC CONTROL, GRADING, AND ALL INCIDENTALS SHALL BE INCLUDED AS PART OF THE REQUIRED WORK.
4. THE CONTRACTOR SHALL VERIFY ALL TEMPORARY BENCH MARKS BEFORE USE.
5. THE WORKMEN AND PUBLIC SHALL BE PROTECTED BY THE CONTRACTOR FROM ANY AND ALL HAZARDS CONNECTED WITH THE CONSTRUCTION WORK. OPEN TRENCHES, MATERIALS, OR EQUIPMENT WITHIN THE WORKING LIMITS ARE TO BE GUARDED BY THE USE OF ADEQUATE BARRICADES OR FLAGMEN. ALL BARRICADES LEFT IN POSITION OVERNIGHT ARE TO BE PROPERLY LIGHTED. KEROSENE POTS ARE NOT ACCEPTABLE. WHEN WORK NARROWS THE USABLE PAVEMENT, FLAGMEN SHALL BE EMPLOYED TO AID THE FLOW OF TRAFFIC SO THAT THERE WILL BE NO UNDUE DELAYS. THE CONTRACTOR SHALL BE HELD RESPONSIBLE FOR THE SAFETY OF ALL WORKMEN AND THE GENERAL PUBLIC AND ALL DAMAGES TO PROPERTY OCCURRING FROM OR UPON THE WORK OCCASIONED BY NEGLIGENCE OR OTHERWISE GROWING OUT OF A FAILURE ON THE PART OF THE CONTRACTOR TO PROTECT PERSONS OR PROPERTY FROM HAZARDS OF OPEN TRENCHES, MATERIALS, OR EQUIPMENT AT ANY TIME OF THE DAY OR NIGHT WITHIN THE WORKING AREA. ALL WORK SHALL BE IN CONFORMANCE TO OSHA REGULATIONS, TITLE 19, PARTS 1926.651 AND 1926.652.
6. THE CONTRACTOR SHALL VERIFY ALL UTILITY INTERSECTIONS AND CONTACT ENGINEER AND OWNER WITH CONFLICTS.
7. THE CONTRACTOR SHALL CALL, DIG SAFE OR OTHER APPROVED EQUAL UNDERGROUND UTILITY IDENTIFIER PRIOR TO ANY EXCAVATION.
8. THE CONTRACTOR SHALL COORDINATE WITH FINAL ELECTRICAL, STRUCTURAL AND LANDSCAPING PLANS.

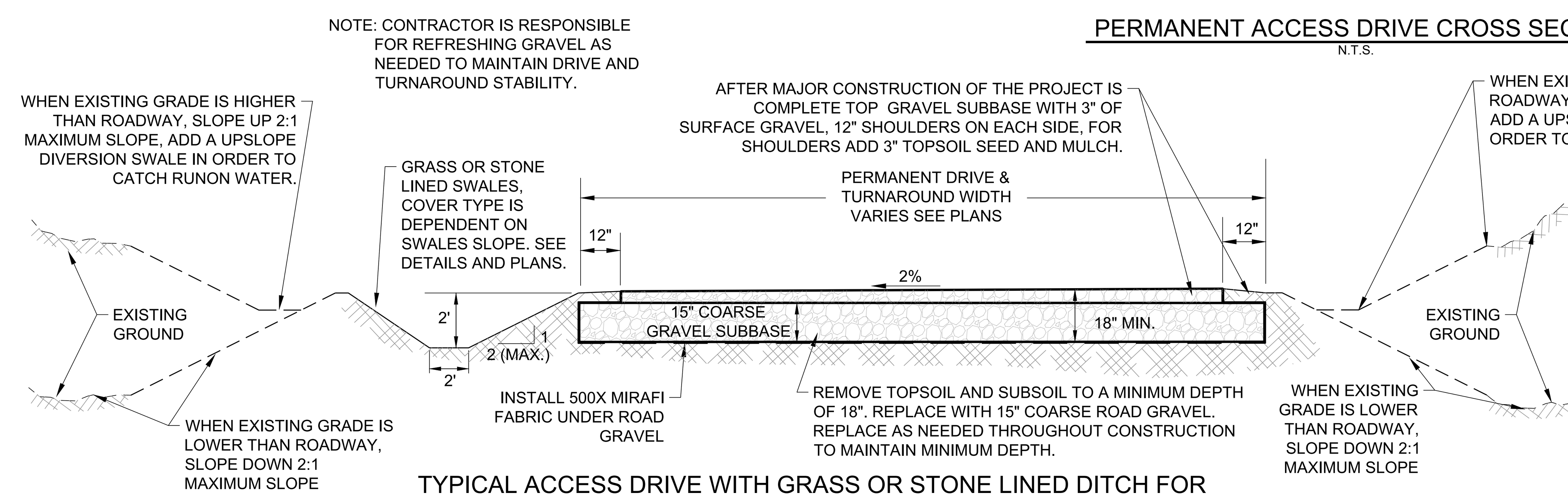
NOTE: FOR THE FIRST 20' OF THE ENTRANCE THE PROJECT WILL PROVIDE A PAVED APRON, CROSS SECTION FOR PAVED APRON WILL MIMIC GRAVEL SECTION BUT WILL HAVE AND ADDITIONAL 3" BIT. CONCRETE.
- 1" TYPE III- TOP
- 2" TYPE II - BASE



PERMANENT ACCESS DRIVE CROSS SECTION

N.T.S.

NOTE: CONTRACTOR IS RESPONSIBLE FOR REFRESHING GRAVEL AS NEEDED TO MAINTAIN DRIVE AND TURNAROUND STABILITY.



TYPICAL ACCESS DRIVE WITH GRASS OR STONE LINED DITCH FOR COLLECTION TO DITCH TURNOUT LEVEL SPREADERS CROSS-SECTION

N.T.S.

FREETOWN PLANNING BOARD APPROVAL

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REV. NO.	REVISIONS/COMMENTS	DATE
1.	Changes from 8/24/21 meeting discussions	09/20/21
2.	Revise Environmental features per BRI Survey	09/29/21
3.	Updates for proposed solar array	11/08/21
4.	Updates for Planning Board submission	11/17/21

DRAWING TITLE:

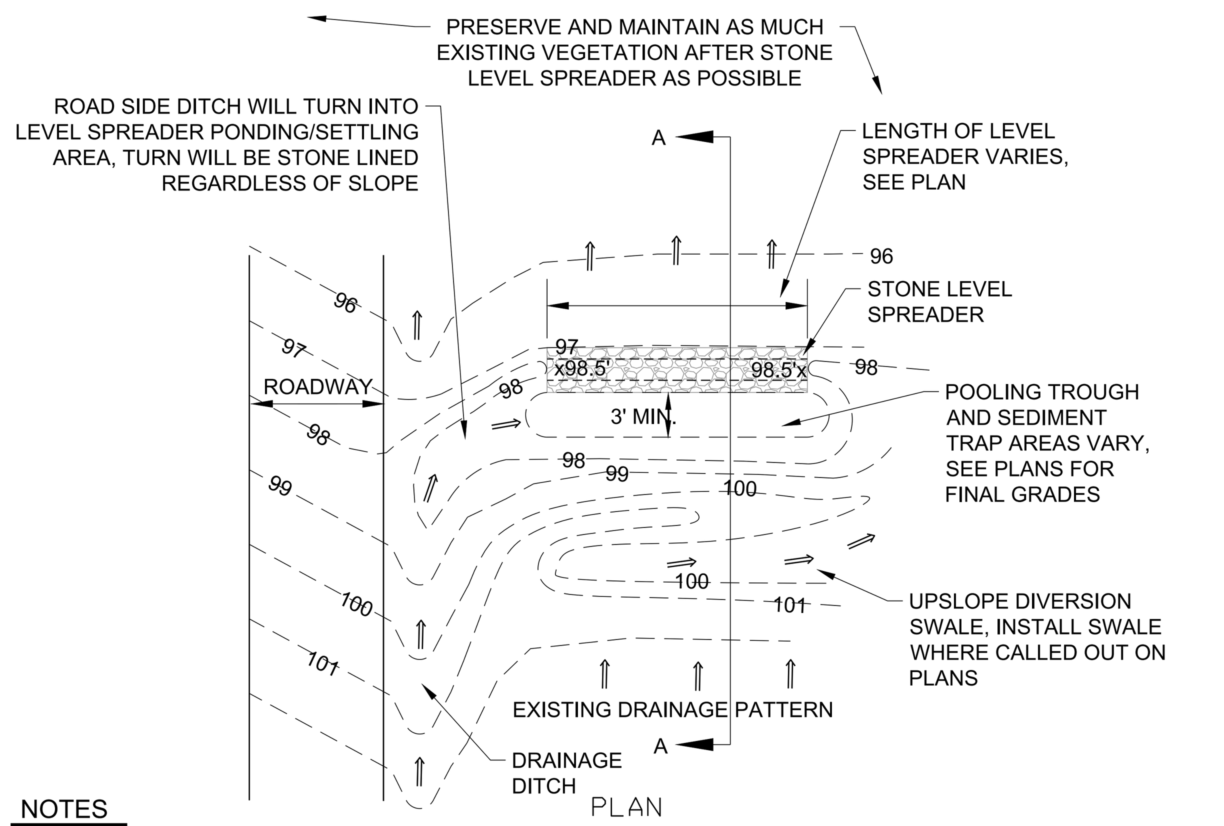
COSTA SOLAR
OPEN BOTTOM BOX CULVERT SPECIFICATIONS AND DETAILS

DATE of Issue: 07/01/2021
Drawn by: EJM/GTD Checked by: GTD
Project No.: 21223 Scale: AS-NOTED
Drawing No.: C-3.00 Rev No.: 4

FOR USE BY THE REGISTRY OF DEEDS OF THE COMMONWEALTH OF MASSACHUSETTS

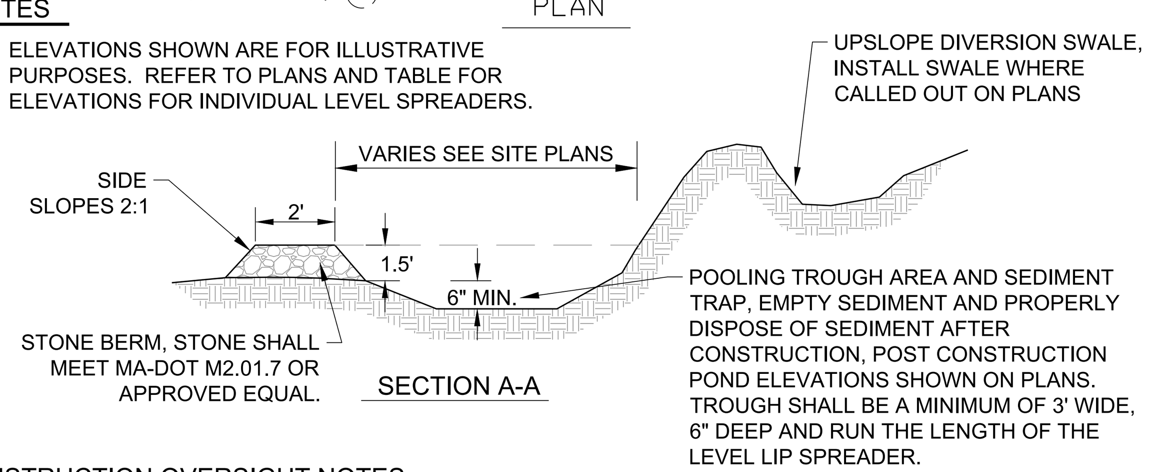
GUIDE TO MULCH MATERIALS, RATES, AND USES

	QUALITY STANDARDS	PER 1000 SQ. FT.	PER ACRE	DEPTH OF APPLICATION	REMARKS
WOOD CHIPS OR SHAVINGS	AIR-DRIED. FREE OF OBJECTIONABLE COARSE MATERIAL	500-900 LBS	10-20 TONS	2 - 7"	USED PRIMARILY AROUND SHRUB AND TREE PLANTINGS AND RECREATION TRAILS TO INHIBIT WEED COMPETITION. RESISTANT TO WIND BLOWING. DECOMPOSES SLOWLY.
WOOD FIBER CELLULOSE (PARTLY DIGESTED WOOD FIBERS)	MADE FROM NATURAL WOOD USUALLY WITH GREEN DYE AND DISPERSING AGENT	50 LBS	2,000 LBS.	-	APPLY WITH HYDROMULCHER. NO TIE DOWN REQUIRED. LESS EROSION CONTROL PROVIDED THAN 2 TONS OF HAY OR STRAW.
GRAVEL, CRUSHED STONE OR SLAG	WASHED; SIZE 2B OR 3A - 1½"	9 CU. YDS.	405 CU. YDS.	3"	EXCELLENT MULCH FOR SHORT SLOPES AND AROUND PLANTS AND ORNAMENTALS. USE 2B WHERE SUBJECT TO TRAFFIC. (APPROXIMATELY 2,000 LBS./CU. YD.). FREQUENTLY USED OVER FILTER FABRIC FOR BETTER WEED CONTROL.
HAY OR STRAW	AIR-DRIED; FREE OF UNDESIRABLE SEEDS & COARSE MATERIALS	90-100 LBS 2-3 BALES	2 TONS (100-120 BALES)	COVER ABOUT 90% SURFACE	USE SMALL GRAIN STRAW WHERE MULCH IS MAINTAINED FOR MORE THAN THREE MONTHS. SUBJECT TO WIND BLOWING UNLESS ANCHORED. MOST COMMONLY USED MULCHING MATERIAL. PROVIDES THE BEST MICRO-ENVIRONMENTAL FOR GERMINATING SEEDS.
COMPOST	UP TO 3" PIECES, MODERATELY TO HIGHLY STABLE	3-9 CU. YDS.	134-402 CU. YDS.	1 - 3"	COARSER TEXTURED MULCHES MAY BE MORE EFFECTIVE IN REDUCING WEED GROWTH AND WIND EROSION.
EROSION CONTROL MIX	WELL-GRADED MIXTURE OF PARTICLE SIZES. ORGANIC CONTENT BETWEEN 80-100%, DRY WEIGHT. PARTICLE SIZE SHALL PASS 6" SCREEN (100%)	* SLOPES 3(HZ.):1(VERT.) OR FLATTER = 2 INCH DEPTH PLUS ADDITIONAL 1/2 INCH DEPTH PER 20 FT. OF SLOPE UP TO 100 FT. ** SLOPES BETWEEN 3(HZ.):1(VERT.) AND 2(HZ.):1(VERT.) = 4 INCH DEPTH PLUS ADDITIONAL 1/2 INCH PER 20 FT. OF SLOPE UP TO 100 FT. *** SLOPES STEEPER THAN 2(HZ.):1(VERT.) USE OF EROSION CONTROL MIX AND MULCH DEPTH TO BE REVIEWED AND APPROVED PRIOR TO USE BY OSPC OR EPSC SPECIALIST			COMPRISED OF SHREDDED BARK, STUMP GRINDINGS, COMPOSTED BARK, OR ACCEPTABLE MANUFACTURED PRODUCTS. MAY CONTAIN ROCK < 4" IN DIAMETER. ORGANICS SHALL BE FIBROUS AND ELONGATED. NO LARGE PORTIONS OF SILTS, CLAYS OR FINE SANDS.



NOTES

1. ELEVATIONS SHOWN ARE FOR ILLUSTRATIVE PURPOSES. REFER TO PLANS AND TABLE FOR ELEVATIONS FOR INDIVIDUAL LEVEL SPREADERS.



CONSTRUCTION OVERSIGHT NOTES

INSPECTION OF THE TURN-OUT STONE BERM LEVEL LIP SPREADERS BY A PROFESSIONAL ENGINEER SHALL CONSIST OF WEEKLY VISITS TO THE SITE TO INSPECT EACH TURN-OUT STONE BERM LEVEL LIP SPREADER CONSTRUCTION, TURN-OUT'S STONE BERM MATERIAL AND PLACEMENT, FROM INITIAL GROUND DISTURBANCE TO FINAL STABILIZATION OF THE STONE BERM LEVEL LIP SPREADER.

LEVEL LIP SPREADER & DITCH TURNOUT DETAIL

N.T.S.

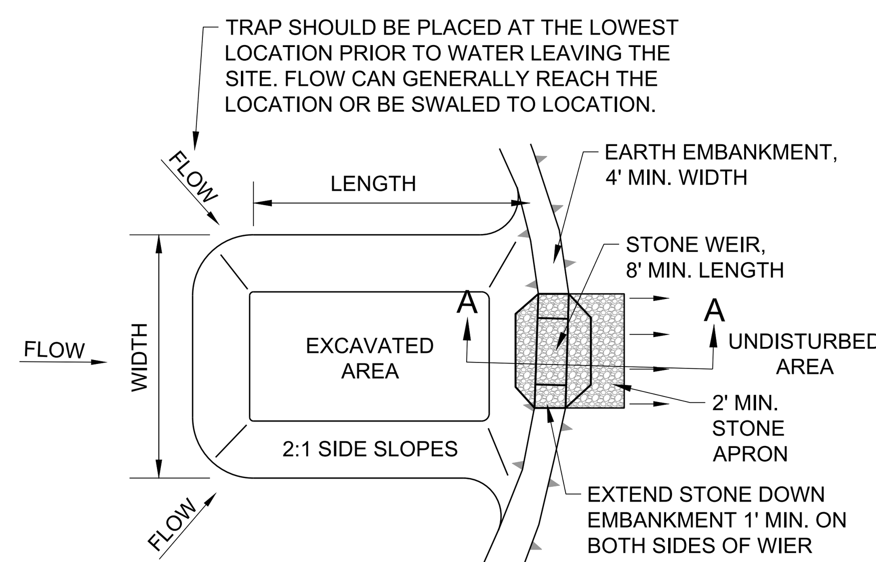
NOTES

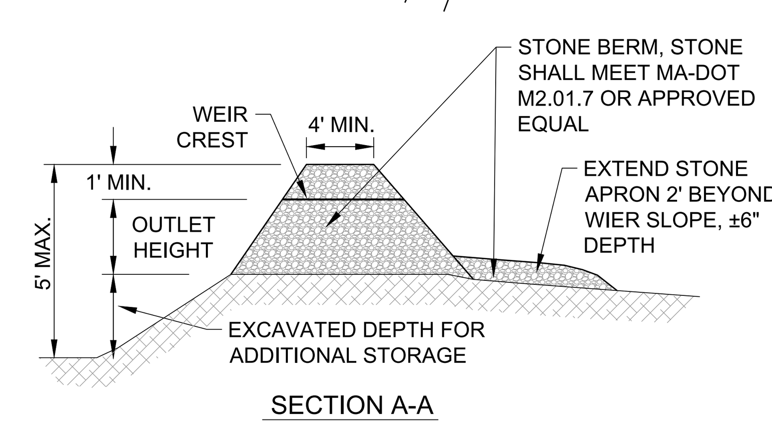
1. AREA UNDER EMBANKMENT SHALL BE CLEARED, GRUBBED AND STRIPPED OF ANY VEGETATION AND ROOT MAT (VEGETATION DUFF LAYER). THE POOL AREA SHALL BE CLEARED.
2. THE FILL MATERIAL FOR THE EMBANKMENT SHALL BE FREE OF ROOTS AND OTHER WOODY VEGETATION AS WELL AS OVER-SIZED STONES, ROCKS, ORGANIC MATERIAL OR OTHER OBJECTIONABLE MATERIAL. THE EMBANKMENT SHALL BE COMPACTED BY TRAVERSING WITH EQUIPMENT WHILE IT IS BEING CONSTRUCTED.
3. ALL CUT AND FILL SLOPES SHALL BE 2:1 OR FLATTER. THE USE OF GREATER SLOPES MAYBE PERMITTED WITH OSPC OR EPSC SPECIALIST APPROVAL.
4. THE STONE USED IN THE OUTLET SHALL BE VAOT 706.04 TYPE 1 STONE OR APPROVED ON SITE SHOT ROCK, PLACED ON MIRAFI 140N OR APPROVED EQUAL DRAINAGE FABRIC.
5. SEDIMENT SHALL BE REMOVED AND TRAP RESTORED TO ITS ORIGINAL DIMENSIONS WHEN THE SEDIMENT HAS ACCUMULATED TO ½ THE DESIGN DEPTH OF THE TRAP. IT SHALL BE PLACED ON SITE AND STABILIZED.
6. THE STRUCTURE SHALL BE INSPECTED AFTER EACH RAIN AND AS REQUIRED BY THE PERMIT.
7. CONSTRUCTION OPERATIONS SHALL BE CARRIED OUT IN SUCH A MANNER THAT EROSION AND SEDIMENT ARE CONTROLLED.
8. IF THE SEDIMENT TRAP IS NOT IN THE LOCATION OF A PERMANENT STORMWATER POND, THE STRUCTURE SHALL BE REMOVED AND THE AREA STABILIZED WHEN THE DRAINAGE AREA HAS BEEN PROPERLY STABILIZED.
9. THE MAXIMUM CONTRIBUTING DRAINAGE AREA IS 5 ACRES.
10. GENERAL SIZING REQUIREMENTS FOR ANY SEDIMENT TRAPS NOT IN THE LOCATION OF A PERMANENT STORMWATER POND, SHALL BE 3,600 CUBIC FEET PER ACRE OF DRAINAGE AREA. VOLUME CALCULATION FOR NATURAL SEDIMENT TRAPS MAY BE APPROXIMATED USING THE SURFACE AREA AT OUTLET ELEVATION (A), TRAPS MAXIMUM DEPTH (D) AND THE FOLLOWING EQUATION:
    - TOTAL VOLUME = 0.4 * A (IN SQUARE FEET) * D (FEET)

    FOR CONSTRUCTED/EXCAVATED TEMPORARY SEDIMENT TRAPS THE SIZE SHALL BE ADJUSTED PROPORTIONALLY FOR LARGER DRAINAGE AREAS BASED ON THE BELOW CHART.

APPROX. DRAINAGE AREA	APPROX. STORAGE VOLUME	RECOMMENDED BOTTOM DIMENSIONS	RECOMMENDED DIMENSIONS AT OUTLET	DEPTH AT OUTLET	SIDE SLOPES
0.25 ACRES (±10,900 S.F.)	±900 C.F.	10 FT. WIDE X 13 FT. LONG	22 FT. WIDE X 25 FT. LONG	3 FT.	2:1

11. FOR THOSE TEMPORARY SEDIMENT TRAPS TO BE PERMANENT DRY OR WET PONDS, SEDIMENT SHALL BE REMOVED AND THE ENTIRE AREA SEEDED AND MULCHED OR COVERED WITH EROSION CONTROL MATTING PRIOR TO PUTTING THE STORMWATER POND INTO USE.
12. LOCATIONS FOR TEMPORARY SEDIMENT TRAPS TO BE APPROVED BY THE OSPC OR THE EPSC SPECIALIST.





TYPICAL TEMPORARY SEDIMENT TRAP

N.T.S.

PERMANENT SEED MIX SHALL BE USED AS EARLY AS PRACTICABLE BETWEEN 5/15 AND 9/15 AND SHALL MEET THE FOLLOWING CRITERIA:

SEED	% WEIGHT
RED FESCUE	50%
SHEEP FESCUE	25%
RED TOP	5%
WHITE CLOVER	10%
ANNUAL RYE	10%

TEMPORARY SEED MIX SHALL BE USED BETWEEN 9/16 AND 5/14 AND SHALL MEET THE FOLLOWING CRITERIA:

SEED	% WEIGHT	%GERMINATION
WINTER RYE	80% MIN.	85% MIN.
RED FESCUE (CREEPING)	4% MIN.	80% MIN.
PERENNIAL RYE GRASS	3% MIN.	90% MIN.
RED CLOVER	3% MIN.	90% MIN.
OTHER CROP GRASS	0.5% MAX.	
NOXIOUS WEED SEED	0.5% MAX.	
INERT MATTER	1% MAX.	

MASSACHUSETTS NCRS DRY SITE POLLINATOR MIX OR APPROVED EQUAL:

SEED	% WEIGHT
EASTERN COLUMBINE	5%
BLUE FALSE INDIGO	10%
HORSEFLYWEED	5%
TALL WHITE BEARD TONGUE	5%
OHIO SPIDERWORT	5%
COMMON MILKWEED	5%
BUTTERFLY MILKWEED	10%
PARTRIDGE PEA	10%
WILD BERGAMOT	5%
VIRGINIA MOUNTAIN MINT	2%
EARLY GOLDENROD	3%
SMOOTH ASTER	10%
NEW ENGLAND ASTER	10%.
HEATH ASTER	5%
GRAY GOLDEN ROD	5%
LITTLE BLUESTEM	5%

SEEDING SPECIFICATIONS

CONSTRUCTION EROSION AND SEDIMENT CONTROL INSPECTOR

1. THE CONTRACTOR SHALL DESIGNATE A "QUALIFIED PROJECT STORMWATER INSPECTOR" FOR THE ENTIRETY OF CONSTRUCTION. THE INSPECTOR OR THEIR DESIGNEE SHALL BE ON-SITE ON A DAILY BASIS DURING ACTIVE CONSTRUCTION.
2. THE INSPECTOR SHALL BE KNOWLEDGEABLE IN PRINCIPLES AND PRACTICES OF EROSION PREVENTION AND STORMWATER CONTROL. IMPLEMENTATION AND POSSESS SKILLS TO ASSESS CONDITIONS AT THE CONSTRUCTION SITE THAT COULD IMPACT STORMWATER QUALITY. TO ASSESS EFFECTIVENESS OF CONSTRUCTION BEST MANAGEMENT PRACTICES (BMPs) SELECTED TO CONTROL QUALITY OF STORMWATER DISCHARGES FROM CONSTRUCTION ACTIVITY.
3. THE INSPECTOR SHALL BE RESPONSIBLE FOR ON-SITE IMPLEMENTATION OF THIS EROSION AND SEDIMENT CONTROL PLAN, INCLUDING INSPECTIONS, MONITORING AND REPORTING.
4. INSPECTIONS SHALL BE PERFORMED AT MINIMUM ONCE EVERY 7 CALENDAR DAYS BUT ALSO PRIOR TO AND 24 HOURS AFTER A WET WEATHER EVENT. A "WET WEATHER EVENT" IS DEFINED AS 0.25 INCHES OR GREATER IN A 24 HOUR PERIOD.
5. THE SCOPE OF CONSTRUCTION INSPECTIONS SHALL INCLUDE BUT ARE NOT LIMITED TO ALL THE EROSION AND SEDIMENT CONTROL MEASURES ON SITE. DOCUMENTATION OF THE OVERALL DISTURBANCE FOR THE PROJECT SITE. REVIEW OF ALL STOCKPILE AREAS AND VEHICLE EGRESSES FROM THE PROJECT SITE.
6. CONSTRUCTION INSPECTION AND CORRECTIVE ACTION DOCUMENTATION RECORDS SHALL BE MAINTAINED FOR A MINIMUM OF 3 YEARS. THIS DOCUMENTATION SHALL BE MAINTAINED BY THE CONTRACTOR UNLESS OTHERWISE AUTHORIZED BY THE OWNER. CORRECTIVE ACTIONS SHOULD BE STARTED SAME DAY COMPLETED WITHIN 7 DAYS OR BEFORE THE NEXT STORM EVENT, WHICHEVER IS FIRST.
7. THE INSPECTOR SHALL HAVE AUTHORITY TO STOP AND/OR MODIFY CONSTRUCTION ACTIVITIES AS NECESSARY TO COMPLY WITH THESE PLANS AND TERMS AND CONDITIONS OF THE PERMIT.
8. THE INSPECTORS CONTACT INFORMATION SHALL BE PROVIDED TO CONSTRUCTION ENGINEER TO BE INCLUDED IN THE PROJECTS SWPPP.

CONSTRUCTION LIMITS FOR EROSION AND SEDIMENT CONTROL

1. ALL EROSION AND SEDIMENT CONTROL MEASURES SHALL BE PERFORMED IN ACCORDANCE WITH THIS PLAN SET, THE MEASURES MANUFACTURERS SPECIFICATIONS, DEPARTMENT OF ENVIRONMENTAL PROTECTION, LATEST REVISION. CONTRACTOR SHALL HAVE A COPY OF THE LATEST REVISION ON SITE AT ALL TIMES.
2. CONTRACTOR SHALL LIMIT EXCAVATION AND EARTHWORK TO NO MORE THAN 5 ACRES CONCURRENT THROUGHOUT THE CONSTRUCTION SITE AT ONE TIME. TEMPORARY STABILIZE ALL AREAS OF COMPLETED EXCAVATION AND EARTHWORK PRIOR TO MOVING ONTO A NEW AREA.
3. EXPOSED OR OPEN AREA FREE OF VEGETATION FROM CONSTRUCTION ACTIVITY SHALL BE LIMITED TO THAT WHICH CAN BE MULCHED IN ONE DAY.
4. CONTRACTOR SHALL MINIMIZE THE AMOUNT OF TIME AN AREA UNDERGOING CONSTRUCTION WILL BE LEFT EXPOSED OR FREE OF VEGETATION. AREAS WHICH ARE INITIALLY DISTURBED BUT FURTHER CONSTRUCT IS PLANNED MUST BE TEMPORARILY STABILIZED WITHIN 14 DAYS, IF THE AREAS ARE BEING LEFT FOR AN EXTENDED PERIOD OF TIME. AREAS WHICH ARE CONSIDERED FINISHED SHALL BE PERMANENTLY STABILIZED WITHIN 14 DAYS OF THE FINISH WORK.
5. ALL EROSION AND SEDIMENT CONTROL BMPs SHALL BE INSTALLED PRIOR TO ANY SOIL DISTURBANCE. CONTRACTOR SHALL MAINTAIN THE BMPS THROUGHOUT CONSTRUCTION. REFER TO INDIVIDUAL DETAILS FOR EACH BMP.
6. REPAIR AND/OR REPLACE ANY EROSION AND SEDIMENT CONTROL BMPs WHICH HAVE BEEN DAMAGED OR NEED MAINTENANCE. ONCE A PROBLEM HAS BEEN IDENTIFIED BY THE INSPECTOR OR OTHERS, THE REPAIR SHALL BE UNDERWAY WITHIN THE END OF THE NEXT WORKING DAY AND COMPLETED WITHIN 7 DAYS OR BEFORE THE NEXT STORM EVENT.
7. CONTRACTOR IS RESPONSIBLE TO REMOVE ALL EROSION AND SEDIMENT CONTROL BMPs WITHIN 30 DAYS OF PERMANENT STABILIZATION. PERMANENT STABILIZATION IS DEFINED AS 70% GRASS CATCH IN VEGETATED AREAS.

EROSION CONTROL BLANKET

NORTH AMERICAN GREEN S75BN

MATERIAL SPECIFICATIONS:

- EROSION CONTROL BLANKET SHALL BE A MACHINE-PRODUCED MAT OF 100% AGRICULTURAL STRAW.
- THE BLANKET SHALL BE OF CONSISTENT THICKNESS WITH THE STRAW EVENLY DISTRIBUTED OVER THE ENTIRE AREA OF THE MAT. THE BLANKET SHALL BE COVERED ON THE TOP SIDE WITH 100% BIODEGRADABLE WOVEN NATURAL ORGANIC FIBER NETTING HAVING AN APPROXIMATE 1/2" X 1" MESH AND BE SEWN TOGETHER WITH BIODEGRADABLE THREAD.
- STRAW EROSION CONTROL BLANKET SHALL BE S75BN AS MANUFACTURED BY NORTH AMERICAN GREEN, INC. (812-867-6632) OR EQUIVALENT. EROSION CONTROL BLANKET SHALL HAVE THE FOLLOWING PROPERTIES:

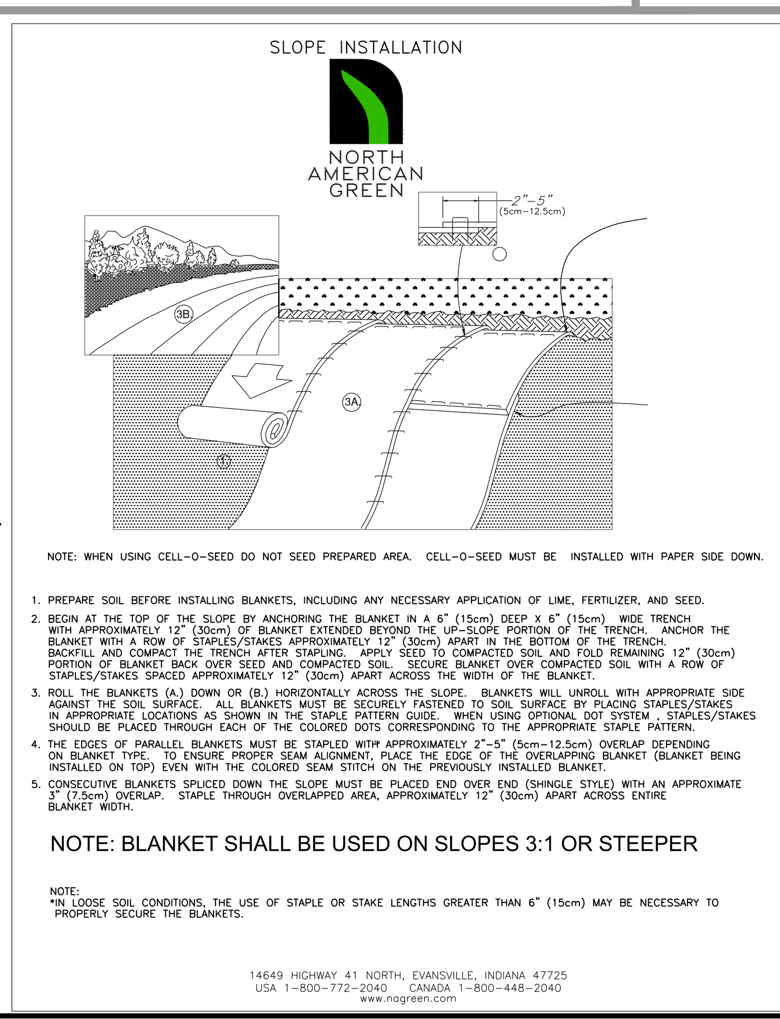
MATERIAL CONTENT:

- STRAW: 100% (0.50 lbs/sq.yd.)(0.27 kg/m^2)
- NETTING: ONE SIDE ONLY, LENO WOVEN 100% BIODEGRADABLE NATURAL ORGANIC FIBER (APPROX. WEIGHT 9.3 lbs./100 sq. ft.)
- THREAD: BIODEGRADABLE

PHYSICAL SPECIFICATIONS (ROLL):

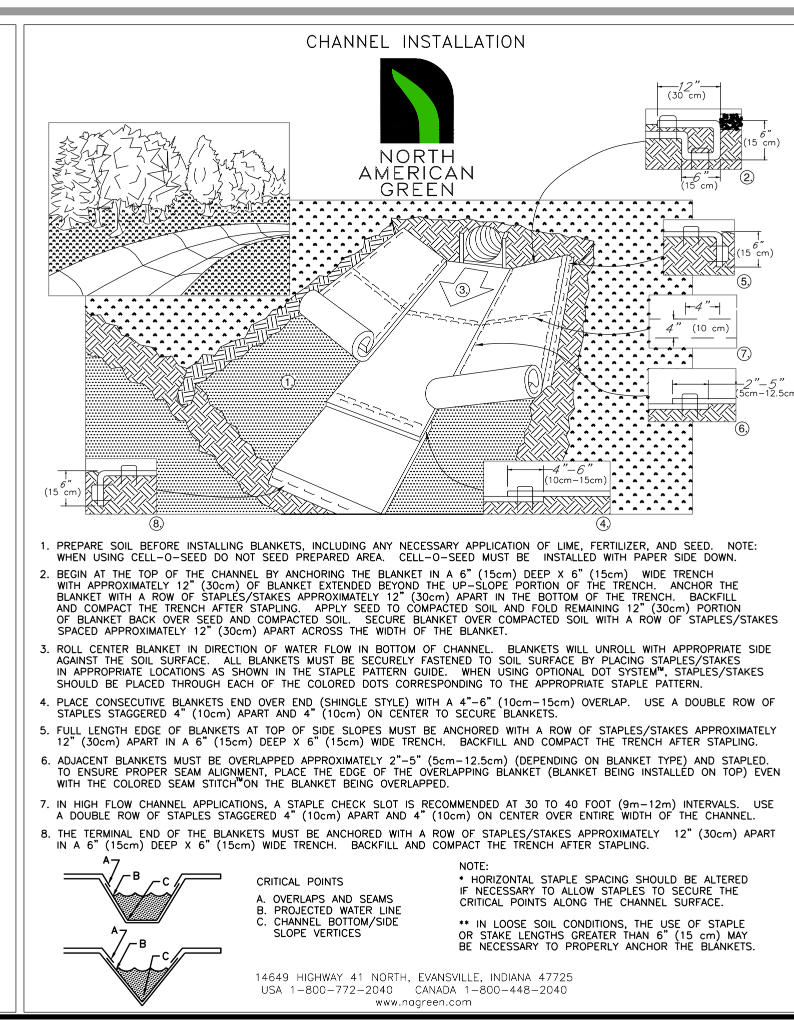
- WIDTH: 6.67 feet (2.03 m)
- LENGTH: 108 feet (32.92 m)
- WEIGHT: 46.4 lbs. ± 10% (21.05 kg)
- AREA: 80 sq. yd. (50 m^2)

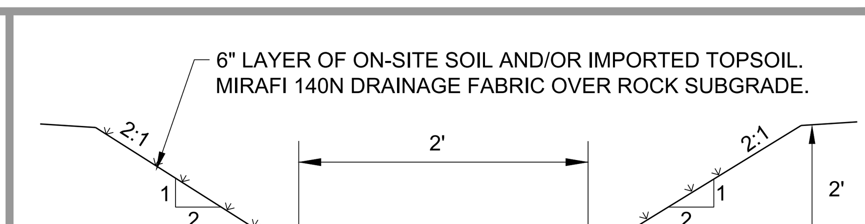
SLOPE INSTALLATION



NOTE: BLANKET SHALL BE USED ON SLOPES 3:1 OR STEEPER

CHANNEL INSTALLATION





NOTES

1. TYPICAL GRASSED CHANNEL SWALE. SEE PLAN VIEW FOR LOCATIONS.
2. TYPICAL SIDE SLOPES TO BE 2:1.
3. DURING CONSTRUCTION TEMPORARILY SEEDED AND HEAVILY MULCHED. EROSION CONTROL BLANKET MAY BE NECESSARY IN STEEPER SLOPES, INSTALL BLANKET IF EROSION PERSISTS AND/OR GRASS IS HAVING DIFFICULTY GERMINATING. POST CONSTRUCTION CONTRACTOR SHALL RE-GRADE ANY EROSION, REMOVE BUILD UP SEDIMENTS, PERMANENT SEED AND HEAVILY RE-MULCH.
4. CROSS-SECTION SHALL BE EXCAVATED TO NEAT LINES AND GRADES. OVER-EXCAVATED AREAS SHALL BE BACKFILLED WITH MOIST SOIL COMPACTED TO DENSITY OF SURROUNDING MATERIAL.
5. ALL EARTH REMOVED AND NOT NEEDED IN CONSTRUCTION SHALL BE SPREAD OR DISPOSED OF IN APPROVED UPLAND AREA (PER ON SITE PLAN COORDINATOR) SUCH THAT IT DOES NOT INTERFERE WITH FUNCTION.
6. GRASSED CHANNEL SHOULD MEET SPECIFICATIONS IN THE STATE OF MASSACHUSETTS VOLUME 2, CHAPTER 2, STRUCTURAL BMP SPECIFICATIONS FOR THE MASSACHUSETTS STORMWATER HANDBOOK. GRASSED CHANNEL IS NOT DESIGNED FOR TSS REMOVAL BUT WILL BE CONSTRUCTED TO THOSE SPECIFICATIONS.

GRASSED CHANNEL CROSS SECTION

N.T.S.

EPSC CONSTRUCTION NOTES:

1. EXISTING VEGETATION SHALL BE PROTECTED AND MAINTAINED TO THE EXTENT PRACTICABLE.
2. A VEGETATED BUFFER SHALL BE MAINTAINED FOR WATER BODIES WHERE FEASIBLE (E.G., WETLANDS AND STREAMS).
3. TO THE EXTENT PRACTICABLE, SURFACE FLOW SHALL BE DIVERTED AWAY FROM EXPOSED SOILS VIA DIVERSION BERMS, EARTH DIKES, PERIMETER DIKES/SWALES, TEMPORARY SWALES, WATER BARS, AND/OR CHECK DAMS.
4. RESOURCE AREAS (E.G., WETLANDS, STREAMS, RTE PLANT SPECIES) SHALL BE FLAGGED PRIOR TO ANY CONSTRUCTION RELATED ACTIVITIES OCCURRING WITHIN CLOSE PROXIMITY TO THOSE AREAS.
5. EFFLUENT FROM DEWATERING OPERATIONS SHALL BE FILTERED OR PASSED THROUGH AN APPROVED SEDIMENT TRAPPING DEVICE, OR BOTH, AND DISCHARGED IN A MANNER THAT DOES NOT VIOLATE WATER QUALITY STANDARDS OR CONTRIBUTE TO EROSION. DEWATERING DETAILS SHALL BE REVIEWED AND APPROVED BY THE CONSTRUCTION ENGINEER PRIOR TO USE.
6. CONCENTRATED RUNOFF SHALL NOT FLOW DOWN STEEP SLOPES UNLESS CONTAINED WITHIN AN ADEQUATE TEMPORARY OR PERMANENT CHANNEL (SEE DETAILS), FLUME, OR SLOPE DRAIN STRUCTURE.
7. UNDERGROUND UTILITY LINES SHALL BE INSTALLED IN ACCORDANCE WITH THE FOLLOWING STANDARDS IN ADDITION TO OTHER APPLICABLE CRITERIA:
   A. NO MORE THAN 500 LINEAR FEET OF TRENCH MAY BE OPENED AT ONE TIME.
   B. EXCAVATED MATERIAL SHALL BE PLACED ON THE UPHILL SIDE OF TRENCHES, WHERE FEASIBLE, BUT NOT IN RESOURCE AREAS.
8. WHERE FEASIBLE, ALL SEDIMENT REMOVED FROM SEDIMENT CONTROL PRACTICES AS PART OF MAINTENANCE SHALL BE DISPOSED OF IN AN AREA THAT IS AT LEAST ONE OF THE FOLLOWING, WITH IMMEDIATE STABILIZATION FOLLOWING DISPOSAL OF MATERIAL:
   A. LESS THAN ±5% SLOPE
   B. AT LEAST 100 FEET FROM ANY DOWNSLOPE WATER BODY OR CONVEYANCE TO A WATER BODY, INCLUDING A DITCH
   C. VEGETATED
9. DISTURBED AREAS BORDERING OR DRAINING TO EXISTING ROADS SHALL HAVE AN APPROPRIATE SEDIMENT BARRIER (E.G., SILT FENCE) SPANNING THE EDGE OF THE DISTURBANCE TO PREVENT WASHING OF SEDIMENT ONTO ROADWAYS OR INTO ROAD DITCHES.
10. IN ADVANCE OF PREDICTED RAINFALL OR SNOWMELT, ALL EPSC MEASURES THAT ARE LOCATED IN ACTIVE AREAS OF EARTH DISTURBANCE SHALL BE INSPECTED AND REPAIRED, AS NEEDED. IF NECESSARY, THIS SHALL INCLUDE TEMPORARY STABILIZATION OF ALL DISTURBED SOILS ON THE SITE IN ADVANCE OF THE ANTICIPATED RUNOFF PERIOD.
11. DUST CONTROL SHALL BE HANDLED VIA WATER APPLICATION TO ROADWAYS AND OTHER AREAS WHERE DUST MAY BE GENERATED.

FREETOWN PLANNING BOARD APPROVAL

DATE

COSTA SOLAR

Costa Drive
Freetown, Massachusetts

BIODIVERSITY RESEARCH INSTITUTE

KREBS & LANSING CONSULTING ENGINEERS

ISSUED FOR PERMIT REVIEW
NOT FOR CONSTRUCTION

CIVIL ENGINEER:
Krebs and Lansing Consulting Engineers, Inc.
164 Main Street, Suite 201
Colchester, Vermont 05446

ENVIRONMENTAL:
BRI Environmental
30 Danforth Street, Suite 213
Portland, ME 04101

APPLICANT:
Costa Solar LLC
Ironwood Renewables, LLC c/o Adrian Ortlieb
P.O. Box 51794
Lafayette, LA 70505
(p) (337) 412-9199

OWNER & PROPERTY INFORMATION:

East Property Owner:	Estate of Anthony N Costa
Owner Address:	5226 Townsend Avenue Los Angeles, CA 90041
Parcel ID:	241-53-0
Parcel Address:	5 Costa Drive Freetown, MA 02717
West Property Owner:	Michael & Karen Costa
Owner Address:	5226 Townsend Avenue Los Angeles, CA 90041
Parcel ID:	247-6-0
Parcel Address:	0-Rear Costa Drive Freetown, MA 02717

STAMP:

COMMONWEALTH OF MASSACHUSETTS
GREGORY T. DIXSON
CIVIL ENGINEER
No. 55649
REGISTERED PROFESSIONAL ENGINEER

REV. NO.	REVISIONS/COMMENTS	DATE
1.	Changes from 8/24/21 meeting discussions	09/20/21
2.	Updates for proposed solar array	11/08/21
3.	Updates for Planning Board submission	11/17/21

DRAWING TITLE:

COSTA SOLAR DETAILS

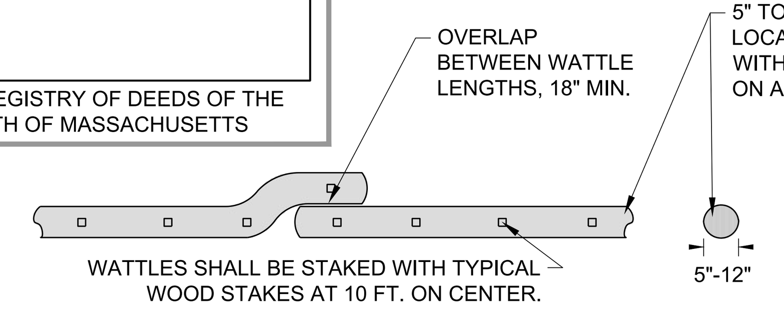
DATE of Issue: 07/01/2021

Drawn by: EJM/GTD	Checked by: GTD
Project No.: 21223	Scale: N/A
Drawing No.: C-3.01	Rev No.: 3

FOR USE BY THE REGISTRY OF DEEDS OF THE COMMONWEALTH OF MASSACHUSETTS

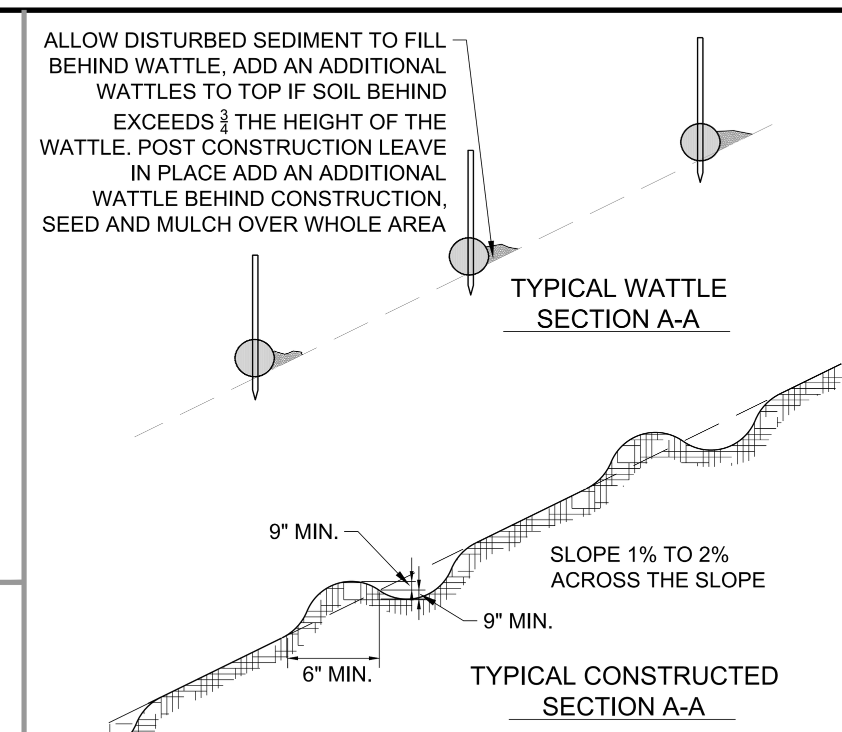
NOTES

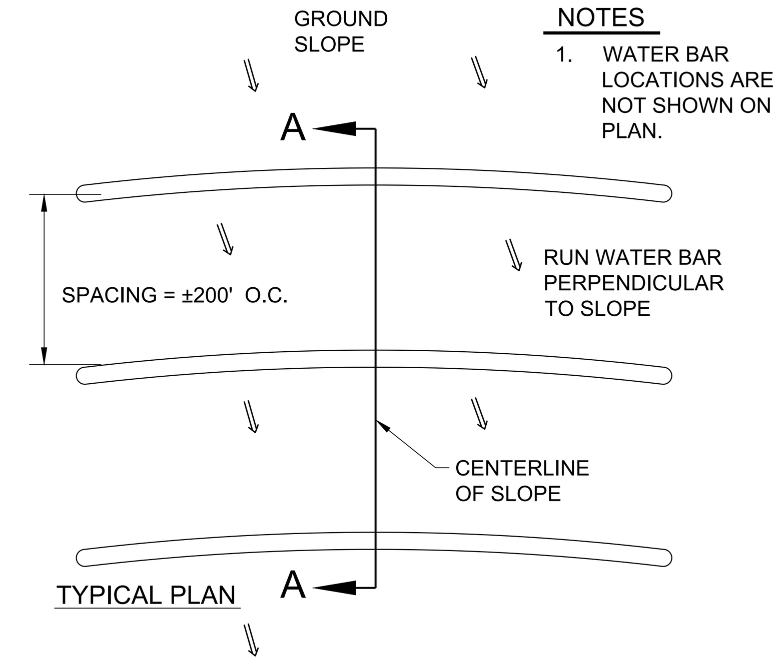
1. CONTRACTOR SHALL BE RESPONSIBLE FOR THE INSTALLATION, MAINTENANCE, AND REMOVAL OF WATTLE IN ALL LOCATIONS SHOWN ON THE PLANS. WATTLE MAY BE LEFT IN PLACE IF THE CONTRACTOR SEEDS AND MULCHES OVER WATTLE FOR GROWTH POST CONSTRUCTION.
2. MAINTENANCE SHALL BE PERFORMED AS NEEDED AND ADDITIONAL WATTLES WILL BE ADDED WHEN SEDIMENT REACHES HALF OF PRODUCT HEIGHT.
3. WHEN INSTALLING LENGTHS OF WATTLE, LENGTHS WILL OVERLAP BY MINIMUM 18" WHEN TRANSITIONING TO A NEW LENGTH OF WATTLE.
4. CONTRACTOR SHALL REFER TO ALL MANUFACTURES SPECIFICATIONS AND DETAILS.
5. SILTSOXX IS A SPECIFIC MANUFACTURER, OTHER MANUFACTURERS WITH EQUAL PRODUCTS MAY BE USED IF APPROVED BY ENGINEER.
6. WATTLE CAN BE USED AS A SILT FENCE ALTERNATIVE, WITH PRIOR APPROVAL OF THE ENGINEER.



TYPICAL WATTLE SEDIMENT CONTROL

N.T.S.



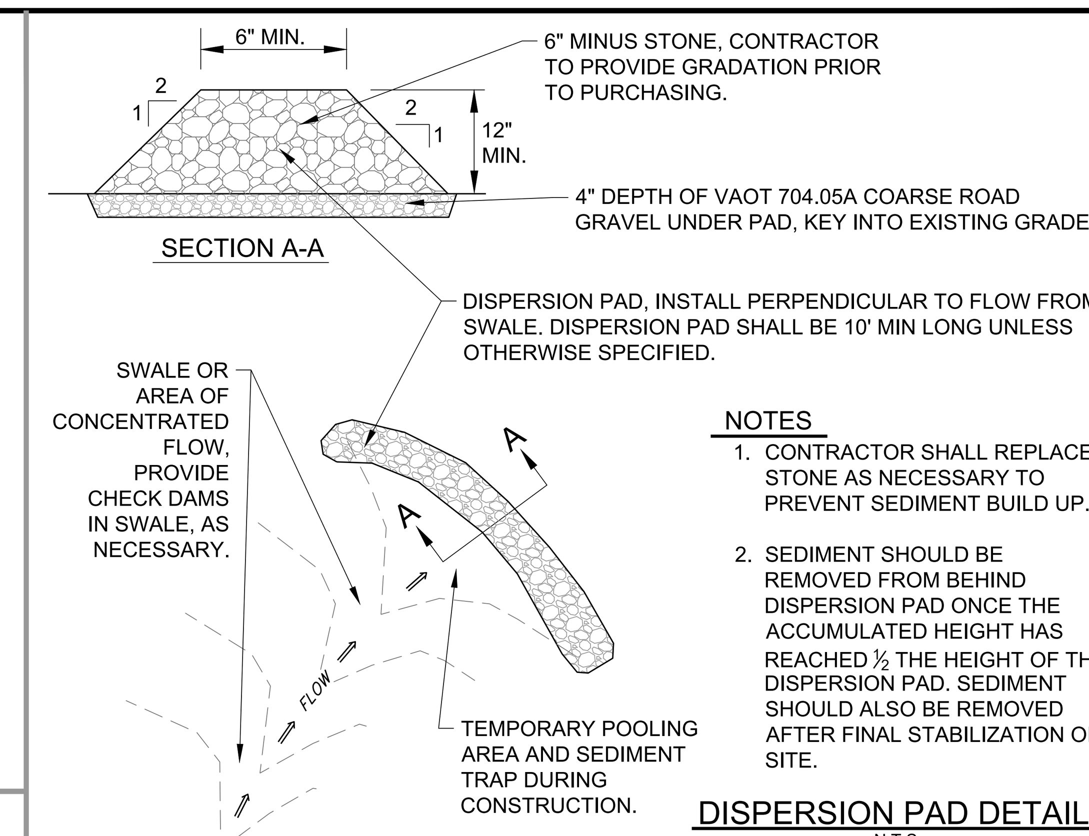


NOTES

1. WATER BAR LOCATIONS ARE NOT SHOWN ON PLAN.

SILTSOXX OR CONSTRUCTED WATER BAR DETAIL

N.T.S.



NOTES

1. CONTRACTOR SHALL REPLACE STONE AS NECESSARY TO PREVENT SEDIMENT BUILD UP.
2. SEDIMENT SHOULD BE REMOVED FROM BEHIND DISPERSION PAD ONCE THE ACCUMULATED HEIGHT HAS REACHED ½ THE HEIGHT OF THE DISPERSION PAD. SEDIMENT SHOULD ALSO BE REMOVED AFTER FINAL STABILIZATION OF SITE.

DISPERSION PAD DETAIL

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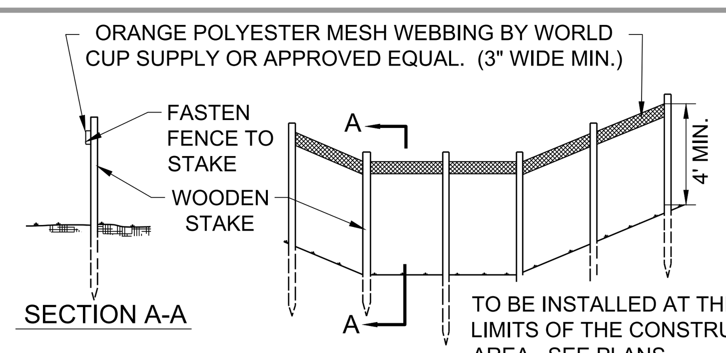
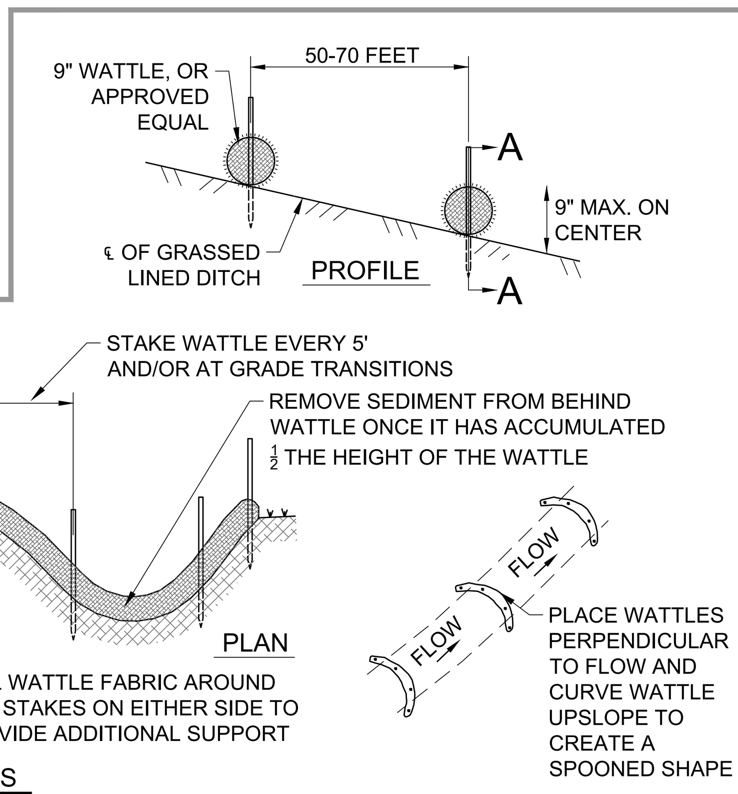


NOTES

1. ACCEPTABLE EPSC MEASURE DETAILS ARE PROVIDED BELOW.
2. LIMITS OF DISTURBANCE (OR "CONSTRUCTION DEMARCATION") SHALL BE INSTALLED PRIOR TO ANY EARTH DISTURBING ACTIVITIES.
3. BARRIER TAPE/ROPE: FOR USE WHERE PROPOSED DISTURBANCE BORDERS NON-WOODED, VEGETATED AREAS MORE THAN 100 FT FROM THE NEAREST WATER RESOURCE (STREAM, BROOK, LAKE, POND, WETLAND, ETC.). BARRIER TAPE IS HIGH VISIBILITY FIBERGLASS TAPE, MINIMUM 3" IN WIDTH COMMONLY USED IN SKI AREAS FOR DEMARCATING CLOSED AREAS. BARRIER TAPE AND ROPE SHOULD BE ATTACHED TO STAKES, AT A MINIMUM HEIGHT OF 4 FT FROM THE GROUND.
4. MINIMUM 1 TO 2 ROWS OF MESH BARRIER TAPE TO BE INSTALLED ALONG CONSTRUCTION PERIMETER.
5. EACH ROW OF BARRIER TAPE TO BE 3" WIDE MINIMUM.
6. BARRIER TAPE TO BE ORANGE.
7. SECURE BARRIER TAPE TO STAKES OR EXISTING TREE TRUNKS WITH BOTTOM ROW AT 4' DISTANCE FROM GROUND SURFACE (MINIMUM).
8. MAINTAIN AND REPLACE AS NEEDED. REMOVE AT COMPLETION OF PROJECT PER OSPC.
9. IN EVENT THE OSPC DETERMINES BARRIER TAPE IS NOT SUFFICIENT, REPLACE WITH ORANGE CONSTRUCTION FENCE OR SNOW FENCE.

TYPICAL CONSTRUCTION LIMIT BARRIER

N.T.S.



NOTES

1. CONTRACTOR SHALL BE RESPONSIBLE FOR THE INSTALLATION, MAINTENANCE, AND REMOVAL OF WATTLE IN ALL LOCATIONS SHOWN ON THE PLANS. WATTLE MAY BE LEFT IN PLACE IF THE CONTRACTOR SEEDS AND MULCHES WATTLE FOR GROWTH POST CONSTRUCTION.
2. MAINTENANCE SHALL BE PERFORMED AS NEEDED AND ADDITIONAL WATTLE WILL BE ADDED WHEN SEDIMENT REACHES HALF OF PRODUCT HEIGHT.
3. WHEN INSTALLING LENGTHS OF WATTLE, LENGTHS WILL OVERLAP BY MINIMUM 18" WHEN TRANSITIONING TO A NEW LENGTH OF WATTLE.
4. CONTRACTOR SHALL REFER TO ALL MANUFACTURES SPECIFICATIONS AND DETAILS.
5. WATTLE CAN ONLY BE USED IN A GRASS LINED SWALE, MAY NOT BE USED IN STONE LINED SWALES.
6. WATTLE CHECK DAM CAN ONLY BE USED IN CHANNELS WITH SLOPES LESS THAN 5%.
5. SILTSOXX IS A SPECIFIC MANUFACTURER, OTHER MANUFACTURERS WITH EQUAL PRODUCTS MAY BE USED IF APPROVED BY ENGINEER.

TYPICAL WATTLE CHECK DAM DETAIL

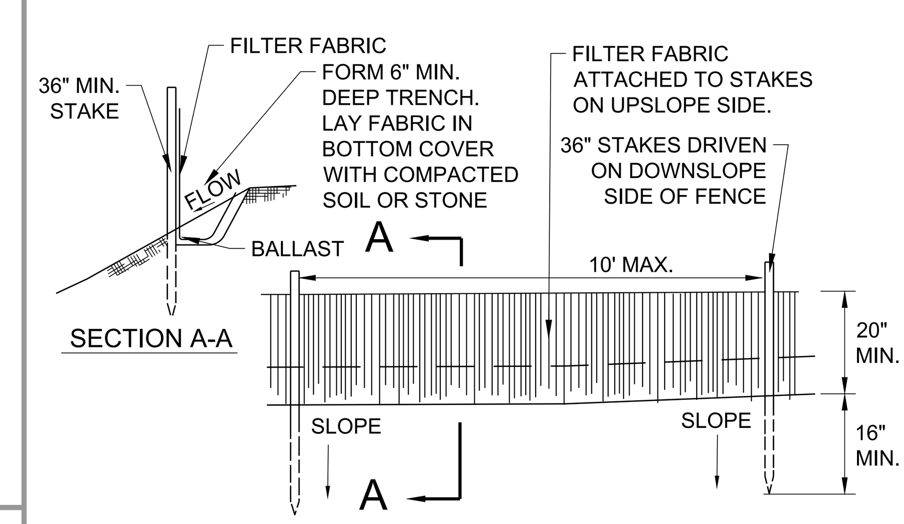
N.T.S.

NOTES

1. PERIMETER CONTROLS SHALL BE UTILIZED IN SMALL AREAS < 1 ACRE. IN AREAS > 1 ACRE, TEMPORARY SEDIMENT TRAPS OR TEMPORARY SEDIMENT BASINS ARE TO BE UTILIZED.
2. PERIMETER CONTROLS SHALL BE INSTALLED ON DOWNSLOPE SIDE OF PLANNED EARTH DISTURBANCE.
3. PERIMETER CONTROLS SHALL BE INSTALLED PRIOR TO ANY EARTH DISTURBING ACTIVITIES WITHIN UPSLOPE CONTRIBUTING AREA.
4. SILT FENCE SHALL NOT BE USED AS CONSTRUCTION DEMARCATION.
5. SILTSOXX CAN BE USED AS A SILT FENCE ALTERNATIVE, WITH PRIOR APPROVAL OF THE ENGINEER. SEE DETAIL.
6. IF SILT FENCE IS INSTALLED WHEN GROUND IS FROZEN, A GRAVEL, SHOT ROCK, OR SAND BALLAST MUST BE USED.

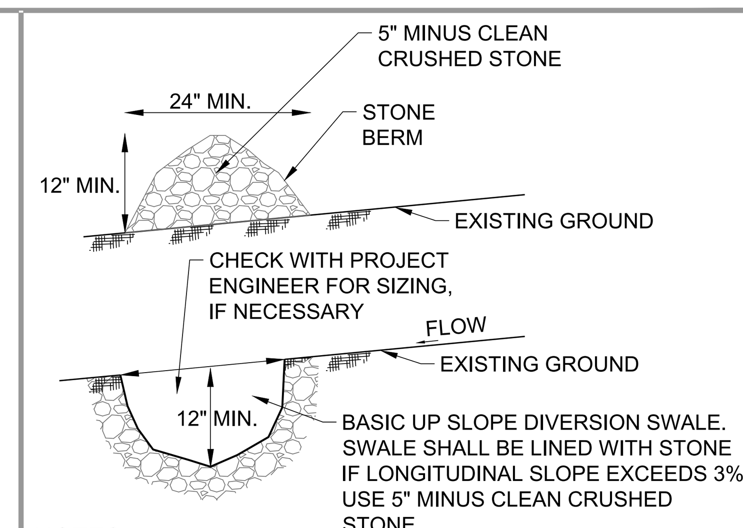
SILT FENCE SPACING CHART

SLOPE	SPACING
5% TO 10%	50 FT. OR LESS
10% TO 20%	25 FT. OR LESS
> 20%	15 FT. OR LESS



TYPICALTEMPORARY SILT FENCE

N.T.S.



NOTES

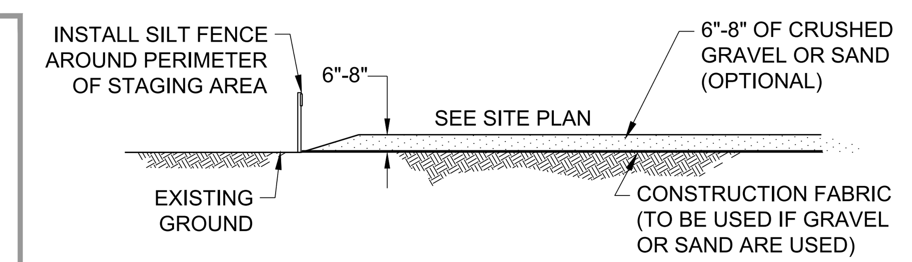
1. UPSLOPE DIVERSION BERM WILL BE USED AS SHOWN ON PLAN AND DETAIL. DIVERSION SWALES ARE NOT PART OF THIS DESIGN, IF NECESSARY DURING CONSTRUCTION, CONTRACTOR SHALL CHECK WITH THE PROJECT ENGINEER FOR SIZING.

TYPICAL UPSLOPE DIVERSION DETAIL

N.T.S.

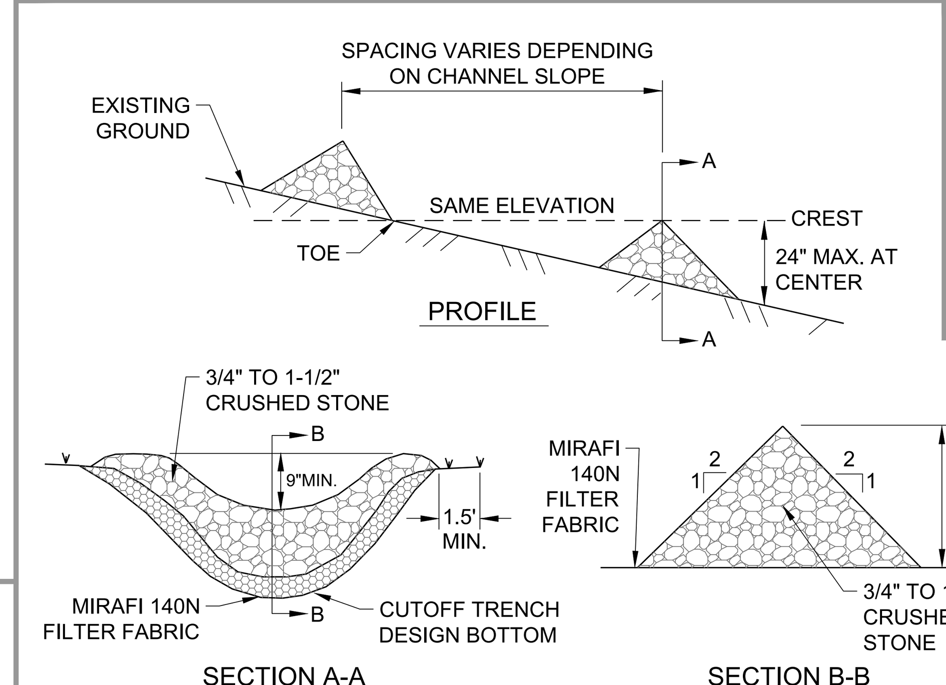
NOTES

1. SILT FENCING TO BE INSTALLED BEFORE CONSTRUCTION OF STAGING AREA IS INSTALLED.
2. INSTALL AND MAINTAIN SURFACE OF STAGING AREA WITH CONSTRUCTION FABRIC OVER EXISTING GROUND, COVER WITH 6"-8" OF CRUSHED GRAVEL OR SAND, SEE DETAIL. MAINTAIN DEPTH OF GRAVEL OR SAND THROUGHOUT PROJECT CONSTRUCTION.
3. INSTALL AND MAINTAIN STABILIZED CONSTRUCTION ENTRANCE, SEE DETAIL. INSTALL WOODEN GATE AT ENTRANCE OF OF STAGING AREA.
4. ALL ABUTTERS TO STAGING AREA WILL BE NOTIFIED OF THE PROJECT. DUE TO LIKELY CONSTRUCTION NOISE, ACTIVITIES AT STAGING AREA AND CONSTRUCTION SITE SHALL ABIDE BY LOCAL NOISE ORDINANCES.
5. STAGING AREA IS LIKELY TO BE USED FOR PARKING DURING CONSTRUCTION, STAGING OF CONSTRUCTION MATERIALS, BASE OF PROJECT OPERATIONS AND MISCELLANEOUS PROJECT ACTIVITIES.
6. CLOSE TO PROJECT CONSTRUCTION COMPLETION, STAGING AREA WILL BE REMOVED. TOP LAYER OF GRAVEL OR SAND AND CONSTRUCTION FABRIC SHALL BE REMOVED AND PROPERLY DISPOSED OF. RESTORE THE PORTION OF EXISTING MEADOW COVERED BY STAGING AREA BY SEEDING, MULCHING, AERATING, ETC AS NECESSARY TO RESTORE FIELD TO ITS NATURAL PRECONSTRUCTION STATE.
7. CONTRACTOR IS RESPONSIBLE FOR REFRESHING GRAVEL AS NEEDED TO MAINTAIN STABILITY OF STABILIZED STAGING AREA.



TYPICAL STABILIZED STAGING AREA SURFACE

N.T.S.



STONE CHECK DAM

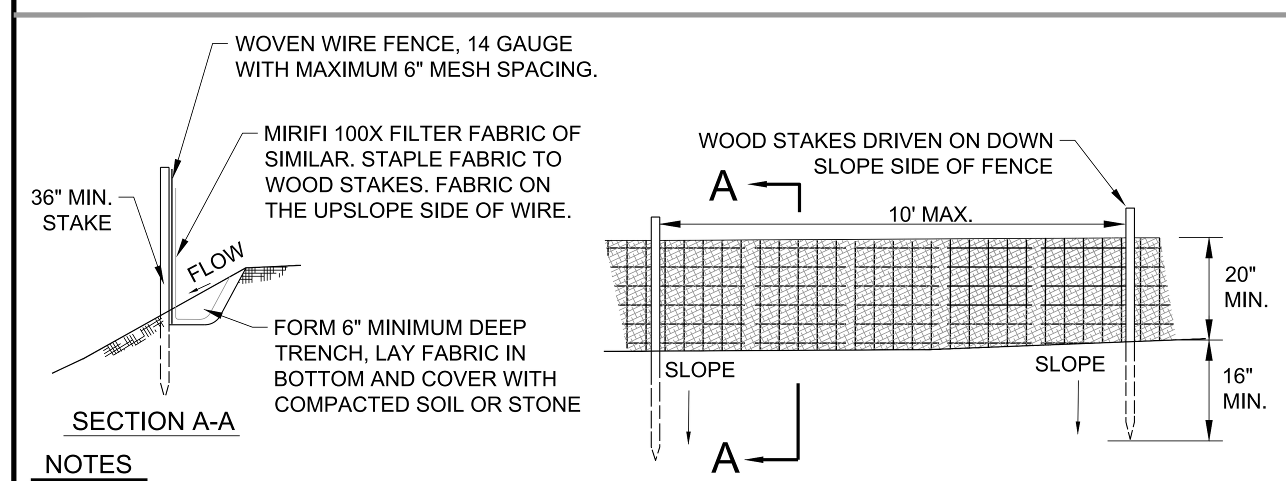
N.T.S.

NOTES

1. STONE WILL BE PLACED ON A FILTER FABRIC FOUNDATION TO THE LINES, GRADES AND LOCATIONS SHOWN IN THE PLAN.
2. SET SPACING OF CHECK DAMS TO ASSUME THAT THE ELEVATIONS OF THE CREST OF THE DOWNSTREAM DAM IS AT THE SAME ELEVATION OF THE TOE OF THE UPSTREAM DAM.
3. EXTEND THE STONE A MINIMUM OF 1.5 FEET BEYOND THE DITCH BANKS TO PREVENT CUTTING AROUND THE DAM.
4. PROTECT THE CHANNEL DOWNSTREAM OF THE LOWEST CHECK DAM FROM SCOUR AND EROSION WITH STONE OR LINER AS APPROPRIATE.
5. ENSURE THAT CHANNEL APPURTENANCES SUCH AS CULVERT ENTRANCES BELOW CHECK DAMS ARE NOT SUBJECT TO DAMAGE OR BLOCKAGE FROM DISPLACED STONES.

PERIMETER EROSION CONTROL SCHEDULE

DISTANCE FROM RECIEVING WATER AND ALL WATER RESOURCE AREAS (WRA)	SLOPE	ACCEPTABLE EPSC MEASURE
≤ 100 FEET	ALL	REINFORCED SILT FENCE, TWO ROWS OF NONREINFORCED SILT FENCE OR ROW OF WATTTLE INSIDE OF NONREINFORCED SILT FENCE
> 100 FEET	ALL	NONREINFORCED SILT FENCE OR WATTLE PER SPECIFICATIONS BELOW



NOTES

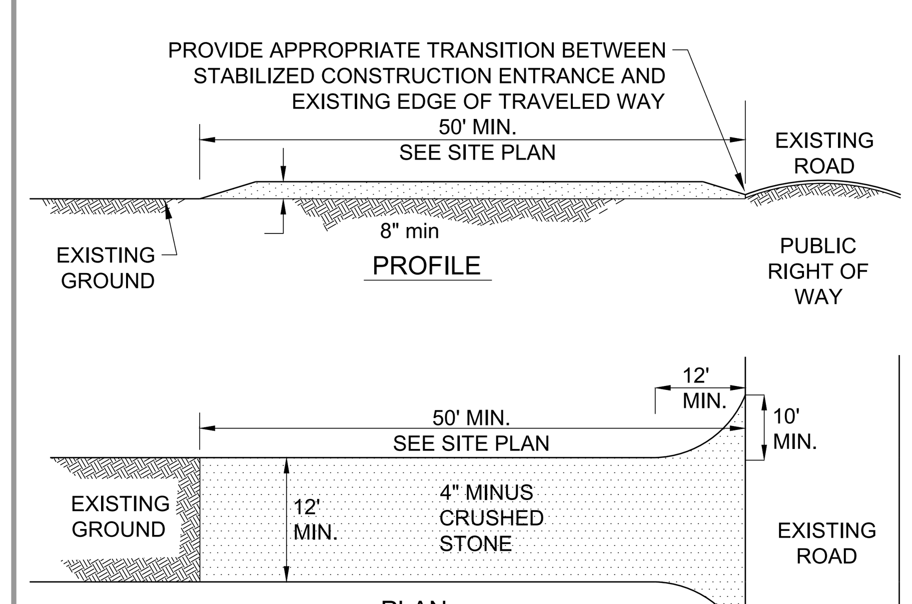
1. WOVEN WIRE FENCE TO BE FASTENED SECURELY TO FENCE POSTS WITH WIRE TIES WIRE FENCE REINFORCEMENT REQUIRED WITHIN 100 FT UPSLOPE OF RECEIVING WATERS.
2. FILTER CLOTH TO BE FASTENED SECURELY TO WOVEN WIRE FENCE WITH ITIES SPACED 24" AT THE TOP AND MID SECTION.
3. WHEN TWO SECTIONS OF FILTER CLOTH ADJOIN EACH OTHER THEY SHALL BE OVERLAPPED BY 6" AND FOLDED. FILTER CLOTH SHALL BE MIRAFI 100X OR APPROVED EQUIVALENT.
4. PREFABRICATED UNITS SHALL BE GEOFAB, ENVIROFENCE OR EQUIVALENT.
5. CONTRACTOR SHALL BE RESPONSIBLE FOR THE INSTALLATION, MAINTENANCE, AND REMOVAL OF SILT FENCE IN ALL LOCATIONS SHOWN ON THE PLANS.
6. MAINTENANCE SHALL BE PERFORMED AS NEEDED AND MATERIAL REMOVED WHEN SEDIMENT REACHES HALF OF FABRIC HEIGHT. REMOVE SILT FENCE AFTER SUCCESSFUL ESTABLISHMENT OF VEGETATION.
7. OTHER MEASURES MAY BE USED TO REINFORCE SILT FENCE IN PLACE OF WIRE MESH, CONTRACTOR WILL APPROVE ALL MEASURES WITH ENGINEER PRIOR TO USE.
8. IF SILT FENCE IS INSTALLED WHEN GROUND IS FROZEN, A GRAVEL, SAND OR WATTLE BALLAST MUST BE USED.
9. CONTRACTOR MAY USE IVI WIRE BACK SILT FENCE (IVI PRODUCT 940-3610-B48-W6H) OR EQUIVALENT.
10. SILT FENCE SHALL BE INSTALLED ALONG CONTOURS.
11. SILT FENCE SHALL NOT BE LOCATED IN AREAS OF CONCENTRATED FLOW.
12. DRAINAGE AREA SHALL BE ≤ ¼ ACRE PER 100 LINEAR FEET OF SILT FENCE.

TYPICAL TEMPORARY REINFORCED SILT FENCE

N.T.S.

NOTES

1. CONTRACTOR SHALL STABILIZE CONSTRUCTION ENTRANCE AS REQUIRED TO PREVENT TRACKING OF SEDIMENT OFF-SITE.
2. CONTRACTOR TO USE MIRAFI 500X UNDER STONE FOR TEMPORARY CONSTRUCTION ROADS.
3. CRUSHED STONE SHALL BE ADDED OR REPLACED WHEN 80% OF THE VOIDS ARE FILLED WITH SEDIMENT.
4. STONE SIZE SHALL BE 1-4".
5. ALL SURFACE WATER FLOWING OR DIVERTED TOWARD CONSTRUCTION ENTRANCE SHALL BE PIPED BENEATH ENTRANCE. IF PIPING IS IMPRACTICAL, A MOUNTABLE BERM WITH 5:1 SLOPES IS ALLOWED.



STABILIZED CONSTRUCTION ENTRANCE

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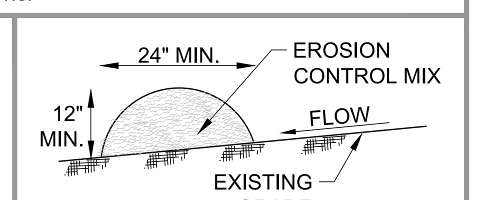


COMPOSITION:

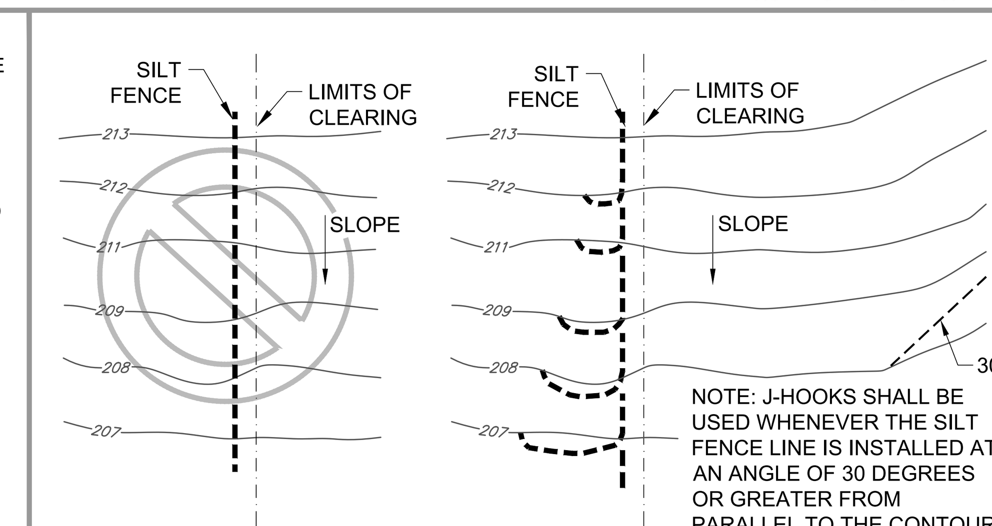
EROSION CONTROL MIX BERM SHALL BE MANUFACTURED ON OR OFF THE PROJECT SITE SUCH THAT ITS COMPOSITION IS IN ACCORDANCE WITH THE MAINE DEPT. OF EROSION CONTROL AND SEDIMENT CONTROL BMP, B-1 SEDIMENT BARRIERS. IT MUST CONSIST PRIMARILY OF ORGANIC MATERIAL, SEPARATED AT THE POINT OF GENERATION, AND MAY INCLUDE: SHREDDED BARK, STUMP GRINDINGS, COMPOSTED WOOD AND BARK CHIPS AND/OR ACCEPTABLE MANUFACTURED PRODUCTS. GROUND CONSTRUCTION DEBRIS OR REPROCESSED WOOD PRODUCTS WILL NOT BE ACCEPTABLE. ALL MATERIALS USED TO MANUFACTURE THE EROSION CONTROL MIX SHALL BE NATIVE MASSACHUSETTS MATERIALS.

NOTES

1. THE BARRIER MUST BE PLACED ALONG A RELATIVELY LEVEL CONTOUR.
2. EXISTING GROUND SHALL BE PREPARED AS NEEDED SUCH THAT THE BARRIER LIES NEARLY FLAT ALONG THE GROUND TO AVOID THE CREATION OF VOIDS AND BRIDGES IN ORDER TO MINIMIZE THE POTENTIAL OF WASH OUTS UNDER THE BARRIER.
3. ON SLOPES < 5% OR AT THE BOTTOM OF STEEPER SLOPES (<2:1) UP TO 20' LONG, THE BARRIER MUST BE A MINIMUM OF 12" HIGH, AS MEASURED ON THE UPHILL SIDE OF THE BARRIER, AND A MINIMUM OF 2 FT. WIDE. ON LONGER OR STEEPER SLOPES, THE BARRIER SHALL BE WIDER TO ACCOMMODATE ADDITIONAL FLOW.
4. EROSION CONTROL MIX MAY BE INSTALLED WHERE SILT FENCE IS ILLUSTRATED AND SCHEDULED ON THE DESIGN PLANS EXCEPT IN, BUT NOT LIMITED TO, THE FOLLOWING AREAS: WETLAND AREAS, AT POINTS OF CONCENTRATED FLOW, BELOW STORMWATER END SECTIONS AT OUTFALLS, AROUND CATCH BASINS AND CLOSED STORM SYSTEMS AND AT THE BOTTOM OF STEEP SLOPES (UP TO 2:1 WITH ENGINEER APPROVAL) THAT ARE MORE THAN 50 FEET FROM TOP TO BOTTOM. IN WETLAND BUFFER AREAS EROSION CONTROL MIX MAY BE USED ONLY IN THE SPECIFIC AREAS THAT HAVE RECEIVED REGULATORY APPROVAL FOR DISTURBANCE FROM EITHER THE STATE OF MASSACHUSETTS OR THE U.S. ARMY CORPS OF ENGINEERS. EROSION CONTROL MIX MAY NOT BE USED IN WETLAND AREAS.

TYPICAL EROSION CONTROL MIX BERM

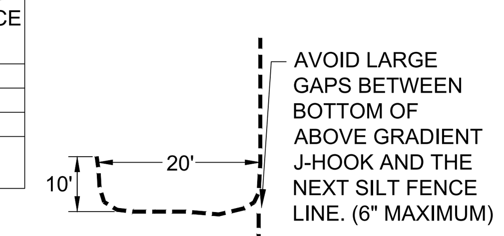
N.T.S.



INCORRECT
SILT FENCE INSTALLED PARALLEL TO SLOPE (PERPENDICULAR TO CONTOUR) IN ONE, LONG RUN

CORRECT
SILT FENCE INSTALLED IN SHORTER RUNS WITH J-HOOKS TO AVOID CONCENTRATION OF FLOWS AT ONE LOCATION BY TRAPPING RUNOFF AT MULTIPLE POINTS ALONG A SLOPE.

SLOPE STEEPNESS	MAXIMUM SPACING BETWEEN SILT FENCE J-HOOKS (FT.)
2:1 SLOPE (50%)	25
3:1 SLOPE (33%)	50
4:1 SLOPE (25%)	75
5:1 SLOPE OR FLATTER (50%)	100



TYPICAL SILT FENCE "J-HOOK" CONSTRUCTION

N.T.S.

NOTES

1. PROPER INSTALLATION OF J-HOOKS PROVIDES SILT FENCE THE ABILITY TO TEMPORARILY POND RUNOFF, ALLOWING TIME FOR SEDIMENTS TO SETTLE.
2. LONG RUNS OF SILT FENCE BETWEEN J-HOOKS SHOULD BE AVOIDED REFER TO ADJACENT TABLE FOR PROPER SPACING OF J-HOOKS.
3. J-HOOKS SHOULD BE BUILT ALONG CONTOUR IN A "SMILE" SHAPE WITH A MINIMUM WIDTH OF 20 FEET AND MINIMUM DEPTH OF 10 FEET.
4. ALONG A NARROW RIGHT OF WAY, NARROWER J-HOOKS CAN BE USED WITH A HIGHER SPACING FREQUENCY.

FREETOWN PLANNING BOARD APPROVAL

DATE

COSTA SOLAR

Costa Drive
Freetown, Massachusetts

IRONWOOD RENEWABLES

BIODIVERSITY RESEARCH INSTITUTE

KREBS & LANSING CONSULTING ENGINEERS

ISSUED FOR PERMIT REVIEW
NOT FOR CONSTRUCTION

CIVIL ENGINEER:
Krebs and Lansing Consulting Engineers, Inc.
164 Main Street, Suite 201
Colchester, Vermont 05446

ENVIRONMENTAL:
BRI Environmental
30 Danforth Street, Suite 213
Portland, ME 04101

APPLICANT:
Costa Solar LLC
Ironwood Renewables, LLC c/o Adrian Ortlieb
P.O. Box 51794
Lafayette, LA 70505
(p) (337) 412-9199

OWNER & PROPERTY INFORMATION:

East Property Owner: Estate of Anthony N Costa
Owner Address: 5226 Townsend Avenue, Los Angeles, CA 90041
Parcel ID: 241-53-0
Parcel Address: 5 Costa Drive, Freetown, MA 02717

West Property Owner: Michael & Karen Costa
Owner Address: 5226 Townsend Avenue, Los Angeles, CA 90041
Parcel ID: 247-6-0
Parcel Address: 0-Rear Costa Drive, Freetown, MA 02717

STAMP:

COMMONWEALTH OF MASSACHUSETTS
GREGORY T. DIXSON
CIVIL ENGINEER
No. 55649
REGISTERED PROFESSIONAL ENGINEER

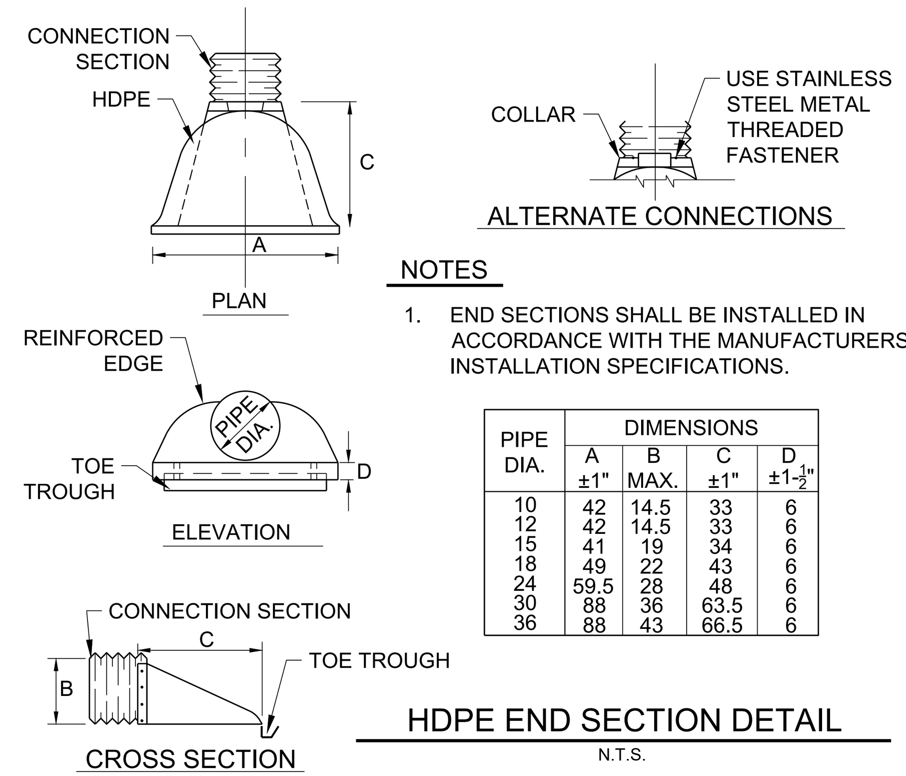
REV. NO.	REVISIONS/COMMENTS	DATE
1.	Changes from 8/24/21 meeting discussions	09/20/21
2.	Updates for proposed solar array	11/08/21
3.	Updates for Planning Board submission	11/17/21

DRAWING TITLE:

COSTA SOLAR DETAILS

DATE of Issue: 07/01/2021
Drawn by: EJM/GTD   Checked by: GTD
Project No.: 21223   Scale: N/A
Drawing No.: C-3.02   Rev No.: 3

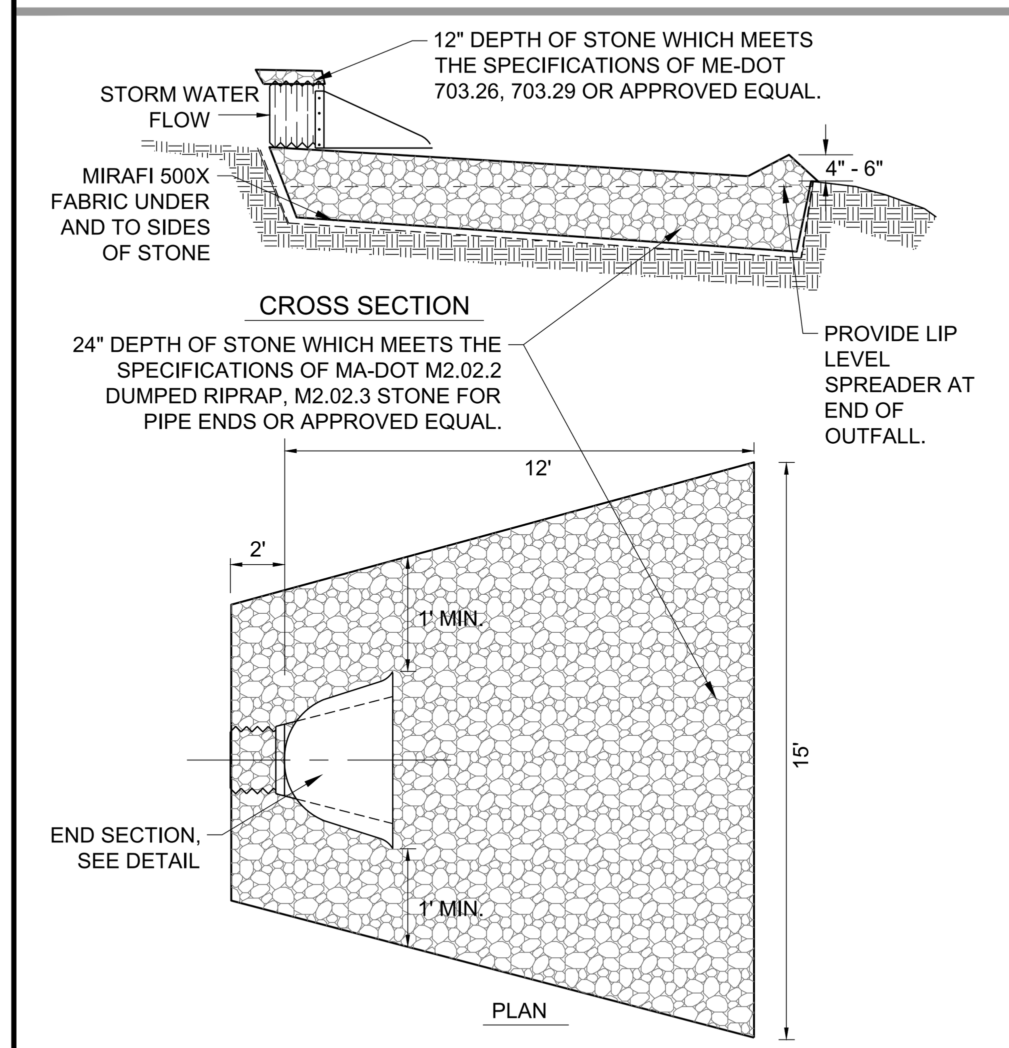
FOR USE BY THE REGISTRY OF DEEDS OF THE COMMONWEALTH OF MASSACHUSETTS



NOTES
1. END SECTIONS SHALL BE INSTALLED IN ACCORDANCE WITH THE MANUFACTURERS INSTALLATION SPECIFICATIONS.

PIPE DIA.	DIMENSIONS A ±1"	B MAX.	C ±1"	D ±1-½"
10	42	14.5	33	6
12	42	14.5	33	6
15	41	19	34	6
18	49	22	43	6
24	59.5	28	48	6
30	88	36	63.5	6
36	88	43	66.5	6

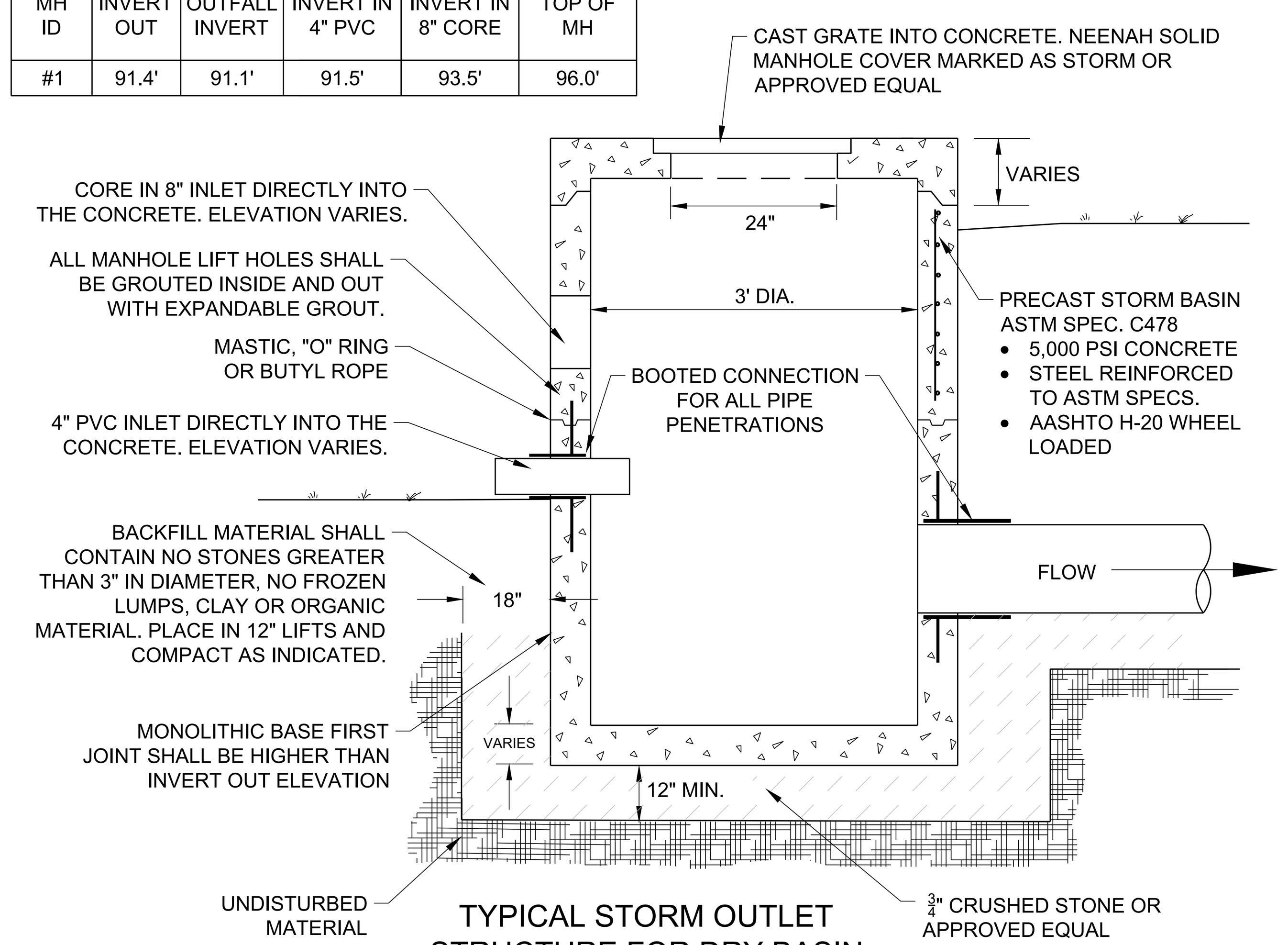
HDPE END SECTION DETAIL
N.T.S.



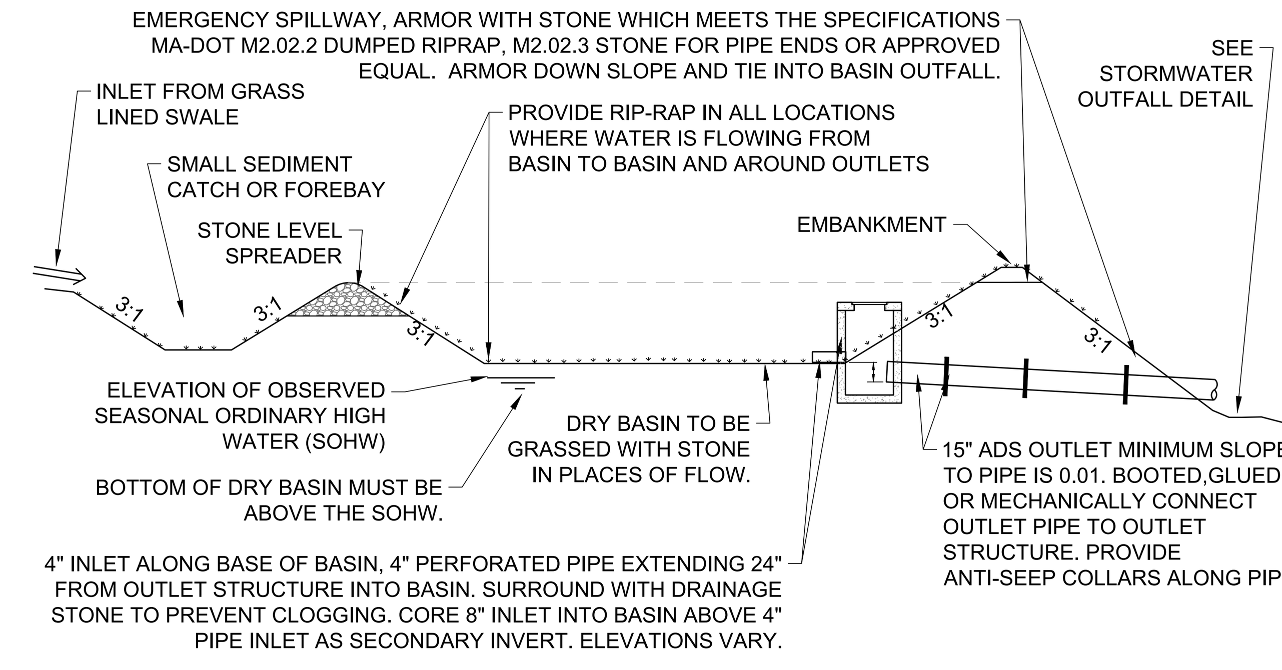
STORMWATER OUTFALL DETAIL
N.T.S.

MANHOLE SCHEDULE

MH ID	INVERT OUT	OUTFALL INVERT	INVERT IN 4" PVC	INVERT IN 8" CORE	TOP OF MH
#1	91.4'	91.1'	91.5'	93.5'	96.0'



TYPICAL STORM OUTLET STRUCTURE FOR DRY BASIN
N.T.S.



DRY BASIN SCHEDULE

DB ID	VOLUME PROVIDED IN POND (C.F.)	BOTTOM POND ELEV. (FT.)	BROAD CRESTED WEIR OVERFLOW ELEV. (FT.)	TOP OF POND ELEV. (FT.)
#1	±47,400	91.5'	94.5'	95.5'

CROSS-SECTION DETENTION BASIN
N.T.S.

CONSTRUCTION OVERSIGHT NOTES

CONSTRUCTION SEQUENCE:

CONSTRUCTION CAN BE STARTED NO LATER THAN SEPTEMBER 1ST. IF SIDE SLOPES AND BANKS CANNOT BE REVEGETATED AND STABILIZED BY THE END OF THE GROWING SEASON, BASIN CONSTRUCTION SHOULD BE DELAYED TO THE FOLLOWING GROWING SEASON. SEEDING MUST OCCUR BEFORE SEPTEMBER 15TH OR OTHER STABILIZATION MEASURES MUST BE IMPLEMENTED BEFORE WINTER. DO NOT DISCHARGE STORMWATER TO THE BASIN UNTIL THE BASIN IS FULLY STABILIZED OR PROVIDES A SEDIMENT BARRIER AT THE OUTLET.

CONSTRUCTION OVERSIGHT:

- EMBANKMENT FILLS SHALL BE FREE OF FROZEN SOIL, ROCKS OVER 6", SOD, BRUSH STUMPS, TREE ROOTS, WOOD, OR OTHER PERISHABLE MATERIALS. EMBANKMENT FILLS SHALL BE COMPACTED USING METHODS THAT WOULD GUARANTEE A FILL DENSITY OF 90% OF THE MAXIMUM DENSITY AS DETERMINED BY STANDARD PROCTOR (ASTM-698). FILLS SHALL BE CONSTRUCTED IN 12" LIFTS.
- ALL AREAS OF CONCENTRATED FLOW IN OR OUT OF THE BASIN ARE TO BE ARMORED IN STONE RIP-RAP. STONE SHALL MEET THE SPECIFICATIONS OF MA-DOT M2.02.2 DUMPED RIPRAP, M2.02.3 STONE FOR PIPE ENDS OR APPROVED EQUAL.
- ALL THE MATERIAL USED FOR THE CONSTRUCTION OF THE BASIN MUST BE CONFIRMED AS SUITABLE BY THE DESIGN ENGINEER.
- INSPECTION OF THE DRY POND BY A PROFESSIONAL ENGINEER SHALL CONSIST AT A MINIMUM OF WEEKLY SITE VISITS TO THE SITE TO INSPECT EACH DRY POND. THIS SHALL INCLUDE MATERIAL AND PLACEMENT, FROM INITIAL GROUND DISTURBANCE TO FINAL STABILIZATION OF THE POND SIDESLOPES. INSPECTIONS SHALL INCLUDE WITNESSING THE INSTALLATION OF BERMS AND EMERGENCY SPILLWAYS.

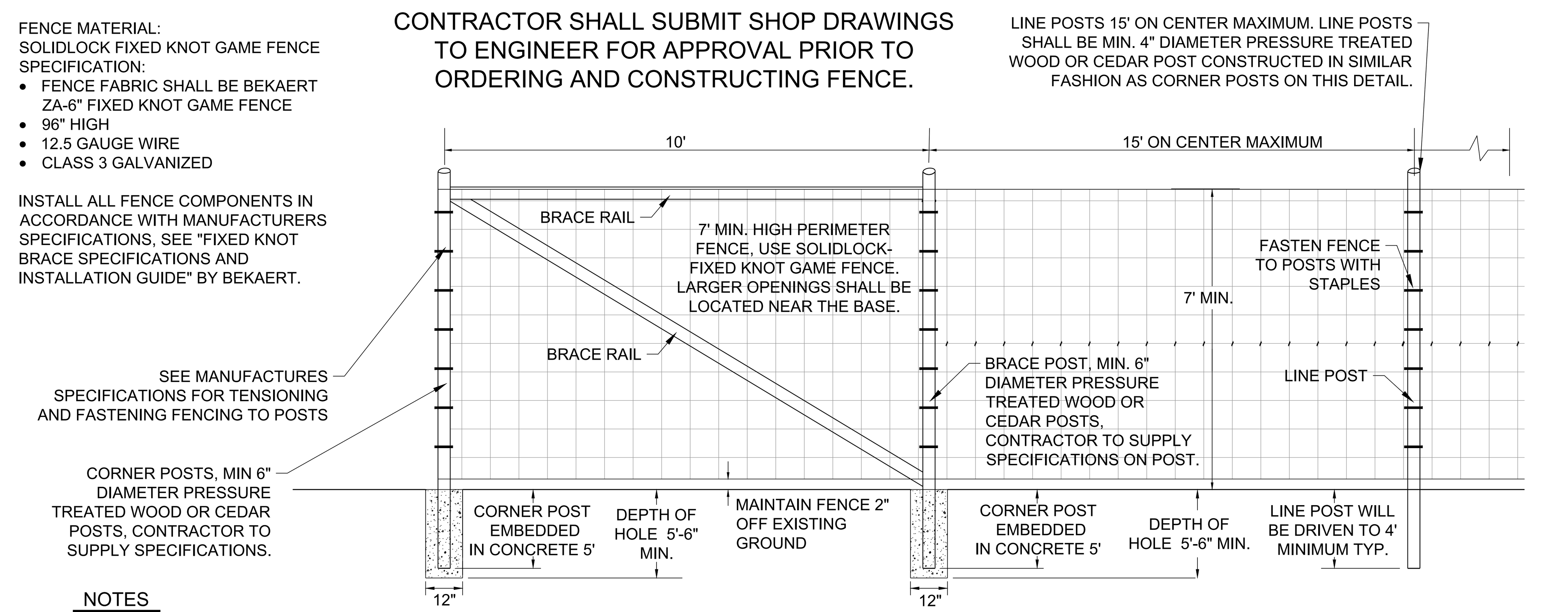
TESTING AND SUBMITTALS:

THE CONTRACTOR SHALL IDENTIFY THE LOCATION OF THE SOURCE OF EACH COMPONENT OF THE BASIN. ALL RESULTS OF FIELD AND LABORATORY TESTING SHALL BE SUBMITTED TO THE PROJECT ENGINEER FOR CONFIRMATION.

FENCE MATERIAL:
SOLIDLOCK FIXED KNOT GAME FENCE
SPECIFICATION:
- FENCE FABRIC SHALL BE BEKAERT ZA-6" FIXED KNOT GAME FENCE
- 96" HIGH
- 12.5 GAUGE WIRE
- CLASS 3 GALVANIZED

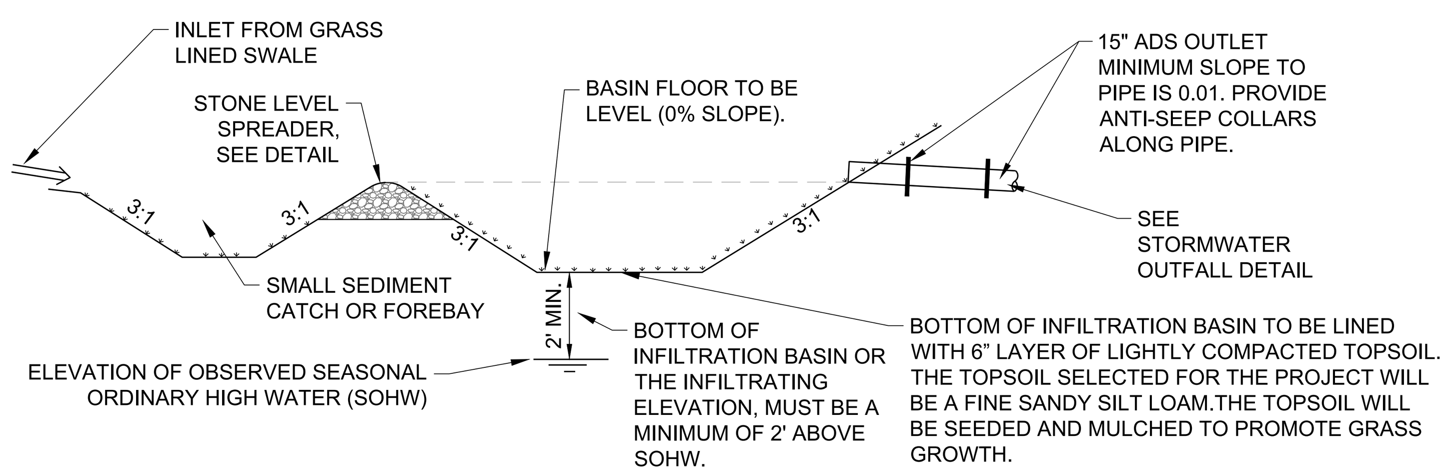
INSTALL ALL FENCE COMPONENTS IN ACCORDANCE WITH MANUFACTURERS SPECIFICATIONS, SEE "FIXED KNOT BRACE SPECIFICATIONS AND INSTALLATION GUIDE" BY BEKAERT.

CONTRACTOR SHALL SUBMIT SHOP DRAWINGS TO ENGINEER FOR APPROVAL PRIOR TO ORDERING AND CONSTRUCTING FENCE.



NOTES
1. ADDITIONAL BRACING MAY BE REQUIRED ON LONGER FENCE RUNS. CONTRACTOR TO ADD ADDITIONAL BRACING WHEN CONTRACTOR OBSERVES CORNER POST DEFLECTION DURING FENCE TENSINOING/FASTENING.
2. FABRIC TO BE FASTENED TO POSTS WITH STAPLES APPROVED BY THE ENGINEER.

TYPICAL FIXED KNOT GAME FENCE AROUND ARRAY (RENDERING)
N.T.S.



INFILTRATION BASIN SCHEDULE

IB ID	BOTTOM AREA PROVIDED (S.F.)	VOLUME PROVIDED (C.F.)	FINISH GRADE ELEV. (FT.)	INVERT FOR PIPE OUTLET ELEV. (FT.)	TOP OF POND ELEV. (FT.)
#1	±130	±2,310	92.0'	94.25'	95'

CROSS-SECTION OF INFILTRATION BASIN
N.T.S.

CONSTRUCTION OVERSIGHT NOTES

CONSTRUCTION SEQUENCE:

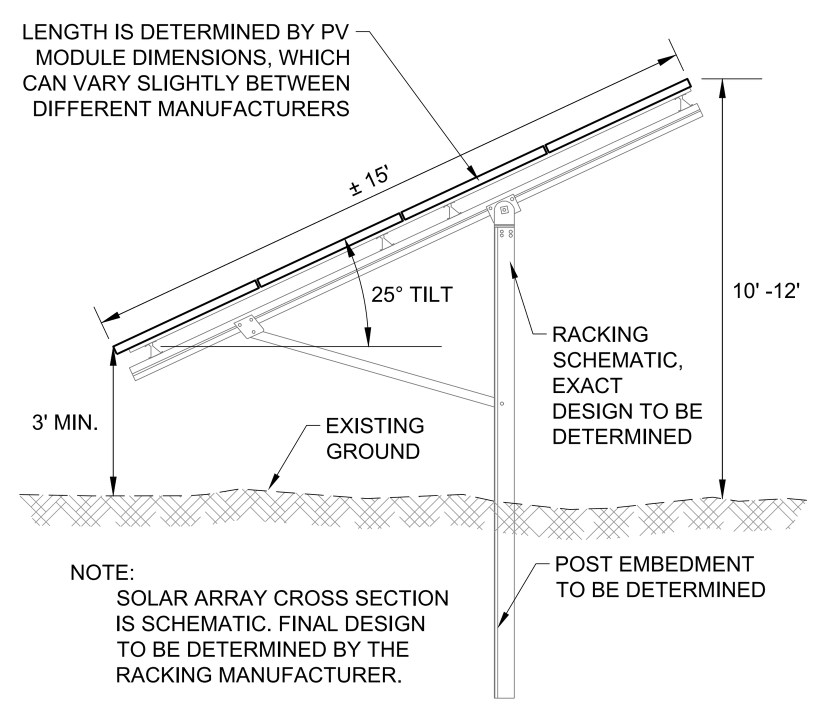
CONSTRUCTION CAN BE STARTED NO LATER THAN SEPTEMBER 1ST. IF SIDE SLOPES AND BANKS CANNOT BE REVEGETATED AND STABILIZED BY THE END OF THE GROWING SEASON, BASIN CONSTRUCTION SHOULD BE DELAYED TO THE FOLLOWING GROWING SEASON. SEEDING MUST OCCUR BEFORE SEPTEMBER 15TH OR OTHER STABILIZATION MEASURES MUST BE IMPLEMENTED BEFORE WINTER. DO NOT DISCHARGE STORMWATER TO THE BASIN UNTIL THE BASIN IS FULLY STABILIZED OR PROVIDES A SEDIMENT BARRIER AT THE OUTLET.

CONSTRUCTION OVERSIGHT:

- EMBANKMENT FILLS SHALL BE FREE OF FROZEN SOIL, ROCKS OVER 6", SOD, BRUSH STUMPS, TREE ROOTS, WOOD, OR OTHER PERISHABLE MATERIALS. EMBANKMENT FILLS SHALL BE COMPACTED USING METHODS THAT WOULD GUARANTEE A FILL DENSITY OF 90% OF THE MAXIMUM DENSITY AS DETERMINED BY STANDARD PROCTOR (ASTM-698). FILLS SHALL BE CONSTRUCTED IN 12" LIFTS.
- ALL AREAS OF CONCENTRATED FLOW IN OR OUT OF THE BASIN ARE TO BE ARMORED IN STONE RIP-RAP. STONE SHALL MEET THE SPECIFICATIONS OF MA-DOT M2.01.7 OR APPROVED EQUAL.
- ALL THE MATERIAL USED FOR THE CONSTRUCTION OF THE BASIN MUST BE CONFIRMED AS SUITABLE BY THE DESIGN ENGINEER.
- INSPECTION OF THE INFILTRATION BASIN CONSTRUCTION SHALL BE PERFORMED BY A PROFESSIONAL ENGINEER. INSPECTION SHALL INCLUDE MATERIAL AND PLACEMENT, FROM INITIAL GROUND DISTURBANCE TO FINAL STABILIZATION OF THE POND SIDESLOPES. INSPECTIONS SHALL INCLUDE WITNESSING THE INSTALLATION OF ALL INLET AND OUTLET PIPES, OUTLET STRUCTURES, BERMS, AND EMERGENCY SPILLWAYS.

TESTING AND SUBMITTALS:

THE CONTRACTOR SHALL IDENTIFY THE LOCATION OF THE SOURCE OF EACH COMPONENT OF THE BASIN. ALL RESULTS OF FIELD AND LABORATORY TESTING SHALL BE SUBMITTED TO THE PROJECT ENGINEER FOR CONFIRMATION.

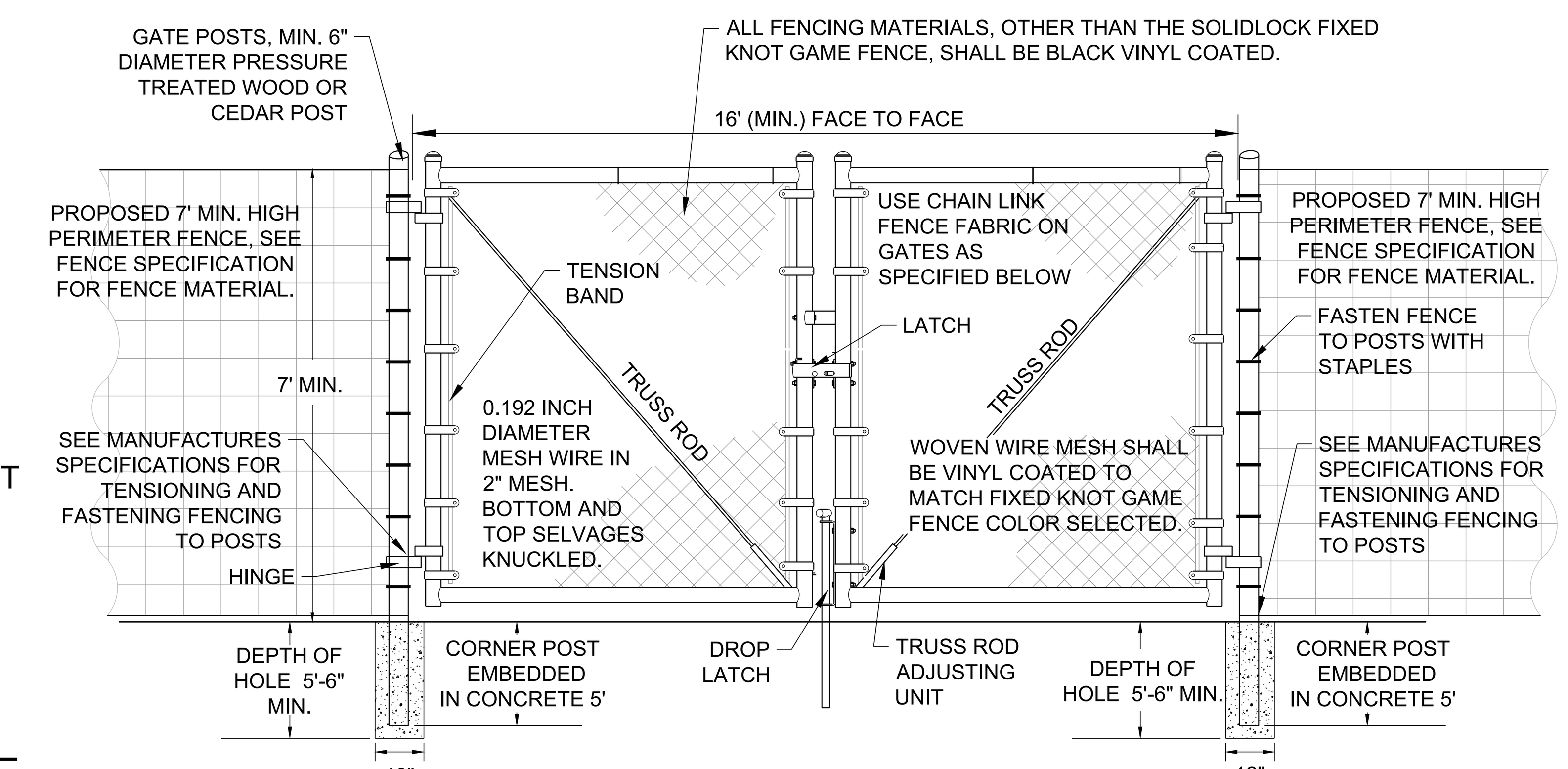


NOTE:
SOLAR ARRAY CROSS SECTION IS SCHEMATIC. FINAL DESIGN TO BE DETERMINED BY THE RACKING MANUFACTURER.

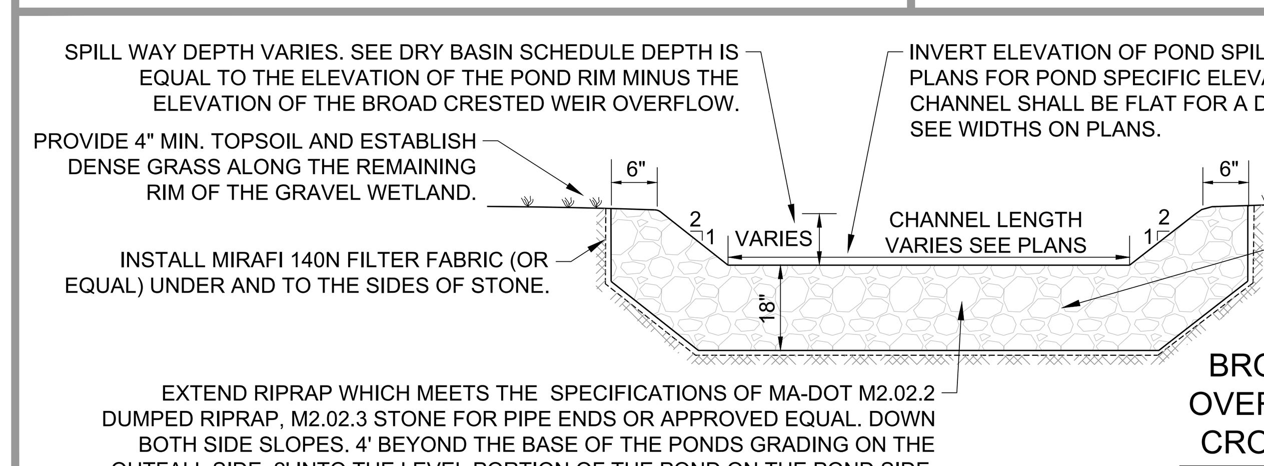
TYPICAL SOLAR ARRAY CROSS SECTION (RENDERING)
N.T.S.

NOTES
1. PAINT ALL GALVANIZED PIPE AND FITTINGS TO MATCH SOLIDLOCK FIXED KNOT GAME FENCE. PAINT SHALL BE SUITABLE FOR USE ON GALVANIZED SURFACES.
2. EMERGENCY CONTACT SIGN SHALL BE PLACED ON THE GATE, WHICH IDENTIFIES THE PROJECT OWNER AND PROVIDES A 24-HOUR EMERGENCY CONTACT PHONE NUMBER.

CONTRACTOR SHALL SUBMIT SHOP DRAWINGS TO ENGINEER FOR APPROVAL PRIOR TO ORDERING AND CONSTRUCTING FENCE.



DOUBLE SWING GATE (RENDERING)
N.T.S.



BROAD CRESTED WEIR OVERFLOW OR SPILLWAY CROSS SECTION DETAIL
N.T.S.

FREETOWN PLANNING BOARD APPROVAL

DATE

COSTA SOLAR
Costa Drive
Freetown, Massachusetts

IRONWOOD RENEWABLES

BIODIVERSITY RESEARCH INSTITUTE

KREBS & LANSING CONSULTING ENGINEERS

ISSUED FOR PERMIT REVIEW
NOT FOR CONSTRUCTION

CIVIL ENGINEER:
Krebs and Lansing Consulting Engineers, Inc.
164 Main Street, Suite 201
Colchester, Vermont 05446

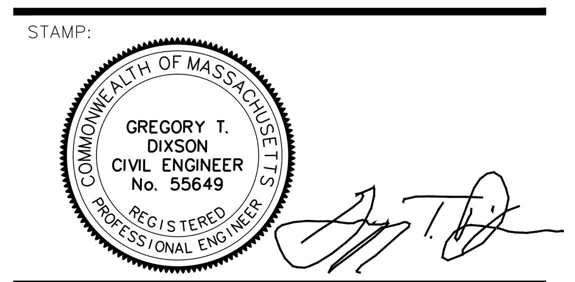
ENVIRONMENTAL:
BRI Environmental
30 Danforth Street, Suite 213
Portland, ME 04101

APPLICANT:
Costa Solar LLC
Ironwood Renewables, LLC c/o Adrian Ortlieb
P.O. Box 51794
Lafayette, LA 70505
(p) (337) 412-9199

OWNER & PROPERTY INFORMATION:

East Property Owner:	Estate of Anthony N Costa
Owner Address:	5226 Townsend Avenue Los Angles, CA 90041
Parcel ID:	241-53-0
Parcel Address:	5 Costa Drive Freetown, MA 02717
West Property Owner:	Michael & Karen Costa
Owner Address:	5226 Townsend Avenue Los Angles, CA 90041
Parcel ID:	247-6-0
Parcel Address:	0-Rear Costa Drive Freetown, MA 02717

STAMP:



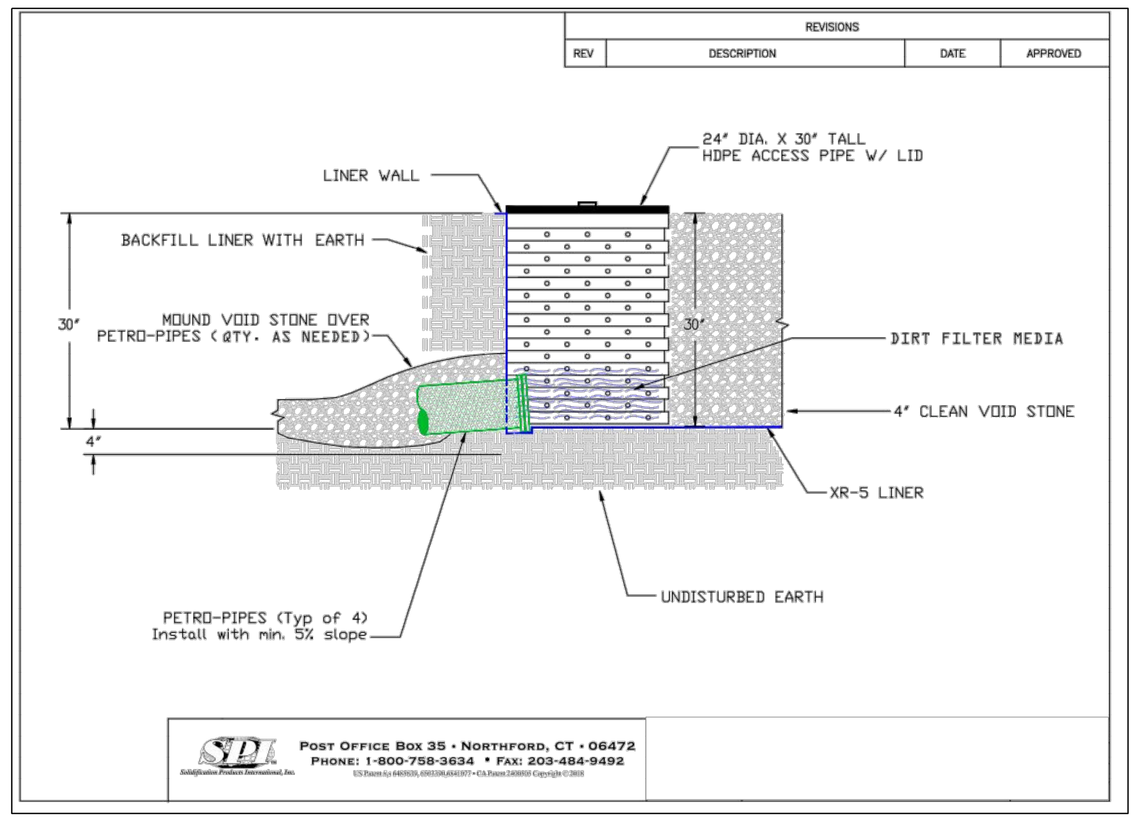
REV. NO.	REVISIONS/COMMENTS	DATE
1.	Updates for Planning Board submission	11/17/21

DRAWING TITLE:

COSTA SOLAR
DETAILS

DATE of Issue: 11/08/2021
Drawn by: EJM/GTD Checked by: GTD
Project No.: 21223 Scale: N/A
Drawing No.: C-3.03 Rev No.: 1

FOR USE BY THE REGISTRY OF DEEDS OF THE COMMONWEALTH OF MASSACHUSETTS



NOTE: EXACT EQUIPMENT HAS NOT BEEN DETERMINED AT THIS TIME. SOLAR TECHNOLOGY IS AN EVOLVING FIELD AND THE CONSTRUCTION DATE FOR THIS PROJECT COULD BE YEARS OUT. PROJECT ENGINEERS WILL EVALUATE EQUIPMENT PURCHASED FOR CONSTRUCTION AND MAKE SURE IT MEETS THE SPECIFICATIONS BELOW.

VOLUME CALCULATIONS:

REQUIRED CAPACITY:
125% OF THE 500 GALLONS OF TRANSFORMER OIL = 625 GAL. = 84 C.F.

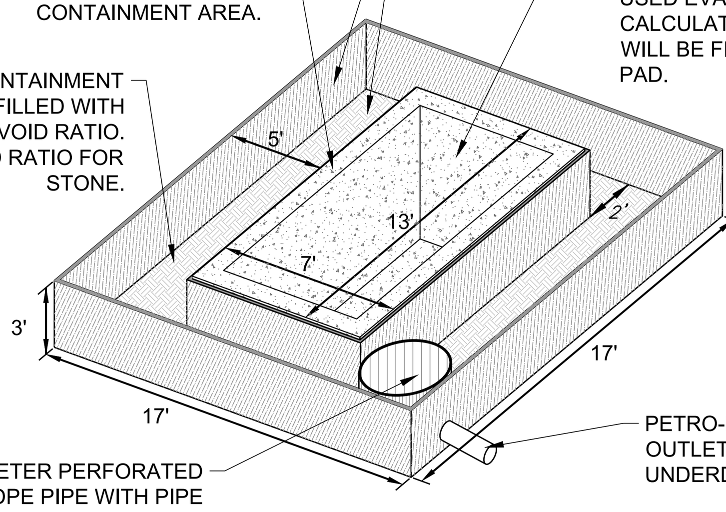
REQUIRED MINIMUM FREEBOARD
(24-HOUR DURATION, 25 YEAR STORM) = 6.02" (0.50')
CONTAINMENT AREA & PAD = 17' X 17' = 289 S.F.
VOLUME OF FREEBOARD REQUIRED = 289 S.F. X 0.50 FT. = 145C.F.

TOTAL CAPACITY REQUIRED = 84 C.F. + 145 C.F. = 229 C.F.

CAPACITY PROVIDED IN SECONDARY OIL CONTAINMENT SYSTEM:
AREA OF CONTAINMENT = (17'X17') - (13'X7') = 198 S.F.
VOLUME OF CONTAINMENT = 198 S.F. X 3.0' OF DEPTH = 594 C.F.
WHEN FILLED WITH STONE WITH 45% VOID RATIO = 594 C.F. * 0.45 = 267 C.F.
TOTAL CAPACITY PROVIDED = 267 C.F. > 229 C.F. REQUIRED

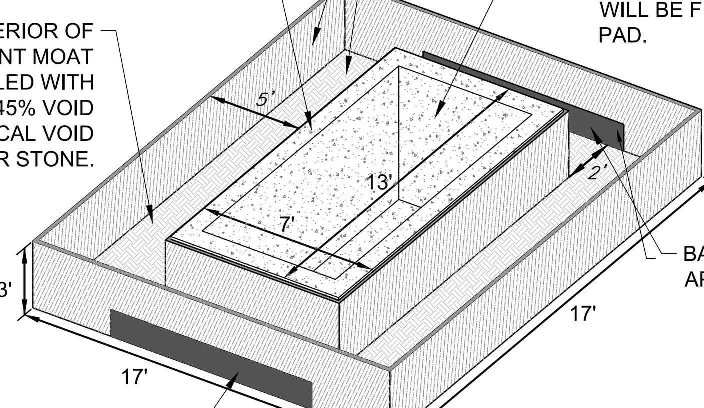
NOTE:

1. THE O&M FIRM WILL REVIEW THE INSTALLATION FOR SAFETY AND CODE COMPLIANCE (BY THE APPROPRIATE QUALIFIED LICENSED MECHANICAL AND ELECTRICAL PROFESSIONALS), ACCURATE AND UP TO DATE REPORTING INFORMATION AND UPDATES REQUIRED. PLEASE NOTE THAT KREBS AND LANSING CONSULTING ENGINEERS, INC. WORK PERTAINS TO THE STORMWATER CONTROLS ONLY. THE SAFETY AND CODE COMPLIANCE PORTION OF THE DESIGN AND REVIEW SHALL BE COMPLETED BY THE APPROPRIATE LICENSED MECHANICAL AND ELECTRICAL PROFESSIONALS (ENGINEERS) HIRED BY THE O&M FIRM PRIOR TO CONSTRUCTION OF THE PROJECT. ANY APPROPRIATE CODE OR SAFETY MODIFICATIONS DICTATED BY THAT REVIEW SHALL BE INCORPORATED INTO O&M PROTOCOLS FOR THE SITE PRIOR TO CONSTRUCTION COMMENCING.
2. THIS DESIGN ASSUMES THAT ALL PENETRATIONS THROUGH THE CONCRETE BASE OF THE TRANSFORMER VAULT COVER WILL BE SEALED. IF PENETRATIONS ARE NOT SEALED CONTRACTOR MUST MAKE BOTTOM OF THE TRANSFORMER VAULT SUMP WATER TIGHT OR INSTALL AN OIL REACTIVE PLUG IN ALL VAULT DRAINS, "PETRO PLUG" OR APPROVED EQUAL.
3. THIS DESIGN IS FOR A 2,000 KVA PAD MOUNTED TRANSFORMER BY COOPER POWER SYSTEMS, FILLED WITH 500 GALLONS OF FLUID.
4. SECONDARY OIL CONTAINMENT WILL BE REVIEWED PRIOR TO INSTALLATION AND DESIGNED SPECIFICALLY FOR THE EQUIPMENT BEING INSTALLED. EQUIPMENT MANUFACTURER MAY PROVIDE THEIR OWN SECONDARY OIL CONTAINMENT. CONTAINMENT DESIGN WILL NEED TO BE REVIEWED BY THE ENGINEER AND FIT THE STATE SPECIFIED VOLUME.



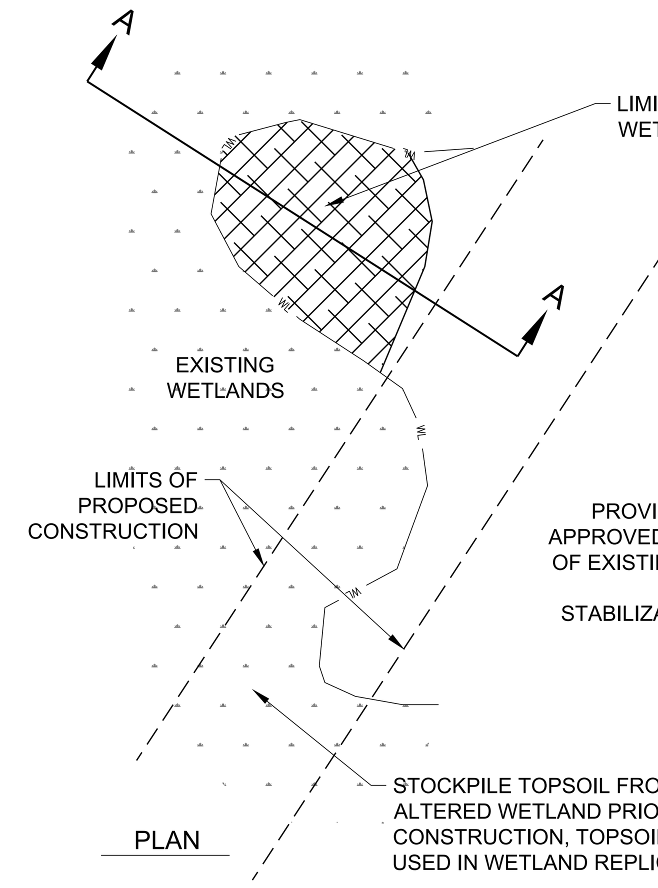
OPTION A
SCHEMATIC OF CONTAINMENT
N.T.S.

OR

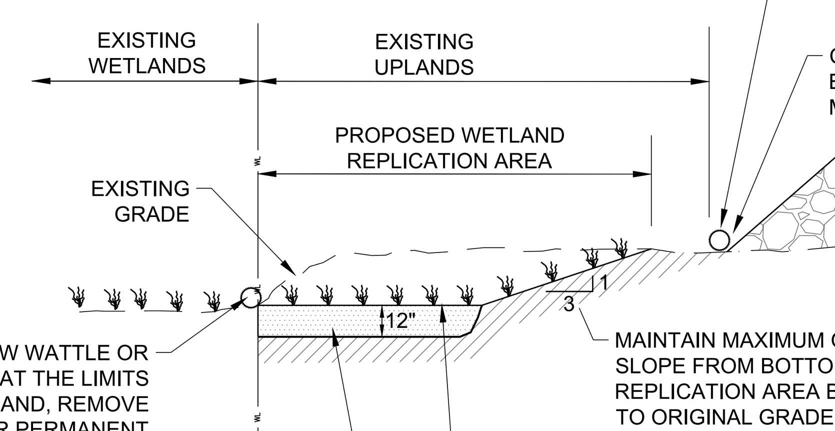


OPTION B
SCHEMATIC OF CONTAINMENT
N.T.S.

TYPICAL SECONDARY OIL CONTAINMENT DESIGN FOR 1,500 kVA TO 2,000 kVA TRANSFORMERS
N.T.S.



PLAN



SECTION A-A

TYPICAL PLANT SPECIES WHICH COULD BE INCLUDED IN A NEW ENGLAND WETLAND SEED MIX:

SEED
CAREX VULPINOIDEA (FOX SEDGE)
CAREX SCOPARIA (BLUNT BROOM SEDGE)
CAREX LURIDA (LURID SEDGE)
CAREX LUPULINA (HOP SEDGE)
POA PALUSTRIS (FOWL BLUEGRASS)
BIDENS FRONDOSA (BEGGAR TICKS)
SCIRPUS ATROVIRENS (GREEN BULRUSH)
ASCLEPIAS INCARNATA (SWAMP MILKWEED)
CAREX CRINITA (FRINGE SEDGE)
VERNONIA NOVEBORACENSIS (NEW YORK IRONWEED)
JUNCUS EFFUSUS (SOFT RUSH)
ASTER LATERIFLORUS (STARVED ASTER)
SYMPHYOTRICHUM LATERIFLORUS (CALICO ASTER)
IRIS VERSICOLOR (BLUE FLAG)
GLYCERIA GRANDIS (AMERICAN MANNAGRASS)
MIMULUS RINGENS (SQUARE STEMMED MONKEY FLOWER)
EUPATORIUM MACULATUM (SPOTTED JOE PYE WEED)

*SPECIFICATION FROM *NEW ENGLAND WETLAND PLANTS, INC.* - AMHERST MASSACHUSETTS

WETLAND REPLICATION AREA
N.T.S.

FREETOWN PLANNING BOARD APPROVAL

DATE

COSTA SOLAR
Costa Drive
Freetown, Massachusetts

IRONWOOD RENEWABLES

BIODIVERSITY RESEARCH INSTITUTE

KREBS & LANSING CONSULTING ENGINEERS

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CIVIL ENGINEER:
Krebs and Lansing Consulting Engineers, Inc.
164 Main Street, Suite 201
Colchester, Vermont 05446

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BRI Environmental
30 Danforth Street, Suite 213
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APPLICANT:
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Parcel ID:	247-6-0
Parcel Address:	0-Rear Costa Drive Freetown, MA 02717

STAMP:
COMMONWEALTH OF MASSACHUSETTS
GREGORY T. DIXSON
CIVIL ENGINEER
No. 55649
REGISTERED PROFESSIONAL ENGINEER

REV. NO.	REVISIONS/COMMENTS	DATE
1.	Updates for Planning Board submission	11/17/21

DRAWING TITLE:
COSTA SOLAR DETAILS

DATE of Issue: 11/08/2021
Drawn by: EJM/GTD Checked by: GTD
Project No.: 21223 Scale: N/A
Drawing No.: C-3.04 Rev No.: 1

Attachment 4

Impact Statements

Impact Statements

A. Traffic Impact Assessment

The Project is proposing the construction of a private gravel access drive extending off of Costa Drive to access the proposed solar array and battery system. For safety and security reasons the Site will be inaccessible the public. Manual barrier swing gates along the road will limit pedestrian/unauthorized access. Gates will be located near the access drive entrance from Costa Drive, at the entrance to the proposed Battery Energy Storage System (BESS), at the entrance to the solar arrays, and on each side of the railroad crossing that bisects the Project parcels. Each gate will be equipped with a Knox Box for emergency personnel access and a sign displaying 24-hour emergency contact information.

During operations, traffic will be minimal to non-existent. A technician may visit the site for routine maintenance no more than once per month. The access drive is designed for single lane travel, which is all that is necessary for the Project, and allows the road size to be minimized to reduce environmental impacts and visual impacts to the surrounding properties. Several pullovers will allow for parking or passage of multiple vehicles, if necessary. No significant change to traffic on Costa Drive or nearby roads is expected as a result of Project operations.

B. Environmental Impact Assessment

The Project has been designed to avoid and minimize adverse environmental impacts to the greatest extent practicable. A formal wetland delineation, performed in accordance with Delineating Bordering Vegetated Wetlands Under the Massachusetts Wetland Protection Act (1995), has informed Project design. Several on-site wetland resources were identified, including four Bordering Vegetated Wetlands (BVWs). The Project proposes 2,665 square feet of alteration to a BVW and 16 linear feet of Bank alteration to construct a road crossing over an intermittent stream.

The Project proposes to provide replication for the altered wetland greater than a 1:1 ratio in compliance with 310 CMR 10.55 and has filed a Notice of Intent with the Freetown Conservation Commission and the Massachusetts Department of Environmental Protection. Replication will be located in the same general area of the wetland system as the altered area and will provide unrestricted hydraulic access to the same contiguous BVW system. The Project proposes to reestablish a minimum of 75 percent of the surface of the replication area with indigenous wetland plant species within two growing seasons. No significant alteration to the groundwater surface elevation is expected to result from the replication effort. Additionally, the proposed alterations will have no adverse effect on habitat sites within the Natural Heritage & Endangered Species Program (NHESP) Estimated or Priority Habitat.

Alteration to the intermittent stream includes a proposed open bottom box culvert. The installation of this crossing will include no work within the stream channel or the existing Bank, and should not impair the stability of the Bank. The crossing has been designed to comply with the Massachusetts Stream Crossing Standards and has enough water carrying capacity for a 100-year 24-hour flood event. The selection of the open box culvert crossing will allow for a natural substrate to be maintained. Water depth and velocity will be comparable to those found in the natural channel at a variety of flows, and thus the culvert should not impair the Bank's ability to provide breeding habitat, cover, and food for fisheries.

The Project has been designed with stormwater management systems that meet or exceed the State of Massachusetts Department of Environmental Protection's (MassDEP) Stormwater Management Standards.

The majority of the Site will consist of an undeveloped meadow underneath the solar arrays. The meadow will self-treat stormwater and runoff from these areas is not considered contaminated by the MassDEP. The majority of runoff from the proposed impervious surfaces—mainly the gravel access road and concrete equipment pads—will be collected in grassed channels and conveyed to level lip spreaders or sediment forebays. These will pre-treat runoff prior to flowing into further stormwater management systems or off-site, in line with Best Management Practices (BMPs). The Project also has proposed two basins which have volumes large enough to keep water on-site during large storms and reduce peak runoff flows.

During construction, the Project will use Best Management Practices to control erosion and sedimentation on-site, including perimeter controls and a stabilized construction entrance. Construction of the Project will be phased such that no more than 5 acres of land are disturbed at any one time. Disturbed areas within the active construction area will be stabilized before a new phase of construction begins. Additionally, proposed Project transformers will use Envirotemp FR3 Fluid, a non-toxic bio-based natural ester dielectric. More details on the stormwater management systems, erosion and sedimentation BMPs, and spill prevention can be found in the Drainage Report prepared by Krebs & Lansing Consulting Engineers, which is included in **Attachment 10**.

C. Community Impact Assessment

The Project will provide clean, renewable energy to the local electric grid with minimal impact on municipal services, local character, neighboring properties, or intensity of land use. Once construction is finished, the Project will not use any water, and will not produce waste, wastewater, or sewage. Stormwater will be treated on-site by maintaining meadow vegetation underneath solar panels. As a passive project with no day-to-day personnel and only occasional visits for routine maintenance, the need for medical or police services will be minimal. The Project team has discussed emergency response plans with the Freetown Fire Department and the Project access roads will be built in accordance with their requests/specifications. The Project will contribute an increased tax base, which should have a positive impact on local schools.

As discussed above, the Project will be remotely monitored and traffic during Project operation will consist of only occasional visits for maintenance. There will be no on-site personnel, no daily visitors, and no parking areas will be required beyond the access road. The solar arrays will fit in with the character of the surrounding area, as there are existing solar projects to the north, east, and south of the Site, as well as nearby industrial facilities to the north and south. The solar panels will have a maximum height of about 12 feet, and Project visibility will be buffered from public view by surrounding vegetation.

Approximately 2,665 square feet of wetland alteration is unavoidable, and will be mitigated with 2,700 square feet of wetland replication. During Project construction, there will be a minor increase in traffic along Braley Road and Costa Drive. During Project operation, low-levels of sound will be produced by electrical transformers and the Battery Energy Storage System (BESS), but this equipment has been located on the Site to prevent noise impacts to adjacent properties. See the *Noise Impact Assessment* below for more information on anticipated noise levels.

D. Parking Impact Assessment

Due to the low traffic volume during Project operation, the Project does not propose the construction of any parking areas. The several turnarounds and vehicle pull-overs proposed along Project access roads will provide sufficient parking for maintenance vehicles. No vehicles will need to park in the off-site neighborhood, and there should be no impact on the off-site roadway infrastructure.

Emergency vehicles will be able to access Project equipment (solar arrays, equipment pads, and batteries) via the main Project access road and additional emergency access roads that run around the perimeter of each array. All Project gates will include a Knox Box to give access to emergency personnel.

E. Noise Impact Assessment

Project noise levels will be low and will not unreasonably interfere with the use and enjoyment of the adjacent or nearby properties. During construction of the Project, typical heavy equipment and hydraulic pile drivers for solar racking installation will be used. All noise levels from construction will occur between 10:00 p.m. and 7:00 a.m.

Some noise will be generated during normal operation of the Project, mostly from the proposed 2500-kVA transformers, and from the HVAC systems incorporated into the Battery Energy Storage System (BESS). The maximum operational noise levels generated at the nearest property line is expected to be less than the typical noise level of a private indoor office (50 dBA).

According to National Electrical Manufactures Association TR1 Standards for a 2500-kVA transformer, the typical sound level emitted by the transformer is 63 dBA at 33 feet. Sound levels emitted from the BESS system are expected to be between 64 and 70 dBA at 33 feet. As seen in the Site Plan, all transformers and the battery system will be centrally located within the Project area, or as distant as practicable from occupied dwellings, in order to minimize noise at property boundaries and abutting residences.

The Project equipment that will produce the highest noise levels will be the HVAC systems associated with the BESS. The nearest property boundary to the BESS is the lot owned by Sunpin Energy Services (Lot 246-051), located within the Industrial Zoning District. At 250 feet away, the maximum noise level at this property boundary would be 53 dBA. The nearest structure on a residential lot to the BESS is a shed on Lot 241-055. At 400 feet away, the maximum noise level at this shed would be approximately 49 dBA. The nearest property boundary to a transformer is approximately 120 feet (residential Lot 242-134). At this property boundary at the rear of the lot, the noise level would be approximately 52 dBA. For reference, 50 dBA is the typical indoor noise level of a private office.

Attachment 5

Municipal Lien Certificates

The Commonwealth of Massachusetts
Office of the Collector of Taxes
Town of Freetown
Municipal Lien Certificate

Number: 4647
7/6/2021

TOWN OF FREETOWN, MASS. INCORPORATED 1683

Ironwood Renewables
128 demanade Blvd
Lafayette,LA 70503

I Certify from available information that all taxes, assessments, and charges, now payable that constitute liens as of the date of this certificate on the parcel of real estate specified in your application received on 7/6/2021 are listed below:

DESCRIPTION OF PROPERTY

Parcel Identifier	247-6		Assessed Owner	COSTA MICHAEL J & KAREN C		
Account	883		Additional Owner			
Location of Property -REAR COSTA DR			Supposed Present Owner			
			Legal Reference		Book	8520
Acreage	36	Acres			Page	60
					Deed Date	8/15/2014

VALUATION

FY	Residential	Rate1	Open Space	Rate 2	Commercial	Rate 3	Industrial	Rate 4	Exempt
2022	109,400	12.70	0	0.00	0	20.63	0	20.63	0

ASSESSMENT

	2022 1st Quarter	2022 2nd Quarter	2022 3rd Quarter	2022 4th Quarter	FY 2021	FY 2020
Preliminary Tax	$347.35	$347.34	N/A	N/A	$680.95	$654.22
Actual Tax					$708.43	$707.67
Interest To Date	$0.00	$0.00			$0.00	$0.00
Credits					$1,389.38	$1,361.89
Interest Credit					$0.00	$0.00
Per Diem	$0.00	$0.00			$0.00	$0.00
Balance Due	$347.35	$347.34			$0.00	$0.00

Property Tax Interest Per Diem **$0.00**
Committed Tax Balance **$694.69**

PLANNING BOARD

All of the amounts listed above are to be paid to the Collector. I have no knowledge of any other lien outstanding.
INFORMATION ON THIS CERTIFICATE IS COMPLETE AS OF 7/6/2021

Janette Yozell
Jessica Thomas Collector of Taxes
Asst Collector

The Commonwealth of Massachusetts
Office of the Collector of Taxes
Town of Freetown
Municipal Lien Certificate

Number: 4648
7/6/2021

TOWN OF FREETOWN, MASS. INCORPORATED 1683

Ironwood Renewables
128 demanade Blvd
Lafayette,LA 70503

I Certify from available information that all taxes, assessments, and charges, now payable that constitute liens as of the date of this certificate on the parcel of real estate specified in your application received on 7/6/2021 are listed below:

DESCRIPTION OF PROPERTY

Parcel Identifier	241-53	Assessed Owner	COSTA ANTHONY N ESTATE OF		
Account	880	Additional Owner			
Location of Property	5 COSTA DR	Supposed Present Owner			
		Legal Reference		Book	2482
Acreage	14.84 Acres			Page	237
				Deed Date	6/4/1992

VALUATION

FY	Residential	Rate1	Open Space	Rate 2	Commercial	Rate 3	Industrial	Rate 4	Exempt
2022	176,900	12.70	0	0.00	0	20.63	0	20.63	0

ASSESSMENT

	2022 1st Quarter	2022 2nd Quarter	2022 3rd Quarter	2022 4th Quarter	FY 2021	FY 2020
Preliminary Tax	$561.66	$561.66	N/A	N/A	$1,106.05	$1,063.18
Actual Tax					$1,140.58	$1,148.92
Interest To Date	$0.00	$0.00			$0.00	$0.00
Credits					$2,246.63	$2,212.10
Interest Credit					$0.00	$0.00
Per Diem	$0.00	$0.00			$0.00	$0.00
Balance Due	$561.66	$561.66			$0.00	$0.00

Property Tax Interest Per Diem **$0.00**
Committed Tax Balance **$1,123.32**

PLANNING BOARD

All of the amounts listed above are to be paid to the Collector. I have no knowledge of any other lien outstanding.
INFORMATION ON THIS CERTIFICATE IS COMPLETE AS OF 7/6/2021

Linette Yornell
Asst Collector

Jessica Thomas Collector of Taxes

Attachment 6

Certified Abutters Lists

FORM E
CERTIFIED LIST OF ABUTTERS

July 9, 2021

To the Planning Board of the Town of Freetown:

The undersigned, being an applicant for approval of a DEFINITIVE plan of a proposed subdivision entitled Modification of Definitive Plan Overall Site Plan submits the following sketch of the land in the subdivision listing the names of the adjoining owners within three hundred feet (300') in their relative positions and indicating the address of each abutter on the sketch on in a separate list, including owners of land separated from the subdivision by a street.

____
Signature of Applicant

30 Danforth St, STE 213, Portland, ME 04101
Address

____
July 9, 2021
Date

To the Planning Board of the Town of Freetown:

This is to certify that at the time of the last assessment for the taxation made by the Town of Freetown, the names and addresses of the parties assessed as adjoining owners to the parcel of land shown above where as above written, except as follows:

____
Assessor

300 foot Abutters List Report

Freetown, MA
July 06, 2021

Subject Property:

Parcel Number:	241-053	Mailing Address:	COSTA ANTHONY N ESTATE OF
CAMA Number:	241-053		5226 TOWNSEND AVE
Property Address:	5 COSTA DR		LOS ANGELES, CA 90041

Abutters:

Parcel Number:	241-036	Mailing Address:	CHIPAWAY CORP
CAMA Number:	241-036		P O BOX 519
Property Address:	67 CHACE RD		E WAREHAM, MA 02538
Parcel Number:	241-052	Mailing Address:	ENCK ROBERT D JR & LINDA M
CAMA Number:	241-052		4 COSTA DR
Property Address:	4 COSTA DR		E FREETOWN, MA 02717
Parcel Number:	241-053.01	Mailing Address:	ROSE LARRY STEVEN TR LARRY
CAMA Number:	241-053.01		STEVE ROSE LIVING TRUST
Property Address:	3 COSTA DR		3 COSTA DR
			EAST FREETOWN, MA 02717
Parcel Number:	241-055	Mailing Address:	BOSSE JOSEPH A & AMY B
CAMA Number:	241-055		6 COSTA DR
Property Address:	6 COSTA DR		E FREETOWN, MA 02717
Parcel Number:	241-057	Mailing Address:	MELLO JOHN F
CAMA Number:	241-057		P O BOX 702
Property Address:	5 JANICE MARIE WAY		E FREETOWN, MA 02717
Parcel Number:	241-058	Mailing Address:	MELLO JOHN F
CAMA Number:	241-058		P O BOX 702
Property Address:	7 JANICE MARIE WAY		E FREETOWN, MA 02717
Parcel Number:	241-059	Mailing Address:	MELLO JOHN F
CAMA Number:	241-059		P O BOX 702
Property Address:	9 JANICE MARIE WAY		E FREETOWN, MA 02717
Parcel Number:	241-060	Mailing Address:	MELLO JOHN F
CAMA Number:	241-060		P O BOX 702
Property Address:	11 JANICE MARIE WAY		E FREETOWN, MA 02717
Parcel Number:	242-132	Mailing Address:	ARAUJO STEPHEN JOHN & ZEKIA MA
CAMA Number:	242-132		90 BRALEY RD
Property Address:	90 BRALEY RD		E FREETOWN, MA 02717
Parcel Number:	242-133	Mailing Address:	MEDEIROS-SOUSA ANDRE &
CAMA Number:	242-133		MAGDALENE M SOUSA
Property Address:	86 BRALEY RD		86 BRALEY RD
			E FREETOWN, MA 02717

300 foot Abutters List Report

Freetown, MA
July 06, 2021

Parcel Number:	242-134	Mailing Address:	MARTIN JONATHAN & CHARLES 84 BRALEY RD E FREETOWN, MA 02717
CAMA Number:	242-134		
Property Address:	84 BRALEY RD		
Parcel Number:	242-135	Mailing Address:	COSTA JOSEPH JR & NATALIE M 82 BRALEY RD E FREETOWN, MA 02717
CAMA Number:	242-135		
Property Address:	82 BRALEY RD		
Parcel Number:	246-051	Mailing Address:	SUNPIN ENERGY SERVICES 2020 MAIN ST IRVINE, CA 92614
CAMA Number:	246-051		
Property Address:	112 BRALEY RD		
Parcel Number:	246-055	Mailing Address:	MENDOZA CAROLYN C TRUSTEE CATAUMET FAMILY TRUST 9 BILLY MITCHELL DRIVE E FALMOUTH, MA 02536
CAMA Number:	246-055		
Property Address:	98 BRALEY RD		
Parcel Number:	246-056	Mailing Address:	COSTA JOHN B 94 BRALEY ROAD E FREETOWN, MA 02717
CAMA Number:	246-056		
Property Address:	94 BRALEY RD		
Parcel Number:	247-006	Mailing Address:	COSTA MICHAEL J & KAREN C 5226 TOWNSEND AV LOS ANGELES, CA 90041
CAMA Number:	247-006		
Property Address:	0 REAR COSTA DR		
Parcel Number:	247-007	Mailing Address:	SUNPIN ENERGY SERVICES 2020 MAIN ST STE 300 IRVINE, CA 92614
CAMA Number:	247-007		
Property Address:	112 REAR BRALEY RD		
Parcel Number:	253-030	Mailing Address:	CSX TRANSPORTATION INC TAX DEPARTMENT J910 500 WATER ST JACKSONVILLE, FL 32202
CAMA Number:	253-030		
Property Address:	0 NORTH BRALEY CROSS		

Michael T. McCue

7/6/2021

300 foot Abutters List Report

Freetown, MA
July 06, 2021

Subject Property:

Parcel Number:	247-006	Mailing Address:	COSTA MICHAEL J & KAREN C
CAMA Number:	247-006		5226 TOWNSEND AV
Property Address:	0 REAR COSTA DR		LOS ANGELES, CA 90041

Abutters:

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CAMA Number:	241-036		P O BOX 519
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Parcel Number:	241-053	Mailing Address:	COSTA ANTHONY N ESTATE OF
CAMA Number:	241-053		5226 TOWNSEND AVE
Property Address:	5 COSTA DR		LOS ANGELES, CA 90041
Parcel Number:	241-060	Mailing Address:	MELLO JOHN F
CAMA Number:	241-060		P O BOX 702
Property Address:	11 JANICE MARIE WAY		E FREETOWN, MA 02717
Parcel Number:	242-134	Mailing Address:	MARTIN JONATHAN & CHARLES
CAMA Number:	242-134		84 BRALEY RD
Property Address:	84 BRALEY RD		E FREETOWN, MA 02717
Parcel Number:	242-135	Mailing Address:	COSTA JOSEPH JR & NATALIE M
CAMA Number:	242-135		82 BRALEY RD
Property Address:	82 BRALEY RD		E FREETOWN, MA 02717
Parcel Number:	246-051	Mailing Address:	SUNPIN ENERGY SERVICES
CAMA Number:	246-051		2020 MAIN ST
Property Address:	112 BRALEY RD		IRVINE, CA 92614
Parcel Number:	247-007	Mailing Address:	SUNPIN ENERGY SERVICES
CAMA Number:	247-007		2020 MAIN ST STE 300
Property Address:	112 REAR BRALEY RD		IRVINE, CA 92614
Parcel Number:	252-001	Mailing Address:	CHIPAWAY CORP
CAMA Number:	252-001		P O BOX 519
Property Address:	0 REAR CHIPAWAY RD		E WAREHAM, MA 02538
Parcel Number:	253-030	Mailing Address:	CSX TRANSPORTATION INC TAX
CAMA Number:	253-030		DEPARTMENT J910
Property Address:	0 NORTH BRALEY CROSS		500 WATER ST
			JACKSONVILLE, FL 32202

Michael T. McCue

7/6/2021

Attachment 7

Certificate of Liability Insurance

HOSRESO-01 SLAVERGNE

CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YYYY): 11/16/2021

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AFFIRMATIVELY OR NEGATIVELY AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW. THIS CERTIFICATE OF INSURANCE DOES NOT CONSTITUTE A CONTRACT BETWEEN THE ISSUING INSURER(S), AUTHORIZED REPRESENTATIVE OR PRODUCER, AND THE CERTIFICATE HOLDER.

IMPORTANT: If the certificate holder is an ADDITIONAL INSURED, the policy(ies) must have ADDITIONAL INSURED provisions or be endorsed. If SUBROGATION IS WAIVED, subject to the terms and conditions of the policy, certain policies may require an endorsement. A statement on this certificate does not confer rights to the certificate holder in lieu of such endorsement(s).

PRODUCER
Thomson Smith & Leach Insurance Group
210 Rue Fontaine
Lafayette, LA 70508

CONTACT NAME: Shelby Lavergne
PHONE (A/C, No, Ext): (337) 889-0714 FAX (A/C, No): (337) 262-0435
E-MAIL ADDRESS: slavergne@tslins.com

INSURER(S) AFFORDING COVERAGE	NAIC #
INSURER A : StarStone Specialty Insurance Company	44776
INSURER B : LA Workers Compensation Corporation	22350
INSURER C :	
INSURER D :	
INSURER E :	
INSURER F :	

INSURED
Ironwood Renewables, LLC
PO Box 51794
Lafayette, LA 70505

COVERAGES CERTIFICATE NUMBER: REVISION NUMBER:

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

INSR LTR	TYPE OF INSURANCE	ADDL INSD	SUBR WVD	POLICY NUMBER	POLICY EFF (MM/DD/YYYY)	POLICY EXP (MM/DD/YYYY)	LIMITS	
A	X COMMERCIAL GENERAL LIABILITY; CLAIMS-MADE; X OCCUR; GEN'L AGGREGATE LIMIT APPLIES PER: X POLICY; PRO-JECT; LOC; X OTHER: $1,000 Deductible			57338E214AEM	1/26/2021	1/26/2022	EACH OCCURRENCE	$ 1,000,000
							DAMAGE TO RENTED PREMISES (Ea occurrence)	$ 50,000
							MED EXP (Any one person)	$ 5,000
							PERSONAL & ADV INJURY	$ 1,000,000
							GENERAL AGGREGATE	$ 2,000,000
							PRODUCTS - COMP/OP AGG	$ 2,000,000
								$
A	AUTOMOBILE LIABILITY; ANY AUTO; OWNED AUTOS ONLY; SCHEDULED AUTOS; X HIRED AUTOS ONLY; X NON-OWNED AUTOS ONLY			57338E214AEM	1/26/2021	1/26/2022	COMBINED SINGLE LIMIT (Ea accident)	$ 1,000,000
							BODILY INJURY (Per person)	$
							BODILY INJURY (Per accident)	$
							PROPERTY DAMAGE (Per accident)	$
								$
A	X UMBRELLA LIAB; X OCCUR; EXCESS LIAB; CLAIMS-MADE; DED; RETENTION $			K86770212AEM	1/26/2021	1/26/2022	EACH OCCURRENCE	$ 1,000,000
							AGGREGATE	$
								$
B	WORKERS COMPENSATION AND EMPLOYERS' LIABILITY Y/N; ANY PROPRIETOR/PARTNER/EXECUTIVE OFFICER/MEMBER EXCLUDED? (Mandatory in NH) Y; If yes, describe under DESCRIPTION OF OPERATIONS below	N / A		160142-S	2/1/2021	2/1/2022	X PER STATUTE; OTH-ER	
							E.L. EACH ACCIDENT	$ 1,000,000
							E.L. DISEASE - EA EMPLOYEE	$ 1,000,000
							E.L. DISEASE - POLICY LIMIT	$ 1,000,000
A	Professional Liab			57338E214AEM	1/26/2021	1/26/2022	$1,000 deductible	1,000,000

DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES (ACORD 101, Additional Remarks Schedule, may be attached if more space is required)
Adrian Ortileb, James Supple and Thomas Hovis are excluded from Workers Comp. policy

CERTIFICATE HOLDER
Town of Freetown
3 North Main Street
PO Box 438
Assonet, MA 02702

CANCELLATION
SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, NOTICE WILL BE DELIVERED IN ACCORDANCE WITH THE POLICY PROVISIONS.

AUTHORIZED REPRESENTATIVE

AGENCY CUSTOMER ID: HOSRESO-01 SLAVERGNE

LOC #: 1

ADDITIONAL REMARKS SCHEDULE

AGENCY Thomson Smith & Leach Insurance Group		NAMED INSURED Ironwood Renewables, LLC PO Box 51794 Lafayette, LA 70505
POLICY NUMBER SEE PAGE 1		
CARRIER SEE PAGE 1	NAIC CODE SEE P 1	EFFECTIVE DATE: SEE PAGE 1

ADDITIONAL REMARKS

THIS ADDITIONAL REMARKS FORM IS A SCHEDULE TO ACORD FORM,

FORM NUMBER: ACORD 25 FORM TITLE: Certificate of Liability Insurance

Additional Coverage Information:
General Liability:
Blanket Additional Insured Owners, Lessees or Contracters, Included Completed operations as required by written contract
Blanket Primary non contributory as required by written contract
Blanket Waiver of Subrogation Provided if required by written contract

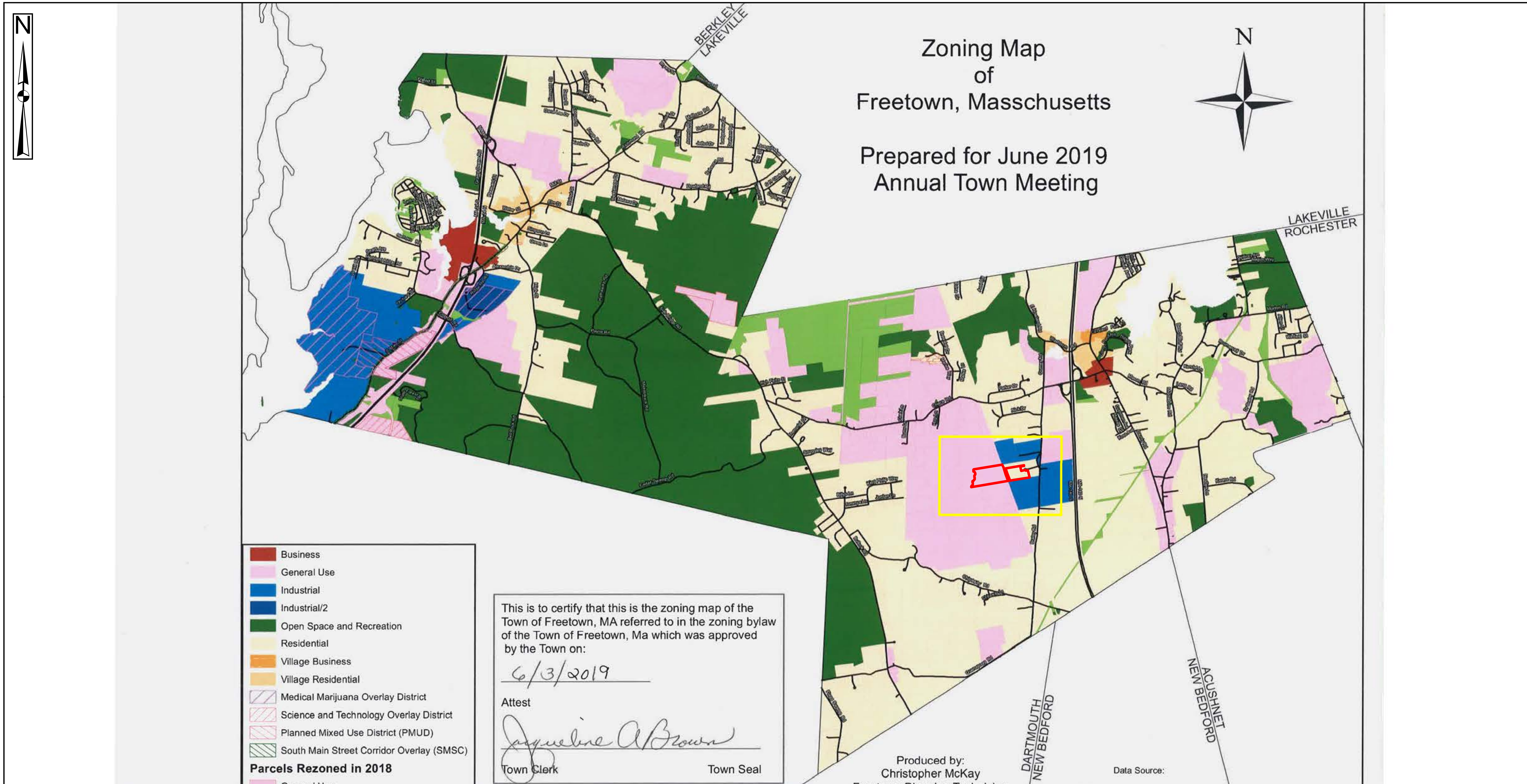
Pollution Liability:
Blanket Additional Insured Owners, Lessees or Contracters, Included Completed operations as required by written contract
Blanket Primary non contributory as required by written contract

Errors and Omissions Liability:
Blanket Additional Insured Owners, Lessees or Contracters, Included Completed operations as required by written contract

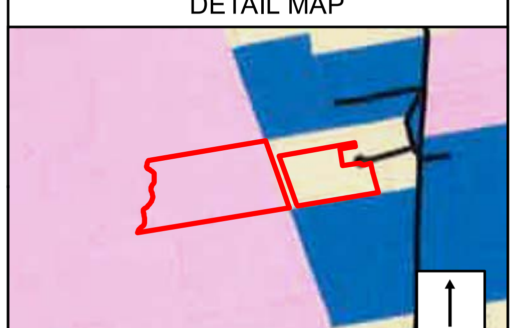
Umbrella Policy follows form with Underlying General Liability, Professional Liability, Hired & Non-owned Auto Liability and Workers Comp.

Attachment 8

Project Zoning



DETAIL MAP



LEGEND

Project Survey Boundary

Biodiversity Research Institute
innovative wildlife science

IRONWOOD RENEWABLES

SCALE:
0 5,000 10,000 Feet
1 inch = 5,000 feet

ZONING DISTRICT MAP
COSTA SOLAR: FREETOWN MASSACHUSETTS

NOVEMBER 17, 2021

TOWN OF FREETOWN
OFFICE OF THE
BUILDING COMMISSIONER
3 North Main Street
P.O. Box 438 - Assonet, Massachusetts 02702
Tel. (508) 644-2202
Fax (508) 644-2183

FEE: $50.00

APPLICATION FOR ZONING DETERMINATION

SECTION 1- PROPERTY OWNERSHIP/AUTHORIZATION AGENT

Property Owner

Name: Michael & Karen Costa; and the Estate of Anthony N Costa

Address: 5226 Townsend Ave, Los Angeles, CA 90041

Telephone: ______________

Person making request

Name: Dale Knapp

Address: 30 Danforth Street, Suite 213, Portland, ME 04101

Telephone: 207-631-9134

Email: dale.knapp@brienvironmental.org

Section 2 - Site Information

1. Property Address: See Supplement

2. Assessors Map & Parcel Number
   - Map #: See Supplement
   - Parcel #: See Supplement

3. Zoning Information:
   - Zoning District: See Supplement
   - Proposed Use: Solar Energy Facility

4. Property Dimensions:
   - Lot Area (sf): See Supplement
   - Frontage (ft): See Supplement

5. When Was Lot Created: See Supplement

Section 3 - Building Setbacks (ft)

Front Yard		Side Yards		Rear Yards	
Required	Provided	Required	Provided	Required	Provided
See Supplement	See Supplement	See Supplement	See Supplement	See Supplement	See Supplement

Water Supply (M.G.L.c.40S54)
Public N/A Private N/A

Flood Zone Information
Zone X Outside Flood Zone Yes

over→

Section 4 - Description of Proposed Work (please circle)

New Construction   Existing Building   Repair   Alterations   Addition

Accessory Bldg.   Demolition   Other Specify: ________________________________

Brief Description of Proposed Work: The Costa Solar Project is proposing a 5-megawatt ground-mounted solar energy facility on a 30.5-acre portion of these parcels.

IT IS UNDERSTOOD AND AGREED THAT THE ZONING DETERMINATION IS ISSUED IN RELIANCE UPON INFORMATION SUBMITTED BY THE PETITIONER ON AND WITH THIS APPLICATION. THEREFORE, IF ANY FALSE OR MISLEADING INFORMATION IS FOUND TO EXIST THEREIN, THE ZONING DETERMINATION IS VOIDABLE BY THE BUILDING OFFICIAL.

ZONING DETERMINATIONS ARE GOOD FOR SIX MONTHS FROM THE DATE THEY ARE ISSUED

ZONING DETERMINATION APPROVED: ______________

ZONING DETERMINATION DENIED: ________________

Date:___________________   By:__________________________________

Building Commissioner

* A SITE PLAN MUST ACCOMPANY THIS APPLICATION

THIS IS NOT A BUILDING PERMIT!

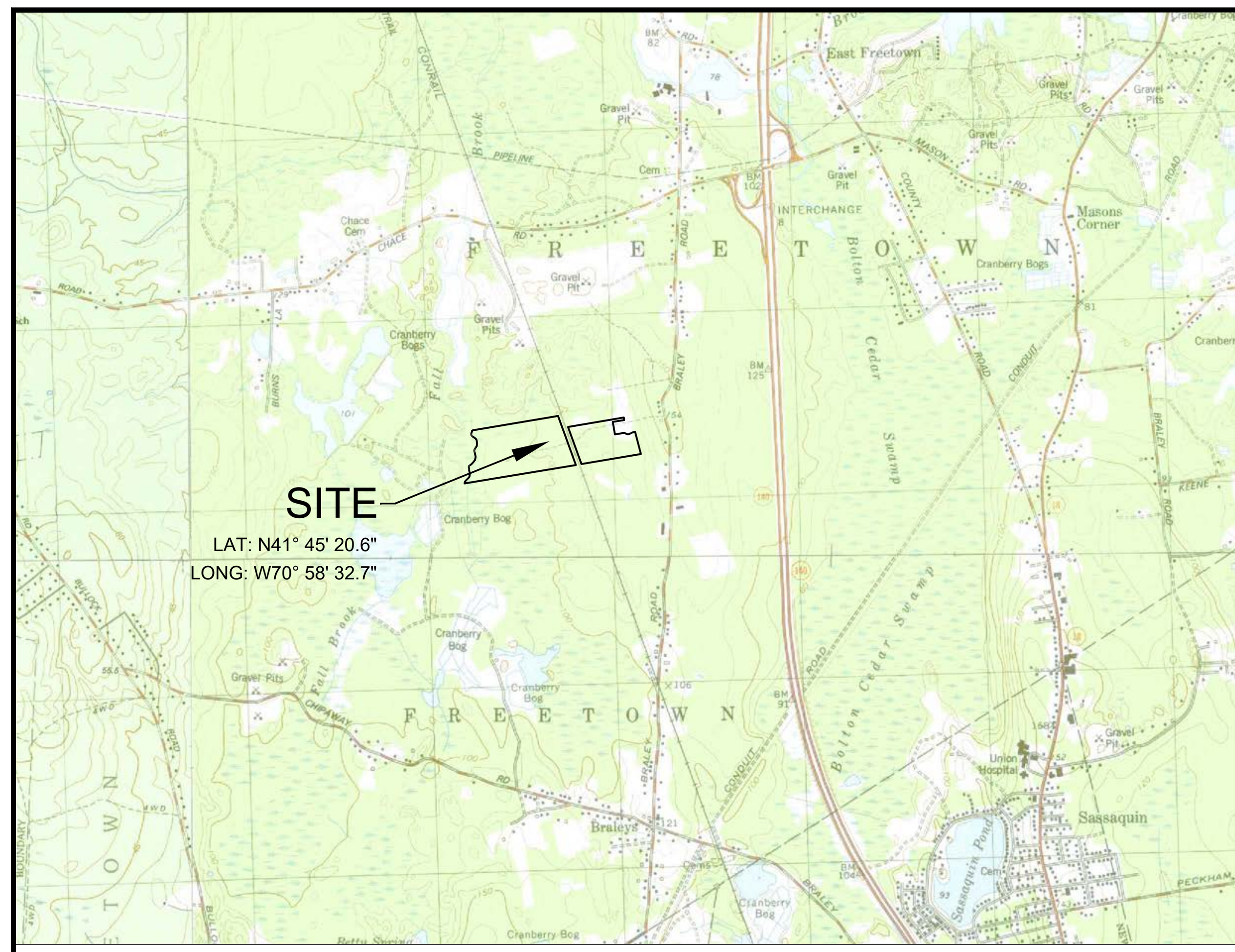
Supplement to Application for Zoning Determination

Section 2 – Site Information

Property Address	Map #	Parcel #	Zoning District	Proposed Use	Lot Area (sq. ft.)	Frontage (ft.)	Lot created
5 Costa Drive	241	53	Residential	Solar Energy Facility	646,430	195	5/26/1992
0 Rear Costa Drive	247	6	General Use	Solar Energy Facility	1,568,160	0	8/13/2014

Section 3 – Building Setbacks

Property Address	Required Front Setback	Provided Front Setback	Required Side Setback	Provided Side Setback	Required Rear Setback	Provided Rear Setback	Water Supply	Flood Zone Information
5 Costa Drive	50 ft	50+ ft	50 ft (north) 20 ft (south)	50+ ft 50 ft	25 ft	50 ft	N/A	X – Outside Flood Zone
0 Rear Costa Drive	50 ft	50+ ft	20 ft	50 ft	25 ft	50+ ft	N/A	X – Outside Flood Zone



LOCATION MAP
SCALE: 1" = ½ MILE

LEGEND

- APPROXIMATE PROPERTY LINES
- APPROXIMATE PROJECT PARCEL
- DELINEATED STEAMS
- DELINEATED WETLANDS
- ENVIRONMENTAL BUFFERS
- FEMA BASE FLOOD LIMIT OF 100 YEAR-24 HOUR STORM EVENT
- PROPOSED PERIMETER FENCING
- PROPOSED FIXED SOLAR PANEL RACKING
- PROPOSED OVERHEAD ELECTRIC LINE/POWER POLE
- PROPOSED UNDERGROUND POWER

NOTES:

1. ASPECTS OF PLAN ARE APPROXIMATE AND DERIVED FROM AERIAL PHOTOGRAPHY.
2. THE HORIZONTAL COORDINATE SYSTEM IS BASED ON NAD83 MASSACHUSETTS STATE PLANE, MAINLAND ZONE (US SURVEY FEET). ELEVATIONS ARE BASED ON THE NAVD88 (US SURVEY FEET).
3. EXISTING GROUND CONTOUR ELEVATIONS ARE BASED ON 2011 LIDAR DATA FROM THE STATE OF MASSACHUSETTS.
4. UTILITIES ARE NOT WARRANTED TO BE COMPLETE OR ACCURATE, CONTRACTOR SHALL CONTACT DIG SAFE BEFORE BEGINNING ANY EXCAVATION.
5. THIS IS IN NO WAY A BOUNDARY SURVEY. PROPERTY LINES ARE FROM TAX MAP INFORMATION PROVIDED BY THE TOWN. AND A PLAN TITLED "ANTHONY N. COSTA CONVEYING LOT D-1 TO LARRY ROSE" DATED 02/24/05 BY GEODETIC ENGINEERING INC.
6. THIS IS A PRELIMINARY DESIGN PLAN. FINAL DESIGN WILL BE MODIFIED TO MATCH EQUIPMENT PURCHASED AND POSSIBLE PERMIT CONSTRAINTS REVEALED DURING PROJECT'S REVIEW.

PROJECT SPECIFICATIONS:

NUMBER OF MODULES: 13,896 (@520 PER PANEL)

DC OUTPUT: 7.23 MW

AC OUTPUT: 5.00 MW

DC/AC RATIO: 1.44

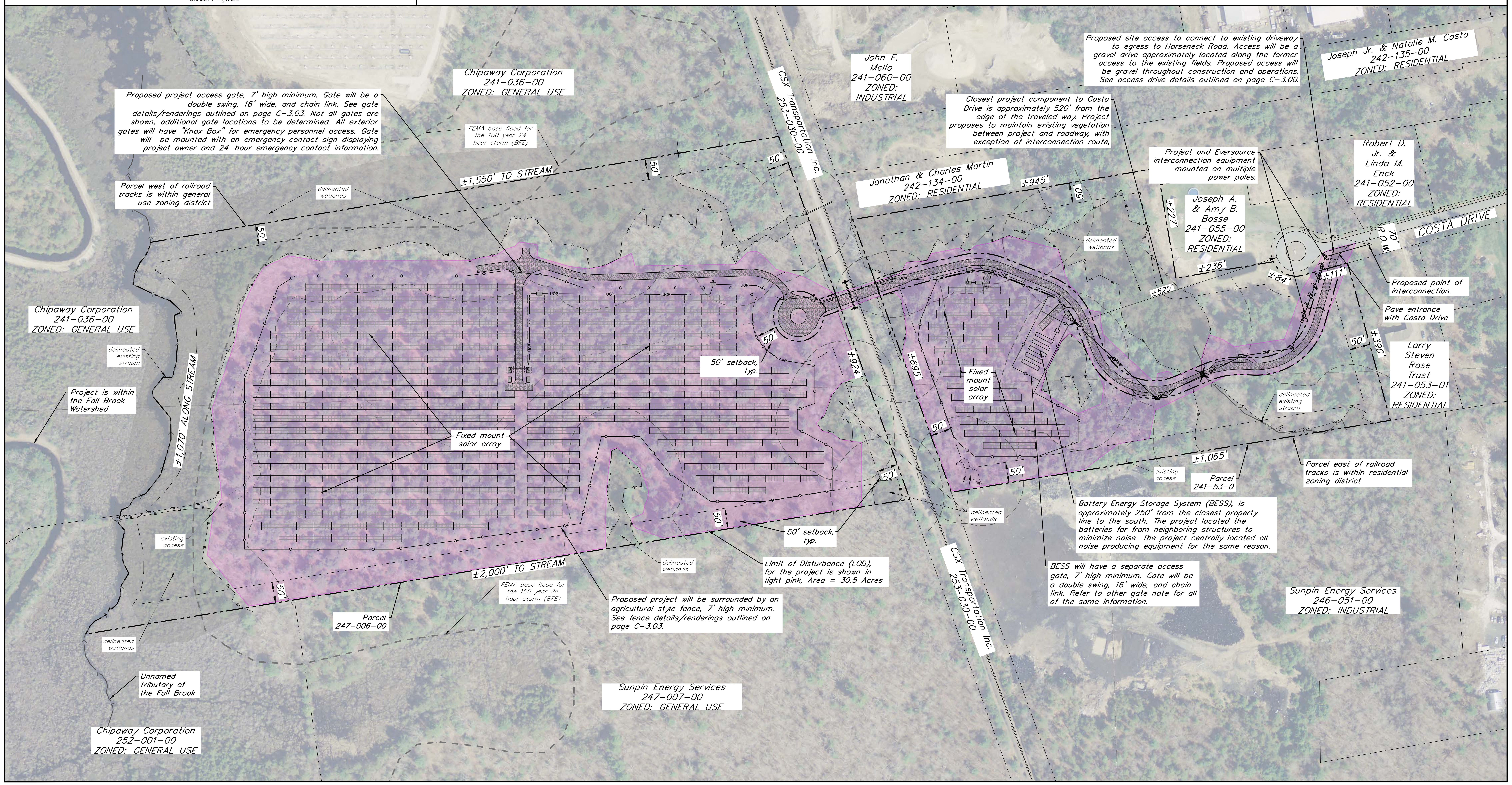
DESIGN: FIXED TILT @ 25° TILT

GCR: 0.476 (47.6%)

FREETOWN PLANNING BOARD APPROVAL

DATE

Massachusetts State Plane Grid North (NAD83)



COSTA SOLAR

Costa Drive
Freetown, Massachusetts

IRONWOOD RENEWABLES

BIODIVERSITY RESEARCH INSTITUTE

KREBS & LANSING CONSULTING ENGINEERS
164 Main Street, Suite 201
Colchester, Vermont 05446
P: (802) 878-0375
www.krebsandlansing.com

ISSUED FOR PERMIT REVIEW
NOT FOR CONSTRUCTION

CIVIL ENGINEER:
Krebs and Lansing Consulting Engineers, Inc.
164 Main Street, Suite 201
Colchester, Vermont 05446

ENVIRONMENTAL:
BRI Environmental
30 Danforth Street
Suite 213
Portland, ME 04101

OWNER & PROPERTY INFORMATION:

East Property Owner:	Estate of Anthony N Costa
Owner Address:	5226 Townsend Avenue Los Angeles, CA 90041
Parcel ID:	241-53-0
Parcel Address:	5 Costa Drive Freetown, MA 02717
West Property Owner:	Michael & Karen Costa
Owner Address:	5226 Townsend Avenue Los Angeles, CA 90041
Parcel ID:	247-6-0
Parcel Address:	0-Rear Costa Drive Freetown, MA 02717

STAMP:
COMMONWEALTH OF MASSACHUSETTS
GREGORY T. DIXSON
CIVIL ENGINEER
No. 55649
REGISTERED PROFESSIONAL ENGINEER

0' 60' 120' 240' 360'
0" 1" 2" 3"
STANDARD GRAPHIC SCALE (1" = 120')
VALID WHEN PLOTTED ON 24" BY 36" MEDIA

REV. NO.	REVISIONS/COMMENTS	DATE

DRAWING TITLE:
OVERALL SITE PLAN
PRELIMINARY SOLAR ARRAY

DATE of Issue: 11/08/2021
Drawn by: EJM/GTD Checked by: GTD
Project No.: 21223 Scale: 1" = 120'
Drawing No.: C-1.00 Rev No.:

Attachment 9

Electrical System Components

COSTA SOLAR, LLC – 5MW SOLAR PROJECT
86 BRALEY ROAD, FREETOWN, MA 02717

REGIONAL MAP

RELAY SETTINGS - SEL651R RELAY ON RECLOSER - UTILITY VOLTAGE 13.2KV 38MS CLEAR TIME			
ELEMENT	PICKUP RANGE	CLEARING TIME RANGE (SEC)	DEFAULT CLEARING TIME (SEC)
UNDERVOLTAGE (27-1)	16.26 V (50% OF NOMINAL)	1.062	1.1
UNDERVOLTAGE (27-2)	28.63 V (88% OF NOMINAL)	1.962	2
OVERVOLTAGE (59-1)	35.79 V (110% OF NOMINAL)	1.962	2
OVER VOLTAGE (59-2)	39 V (120% OF NOMINAL)	0.122	0.16
UNDERFREQUENCY (81U)	56.5 HZ	0.122	0.16
UNDERFREQUENCY (81U)	58.5 HZ	299.962	300
OVERFREQUENCY (81O)	61.0 HZ	299.962	300
OVERFREQUENCY (81O)	62.0 HZ	0.122	0.16
OVERCURRENT (51G)	2.14A	TD; 2.0, CURVE U4	0.01A + 3% OF SETTING
OVERCURRENT (51)	361.25A	TD, 1.5, CURVE U4	0.01A + 3% OF SETTING

GROUNDING TRANSFORMER CALCS, 2MVA XFFMR	
IMPEDANCE	0.108OHMS
VOLTAGE IMBALANCE	0.04PU
REACTANCE BANK	0.06PU
MINIMUM PHASE CURRENT RATING AT STEADY STATE	136.5A
TRANSFORMER KVA	250KVA
MINIMUM FAULT INTERRUPTING CAPCITY FROM SUBSTATION	28.86KA
OCPD PROTECTING INVERTERS	3000A, 10 CYCLE TRIP

GROUNDING TRANSFORMER CALCS, 1MVA XFMR	
IMPEDANCE	0.108OHMS
VOLTAGE IMBALANCE	0.04PU
REACTANCE BANK	0.06PU
MINIMUM PHASE CURRENT RATING AT STEADY STATE	68.25A
TRANSFORMER KVA	250KVA
MINIMUM FAULT INTERRUPTING CAPCITY FROM SUBSTATION	28.86KA
OCPD PROTECTING INVERTERS	1600A, 10 CYCLE TRIP

STYSTEM METRICS	
MODULE DC NAMEPLATE	7.49MW
INVERTER AC NAMEPLATE	5.00MW (LOAD RATIO:1.5)
ANNUAL PRODUCTION (ESTIMATED)	9.745GWH
PERFORMANCE RATIO	82.50%
KWH/KW	1301.4
SAMPLE WEATHER DATASET	TMY, 10KM GRID, NREL (PROSPECTOR)

MODULE SHADING		
ROW-TO-ROW SHADING	IGNORED	CONSIDERED
NAMEPLATE	7.49MW	7.27MW
ENERGY	10.8GWH	10.3GWH
SHADE LOSSES	0.00%	1.20%
NAMEPLATE REDUCTION	0%	14%

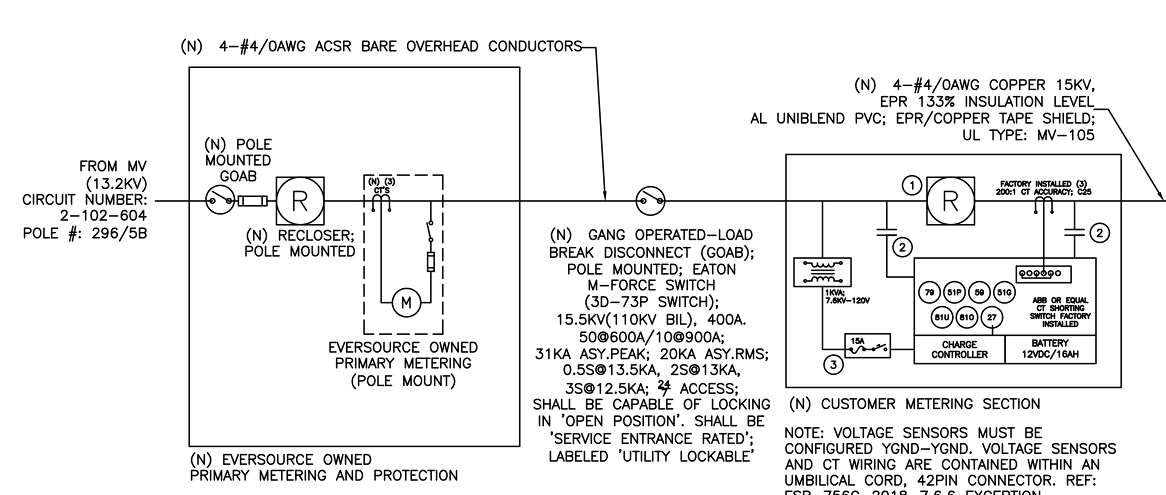
PROJECT SUMMARY	
SYSTEM SIZE (KW-AC)	5000KW
TILT	10
AZIMUTH	162.015
MODULE	SUNPOWER SPR-X22-360-COM
INVERTER	CPS SCH125KTL-DO/US-600
RACKING SYSTEM	TERRASMART OR EQUAL

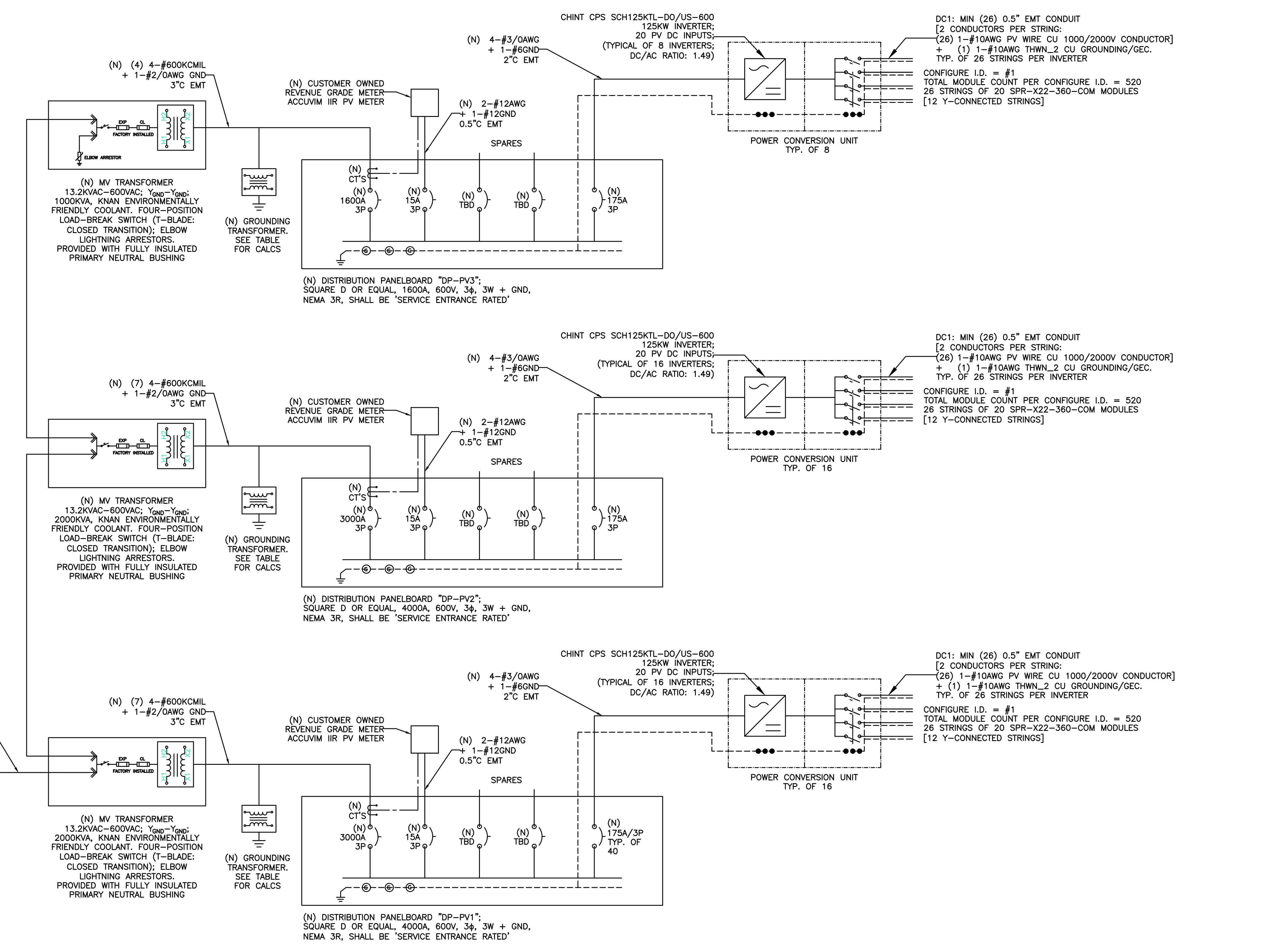
MODULE SPECS	
MAKE	SUNPOWER
MODEL	SPR-X22-360-COM
QUANTITY	20800
STRING LENGTH	20 MODULES PER STRING [26 STRINGS]
VOC	69.5V
VMP	59.1V
ISC	6.48A
IMP	6.09A
GROUNDING	NEGATIVE

INVERTER SPECS	
MAKE	CHINT POWER SYSTEMS
MODEL	CPS SCH125KTL-DO/US-600
QUANTITY	40
DC VOLTAGE RANGE	860VDC-1450VDC
NOM. AC POWER	125KW
NOM. GRID VOLTAGE	600VAC
MAX CURRENT OUTPUT	127.2A
POWER FACTOR RANGE	<0.99 (+/-0.8 ADJUSTABLE)
NOMINAL GRID FREQ	60HZ
DIMENSIONS	45.28IN X 24.25IN X 9.84IN (WXHXD)
WEIGHT	121LBS (+ 55LBS WIRE BOX)
DEGREE OF PROTECTION	NEMA TYPE 4X
COMPLIANCE	UL-1741 SA, IEEE-1547

LABELS:

1. (N) CUSTOMER-OWNED POLE MOUNTED RECLOSER; TAVRIDA-OSM25_AL_2(630_150_2) OR EQUAL; 15.5KV RATED VOLTAGE; 630A RATED CURRENT; RATED POWER FREQUENCY WITHSTAND VOLTAGE (VD), 1 MIN DRY: 50KV; RATED LIGHTNING IMPULSE WITHSTAND VOLTAGE (PEAK, VP): 110KV; RATED SHORT-TIME WITHSTAND CURRENT: 16KA; OPERATING CYCLES, RATED CURRENT (CO-CYCLES): 30,000; STANDARD COMPLIANCE: IEEE C37.60; CURRENT SENSING: 3 CURRENT TRANSFORMERS; VOLTAGE SENSING: 6 VOLTAGE SENSORS; FACTORY ASSEMBLED: SEL-651R RELAY, CT'S (INTERNAL), CAPACITIVE SENSORS (INTERNAL) USED FOR VOLTAGE MEASUREMENTS ON ALL (6) BUSHINGS, UMBILICAL CORD & BATTERY BACKUP; SHALL BE 'SERVICE ENTRANCE RATED'
2. (N) FACTORY INSTALLED: (3) VOLTAGE SENSORS, BASE ACCURACY IS +/-2% (ACCURACY CHANGES 0.4% PER 10°C). LOW VOLTAGE SIGNAL TO SEL-651R
3. (N) FACTORY INSTALLED: ALARM CONTACTS ARE WIRED TO TRIP ON A RELAY FAILURE, OR LOSS OF POWER. BATTERY PROVIDES AN 16HR BACKUP TO PROTECTIVE RELAY. (TO BE TESTED DURING UTILITY WITNESS TEST)





HYDE ENGINEERING SERVICES

THESE DRAWINGS AND SPECIFICATIONS HAVE BEEN PREPARED BY HYDE ENGINEERING SERVICES, INC. FOR THEIR EXCLUSIVE USE IN ACCORD WITH THE 250 CODE OF MASSACHUSETTS REGULATIONS

INTERCONNECTION NOTES

INTERCONNECTION IS FOR (1) GROUND MOUNT FIXED-TILT-RACKING PHOTOVOLTAIC SYSTEM AND ASSOCIATED EQUIPMENT. THE SYSTEM WILL BE DISTRIBUTED BEHIND ONE UTILITY METER AND INTERCONNECTED AT POLE NUMBER #296/5B.

THE NEW PHOTOVOLTAIC SYSTEM WILL HAVE (32) CHINT POWER SYSTEMS CPS SCH125KTL-DO/US-600 INVERTERS BEHIND (12800) SUNPOWER SPR-X22-360-COM PV MODULES FOR A TOTAL CAPACITY OF 4000KWAC WITH A DC/AC RATIO OF 1.15.

COMMONWEALTH OF MASSACHUSETTS
HENRY HOLBROOK HYDE III
NO. 52391
REGISTERED PROFESSIONAL ENGINEER

No.	REVISION/ISSUE	DATE
1.2	INTXN DRAFT 3	10/11/19
1.1	INTXN DRAFT 2	09/23/19
1.0	INTXN DRAFT 1	08/09/19

Firm Name and Address

HYDE ENGINEERING SERVICES, INC
1942 BROADWAY, SUITE #206
BOULDER, CO 80302

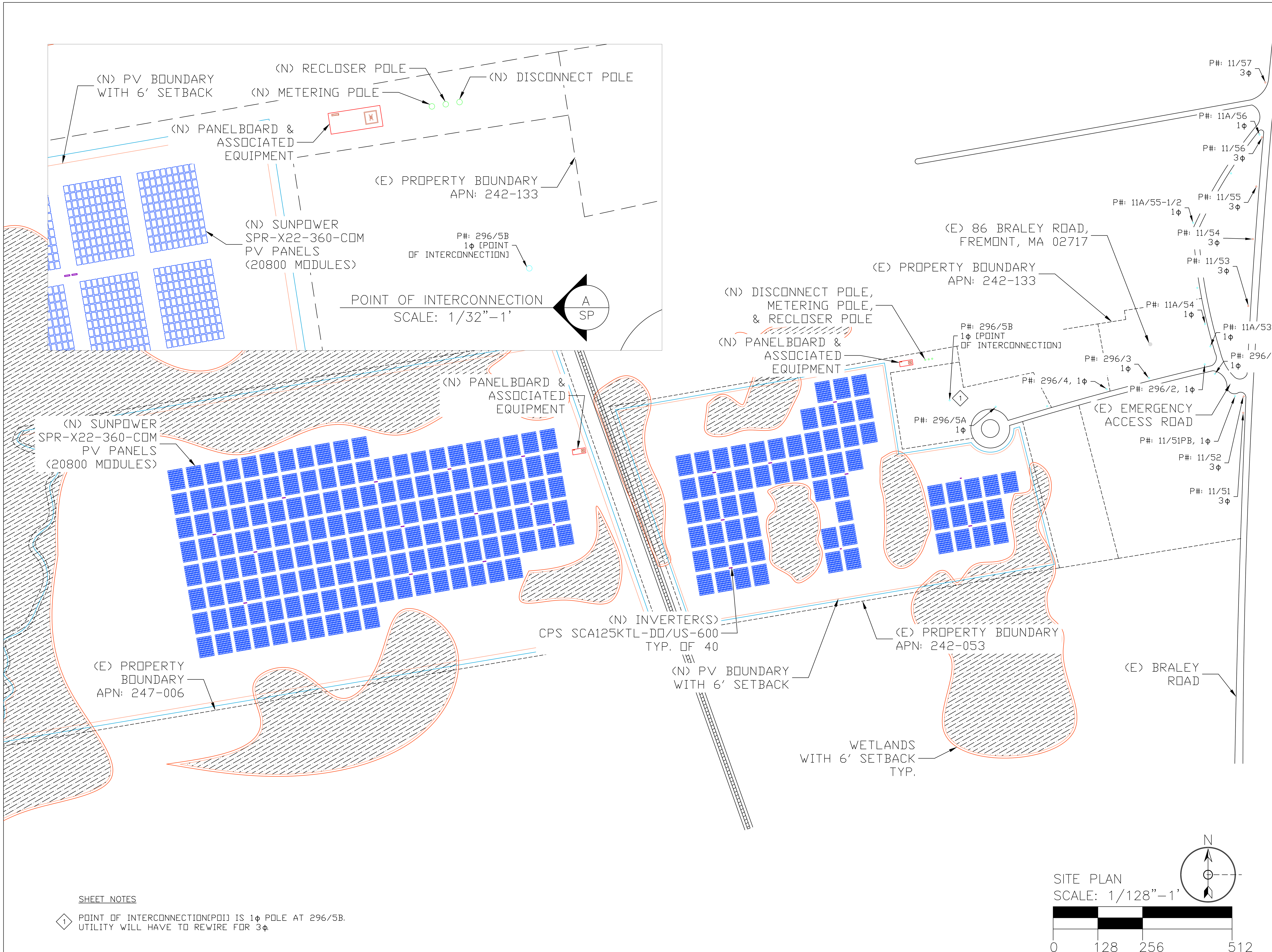
INFO@HYDEENG.COM
860-595-2037

Project Name and Address

COSTA SOLAR, LLC

86 BRALEY ROAD,
FREETOWN, MA 02717

Project 5MW PV	Sheet INTER-CONNECTION
Date 10/11/19	
Scale	



SHEET NOTES

1. POINT OF INTERCONNECTION[POI] IS 1ϕ POLE AT 296/5B. UTILITY WILL HAVE TO REWIRE FOR 3ϕ.

HYDE ENGINEERING SERVICES

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INTERCONNECTION NOTES

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COMMONWEALTH OF MASSACHUSETTS
HENRY HOLBROOK HYDE III
NO. 52391
REGISTERED PROFESSIONAL ENGINEER

No.	REVISION/ISSUE	DATE
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1.1	INTXN DRAFT 2	09/23/19
1.0	INTXN DRAFT 1	08/09/19

Firm Name and Address

HYDE ENGINEERING SERVICES, INC
1942 BROADWAY, SUITE #206
BOULDER, CO 80302

INFO@HYDEENG.COM
860-595-2037

Project Name and Address

COSTA SOLAR, LLC

86 BRALEY ROAD,
FREETOWN, MA 02717

Project	Sheet
5MW PV	INTER-CONNECTION
Date 10/11/19	
Scale	

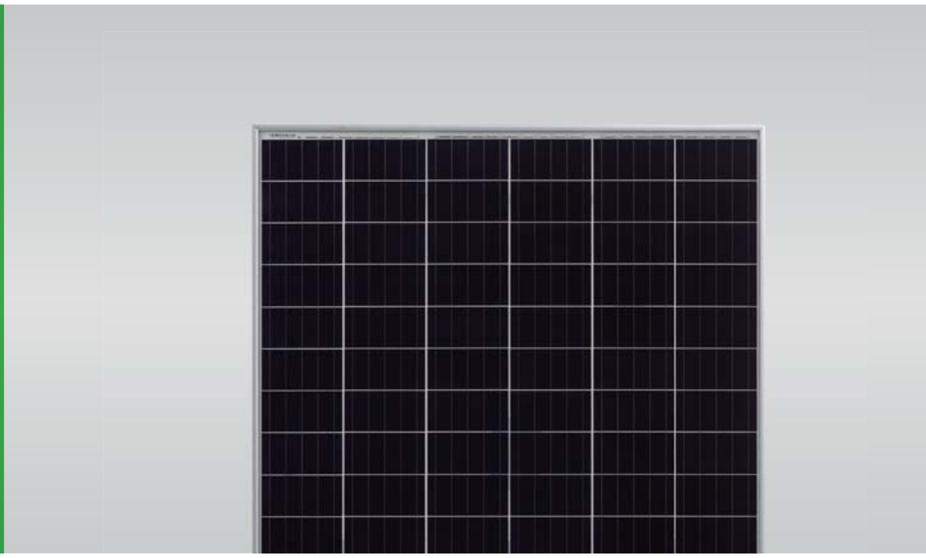
jinkosolar.us

JinKO Solar
Building Your Trust in Solar

Eagle HC 72M G2
380-400 Watt

MONO PERC HALF CELL MODULE

Positive power tolerance of 0~+3%



KEY FEATURES

Diamond Cell Technology
Uniquely designed high performance 5 busbar mono PERC half cell

High Voltage
UL and IEC 1500V certified; lowers BOS costs and yields better LCOE

Higher Module Power
Decrease in current loss yields higher module efficiency

Shade Tolerance
More shade tolerance due to twin arrays

PID FREE
Reinforced cell prevents potential induced degradation

Strength and Durability
Certified for high snow (5400Pa) and wind (2400 Pa) loads

- ISO9001:2008 Quality Standards
- ISO14001:2004 Environmental Standards
- OHSAS18001 Occupational Health & Safety Standards
- IEC61215, IEC61730 certified products
- UL1703 certified products

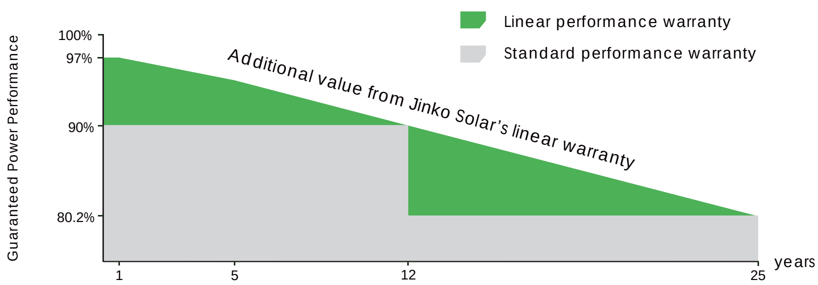
Nomenclature:

JKM400M-72HL-V

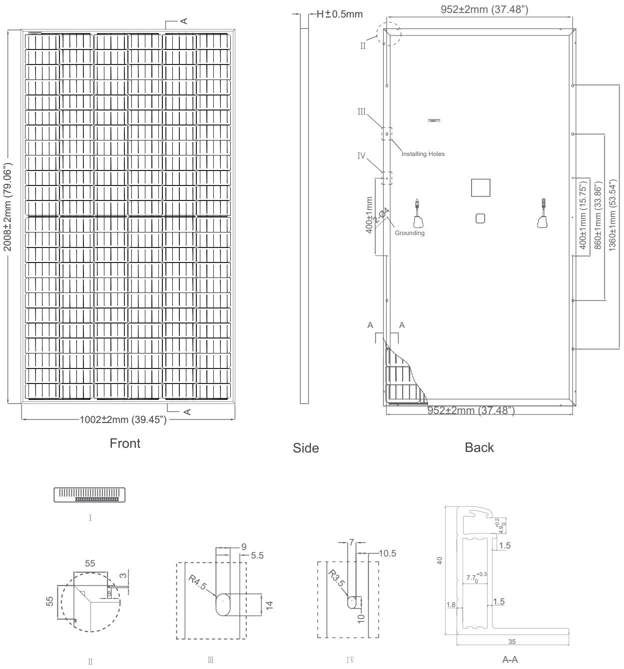
Code	Cell	Code	Cell	Code	Certification
null	Full	null	Normal	null	1000V
H	Half	L	Diamond	V	1500V

LINEAR PERFORMANCE WARRANTY

10 Year Product Warranty • 25 Year Linear Power Warranty

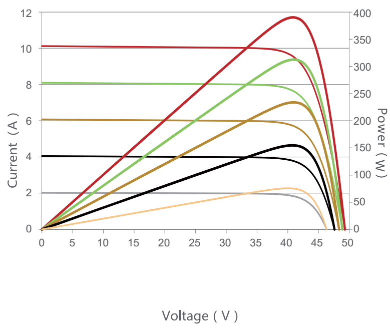


Engineering Drawings

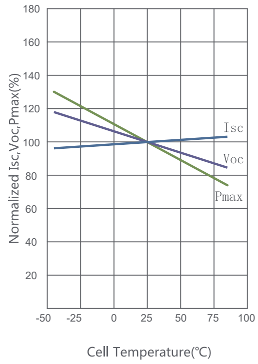


Electrical Performance & Temperature Dependence

Current-Voltage & Power-Voltage Curves (390W)



Temperature Dependence of Isc,Voc,Pmax



Mechanical Characteristics

Cell Type	Mono PERC Diamond Cell (158.75 x 158.75 mm)
No.of Half-cells	144 (6×24)
Dimensions	2008×1002×40mm (79.06×39.45×1.57 inch)
Weight	22.5 kg (49.6 lbs)
Front Glass	3.2mm, Anti-Reflection Coating, High Transmission, Low Iron, Tempered Glass
Frame	Anodized Aluminium Alloy
Junction Box	IP67 Rated
Output Cables	12AWG, Anode 1400mm(55.12 in), Cathode 1400mm(55.12 in) or Customized Length
Fire Type	Type 1

Packaging Configuration

(Two pallets = One stack)

26pcs/pallet, 52pcs/stack, 572pcs/40'HQ Container

SPECIFICATIONS

Module Type	JKM380M-72HL-V		JKM385M-72HL-V		JKM390M-72HL-V		JKM395M-72HL-V		JKM400M-72HL-V	
	STC	NOCT	STC	NOCT	STC	NOCT	STC	NOCT	STC	NOCT
Maximum Power (Pmax)	380Wp	286Wp	385Wp	290Wp	390Wp	294Wp	395Wp	298Wp	400Wp	302Wp
Maximum Power Voltage (Vmp)	40.5V	38.6V	40.8V	38.8V	41.1V	39.1V	41.4V	39.3V	41.7V	39.6V
Maximum Power Current (Imp)	9.39A	7.42A	9.44A	7.48A	9.49A	7.54A	9.55A	7.60A	9.60A	7.66A
Open-circuit Voltage (Voc)	48.9V	47.5V	49.1V	47.7V	49.3V	48.0V	49.5V	48.2V	49.8V	48.5V
Short-circuit Current (Isc)	9.75A	7.88A	9.92A	7.95A	10.12A	8.02A	10.23A	8.09A	10.36A	8.16A
Module Efficiency STC (%)	18.89%		19.14%		19.38%		19.63%		19.88%	
Operating Temperature (℃)	-40℃~+85℃									
Maximum System Voltage	1500VDC(UL)/1500VDC(IEC)									
Maximum Series Fuse Rating	20A									
Power Tolerance	0~+3%									
Temperature Coefficients of Pmax	-0.36%/℃									
Temperature Coefficients of Voc	-0.28%/℃									
Temperature Coefficients of Isc	0.048%/℃									
Nominal Operating Cell Temperature (NOCT)	45±2℃									

STC: Irradiance 1000W/m² Cell Temperature 25°C AM=1.5

NOCT: Irradiance 800W/m² Ambient Temperature 20°C AM=1.5 Wind Speed 1m/s

* Power measurement tolerance: ± 3%

CAUTION: READ SAFETY AND INSTALLATION INSTRUCTIONS BEFORE USING THE PRODUCT.

JKM380-400M-72HL-V-A1-US

SUNNY CENTRAL
2660 UP-US / 2800 UP-US / 2930 UP-US / 3060 UP-US

Efficient

- Up to 4 inverters can be transported in one standard shipping container
- Overdimensioning up to 150% is possible
- Full power at ambient temperatures of up to 25 °C

Robust

- Intelligent air cooling system OptiCool for efficient cooling
- Suitable for outdoor use in all climatic ambient conditions worldwide

Flexible

- Conforms to all known grid requirements worldwide
- Q on demand
- Available as a single device or turnkey solution, including Medium Voltage Power Station

Easy to Use

- Improved DC connection area
- Connection area for customer equipment
- Integrated voltage support for internal and external loads

SUNNY CENTRAL
2660 UP-US / 2800 UP-US / 2930 UP-US / 3060 UP-US

The new Sunny Central: more power per cubic meter

With an output of up to 3060 kVA and system voltages of 1500 V DC, the SMA central inverter allows for more efficient system design and a reduction in specific costs for PV power plants. A separate voltage supply and additional space are available for the installation of customer equipment. True 1500 V technology and the intelligent cooling system OptiCool ensure smooth operation even in extreme ambient temperature as well as a long service life of 25 years.

SUNNY CENTRAL 2660 UP-US / 2800 UP-US

Technical data*	SC 2660 UP-US	SC 2800 UP-US
Input (DC)		
MPP voltage range V_{DC} (at 25 °C / at 50 °C)	880 to 1325 V / 1100 V	921 to 1325 V / 1100 V
Min. input voltage $V_{DC, min}$ / Start voltage $V_{DC, Start}$	849 V / 1030 V	891 V / 1071 V
Max. input voltage $V_{DC, max}$	1500 V	1500 V
Max. input current $I_{DC, max}$	4750 A	4750 A
Max. short-circuit current $I_{DC, sc}$	6400 A	6400 A
Number of DC inputs	24 double pole fused (32 single pole fused)	
Number of DC inputs with optional DC coupling of battery	18 double pole fused (36 single pole fused) for PV, 6 double pole fused for batteries	
Max. number of DC cables per DC input (for each polarity)	2 x 800 kcmil, 2 x 400 mm²	
Integrated zone monitoring	○	
Available DC fuse sizes (per input)	200 A, 250 A, 315 A, 350 A, 400 A, 450 A, 500 A	
Output (AC)		
Nominal AC power at cos φ =1 (at 25°C / at 50°C)	2660 kVA / 2260 kVA	2800 kVA / 2380 kVA
Nominal AC power at cos φ =0.8 (at 25°C / at 50°C)	2128 kW / 1808 kW	2240 kW / 1904 kW
Nominal AC current $I_{AC, nom}$ (at 25°C / at 50°C)	2560 A / 2176 A	2566 A / 2181 A
Max. total harmonic distortion	< 3% at nominal power	< 3% at nominal power
Nominal AC voltage / nominal AC voltage range[1) 8)]	600 V / 480 V to 720 V	630 V / 504 V to 756 V
AC power frequency / range	50 Hz / 47 Hz to 53 Hz 60 Hz / 57 Hz to 63 Hz	
Min. short-circuit ratio at the AC terminals[9)]	> 2	
Power factor at rated power / displacement power factor adjustable[8) 10)]	1 / 0.8 overexcited to 0.8 underexcited	
Efficiency		
Max. efficiency[2)] / European efficiency[2)] / CEC efficiency[3)]	98.7%* / 98.6%* / 98.5%*	98.7%* / 98.6%* / 98.5%*
Protective Devices		
Input-side disconnection point	DC load break switch	
Output-side disconnection point	AC circuit breaker	
DC overvoltage protection	Surge arrester, type I	
AC overvoltage protection (optional)	Surge arrester, class I	
Lightning protection (according to IEC 62305-1)	Lightning Protection Level III	
Ground-fault monitoring / remote ground-fault monitoring	○ / ○	
Insulation monitoring	○	
Degree of protection	NEMA 3R	
General Data		
Dimensions (W / H / D)	2815 / 2318 / 1588 mm (110.8 / 91.3 / 62.5 inch)	
Weight	< 4000 kg / < 8818.5 lb	
Self-consumption (max.[4)] / partial load[5)] / average[6)])	< 8100 W / < 1800 W / < 2000 W	
Self-consumption (standby)	< 370 W	
Internal auxiliary power supply	○ Integrated 8.4 kVA transformer	
Operating temperature range[8)]	−25°C to 60°C / −13°F to 140°F	
Noise emission[7)]	67.0 dB(A)*	
Temperature range (standby)	−40°C to 60°C / −40°F to 140°F	
Temperature range (storage)	−40°C to 70°C / −40°F to 158°F	
Max. permissible value for relative humidity (condensing / non-condensing)	95% to 100% (2 month/year) / 0% to 95%	
Maximum operating altitude above MSL[8)] 1000 m / 2000 m	● / ○ (earlier temperature-dependent derating)	
Fresh air consumption	6500 m³/h	
Features		
DC connection	Terminal lug on each input (without fuse)	
AC connection	With busbar system (three busbars, one per line conductor)	
Communication	Ethernet, Modbus Master, Modbus Slave	
Communication with SMA string monitor (transmission medium)	Modbus TCP / Ethernet (FO MM, Cat-5)	
Enclosure / roof color	RAL 9016 / RAL 7004	
Supply transformer for external loads	○ (2.5 kVA)	
Standards and directives complied with	UL 62109-1, UL 1741 (Chapter 31, CDR 6I), UL 1741-SA, UL 1998, IEEE 1547, MIL-STD-810G	
EMC standards	FCC Part 15 Class A	
Quality standards and directives complied with	VDI/VDE 2862 page 2, DIN EN ISO 9001	
● Standard features ○ Optional * preliminary		

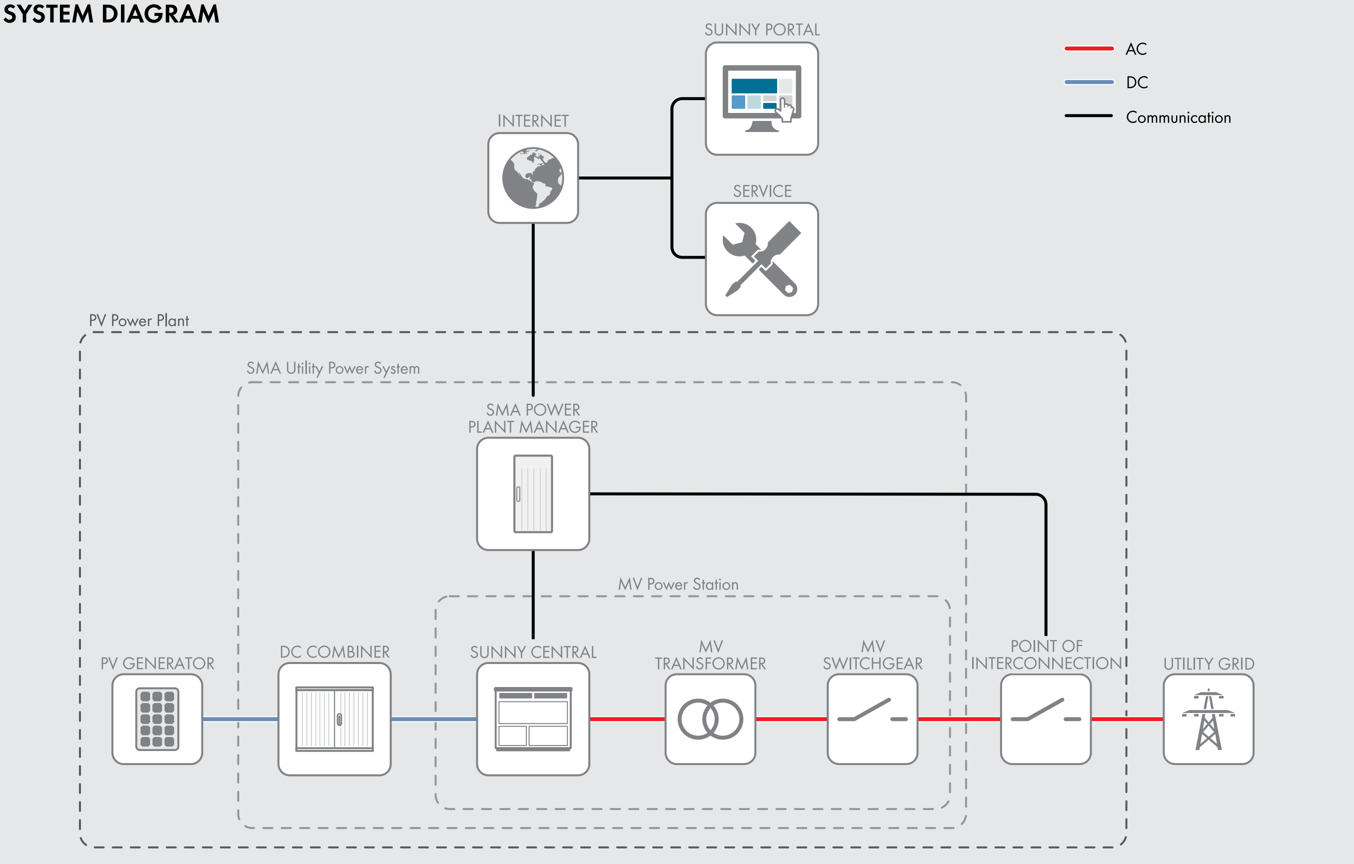
1) At nominal AC voltage, nominal AC power decreases in the same proportion
2) Efficiency measured without internal power supply
3) Efficiency measured with internal power supply
4) Self-consumption at rated operation
5) Self-consumption at < 75% Pn at 25°C
6) Self-consumption averaged out from 5% to 100% Pn at 25°C
7) Sound pressure level at a distance of 10 m
8) Values apply only to inverters. Permissible values for SMA MV solutions from SMA can be found in the corresponding data sheets.
9) A short-circuit ratio of < 2 requires a special approval from SMA
10) Depending on the DC voltage

SUNNY CENTRAL 2930 UP-US / 3060 UP-US

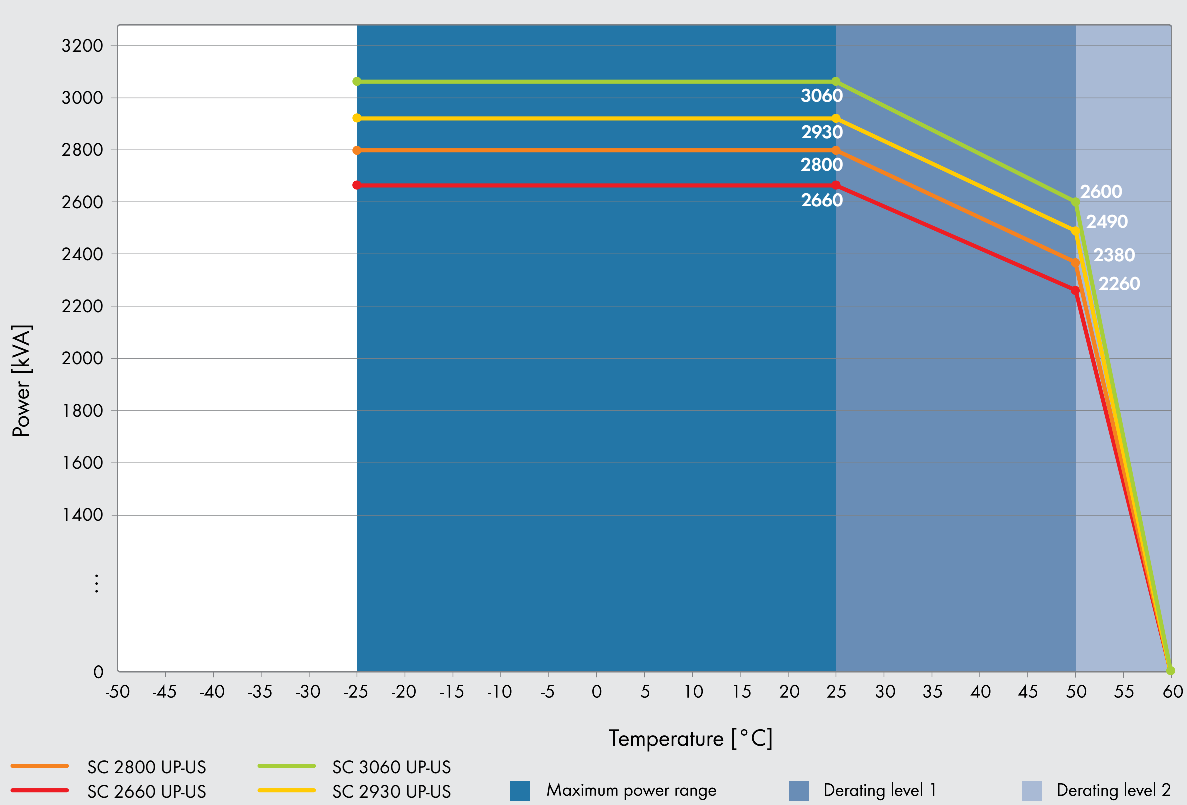
Technical data*	SC 2930 UP-US	SC 3060 UP-US
Input (DC)		
MPP voltage range V_{DC} (at 25 °C / at 50 °C)	962 to 1325 V / 1100 V	1003 to 1325 V / 1100 V
Min. input voltage $V_{DC, min}$ / Start voltage $V_{DC, Start}$	934 V / 1112 V	976 V / 1153 V
Max. input voltage $V_{DC, max}$	1500 V	1500 V
Max. input current $I_{DC, max}$	4750 A	4750 A
Max. short-circuit current $I_{DC, sc}$	6400 A	6400 A
Number of DC inputs	24 double pole fused (32 single pole fused)	
Number of DC inputs with optional DC coupling of battery	18 double pole fused (36 single pole fused) for PV, 6 double pole fused for batteries	
Max. number of DC cables per DC input (for each polarity)	2 x 800 kcmil, 2 x 400 mm²	
Integrated zone monitoring	○	
Available DC fuse sizes (per input)	200 A, 250 A, 315 A, 350 A, 400 A, 450 A, 500 A	
Output (AC)		
Nominal AC power at cos φ =1 (at 25°C / at 50°C)	2930 kVA / 2490 kVA	3060 kVA / 2600 kVA
Nominal AC power at cos φ =0.8 (at 25°C / at 50°C)	2344 kW / 1992 kW	2448 kW / 2080 kW
Nominal AC current $I_{AC, nom}$ (at 25°C / at 50°C)	2563 A / 2179 A	2560 A / 2176 A
Max. total harmonic distortion	< 3% at nominal power	< 3% at nominal power
Nominal AC voltage / nominal AC voltage range[1) 8)]	660 V / 528 V to 759 V	690 V / 552 V to 759 V
AC power frequency / range	50 Hz / 47 Hz to 53 Hz 60 Hz / 57 Hz to 63 Hz	
Min. short-circuit ratio at the AC terminals[9)]	> 2	
Power factor at rated power / displacement power factor adjustable[8) 10)]	1 / 0.8 overexcited to 0.8 underexcited	
Efficiency		
Max. efficiency[2)] / European efficiency[2)] / CEC efficiency[3)]	98.7%* / 98.6%* / 98.5%*	98.7%* / 98.6%* / 98.5%*
Protective Devices		
Input-side disconnection point	DC load break switch	
Output-side disconnection point	AC circuit breaker	
DC overvoltage protection	Surge arrester, type I	
AC overvoltage protection (optional)	Surge arrester, class I	
Lightning protection (according to IEC 62305-1)	Lightning Protection Level III	
Ground-fault monitoring / remote ground-fault monitoring	○ / ○	
Insulation monitoring	○	
Degree of protection	NEMA 3R	
General Data		
Dimensions (W / H / D)	2815 / 2318 / 1588 mm (110.8 / 91.3 / 62.5 inch)	
Weight	< 4000 kg / < 8818.5 lb	
Self-consumption (max.[4)] / partial load[5)] / average[6)])	< 8100 W / < 1800 W / < 2000 W	
Self-consumption (standby)	< 370 W	
Internal auxiliary power supply	○ Integrated 8.4 kVA transformer	
Operating temperature range[8)]	−25°C to 60°C / −13°F to 140°F	
Noise emission[7)]	67.0 dB(A)*	
Temperature range (standby)	−40°C to 60°C / −40°F to 140°F	
Temperature range (storage)	−40°C to 70°C / −40°F to 158°F	
Max. permissible value for relative humidity (condensing / non-condensing)	95% to 100% (2 month/year) / 0% to 95%	
Maximum operating altitude above MSL[8)] 1000 m / 2000 m	● / ○ (earlier temperature-dependent derating)	
Fresh air consumption	6500 m³/h	
Features		
DC connection	Terminal lug on each input (without fuse)	
AC connection	With busbar system (three busbars, one per line conductor)	
Communication	Ethernet, Modbus Master, Modbus Slave	
Communication with SMA string monitor (transmission medium)	Modbus TCP / Ethernet (FO MM, Cat-5)	
Enclosure / roof color	RAL 9016 / RAL 7004	
Supply transformer for external loads	○ (2.5 kVA)	
Standards and directives complied with	UL 62109-1, UL 1741 (Chapter 31, CDR 6I), UL 1741-SA, UL 1998 IEEE 1547, MIL-STD-810G	
EMC standards	FCC Part 15 Class A	
Quality standards and directives complied with	VDI/VDE 2862 page 2, DIN EN ISO 9001	
● Standard features ○ Optional * preliminary		

1) At nominal AC voltage, nominal AC power decreases in the same proportion
2) Efficiency measured without internal power supply
3) Efficiency measured with internal power supply
4) Self-consumption at rated operation
5) Self-consumption at < 75% Pn at 25°C
6) Self-consumption averaged out from 5% to 100% Pn at 25°C
7) Sound pressure level at a distance of 10 m
8) Values apply only to inverters. Permissible values for SMA MV solutions from SMA can be found in the corresponding data sheets.
9) A short-circuit ratio of < 2 requires a special approval from SMA
10) Depending on the DC voltage

SYSTEM DIAGRAM



TEMPERATURE BEHAVIOR (at 1000 m)



Toll Free +1 888 4 SMA USA
www.SMA-America.com

SMA America, LLC

SMA DC-DC CONVERTER

Flexible

- Wide range for battery and PV voltages
- Scalable
- Retrofittable (storage solution can be integrated anytime)

4-Quadrant Operation

- Step-up/step-down converter with battery charge/discharge function
- Limits high short-circuit currents of the battery
- Compatible with 1,500-V batteries

Integrated Solution

- Intelligent power flow control of the system in the Sunny Central
- Coordinated protection concept with Sunny Central
- Uniform warranty and service concept

Efficient

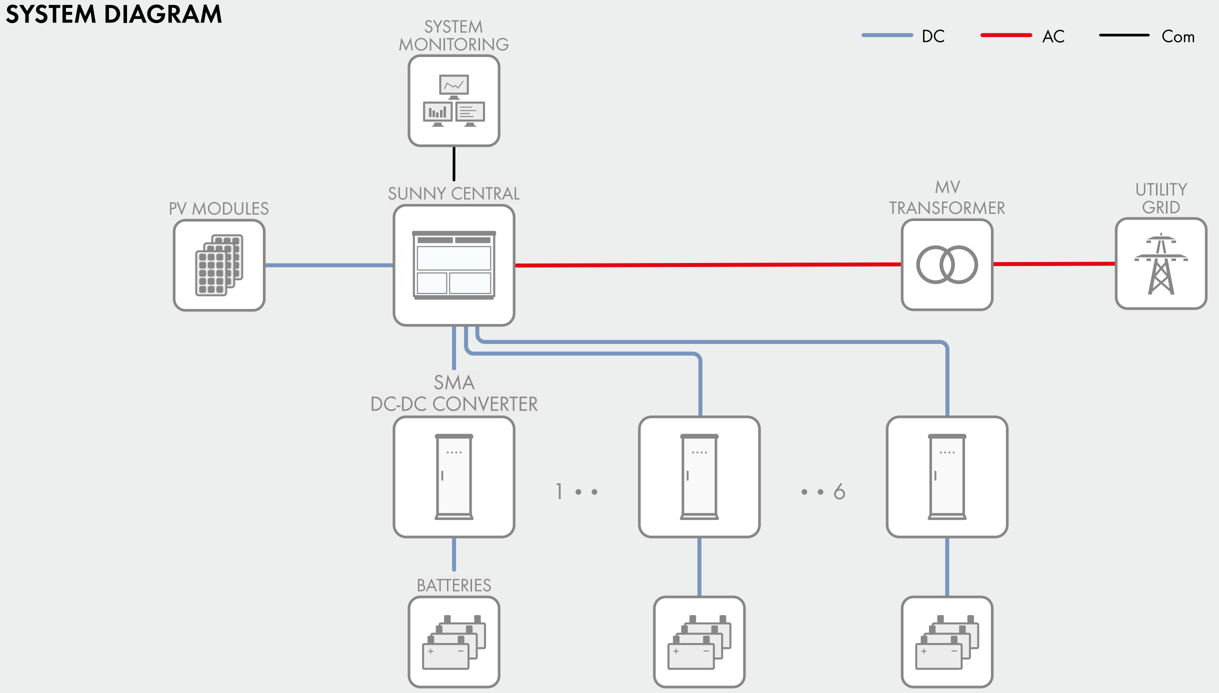
- Enables new business models
- High efficiency at different DC voltages as well as partial and full load
- Overnight charging/discharging

SMA DC-DC CONVERTER

Greater efficiency for large PV power plants

The new SMA DC-DC converter allows designers to increase their PV power plant's yields by oversizing the DC array without compromising energy losses. This is accomplished with the new DC-coupling option and the generous DC–AC ratios of the Sunny Central EV inverter series. The inverter can intelligently control the flow of power for many different use-cases, including clipped-loss capturing. The stored energy can be fed in at attractive times, for example, in the morning or at night, to achieve a better price-point for the energy. Grid operators are able to benefit from grid services, such as frequency control or time-based feed-in schedules. Up to six DC-DC converters can be connected and operated simultaneously on the Sunny Central inverter. This minimizes battery short-circuits currents for high energy applications and avoids the need for additional and expensive protection measures inside the battery container.

SYSTEM DIAGRAM



Technical Data	SMA DC-DC CONVERTER
Electrical Data	
Max. continuous power (at 30 °C)	500 kW at 1000 VDC 600 kW at 1200 VDC to 1500 VDC
Battery input voltage range	550 V to 1500 V
PV input voltage range	550 V to 1500 V
Max. continuous current (at 30 °C)	+/− 500 A
Supply voltage	120 V , 1-ph, 60 Hz, 600 VA 230 V , 1-ph, 50 Hz, 600 VA 277 V , 1-ph, 60 Hz, 600 VA
Battery technology	compatible with all common battery technologies
Efficiency	
Average efficiency	98.2 %
Protective devices	
Battery-side disconnection point	Circuit breaker in the battery system
PV-side disconnection point	Fusing inside the Sunny Central
Ground-fault monitoring and insulation monitoring	Use of monitoring in the Sunny Central
Overvoltage protection for auxiliary supply	●
General Data	
Dimensions (W / H /D)	850.9 / 2044.7 / 1000.8 mm (33.5 / 80.5 / 39.4 inches)
Weight	590 kg/1300 lb
Operating temperature	−25 °C to 55 °C / −13 °F to 131 °F
Storage temperature	−40 °C to 70 °C / −40 °F to 158 °F
Noise emission (sound pressure level at a distance of 10 m)	< 65 db(A)
Cooling method	Forced air-cooling
Degree of protection of enclosure	IP54 / UL Type 3R
Application in unprotected outdoor environments	●
Max. permissible value for relative humidity (non-condensing)	95%
Maximum operating altitude above MSL) 1000 m / 2000 m / 3000 m	● / ○ / ○ (earlier temperature-dependent de-rating)
Fresh air consumption	2720 m³/h (96000 ft³/h)
Equipment	
Cable Entry	Bottom
Communication / protocols	Modbus TCP/IP
System monitoring	Real-time monitoring with automated alerts and data storage
Status lights	On the front for operating mode, alert and error state
Warranty: 5 / 10 / 15 years	● / ○ / ○
Certificates and approvals	CE Label, CISPR 11:2015+A1:2016, CSA 22.2 #107, EN 62109-1, FCC Part 15 Class A, IEC 61000-6-2, IEC 62109-1, UL 1741, UL 62109-1,
● Standard features ○ Optional features – Not available	
Type designation	DPS-500

MEDIUM VOLTAGE POWER STATION
2660-S2-US / 2750-S2-US / 2800-S2-US / 2930-S2-US / 3060-S2-US

Robust
- Complete station is UL1741 listed for higher safety and lower risk
- Station and all individual components type-tested for maximum reliability
- Optimally suited to extreme ambient conditions

Simple Integration
- Plug and play concept
- Completely pre-assembled for easy set-up and commissioning

Cost-Effective
- Fully integrated transformer and switchgear simplifies logistics
- Minimun O&M requirements create lowest cost of ownership

Flexible
- One product for every global market and application
- Ideally suited for PV applications, PV plus storage (DC coupled) and storage applications (AC coupled)

MEDIUM VOLTAGE POWER STATION
2660-S2-US / 2750-S2-US / 2800-S2-US / 2930-S2-US / 3060-S2-US
Turnkey solution for PV power plants

With the power of the new robust central inverters, the Sunny Central UP or Sunny Central Storage UP, and with perfectly integrated medium-voltage components, the new Medium Voltage Power Station (MVPS) offers even more power density in a turnkey solution available worldwide. The solution is the ideal choice for next-generation PV power plants operating at 1500 V DC. Delivered pre-configured on a 20-foot container-integrated skid, the solution is easy to transport and quick to commission. The UL1741-listed MVPS combines rigorous plant safety with maximum energy yield and minimized deployment and operating risk. The MVPS is DC-coupling ready for large-scale storage integration.

MEDIUM VOLTAGE POWER STATION 2660-S2-US / 2750-S2-US / 2800-S2-US

Technical Data	MVPS 2660-S2-US	MVPS 2750-S2-US	MVPS 2800-S2-US
Input (DC)			
Available inverters	1 x SC 2660 UP-US	1 x SC 2750 UP-US	1 x SC 2800 UP-US
Max. input voltage	1500 V	1500 V	1500 V
Number of DC inputs	dependent on the selected inverter		
Integrated zone monitoring	○		
Available DC fuse sizes (per input)	200 A, 250 A, 315 A, 350 A, 400 A, 450 A, 500 A		
Output (AC) on the medium-voltage side			
Rated power with SC-UP-US at 1000 m and cos phi = 1 (at -25°C to + 25°C/40°C optional 50°C)[1]	2660 kVA / 2260 kVA	2750 kVA / 2380 kVA	2800 kVA / 2380 kVA
Typical nominal AC voltages	12 kV to 34.5 kV		
AC power frequency	50 Hz / 60 Hz		
Transformer vector group Dy11 / YNd11 / YNy0	● / ○ / ○		
Transformer cooling methods	KNAN[2]		
Transformer no-load losses Standard / Ecodesign	2.8 kW / 2.1 kW	2.9 kW / 2.2 kW	2.9 kW / 2.2 kW
Transformer short-circuit losses Standard / Ecodesign	25.5 kW / 25.3 kW	26.5 kW / 26.3 kW	26.5 kW / 26.3 kW
Max. total harmonic distortion	< 3%		
Reactive power feed-in (up to 60% of nominal power)	○		
Power factor at rated power / displacement power factor adjustable	1 / 0.8 overexcited to 0.8 underexcited		
Inverter efficiency			
Max. efficiency[3] / European efficiency[3] / CEC weighted efficiency[4]	98.7% / 98.6% / 98.5%		
Protective devices			
Input-side disconnection point	DC load-break switch		
Output-side disconnection point	Medium-voltage vacuum circuit breaker		
DC overvoltage protection	Surge arrester type I		
Galvanic isolation	●		
Internal arc classification medium-voltage control room (according to IEC 62271-202)	IAC A 20 kA 1 s		
General Data			
Dimensions equal to 20-foot HC shipping container (W / H / D)	6058 mm / 2896 mm / 2438 mm		
Weight	< 18 t		
Self-consumption (max. / partial load / average)[1]	< 8.1 kW / < 1.8 kW / < 2.0 kW		
Self-consumption (stand-by)[1]	< 370 W		
Degree of protection according to IEC 60529	Control rooms IP23D, inverter electronics IP54		
Environment: standard / harsh	● / ○		
Degree of protection according to IEC 60721-3-4 (4C1, 4S2 / 4C2, 4S4)	● / ○		
Maximum permissible value for relative humidity	95% (for 2 months/year)		
Max. operating altitude above mean sea level 1000 m / 2000 m	● / ○		
Fresh air consumption of inverter	6500 m^3/h		
Features			
DC terminal	Terminal lug		
AC connection	Outer-cone angle plug		
Tap changer for MV-transformer: without / with	● / ○		
Shield winding for MV-Transformer: without / with	● / ○		
Station enclosure color	RAL 7004		
Transformer for external loads: without / 10 / 20 / 30 / 40 / 50 / 60 kVA	● / ○ / ○ / ○ / ○ / ○ / ○		
Medium-voltage switchgear: without / 3 feeders 2 cable feeders with load-break switch, 1 transformer feeder with circuit breaker, internal arc classification IAC A FL 20 kA 1 s according to IEC 62271-200	● / ○		
Short circuit rating medium voltage switchgear (25 kA 1s)	○		
Integrated oil containment: without / with	● / ○		
Industry standards (for other standards see the inverter datasheet)	IEC 60076, IEC 62271-200, IEC 62271-202, EN50588-1 IEEE C37.100.1, IEEE C57.12, C37.20.9, UL 1741 listed, CSC Certificate, UL 347		
● Standard features ○ Optional features — Not available			
Type designation	MVPS-2060-S2-US	MVPS-2750-S2-US	MVPS-2800-S2-US

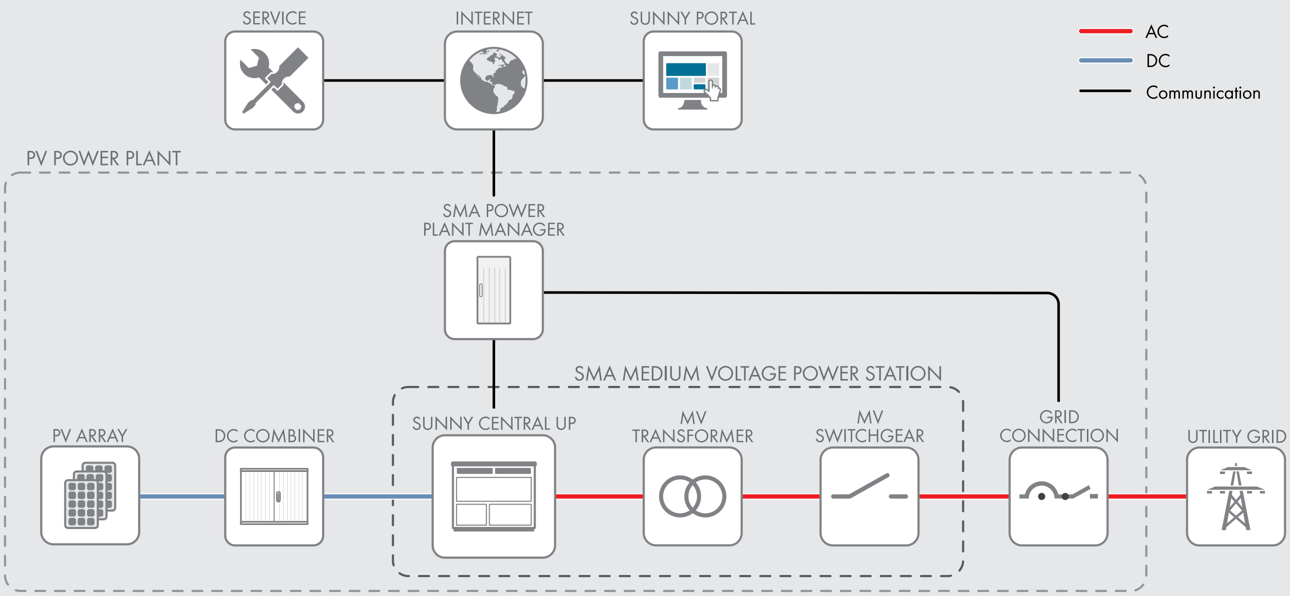
1) Data based on inverter. Further details can be found in the data sheet of the inverter.
2) KNAN = Natural ester fluid with natural air cooling
3) Efficiency measured at inverter without internal power supply
4) Efficiency measured at inverter with internal power supply

MEDIUM VOLTAGE POWER STATION 2930-S2-US / 3060-S2-US

Technical Data	MVPS 2930-S2-US	MVPS 3060-S2-US
Input (DC)		
Available inverters	1 x SC 2930 UP-US	1 x SC 3060 UP-US
Max. input voltage	1500 V	1500 V
Number of DC inputs	dependent on the selected inverter	
Integrated zone monitoring	○	
Available DC fuse sizes (per input)	200 A, 250 A, 315 A, 350 A, 400 A, 450 A, 500 A	
Output (AC) on the medium-voltage side		
Rated power with SC-UP-US at 1000 m and cos phi = 1 (at -25°C to + 25°C/40°C optional 50°C)[1]	2900 kVA / 2490 kVA	3060 kVA / 2600 kVA
Typical nominal AC voltages	12 kV to 34.5 kV	
AC power frequency	50 Hz / 60 Hz	
Transformer vector group Dy11 / YNd11 / YNy0	● / ○ / ○	
Transformer cooling methods	KNAN[2]	
Transformer no-load losses Standard / Ecodesign	3.0 kW / 2.3 kW	3.1 kW / 2.4 kW
Transformer short-circuit losses Standard / Ecodesign	27.4 kW / 27.3 kW	28.4 kW / 28.3 kW
Max. total harmonic distortion	< 3%	
Reactive power feed-in (up to 60% of nominal power)	○	
Power factor at rated power / displacement power factor adjustable	1 / 0.8 overexcited to 0.8 underexcited	
Inverter efficiency		
Max. efficiency[3] / European efficiency[3] / CEC weighted efficiency[4]	98.7% / 98.6% / 98.5%	
Protective devices		
Input-side disconnection point	DC load-break switch	
Output-side disconnection point	Medium-voltage vacuum circuit breaker	
DC overvoltage protection	Surge arrester type I	
Galvanic isolation	●	
Internal arc classification medium-voltage control room (according to IEC 62271-202)	IAC A 20 kA 1 s	
General Data		
Dimensions equal to 20-foot HC shipping container (W / H / D)	6058 mm / 2896 mm / 2438 mm	
Weight	< 18 t	
Self-consumption (max. / partial load / average)[1]	< 8.1 kW / < 1.8 kW / < 2.0 kW	
Self-consumption (stand-by)[1]	< 370 W	
Degree of protection according to IEC 60529	Control rooms IP23D, inverter electronics IP54	
Environment: standard / harsh	● / ○	
Degree of protection according to IEC 60721-3-4 (4C1, 4S2 / 4C2, 4S4)	● / ○	
Maximum permissible value for relative humidity	95% (for 2 months/year)	
Max. operating altitude above mean sea level 1000 m / 2000 m	● / ○	
Fresh air consumption of inverter	6500 m^3/h	
Features		
DC terminal	Terminal lug	
AC connection	Outer-cone angle plug	
Tap changer for MV-transformer: without / with	● / ○	
Shield winding for MV-Transformer: without / with	● / ○	
Station enclosure color	RAL 7004	
Transformer for external loads: without / 10 / 20 / 30 / 40 / 50 / 60 kVA	● / ○ / ○ / ○ / ○ / ○ / ○	
Medium-voltage switchgear: without / 3 feeders 2 cable feeders with load-break switch, 1 transformer feeder with circuit breaker, internal arc classification IAC A FL 20 kA 1 s according to IEC 62271-200	● / ○	
Short circuit rating medium voltage switchgear (25 kA 1s)	○	
Integrated oil containment: without / with	● / ○	
Industry standards (for other standards see the inverter datasheet)	IEC 60076, IEC 62271-200, IEC 62271-202, EN50588-1 IEEE C37.100.1, IEEE C57.12, C37.20.9, UL 1741 listed, CSC Certificate, UL 347	
● Standard features ○ Optional features – Not available		
Type designation	MVPS-2930-S2-US	MVPS-3060-S2-US

1) Data based on inverter. Further details can be found in the data sheet of the inverter.
2) KNAN = Natural ester fluid with natural air cooling
3) Efficiency measured at inverter without internal power supply
4) Efficiency measured at inverter with internal power supply

System diagram with Sunny Central UP



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Battery Business

Global Network

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Feb. 2019

www.samsungsdi.com

ESS Batteries by Samsung SDI

Top Safety & Reliability Solutions

SAMSUNG SDI

SAMSUNG SDI

Creative Energy & Materials Solution Leader

Samsung SDI is leading the change of a new era with lithium-ion batteries.

Through our constant innovation towards excellence, we led with the technological superiority of our innovative IT devices and expanded into electric cars which have now become reality. In addition, we are contributing to the expansion of an eco-friendly environment by the deployment of batteries for energy storage.

We are all dreaming of a better future with BoT (Battery of Things) in which Samsung SDI will provide solutions for the world.

1970	2000	2008	2010
Established Samsung SDI	Began Lithium-ion Battery Business	Expanded Business into Automotives	Expanded Business into Energy Storage

Powering Tomorrow, Samsung SDI Battery Solution for Energy Storage

Samsung SDI's technology supplies eco-friendly energy solutions for the present and the future.

We provide safe, reliable and long-lasting performance with our Energy Storage solutions. ESS projects are deployed using Samsung SDI's battery solutions optimized for a range from residential to utility-scale projects.

Utility & Commercial Battery Platform

Optimized Battery Platforms Based on High-Density Design Technology

Solar & Wind Farm | Grid (Substation) | Building, Factory

UPS Lithium-ion Solution

Proven High-Voltage LIB Solutions Compatible with Premium UPS

Data Center | Factory

Residential & Telecom Battery Pack Solution

Scalable Standard Battery Pack for Customized ESS

PV Home | Telecom

Why Samsung SDI

Samsung SDI optimizes battery systems with advanced cell technology.

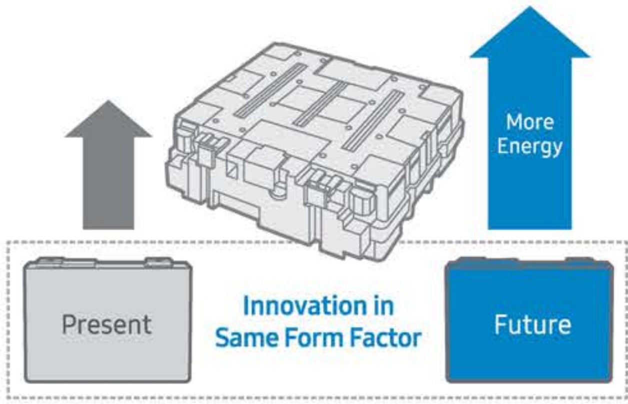
Safety First

Multi-Layered
Protection

Safety first is Samsung SDI priority. Prismatic cell has multi-layered protection at the cell level resulting in best in class safety. In addition, the aluminum exterior has excellent thermal conductivity and cooling performance, and it releases high temperature safely and efficiently from the inside to the outside.

Sustainable Design

Easy to Upgrade
Capacity without
Design Change



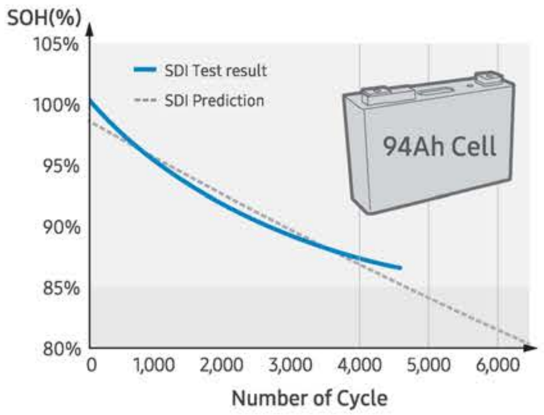
We are continuously innovating to increase the energy density while maintaining the same form factor and cell dimensions, thus facilitating future upgrades to higher capacity, higher energy density, ESS with no change to pack design.

Long Cycle Life

Industry Leading Cycle Life Performance

6,000 Cycles

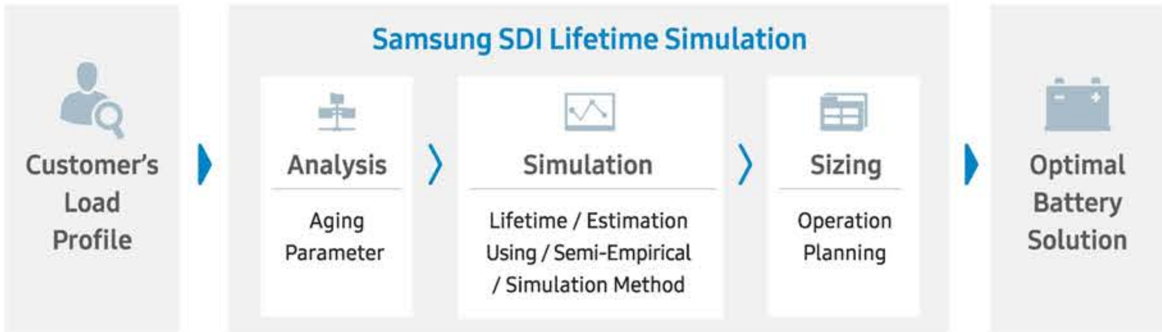
@continuous 1C /1C, SOH 80%



(Test Condition at 25°C, 1C/1C, DoD 100%)
*Warranty condition could be different depending on the load profile

Samsung SDI ESS leverages our manufacturing experience in IT and automotive battery cells resulting in superior and adaptive technology. Samsung SDI ESS is recognized as the industry leader in the market, providing our customers with the safest and long lasting batteries.

Accurate Lifetime Simulation

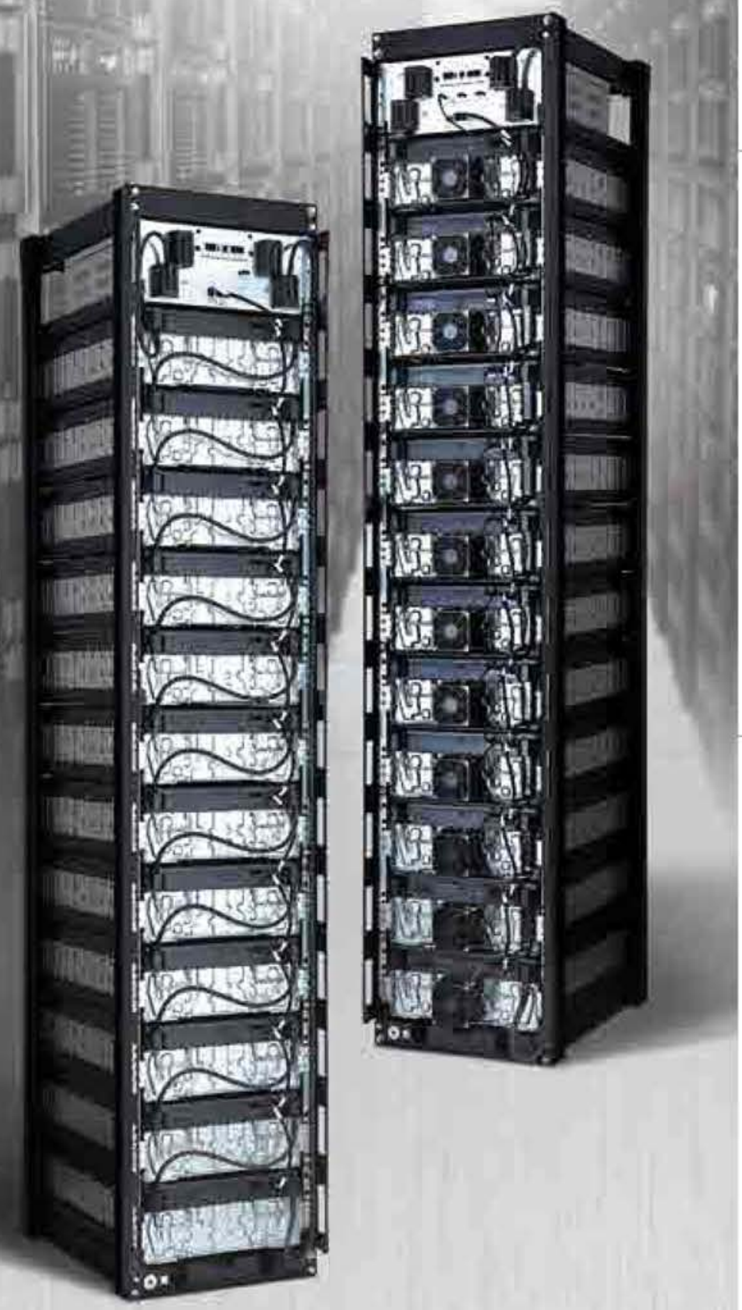


Samsung SDI offers optimal battery solution with its superior lifetime prediction technology.
We design and propose a battery system with analyzing the various parameter such as purpose, operation period and installation environment.

Battery Platform for **Utility & Commercial ESS**

Optimized Battery Platforms Based on High-Density Design Technology

- Solar & Wind Farm
- Grid (Substation)
- Building, Factory



Standard Platform

Energy Platform New

Over 2 hours

- Energy density has increased more than 16% with upgrades to Samsung SDI's new advanced module
- Higher density enables better footprint and installation cost savings

Item		Module	Rack		
Model		E3-M088	E3-R168	E3-R203	E3-R221
Cell Capacity	Ah	100	100	100	100
Energy	kWh	8.8	168	203	221
Operating Voltage	V	38.4~49.8	730~946	883~1,145	960~1,245
Dimension (W x D x H)	mm	370 x 637 x 160	876 x 711 x 1,791	876 x 711 x 2,123	876 x 711 x 2,289
Weight	kg	61	1,268	1,523	1,650

Medium Platform

1+hour up to 45 minutes

- Unique Platform in the ESS Industry with Mid-range Capabilities
- Optimized Solution for around One hour of Grid Service
- The Highest Lifetime Performance in a Continuous Charge/Discharge for 1 hour

Item		Module	Rack		
Model		M3-M081	M3-R073	M3-R089	M3-R097
Cell Capacity	Ah	100	100	100	100
Energy	kWh	8.1	73	89	97
Operating Voltage	V	70.4~91.3	634~822	774~1,004	845~1,096
Dimension (W x D x H)	mm	370 x 650 x 160	438 x 711 x 1,791	438 x 711 x 2,123	438 x 711 x 2,289
Weight	kg	56	564	683	742

Power Platform

30 minutes up to 20 minutes

- High Power Platform Optimized for Less than 30 minutes of Use
- Optimized Solution for Power Applications such as F/R, Railway, Ship, etc.

Item		Module	Rack		
Model		P3-M063	P3-R057	P3-R070	P3-R076
Cell Capacity	Ah	78	78	78	78
Energy	kWh	6.3	57	70	76
Operating Voltage	V	68.2~90.2	614~812	750~992	818~1,082
Dimension (W x D x H)	mm	370 x 650 x 160	438 x 711 x 1,791	438 x 711 x 2,123	438 x 711 x 2,289
Weight	kg	54	560	675	734

Battery Platform for

Utility & Commercial ESS

Optimized Battery Platforms Based on High-Density Design Technology

- Solar & Wind Farm
- Grid (Substation)
- Building, Factory

Special Platform

1,500 High Voltage Platform New

- High Efficiency Battery Solution for 1,500V PCS

Minimize Power Loss
by Enabling High PowerOutput

Minimize Total Footprint
by Reducing Footprint of PCS and Battery System

Maximize Economics & Efficiency

Product Lineup

Item		Rack		
Model		E3-R256	M3-R130	P3-R101
Platform		Energy	Medium	Power
Backup Time		2 hours	1 hour	30 minutes
Cell Capacity	Ah	100	100	78
Energy	kWh	256	130	101
Operating Voltage	V	1,114~1,444	1,126~1,461	1,091~1,443
Dimension (W x D x H)	mm	876 x 711 x 2,750	438 x 711 x 3,082	438 x 711 x 3,082
Weight	kg	1,929	1,001	965

Batteries for UPS Uninterruptible Power Supply

Proven High-Voltage LIB Solutions
Compatible with Premium UPS

- Data Center
- Factory

Benefits of Lithium-ion Batteries

Less Space / Weight

Lead-acid | Lithium-ion

[Equal Capacity]

- Less Space for Battery Room
- No Structure Reinforcement Required

Longer Life

Lead-acid 3~7 years | Lithium-ion 15 years

- Battery Replacement Deferral
- Enhanced Reliability

Fast Charge / Discharge Rate

Charge / Discharge

Lead-acid 0.1C 2C | Lithium-ion 0.5C 6C

[Back-up 10min]

- No Oversizing Required
- Shorter Charging Time

*This comparison above is based on each material's characteristic. The Battery life time may vary depending on the environmental condition which the device are used in and the customer's usage pattern.

Why Samsung SDI

- Only Samsung SDI can provide a 10 minute backup battery solution
- Compatible with Global UPS Battery Solutions
- Proven Safety & Quality
- Global Reference to IDC, a Factory in Operation for over 5 years

IDC (Internet Data Center)

2012, Shinhan Bank
World's First LIB Solution

Factory

2016, Samsung Display /Semiconductor
World's Largest factory

(Certified by TÜV)

Product Lineup

Item		Module	Rack
Model		U6-M020	U6-R035
Cell Capacity	Ah	67	67
Energy	kWh	2.0	35
Operation Voltage	V	24~33.6	408~572
Dimension (W x D x H)	mm	216 x 414 x 163	650 x 600 x 2,055
Weight	kg	17	550

*It is compatible with global UPS solution

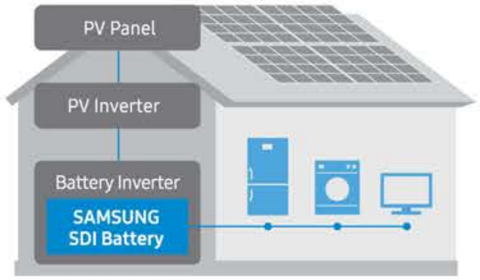
Residential & Telecom

Scalable Standard Battery Pack for Customized ESS

- PV Home
- Telecom

PV Storage / Off-Grid Backup

- PV Storage



- Off-Grid Backup

High Energy Cell
- Advanced High Capacity and Long Lifecycle

Easy Installation
- Easy Installation by Simple Module Structure

Scalability
- Easy to Expand Capacity

Standard Module
- Standard Module for Various Customer Needs

Compatibility
- Compatible with Various Standard Inverters

* Inverter for Residential, SMPS for Telecom

48V Solution

- High Energy 94Ah Prismatic Cell
- High Energy Density & Long Cycle Life
- Available up to 1C-rate
- Fits on 19 inch Standard Rack
- Wide Temperature Range

Scalable Capacity

188kWh

X Max.39

4.8kWh

Item		R1-M048
Component		Battery Module, BMS
Nominal Energy	kWh	4.8
Operating Voltage	V	44.8~58.1
Dimension (W x D x H)	mm	446 x 440 x 158
Weight	kg	35
Operating Temperature	℃	-10~50

HVS Solution New
(High Voltage System)

- Advanced 21700 Cylindrical Cell
- High Conversion Efficiency (DC to AC)
- Optimized for High Voltage PCS
- Superior Performance at High Temperature

Scalable Voltage & Capacity

100V 200V ... 600V

2.0kWh

X Max.6

12.0kWh

Item		R3-M020
Component		Battery Module, BMS
Nominal Energy	kWh	2.0
Operating Voltage	V	88.2 ~ 112.5
Dimension (W x D x H)	mm	191 x 433 x 172
Weight	kg	17.5
Operating Temperature	℃	0~60

Global Track Record

Since 2010, Samsung SDI's ESS products have been successfully operating in over 30 countries.

Today, Samsung SDI continues to make history by leading the growing global ESS market, based on best in class battery technology and strong partnerships.

SINCE
'10

COUNTRIES
30+

TOTAL GWh
10+

Americas

USA

California 150MWh Deployed 2017~

Austin, TX 36MW / 14MWh
El Cajon/Escondido, CA 37.5MW / 150MWh
Pomona, CA 20MW / 80MWh
Indianapolis, IN 20MW / 20MWh
El Centro, CA 30MW / 20MWh
Tucson, AZ 10MW / 5MWh
Punta Gorda, FL 10MW / 40MWh

Canada

Sault Sainte Marie, Ontario 8MW / 8MWh

Europe

Germany

Schwerin 15MWh Deployed 2014/17~

Schwerin 15MW / 15MWh
Chemnitz 10MW / 10MWh
Hassfurth 10MW / 10MWh

UK

Leighton Buzzard 10MWh Deployed 2014~

Leighton Buzzard 6MW / 10MWh
Barrow in Furness 49MW / 25MWh
Broxburn 20MW / 22MWh
Port of Tyne 36MW / 28MWh
Tynemouth 25MW / 17MWh
Pelham 50MW / 50MWh

Italy

Potenza 2MW / 2MWh

Netherlands

Zeeland 10MW / 10MWh

Spain

Carboneras 20MW / 12MWh

Asia & Oceania

Korea

KEPCO F/R 38MWh Deployed 2015~

KEPCO(5 Sites) 128MW / 38MWh
KOEN(3 Sites) 22MW / 63MWh
PyeongChang 6MW / 18MWh
Ulsan 24MW / 51MWh

China

Tibet 28MWh(2 Sites) Deployed 2016~

Tibet Shuanghu 4MW / 14MWh
Tibet Gaize 4MW / 14MWh

Japan

Hokkaido 25+MWh(3 Sites) Deployed 2017~

Hokkaido Shinhidaka 17MW / 9MWh
Hokkaido Chitose 17MW / 14MWh

Australia

Alice Spring 6MW / 2MWh
Western Australia 4MW / 2MWh
Adelaide 30MW/15MWh

(As of Dec, 2018 Installation & Award)

Envirotemp™ FR3™ fluid

Formulated for performance.

FR3™

ENVIROTEMP™ NATURAL ESTER FLUID

envirotempfluids.com

Envirotemp™ FR3™ fluid. Trusted worldwide a million times over.

With over one million installations across six continents and validated in over 250 tests, Cargill's Envirotemp™ FR3™ natural ester fluid is trusted by our customers to deliver cost-effective solutions that help improve transformer performance reliably and safely.

Our team of dielectric experts is active in the standards community globally and has extensive knowledge of not only dielectric fluid properties but also fluid performance in application. And they have transformer design experience, too. This means our customers adopting FR3 natural ester technology have comprehensive dielectric fluids support from initial planning stages through best practices implementation and beyond.

Backed by Cargill's global supply chain network, our customers can rely on us to deliver the best solution for their application - when they need it, anywhere in the world.

With FR3 fluid, our customers can:

- Gain cost efficiencies either on initial cost or total cost of ownership without sacrificing reliability.
- Extend transformer insulation and asset life.
- Optimize load capacity.
- Significantly improve fire safety.
- Enhance their environmental footprint and sustainable supply chain initiatives.

Improve performance with life extension and loading flexibility.

Protect insulation life to extend asset life.

Insulation paper is one of the primary factors that determines the life of a transformer. FR3™ fluid's unique chemistry absorbs free water and essentially wicks it away from the insulation paper. FR3 fluid has 10 times the water saturation level of mineral oil. This results in extending the insulation life 5-8 times longer than mineral oil.

Insulation aging study comparing thermally upgraded paper using FR3 fluid vs. mineral oil.

- Save significantly on replacement costs by extending the asset life with FR3 fluid.
- Reduce the risk of failure to improve reliability of the transformer.
- Reduce processing maintenance costs, since FR3 fluid does not sludge like mineral oil.

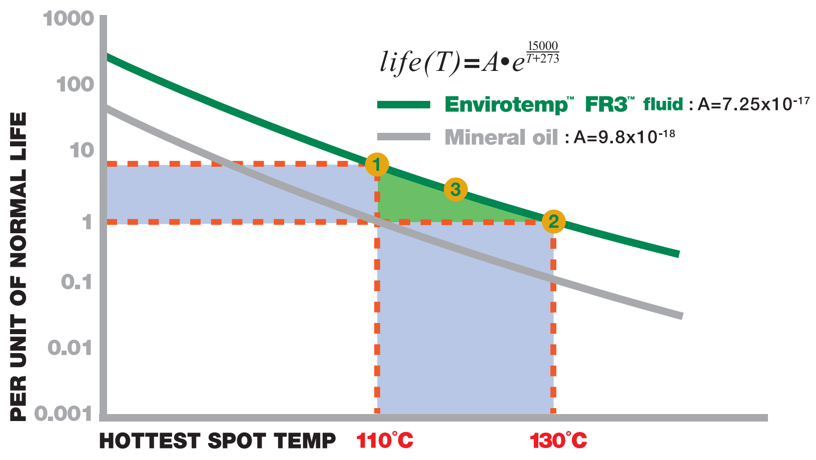
With FR3™ fluid's unique capabilities to extend insulation life and increase load capacity, organizations now have the flexibility to optimize their transformer fleet loading profiles in order to gain cost savings without sacrificing reliability.

Leverage higher thermal capability with FR3 fluid.

Historically, standards were written to accommodate a 95°C or 110°C hot spot for cellulose and Thermally Upgraded Kraft (TUK), respectively. However, published high temperature insulation system standards - IEC (60076-14) and IEEE (C157.154) – accommodate a 15°C or 20°C increase in hot spot without sacrificing the life or reliability of the transformer, when immersed in natural ester fluid.

Paper	Dielectric Fluid	Thermal Class	Hot spot	IEEE AWR	IEC AWR
TUK	Mineral Oil	120	110°C	65°C	75K
TUK	Natural Ester	140	130°C	85°C	95K

TUK life curves



OPTION 1: **Extend asset life at current 110° hotspot.**

OPTION 2: **Increase load capability up to 20% with 130°C hotspot.**

OPTION 3: **Incrementally extend asset life and increase load capability with 120°C hotspot.**

IEC 60076-14 Part 14: Liquid-immersed power transformers using high-temperature insulation materials. Edition 1.0 September 2013.

IEEE C57.154 Standard for the Design, Testing, and Application of Liquid-Immersed Distribution, Power, and Regulating Transformers Using High-Temperature Insulation Systems and Operating at Elevated Temperature. Published October 30, 2012.

Improve fire safety.

Add more sustainability to your sustainable supply chain.

Reduce costs while increasing fire safety.

FR3™ fluid has the highest fire point of any dielectric fluid (360°C compared to 160°C for mineral oil) making it the ideal choice for densely populated areas where transformers are positioned indoors, underground or in close proximity to buildings and other equipment. FR3 fluid is a K-class, less flammable fluid as certified by Underwriters Laboratory and approved by FM Global.

- Reduce clearance to buildings which saves precious real estate, particularly in space-constrained areas.
- Retrofill older transformers with FR3 fluid instead of replacing or moving them to help comply with current fire code regulations.
- For power transformers, potentially eliminate the need for expensive fire walls and deluge systems (and their ongoing maintenance costs).

"Being green" also benefits your bottom line.

FR3 fluid not only has best-in-class environmental properties, but with its enhanced thermal capabilities enabling smaller transformer designs, your supply chain just got a whole lot more sustainable.

- Smaller, more efficient transformer designs:
    1. Use less fluid and construction materials.
    2. Are typically lighter which could make installations easier for work crews and could reduce transportation costs.

Envirotemp™ FR3™ fluid properties: standard acceptance values and typical values

	Standard test methods		ASTM D6871/IEEE C57.147	IEC 62770	Envirotemp FR3 fluid
PROPERTY	**ASTM**	**ISO/IEC**	**As-received new fluid property requirements**	**Unused new fluid property requirements**	**TYPICAL**
Physical					
Color	D1500	ISO 2211	≤1.0	–	0.5
Flash Point PMCC (˚C)	D93	ISO 2719	–	≥250	255
Flash Point COC (˚C)	D92	ISO 2592	≥275	–	320-330
Fire Point (˚C)	D92	ISO 2592	≥300	>300	350-360
Pour Point (˚C)	D97	ISO 3016	<-10	≤-10	-18 - -23
Density at 20˚C (g/cm³)	–	ISO 3675	–	≤1.0	0.92
Relative Density (Specific Gravity) 15˚C	D1298	–	≤0.96	–	0.92
Viscosity (mm²/sec)					
100˚C	D445	ISO 3104	≤15	≤15	7.7 - 8.3
40˚C			≤50	≤50	32 - 34
0˚C			≤500	–	190
Visual Examination	D1524	IEC 62770 4.2.1	bright and clear	clear, free from sediment and suspended matter	clear, light green
Biodegradation	OECD 301		readily biodegradable	readily biodegradable	readily biodegradable
Electrical					
Dielectric Breakdown (kV)	D877	–	≥30	–	47
Dielectric Breakdown (kV)					
1mm gap	D1816	–	≥20	–	28
2mm gap	D1816	–	≥35	–	48-75
2.5mm gap	–	IEC 60156	–	≥35	73
Gassing Tendency (mm/min)	D2300	–	≤0	–	-79
Dissipation Factor					
25˚C (%)	D924	–	≤0.20	–	0.010 - 0.15
90˚C (tan~)	–	IEC 60247	–	≤0.05	0.02
100˚C (%)	D924	–	≤4.0	–	0.41 - 3.85
Chemical					
Corrosive Sulfur	D1275	IEC 62697	non-corrosive	non-corrosive	non-corrosive
Water Content (mg/kg)	D1533	IEC 60814	≤200	≤200	4 - 50
Acid Number (mg KOH/g)	D974	IEC 62021.3	≤0.06	≤0.06	0.013 - 0.042
PCB Content (mg/kg)	D4059	IEC 61619	not detectable	free from PCBs	not detectable
Total Additives	–	IEC 60666	–	Max weight fraction 5%	<2%
Oxidation Stability (48 hrs, 120˚C)	–	IEC 61125C			
Total Acidity (mg KOH/g)	–	IEC 62621.3	–	≤0.6	0.1
Viscosity at 40°C (mm²/sec)	–	ISO 3104	–	≤ 30% increase over initial	17.1% increase
Dissipation Factor at 90°C (tan~)	–	IEC 60247	–	≤ 0.5	0.1

NOTE: Specifications should be written referencing only the defined ASTM or IEC industry standard acceptance values and test methods. The listed 'typical' values are average values summarized from a significant number of data points over many years; they are not to be identified as acceptance values.

ASTM D6871 Standard Specification for Natural (Vegetable Oil) Ester Fluids Used in Electrical Apparatus.

IEC 62770: Fluids for electrotechnical applications – Unused natural esters liquids for transformers and similar electrical equipment.

A transformer filled with FR3™ fluid complies with the transformer temperature operating range requirements defined in IEEE C57.12.00 and IEC 60076-1.

- Made from a renewable source with global, reliable supply.
- Carbon neutral (according to BEES 4.0 lifecycle analysis).
- Non-toxic and non-hazardous in soil and water.
- Readily Biodegradable per OECD 301.
- Contains no petroleum, halogens, silicones or sulfurs.
- Recyclable.









envirotemp™
ester dielectric fluids

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Cargill

Attachment 10

Drainage Report

Drainage Report

Costa Solar Project
Freetown, Massachusetts

Submitted on behalf of:

IRONWOOD RENEWABLES

&

BRI BIODIVERSITY RESEARCH INSTITUTE

Prepared by:

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November 4th, 2021

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List of Appendices

Section 1.0 – Introduction

The following plan outlines anticipated inspection and maintenance procedures for the proposed erosion and sediment control measures, as well as stormwater management systems for the proposed solar project. This document also outlines several housekeeping requirements that shall be followed by the contractor and project owner during and after construction. The described procedures must be followed to ensure proper function of the stormwater measures as designed and to mitigate the risk of adverse impacts to the natural environment in the vicinity of the project.

The proposed project is a 5.0 MW AC solar-generation facility located in Freetown, Massachusetts. The project will be located at the end of the cul-de-sac on Costa Drive. The existing project area is currently an undeveloped wooded lot which is bisected by the existing railroad. The property is surrounded by some residential homes and some properties which are used for commercial/industrial use. The project will be accessed from Costa Drive. Refer to the site plans and project details more information about the project.

The development of the project site includes general construction work such as tree clearing, stump removal, grading, installation of fencing, construction of gravel access roads and temporary construction entrances, use of temporary staging areas, and other typical construction activities for preparing a site for solar development. Specific tasks needed for the solar array construction include driving of support posts, erecting panel racking, installation of solar panels, construction of equipment pads, installation of project transformers and inverters, trenching for underground conduit, install battery system, and installation of power poles collection lines.

In addition, the project will utilize temporary erosion and sediment control Best Management Practices (BMPs) during construction, with the proposed permanent stormwater management structures providing treatment and control during the operational life of the project. Construction of the project will be phased as such that no more than 5 acres of land are disturbed at any one time on the project site. Any disturbed areas within the active construction area will be stabilized before a new phase of construction will commence. Refer to Appendix C for site plans and details associated with the proposed erosion, sediment control, and stormwater BMP's to be utilized during and after construction.

This plan and the project design have been prepared in accordance with the Massachusetts DEP Volume 1, Chapter 1 -Stormwater Management Standards using BMP's suggested in the Massachusetts Stormwater Handbook Volume 2, Chapter 1, and the Town of Freetown.

Section 2.0 – Overview of Modeling Methodology & Source Information

The pre- and post-development site conditions were modeled using the HydroCAD modeling program, version 10. This program was developed in accordance with the methodology published by the USDA Soil Conservation Service TR-55 document. Precipitation data used in the analysis, which was obtained from the NOAA Precipitation Frequency Data Server, is shown in the table below.

Recurrence Interval	24-hour storm depth
2-year storm	3.40 inches
10-year storm	5.04 inches
25-year storm	6.07 inches
100-year storm	7.65 inches

Section 3.0 – Description of Analysis Points

The watershed model developed analyzed the discharge of runoff from the project site at four Analysis Points downstream of the proposed development. The selected analysis points are described below and can be found on C-1.01 Existing Conditions Plan and C-1.03 Stormwater and Grading Plan. Grading and minor earthwork are proposed on a portion of the site, in some cases the pre- and post- development watersheds have change based on the change in grades. The analysis points and total area assessed for pre- and post- development remain the same allowing us to compare the values.

Analysis Point #1

Location: Latitude: N41° 45’ 23.4”
Longitude: W70° 58’ 29.9”

Description: Large wooded drainage area on the east side of the existing railroad. Contains wetland areas and a small tributary which cuts area in half. Area has minimally used for recreation purposes and has an existing path through it.

Pre-Development Drainage Area: 15.94 acres
Post-Development Drainage Area: 15.94 acres

Analysis Point #2

Location: Latitude: N41° 45’ 22.8”
Longitude: W70° 58’ 51.8”

Description: Large wooded drainage area on the west side of the existing railroad. Area is boardered by the railroad to the east, wetland areas to the north, stream to the west, and

Watershed 3 to the south . Area has minimally used for recreation purposes and has an existing path through it.

Pre-Development Drainage Area: 11.44 acres
Post-Development Drainage Area: 11.64 acres

Analysis Point #3

Location: Latitude: N41° 45’ 16.3”
Longitude: W70° 58’ 52.8”

Description: Large wooded drainage area on the west side of the existing railroad. Area is boardered by the railroad to the east, Watershed 2 to the north, stream to the west, and wetland areas to the south . Area has minimally used for recreation purposes and has an existing path through it.

Pre-Development Drainage Area: 16.29 acres
Post-Development Drainage Area: 16.09 acres

Section 4.0 – Pre-Development Site Conditions

The pre-development conditions and drainage patterns are shown on Sheet C-1.01 of the plan set. The project area to be disturbed for the proposed project encompasses approximately 30.5 acres. The project drains to unnamed tributaries and wetlands in the Fall Brook watershed. The existing drainage points described above make up the analyzed watershed of approximately 43.67 acres. This area is primarily composed of existing forest with wetland areas. The site is currently an undeveloped wood lot, and the site is primarily flat with minor grades towards the edges of the northern, southern, and western property lines. The majority of the analyzed watershed is composed of D-soils with some A-soils if those soils are not satutrated. The poor infiltration rates of the soils on site create some higher pre-development peak flow rates. Watershed 2 is comprised of mostly dry A-soils and therefore has lower pre-development peak flow rates. The pre-development peak flow rates were evaluated for storms ranging from the 2-year, 24-hour storm all the way up to the 100-year storm. Below are the peak flow values for the 2-year, 10-year, 25-year and 100-year storms.

Pre-Development Peak Flows (cfs)				
Analysis Point	2-year	10-year	25-year	100-year
SN001	4.71	10.56	14.97	22.69
SN002	0.00	0.06	0.27	1.10
SN003	0.45	2.58	4.71	8.79

Section 5.0 – Post-Development Site Conditions

The post-development conditions and drainage patterns are shown on Sheet C-1.03 of the plan set. The proposed project is a 5.0 MW-AC solar energy facility. The project will include roadways, equipment pads, posts to support solar racking and surrounded by perimeter fences. The new gravel roadways and concrete equipment pad will be the infrastructure which generates the proposed impervious surface on site. The proposed impervious area for the site is ±1.52 acres.

The majority roadways will be approximately 16' wide, but will increase to a maximum width of 20' and a minimum width of 12'. See project plans and details for additional information. There is approximately 2,900 feet of new gravel access roads. The roadways have turnoffs/turnarounds at equipment locations for servicing the equipment and parking.

In addition, there are multiple equipment pads and vaults proposed on the project site. These will be concrete and will also be impervious The equipment locations are shown on the site plans containing various electric equipment, battery storage, and transformers.

The array fields themselves will be made up of acres of racked solar panels. The panels sit on supports which are held above the ground on metal I-beam posts similar to a guardrail. These posts have a very small cross sectional area which are not included in the impervious calculations.

The total disturbed area associated with the project installation will be approximately 30.5 acres. Please refer to the project plans for additional information and detail. The post-development peak flow rates were evaluated for storms ranging from the 2-year, 24-hour storm all the way up to the 100-year storm. Below are the peak flow values for the 2-year, 10-year, 25-year and 100-year storms.

Post-Development Peak Flows (cfs)				
Analysis Point	2-year	10-year	25-year	100-year
SN001	4.58	10.13	13.88	22.22
SN002	0.00	0.04	0.19	0.81
SN003	0.39	1.21	2.96	8.52

Section 6.0 – Massachusetts Stormwater Management Standards

Introduction

The following plan outlines the State of Massachusetts Department of Protection's (MassDEP) Stormwater Management Standards and how the proposed project will address each standard. This project has been designed to meet and exceed all relevant standards. The specific standards outlined below are from MassDEP Volume 1, Chapter 1 -Stormwater Management Standards.

Standard 1

Standard 1 recommends that no new stormwater conveyance, such as storm drain outfalls, discharge untreated stormwater directly to wetlands or waterways of the Commonwealth. Flows from woods, fields and other undeveloped areas are to be considered uncontaminated. Flows from paved road surfaces should receive treatment prior to discharge.

The majority of this site will be an undeveloped meadow and the discharges from this meadow are not considered contaminated. The project does not propose paved roads; all access roads will be gravel. There are some concrete pads which house electrical equipment on site, these do not get driven upon and do not generate pollutants. To be conservative, the project proposes to collect the majority of the runoff from the gravel drive and equipment pads in a grassed channels, which will convey runoff to either sediment forebays or level lip spreaders. The sediment forebays and level lip spreader will pretreat the runoff prior to flow into further best management practices or offsite. The project also has two basins on site which have volumes large enough to contain well over the water quality storm, and are designed to keep the water on site for longer and reduce peak runoff flow rates. The designed outfalls are close to wetlands because the property is surrounded by wetlands. However, the water will be treated and the velocity in the flows will be reduced prior to leaving the site. MassDEP Standard 1 is satisfied.

Standard 2

Standard 2 prescribes that stormwater management systems be implemented in order to ensure that the post-development peak flow rates of discharge do not exceed existing flow rates of runoff for the standard applicable storms. The standard storms required to evaluate are the 2-year 24-hour and the 10-year 24-hour storm events. The 100-year 24-hour storm event must also be evaluated to assure that there will not be increased off-site flooding.

The pre- and post-development site conditions were modeled using the HydroCAD modeling program, version 10. This program was developed in accordance with the methodology published by the USDA Soil Conservation Service TR-55 document. Precipitation data used in the analysis was obtained from the NOAA Precipitation Frequency Data Server.

The project has evaluated and reduced all flows coming from the site in all of the storm events including the extreme 100-year 24-hour storm event. Further information, calculations, and details can be found in the attached HydroCAD Reports and on the Plan Set. MassDEP Standard 2 is satisfied.

Peak Flow Comparison (cfs)								
Analysis Point	2-year		10-year		25-year		100-year	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
SN001	4.71	4.58	10.56	10.13	14.97	13.88	22.69	22.22
SN002	0.00	0.00	0.06	0.04	0.27	0.19	1.10	0.81
SN003	0.45	0.39	2.58	1.21	4.71	2.96	8.79	8.52

<u>Standard 3</u>

Standard 3 outlines that the annual recharge from the post development site will approximate the annual recharge from the predevelopment conditions.

The soils on site have very low infiltration rates being Hydrologic Group C and D with some Group A when not saturated. The site currently a forested lot which is used by the property owner for recreational purposes. Post-construction the project will be maintained as a vegetated meadow which should closely mimic the existing forested condition. The land within the fence will have restricted access which will allow those areas to stay uncompacted from recreational use. Furthermore, portions of the project will drain to basins and level lip spreaders were limited infiltration will occur, promoting further recharge.

Again the project does not propose paving. To be conservative, the project proposes to collect the majority of runoff from the gravel drives and equipment; then provides several best management practice for stormwater runoff to be collected. Overall, the project will result in less flow offsite which means more water is infiltrated/recharged on site.

MassDEP Standard 3 is satisfied.

<u>Standard 4</u>

Standard 4 outlines that the stormwater management system shall be designed to remove 80% of the average annual post-construction load of the Total Suspended Solids (TSS).

Standard 4 does not apply to this project because there will be stable grass cover and there will be no source of suspended solids. To be conservative, the project proposes the majority of flows from the gravel road and equipment be collected in a grassed channel and conveyed to a sediment forebays or level lip spreaders for pretreatment. After, the flows will be detained in a basins and the level lip spreaders, resulting in any potential TSS remaining on site. MassDEP Standard 4 is satisfied.

<u>Standard 5</u>

Standard 5 outlines requirements for stormwater management systems for uses with higher potential pollutant loads.

The proposed development is not one that has a potential for higher pollutant loads. Furthermore, the project has included a draft of the Spill Prevention, Control, and Countermeasures (SPCC) plan for the fluid within the proposed transformer. The fluid in the transformers will also be Envirotemp FR3 Fluid. Per manufacturer's specification FR3 is a bio based natural ester dielectric coolant formulated from seed oils and does not contain petroleum, halogen, silicon or corrosive sulfur. The SPCC plan is attached as an Appendix. MassDEP Standard 5 is satisfied.

Standard 6

Standard 6 seeks to protect critical areas. Critical areas are specifically designated Outstanding Resource Waters (ORWs) such as shell fish beds, swimming beaches, cold water fisheries, and recharge areas for public water supplies.

Where possible the project will abide by all Federal, State and Local setbacks/buffers from the natural resources as shown on the site plan C-1.00. Project will be working close to many of the wetlands and streams on site. Project will work closely with the Freetown Conservation Commission and apply for a Notice of Intent (NOI) to disturb areas within the wetlands, streams and environmental buffers. The project will limit the disturbance of the environmental features on site to the greates extent practical.

Furthermore, the project has included a draft of the Spill Prevention, Control, and Countermeasures (SPCC) plan for the fluid within the proposed transformer. The SPCC plan and secondary oil containment around the transformers will also help with protection. Lastly, the project will be maintained as a meadow only being cut 2-3 times a year. This large vegetated space will further help slow flows on site and promote recharge/infiltration, protecting offsite areas from high velocity runoff. Standard 6 is satisfied.

Standard 7

Standard 7 applies to sites which have been previously developed and are being redeveloped. This standard allows for diminished performances of best management practices (BMPs).

This project is not a redevelopment project. MassDEP Standard 7 is satisfied.

Standard 8

Standard 8 requires a plan to control construction related impacts including erosion, sedimentation and other pollutant sources doing constriction and land disturbance activities.

The project plans and details outline Erosion and Sediment Controls for project construction. The plans show the proposed locations for erosion control devices and provide details/specifications for those devices. Also, the project will file a Stormwater Pollution Prevention Plan (SWPPP) with the EPA. For your review, we have included a draft SWPPP, it will be further defined and adjusted prior to construction. The SWPPP details all components of the erosion and sediment control means and methods, it is attached as an Appendix. MassDEP Standard 8 is satisfied.

Standard 9

Standard 9 requires the adoption of a formal operation and maintenance plan to ensure that the stormwater management system functions property as designed.

The project has developed a draft of the Operation and Management plan which is provided to you for review. It will be further defined and adjusted, the project will provide the final O&M plan to the Town of Freetown prior to the end of construction. The O&M Plan is attached as an Appendix, MassDEP Standard 9 is satisfied.

Standard 10

Standard 10 states all illicit discharges to the stormwater management system are prohibited.

As presented in Standards 1-9, this stormwater management system meets all of the relevant standards contained in the MassDEP Stormwater Management Standards. Prior to construction, the project will issue an interim illicit discharge statement based on the existing conditions and design conditions of the project. Once construction is complete, a final illicit discharge statement shall be issued to the Freetown Conservation Commission based on as-constructed conditions. MassDEP Standard 10 will be satisfied.

Section 7.0 – Summary

The proposed permanent stormwater management systems have been designed to mitigate stormwater runoff impacts associated with the proposed solar project in accordance with the Massachusetts DEP Stormwater BMP Manual. An operation and maintenance plan has been developed for the proposed stormwater facilities. A Stormwater Pollution Prevention Plan (SWPPP) has also been developed for the proposed project and will be submitted prior to starting construction The proposed stormwater treatment design meets the applicable Volume 1 Chapter 1 Stormwater Management Standards. The project will continure to work with the Town of Freetown and the Conservation Commission. Project will address any additional conditions which may be required by the Town while working through the permitting process.

Section 8.0 – References

The following sources were utilized in development of the stormwater design and modeling.

- Massachusetts Stormwater Handbook and Stormwater Standards
  https://www.mass.gov/guides/massachusetts-stormwater-handbook-and-stormwater-standards

- Massachusetts DEP State Stormwater Standards and Permits
  https://www.mass.gov/info-details/stormwater#state-stormwater-standards-and-permits-

- NRCS Web Soil Survey
  https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm?TARGET_APP=Web_Soil_Survey_application_pguqa11rkdrp3g5vhqqb4w2z

- NOAA Atlas 14 Precipitation Frequency Data Server
  https://hdsc.nws.noaa.gov/hdsc/pfds/

Appendix A

NRCS Soil Report

United States
Department of
Agriculture

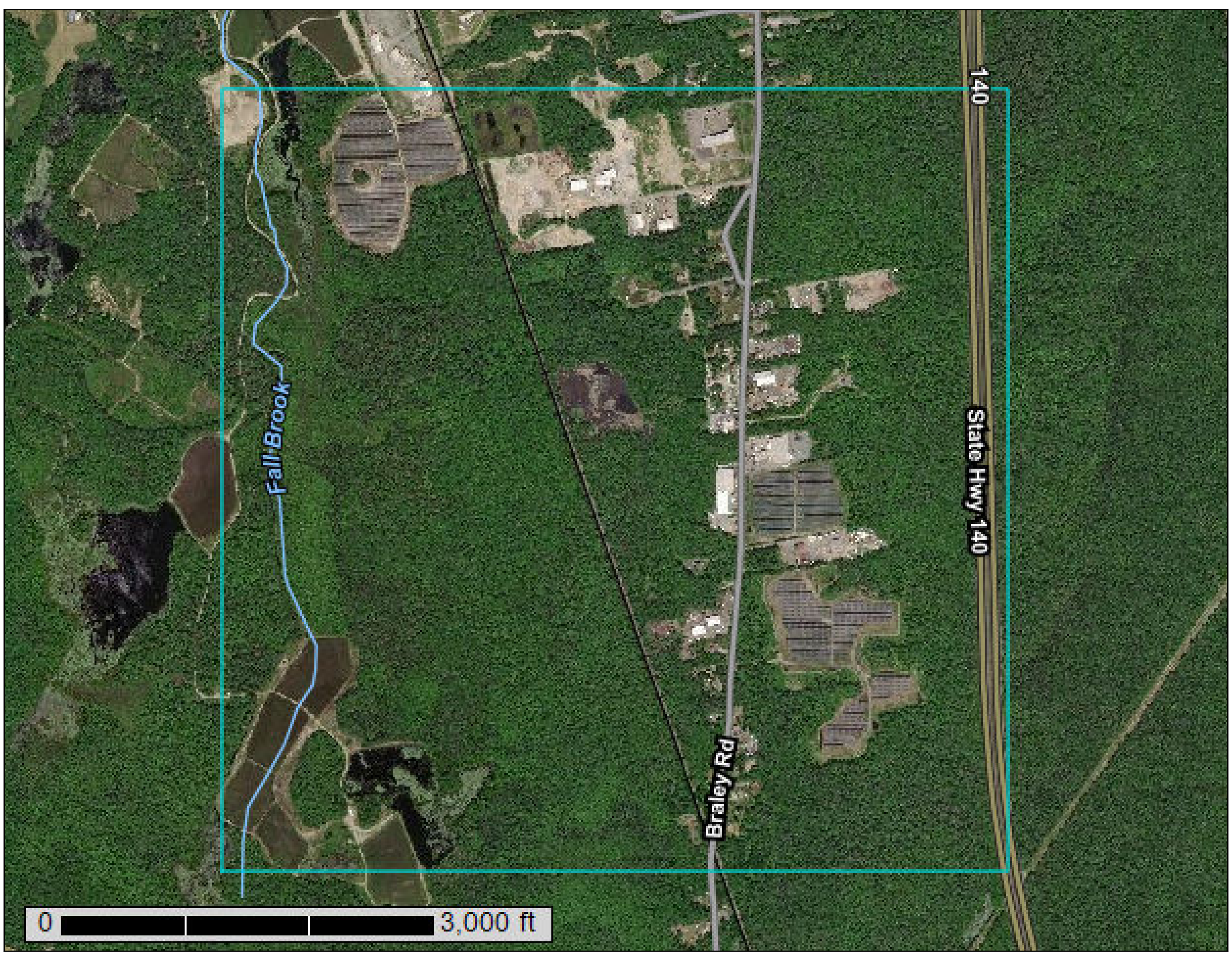
NRCS

Natural
Resources
Conservation
Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for

Bristol County, Massachusetts, Southern Part



March 4, 2021

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

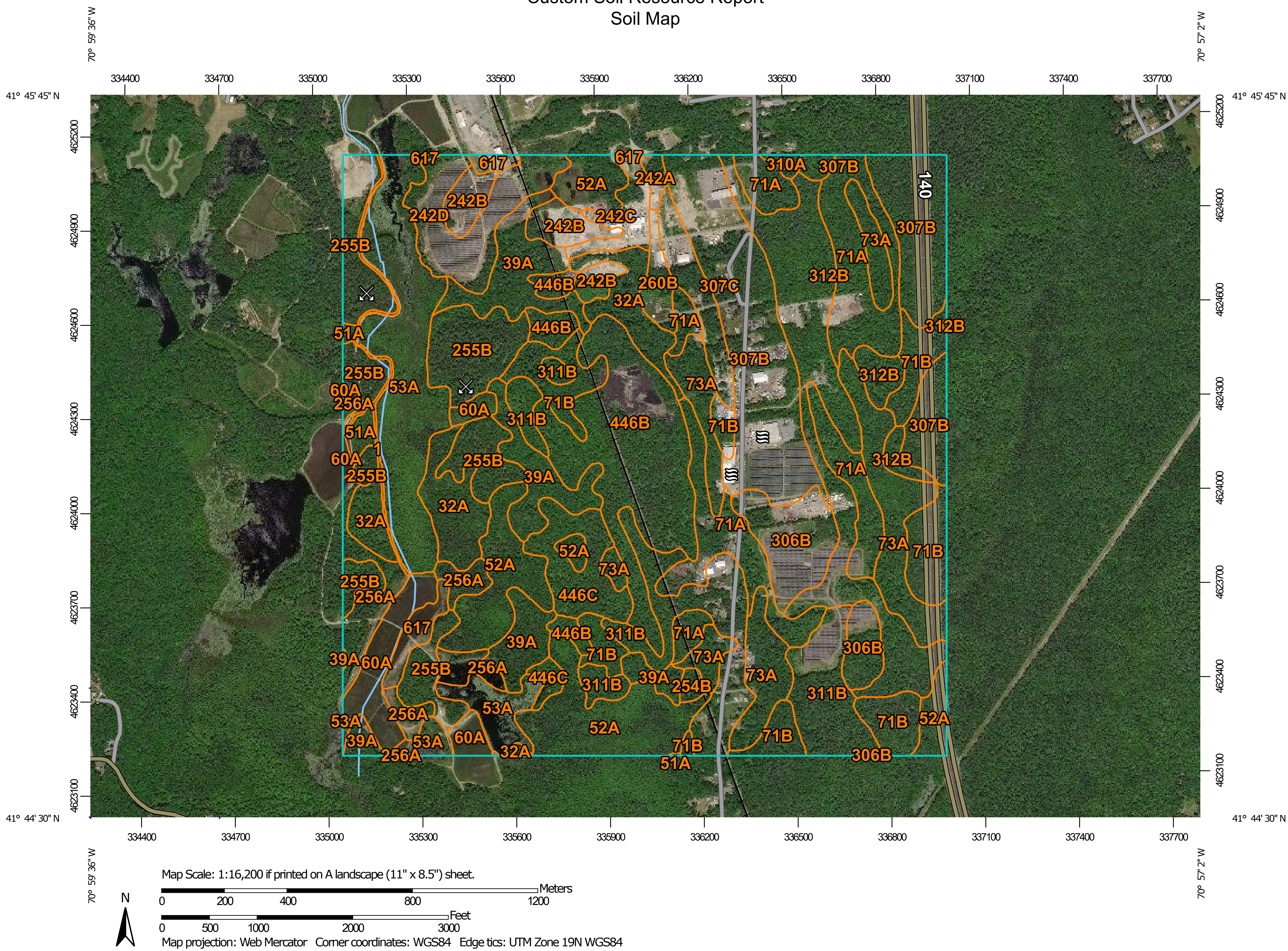
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Soil Map


70° 59' 36" W
70° 57' 2" W
41° 45' 45" N
41° 44' 30" N
334400
334700
335000
335300
335600
335900
336200
336500
336800
337100
337400
337700
4625200
4624900
4624600
4624300
4624000
4623700
4623400
4623100
140
617
242A
242B
242C
242D
52A
310A
307B
307C
71A
73A
312B
255B
39A
446B
446C
260B
32A
51A
60A
53A
256A
311B
71B
1
306B
254B
Map Scale: 1:16,200 if printed on A landscape (11" x 8.5") sheet.
Meters
0
200
400
800
1200
Feet
0
500
1000
2000
3000
N
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 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 1:20,000.

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
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: Bristol County, Massachusetts, Southern Part
Survey Area Data: Version 14, Jun 9, 2020

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

Date(s) aerial images were photographed: Dec 31, 2009—Jul 3, 2017

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

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
1	Water	3.0	0.3%
32A	Wareham loamy sand, 0 to 3 percent slopes	34.0	3.7%
39A	Scarboro mucky fine sandy loam, 0 to 3 percent slopes	48.2	5.3%
51A	Swansea muck, 0 to 1 percent slopes	3.8	0.4%
52A	Freetown muck, 0 to 1 percent slopes	64.0	7.0%
53A	Freetown muck, ponded, 0 to 1 percent slopes	66.4	7.2%
60A	Swansea coarse sand, 0 to 2 percent slopes	21.1	2.3%
71A	Ridgebury fine sandy loam, 0 to 3 percent slopes, extremely stony	71.0	7.7%
71B	Ridgebury fine sandy loam, 3 to 8 percent slopes, extremely stony	49.6	5.4%
73A	Whitman fine sandy loam, 0 to 3 percent slopes, extremely stony	57.9	6.3%
242A	Hinckley loamy sand, 0 to 3 percent slopes	2.2	0.2%
242B	Hinckley loamy sand, 3 to 8 percent slopes	15.9	1.7%
242C	Hinckley loamy sand, 8 to 15 percent slopes	9.0	1.0%
242D	Hinckley loamy sand, 15 to 25 percent slopes	25.0	2.7%
254B	Merrimac fine sandy loam, 3 to 8 percent slopes	1.7	0.2%
255B	Windsor loamy sand, 3 to 8 percent slopes	60.0	6.5%
256A	Deerfield loamy fine sand, 0 to 3 percent slopes	23.7	2.6%
260B	Sudbury fine sandy loam, 3 to 8 percent slopes	6.1	0.7%
306B	Paxton fine sandy loam, 0 to 8 percent slopes, very stony	26.1	2.8%
307B	Paxton fine sandy loam, 0 to 8 percent slopes, extremely stony	94.6	10.3%

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
307C	Paxton fine sandy loam, 8 to 15 percent slopes, extremely stony	12.7	1.4%
310A	Woodbridge fine sandy loam, 0 to 3 percent slopes	1.4	0.1%
311B	Woodbridge fine sandy loam, 0 to 8 percent slopes, very stony	59.5	6.5%
312B	Woodbridge fine sandy loam, 0 to 8 percent slopes, extremely stony	65.7	7.2%
446B	Gloucester-Hinckley complex, 3 to 8 percent slopes, very stony	67.1	7.3%
446C	Gloucester-Hinckley complex, 8 to 15 percent slopes, very stony	19.8	2.2%
617	Pits - Udorthents complex, gravelly	8.0	0.9%
Totals for Area of Interest		**917.2**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Bristol County, Massachusetts, Southern Part

1—Water

Map Unit Setting

National map unit symbol: v5vr
Frost-free period: 120 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition

Water: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

32A—Wareham loamy sand, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: v5s8
Elevation: 100 to 1,000 feet
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Wareham and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Wareham

Setting

Landform: Terraces
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Loose sandy glaciofluvial deposits

Typical profile

H1 - 0 to 9 inches: loamy sand
H2 - 9 to 15 inches: loamy coarse sand
H3 - 15 to 60 inches: sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Capacity of the most limiting layer to transmit water (Ksat): High to very high (6.00 to 20.00 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: None
Frequency of ponding: Occasional

Available water capacity: Low (about 4.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: A/D
Ecological site: F144AY028MA - Wet Outwash
Hydric soil rating: Yes

Minor Components

Scarboro

Percent of map unit: 10 percent
Landform: Terraces
Hydric soil rating: Yes

Pipestone

Percent of map unit: 5 percent
Landform: Terraces
Hydric soil rating: Yes

Deerfield

Percent of map unit: 5 percent
Hydric soil rating: No

39A—Scarboro mucky fine sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2svky
Elevation: 0 to 1,320 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 250 days
Farmland classification: Not prime farmland

Map Unit Composition

Scarboro and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Scarboro

Setting

Landform: Depressions, outwash terraces, outwash deltas, drainageways
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Sandy glaciofluvial deposits derived from schist and/or sandy glaciofluvial deposits derived from gneiss and/or sandy glaciofluvial deposits derived from granite

Typical profile

Oe - 0 to 3 inches: mucky peat
A - 3 to 11 inches: mucky fine sandy loam
Cg1 - 11 to 21 inches: sand
Cg2 - 21 to 65 inches: gravelly coarse sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (1.42 to 14.17 in/hr)
Depth to water table: About 0 to 2 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water capacity: Low (about 4.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: A/D
Ecological site: F144AY031MA - Very Wet Outwash
Hydric soil rating: Yes

Minor Components

Swansea

Percent of map unit: 10 percent
Landform: Bogs, swamps
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Walpole

Percent of map unit: 5 percent
Landform: Outwash plains, depressions, outwash terraces, depressions, deltas
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, dip, talf
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Wareham

Percent of map unit: 5 percent
Landform: Depressions
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

51A—Swansea muck, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 2trl2
Elevation: 0 to 1,140 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Swansea and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Swansea

Setting

Landform: Swamps, bogs
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Highly decomposed organic material over loose sandy and gravelly glaciofluvial deposits

Typical profile

Oa1 - 0 to 24 inches: muck
Oa2 - 24 to 34 inches: muck
Cg - 34 to 79 inches: coarse sand

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: Rare
Frequency of ponding: Frequent
Available water capacity: Very high (about 16.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8w
Hydrologic Soil Group: B/D
Ecological site: F144AY043MA - Acidic Organic Wetlands
Hydric soil rating: Yes

Minor Components

Freetown

Percent of map unit: 10 percent
Landform: Swamps, bogs
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Whitman

Percent of map unit: 5 percent
Landform: Drainageways, depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Scarboro

Percent of map unit: 5 percent
Landform: Depressions, drainageways
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

52A—Freetown muck, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 2t2q9
Elevation: 0 to 1,110 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Freetown and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Freetown

Setting

Landform: Swamps, depressions, depressions, bogs, marshes, kettles
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave

Across-slope shape: Concave
Parent material: Highly decomposed organic material

Typical profile

Oe - 0 to 2 inches: mucky peat
Oa - 2 to 79 inches: muck

Properties and qualities

Slope: 0 to 1 percent
Surface area covered with cobbles, stones or boulders: 0.0 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: Rare
Frequency of ponding: Frequent
Available water capacity: Very high (about 19.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: B/D
Ecological site: F144AY043MA - Acidic Organic Wetlands
Hydric soil rating: Yes

Minor Components

Swansea

Percent of map unit: 5 percent
Landform: Bogs, kettles, depressions, depressions, marshes, swamps
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Scarboro

Percent of map unit: 5 percent
Landform: Depressions, drainageways
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Whitman

Percent of map unit: 5 percent
Landform: Depressions, drainageways
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

53A—Freetown muck, ponded, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 2t2qc
Elevation: 0 to 1,140 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Freetown, ponded, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Freetown, Ponded

Setting

Landform: Depressions, marshes, kettles, swamps, bogs, depressions
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Highly decomposed organic material

Typical profile

Oe - 0 to 2 inches: mucky peat
Oa - 2 to 79 inches: muck

Properties and qualities

Slope: 0 to 1 percent
Surface area covered with cobbles, stones or boulders: 0.0 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: Rare
Frequency of ponding: Frequent
Available water capacity: Very high (about 19.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: B/D
Hydric soil rating: Yes

Minor Components

Whitman, ponded

Percent of map unit: 5 percent
Landform: Depressions on ground moraines
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Swansea, ponded

Percent of map unit: 5 percent
Landform: Bogs, kettles, depressions, depressions, marshes, swamps
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Scarboro

Percent of map unit: 5 percent
Landform: Depressions, drainageways
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, tread, dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

60A—Swansea coarse sand, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 2w68y
Elevation: 0 to 170 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Farmland of unique importance

Map Unit Composition

Swansea, sanded surface, and similar soils: 86 percent
Minor components: 14 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Swansea, Sanded Surface

Setting

Landform: Depressions, bogs, kettles
Down-slope shape: Concave
Across-slope shape: Concave

Parent material: Sandy human-transported material over highly decomposed organic material over sandy and gravelly glaciofluvial deposits

Typical profile

^Ap - 0 to 15 inches: coarse sand
2Oab - 15 to 36 inches: muck
2Cg - 36 to 79 inches: sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: FrequentNone
Frequency of ponding: None
Available water capacity: Very high (about 12.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: B/D
Ecological site: F144AY043MA - Acidic Organic Wetlands
Hydric soil rating: Yes

Minor Components

Freetown, sanded surface

Percent of map unit: 5 percent
Landform: Kettles, depressions, bogs
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Aquic udipsamments

Percent of map unit: 3 percent
Landform: Depressions
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear, convex, concave
Across-slope shape: Linear, convex, concave
Hydric soil rating: No

Rainberry, sanded surface

Percent of map unit: 3 percent
Landform: Depressions, kettles
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: Yes

Tihonet

Percent of map unit: 3 percent
Landform: Bogs
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, tread
Down-slope shape: Linear, concave

Across-slope shape: Linear, concave
Hydric soil rating: Yes

71A—Ridgebury fine sandy loam, 0 to 3 percent slopes, extremely stony

Map Unit Setting

National map unit symbol: 2w69b
Elevation: 0 to 1,480 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Ridgebury, extremely stony, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ridgebury, Extremely Stony

Setting

Landform: Depressions, drumlins, drainageways, hills, ground moraines
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Base slope, head slope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
A - 1 to 6 inches: fine sandy loam
Bw - 6 to 10 inches: sandy loam
Bg - 10 to 19 inches: gravelly sandy loam
Cd - 19 to 66 inches: gravelly sandy loam

Properties and qualities

Slope: 0 to 3 percent
Surface area covered with cobbles, stones or boulders: 9.0 percent
Depth to restrictive feature: 15 to 35 inches to densic material
Drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water capacity: Low (about 3.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Ecological site: F144AY009CT - Wet Till Depressions
Hydric soil rating: Yes

Minor Components

Whitman, extremely stony

Percent of map unit: 7 percent
Landform: Depressions
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Woodbridge, extremely stony

Percent of map unit: 7 percent
Landform: Drumlins, hills, ground moraines
Landform position (two-dimensional): Footslope, summit
Landform position (three-dimensional): Crest, base slope
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: No

Paxton, extremely stony

Percent of map unit: 1 percent
Landform: Drumlins, hills, ground moraines
Landform position (two-dimensional): Shoulder, summit
Landform position (three-dimensional): Crest
Down-slope shape: Linear, convex
Across-slope shape: Convex, linear
Hydric soil rating: No

71B—Ridgebury fine sandy loam, 3 to 8 percent slopes, extremely stony

Map Unit Setting

National map unit symbol: 2w69c
Elevation: 0 to 1,290 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Ridgebury, extremely stony, and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ridgebury, Extremely Stony

Setting

Landform: Ground moraines, depressions, drumlins, drainageways, hills
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Head slope, base slope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
A - 1 to 6 inches: fine sandy loam
Bw - 6 to 10 inches: sandy loam
Bg - 10 to 19 inches: gravelly sandy loam
Cd - 19 to 66 inches: gravelly sandy loam

Properties and qualities

Slope: 3 to 8 percent
Surface area covered with cobbles, stones or boulders: 9.0 percent
Depth to restrictive feature: 15 to 35 inches to densic material
Drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 0 to 6 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water capacity: Low (about 3.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Ecological site: F144AY009CT - Wet Till Depressions
Hydric soil rating: Yes

Minor Components

Woodbridge, extremely stony

Percent of map unit: 10 percent
Landform: Drumlins, hills, ground moraines
Landform position (two-dimensional): Footslope, summit, backslope
Landform position (three-dimensional): Crest, side slope
Down-slope shape: Convex
Across-slope shape: Linear
Hydric soil rating: No

Whitman, extremely stony

Percent of map unit: 8 percent
Landform: Depressions
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Paxton, extremely stony

Percent of map unit: 2 percent
Landform: Drumlins, hills, ground moraines
Landform position (two-dimensional): Shoulder, summit, backslope
Landform position (three-dimensional): Crest, side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex, linear
Hydric soil rating: No

73A—Whitman fine sandy loam, 0 to 3 percent slopes, extremely stony

Map Unit Setting

National map unit symbol: 2w695
Elevation: 0 to 1,580 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Whitman, extremely stony, and similar soils: 81 percent
Minor components: 19 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Whitman, Extremely Stony

Setting

Landform: Depressions, drainageways, hills, ground moraines, drumlins
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Oi - 0 to 1 inches: peat
A - 1 to 10 inches: fine sandy loam
Bg - 10 to 17 inches: gravelly fine sandy loam
Cdg - 17 to 61 inches: fine sandy loam

Properties and qualities

Slope: 0 to 3 percent
Surface area covered with cobbles, stones or boulders: 9.0 percent
Depth to restrictive feature: 7 to 38 inches to densic material
Drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 0 to 6 inches

Frequency of flooding: None
Frequency of ponding: Frequent
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water capacity: Low (about 3.0 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: D
Ecological site: F144AY041MA - Very Wet Till Depressions
Hydric soil rating: Yes

Minor Components

Ridgebury, extremely stony
Percent of map unit: 10 percent
Landform: Ground moraines, depressions, drumlins, drainageways, hills
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Head slope, base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Scarboro
Percent of map unit: 5 percent
Landform: Outwash deltas, outwash terraces, depressions, drainageways
Landform position (three-dimensional): Tread
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Swansea
Percent of map unit: 3 percent
Landform: Swamps, bogs, marshes
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Woodbridge, extremely stony
Percent of map unit: 1 percent
Landform: Drumlins, hills, ground moraines
Landform position (two-dimensional): Backslope, footslope, summit
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

242A—Hinckley loamy sand, 0 to 3 percent slopes

Map Unit Setting
National map unit symbol: 2svm7

Elevation: 0 to 1,420 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Hinckley and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hinckley

Setting

Landform: Outwash deltas, kame terraces, outwash plains, outwash terraces
Landform position (three-dimensional): Tread
Down-slope shape: Convex, linear, concave
Across-slope shape: Convex, linear, concave
Parent material: Sandy and gravelly glaciofluvial deposits derived from gneiss and/or granite and/or schist

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
A - 1 to 8 inches: loamy sand
Bw1 - 8 to 11 inches: gravelly loamy sand
Bw2 - 11 to 16 inches: gravelly loamy sand
BC - 16 to 19 inches: very gravelly loamy sand
C - 19 to 65 inches: very gravelly sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water capacity: Low (about 3.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3s
Hydrologic Soil Group: A
Ecological site: F144AY022MA - Dry Outwash
Hydric soil rating: No

Minor Components

Merrimac

Percent of map unit: 5 percent
Landform: Outwash deltas, kame terraces, outwash terraces
Landform position (three-dimensional): Tread
Down-slope shape: Convex, linear, concave
Across-slope shape: Convex, linear, concave

Hydric soil rating: No

Windsor

Percent of map unit: 5 percent
Landform: Outwash terraces, kame terraces, outwash deltas
Landform position (three-dimensional): Tread
Down-slope shape: Concave, linear, convex
Across-slope shape: Linear, convex, concave
Hydric soil rating: No

Sudbury

Percent of map unit: 5 percent
Landform: Outwash deltas, kame terraces, outwash terraces
Landform position (three-dimensional): Tread
Down-slope shape: Convex, concave, linear
Across-slope shape: Convex, linear, concave
Hydric soil rating: No

242B—Hinckley loamy sand, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2svm8
Elevation: 0 to 1,430 feet
Mean annual precipitation: 36 to 53 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 250 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Hinckley and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hinckley

Setting

Landform: Kames, outwash terraces, outwash deltas, outwash plains, eskers, moraines, kame terraces
Landform position (two-dimensional): Summit, backslope, footslope, shoulder
Landform position (three-dimensional): Nose slope, side slope, base slope, crest, riser, tread
Down-slope shape: Linear, convex, concave
Across-slope shape: Convex, linear, concave
Parent material: Sandy and gravelly glaciofluvial deposits derived from gneiss and/or granite and/or schist

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
A - 1 to 8 inches: loamy sand
Bw1 - 8 to 11 inches: gravelly loamy sand
Bw2 - 11 to 16 inches: gravelly loamy sand

BC - 16 to 19 inches: very gravelly loamy sand
C - 19 to 65 inches: very gravelly sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water capacity: Very low (about 3.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3s
Hydrologic Soil Group: A
Ecological site: F144AY022MA - Dry Outwash
Hydric soil rating: No

Minor Components

Windsor

Percent of map unit: 8 percent
Landform: Eskers, moraines, outwash terraces, outwash deltas, kame terraces, outwash plains, kames
Landform position (two-dimensional): Summit, shoulder, backslope, footslope
Landform position (three-dimensional): Nose slope, side slope, base slope, crest, riser, tread
Down-slope shape: Linear, convex, concave
Across-slope shape: Convex, linear, concave
Hydric soil rating: No

Sudbury

Percent of map unit: 5 percent
Landform: Outwash deltas, kame terraces, outwash plains, moraines, outwash terraces
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Side slope, base slope, head slope, tread
Down-slope shape: Concave, linear
Across-slope shape: Linear, concave
Hydric soil rating: No

Agawam

Percent of map unit: 2 percent
Landform: Outwash terraces, outwash deltas, kame terraces, outwash plains, kames, eskers, moraines
Landform position (two-dimensional): Summit, shoulder, backslope, footslope
Landform position (three-dimensional): Nose slope, side slope, base slope, crest, riser, tread
Down-slope shape: Linear, convex, concave
Across-slope shape: Convex, linear, concave
Hydric soil rating: No

242C—Hinckley loamy sand, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: 2svm9
Elevation: 0 to 1,480 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Hinckley and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hinckley

Setting

Landform: Kames, eskers, moraines, outwash terraces, outwash deltas, kame terraces, outwash plains
Landform position (two-dimensional): Shoulder, toeslope, footslope, backslope
Landform position (three-dimensional): Nose slope, side slope, crest, head slope, riser
Down-slope shape: Linear, concave, convex
Across-slope shape: Convex, linear, concave
Parent material: Sandy and gravelly glaciofluvial deposits derived from gneiss and/or granite and/or schist

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
A - 1 to 8 inches: loamy sand
Bw1 - 8 to 11 inches: gravelly loamy sand
Bw2 - 11 to 16 inches: gravelly loamy sand
BC - 16 to 19 inches: very gravelly loamy sand
C - 19 to 65 inches: very gravelly sand

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water capacity: Low (about 3.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A
Ecological site: F144AY022MA - Dry Outwash
Hydric soil rating: No

Minor Components

Merrimac

Percent of map unit: 5 percent
Landform: Moraines, outwash terraces, outwash plains, kames, eskers
Landform position (two-dimensional): Shoulder, backslope, footslope, toeslope
Landform position (three-dimensional): Side slope, crest, head slope, nose slope, riser
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Windsor

Percent of map unit: 5 percent
Landform: Outwash terraces, outwash deltas, kames, eskers, moraines, kame terraces, outwash plains
Landform position (two-dimensional): Shoulder, backslope, footslope, toeslope
Landform position (three-dimensional): Nose slope, side slope, crest, head slope, riser
Down-slope shape: Linear, concave, convex
Across-slope shape: Convex, linear, concave
Hydric soil rating: No

Sudbury

Percent of map unit: 5 percent
Landform: Kame terraces, outwash plains, moraines, outwash deltas, outwash terraces
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Base slope, tread
Down-slope shape: Concave, linear
Across-slope shape: Linear, concave
Hydric soil rating: No

242D—Hinckley loamy sand, 15 to 25 percent slopes

Map Unit Setting

National map unit symbol: 2svmc
Elevation: 0 to 1,460 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Hinckley and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Hinckley

Setting

Landform: Moraines, outwash terraces, outwash deltas, kame terraces, kames, outwash plains, eskers
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Nose slope, side slope, crest, head slope, riser
Down-slope shape: Convex, linear, concave
Across-slope shape: Linear, convex, concave
Parent material: Sandy and gravelly glaciofluvial deposits derived from gneiss and/or granite and/or schist

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
A - 1 to 8 inches: loamy sand
Bw1 - 8 to 11 inches: gravelly loamy sand
Bw2 - 11 to 16 inches: gravelly loamy sand
BC - 16 to 19 inches: very gravelly loamy sand
C - 19 to 65 inches: very gravelly sand

Properties and qualities

Slope: 15 to 25 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water capacity: Low (about 3.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: F144AY022MA - Dry Outwash
Hydric soil rating: No

Minor Components

Merrimac

Percent of map unit: 8 percent
Landform: Outwash plains, kames, outwash terraces, eskers, moraines
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope, crest, head slope, nose slope, riser
Down-slope shape: Convex
Across-slope shape: Convex

Hydric soil rating: No

Windsor

Percent of map unit: 5 percent
Landform: Outwash terraces, outwash deltas, eskers, moraines, kame terraces, kames, outwash plains
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope, crest, head slope, nose slope, riser
Down-slope shape: Linear, concave, convex
Across-slope shape: Convex, linear, concave
Hydric soil rating: No

Sudbury

Percent of map unit: 2 percent
Landform: Outwash terraces, outwash plains, moraines, outwash deltas, kame terraces, eskers
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Base slope, tread
Down-slope shape: Concave, linear, convex
Across-slope shape: Linear, concave, convex
Hydric soil rating: No

254B—Merrimac fine sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2tyqs
Elevation: 0 to 1,290 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Merrimac and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Merrimac

Setting

Landform: Outwash plains, kames, eskers, moraines, outwash terraces
Landform position (two-dimensional): Backslope, footslope, shoulder, summit
Landform position (three-dimensional): Side slope, crest, riser, tread
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loamy glaciofluvial deposits derived from granite, schist, and gneiss over sandy and gravelly glaciofluvial deposits derived from granite, schist, and gneiss

Typical profile

Ap - 0 to 10 inches: fine sandy loam
Bw1 - 10 to 22 inches: fine sandy loam
Bw2 - 22 to 26 inches: stratified gravel to gravelly loamy sand
2C - 26 to 65 inches: stratified gravel to very gravelly sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 2 percent
Maximum salinity: Nonsaline (0.0 to 1.4 mmhos/cm)
Sodium adsorption ratio, maximum: 1.0
Available water capacity: Low (about 4.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2s
Hydrologic Soil Group: A
Ecological site: F145XY008MA - Dry Outwash
Hydric soil rating: No

Minor Components

Sudbury

Percent of map unit: 5 percent
Landform: Outwash plains, terraces, deltas
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread, dip
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Hinckley

Percent of map unit: 5 percent
Landform: Kames, deltas, outwash plains, eskers
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Nose slope, side slope, crest, head slope, rise
Down-slope shape: Convex
Across-slope shape: Convex, linear
Hydric soil rating: No

Windsor

Percent of map unit: 3 percent
Landform: Dunes, outwash terraces, outwash plains, deltas
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Tread, riser
Down-slope shape: Convex, linear
Across-slope shape: Convex, linear

Hydric soil rating: No

Agawam

Percent of map unit: 2 percent
Landform: Stream terraces, moraines, outwash terraces, outwash plains, kames, eskers
Landform position (three-dimensional): Rise
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

255B—Windsor loamy sand, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2svkf
Elevation: 0 to 1,210 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Windsor, loamy sand, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Windsor, Loamy Sand

Setting

Landform: Outwash terraces, deltas, outwash plains, dunes
Landform position (three-dimensional): Tread, riser
Down-slope shape: Linear, convex
Across-slope shape: Linear, convex
Parent material: Loose sandy glaciofluvial deposits derived from granite and/or loose sandy glaciofluvial deposits derived from schist and/or loose sandy glaciofluvial deposits derived from gneiss

Typical profile

O - 0 to 1 inches: moderately decomposed plant material
A - 1 to 3 inches: loamy sand
Bw - 3 to 25 inches: loamy sand
C - 25 to 65 inches: sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches

Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water capacity: Low (about 4.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2s
Hydrologic Soil Group: A
Ecological site: F144AY022MA - Dry Outwash
Hydric soil rating: No

Minor Components

Hinckley, loamy sand

Percent of map unit: 10 percent
Landform: Kames, deltas, outwash plains, eskers
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Nose slope, side slope, crest, head slope, rise
Down-slope shape: Convex
Across-slope shape: Convex, linear
Hydric soil rating: No

Deerfield, loamy sand

Percent of map unit: 5 percent
Landform: Outwash plains, terraces, deltas
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

256A—Deerfield loamy fine sand, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2xfg8
Elevation: 0 to 1,100 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Deerfield and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Deerfield

Setting

Landform: Kame terraces, outwash plains, outwash deltas, outwash terraces
Landform position (three-dimensional): Tread
Down-slope shape: Convex, linear, concave
Across-slope shape: Concave, linear, convex
Parent material: Sandy outwash derived from granite, gneiss, and/or quartzite

Typical profile

Ap - 0 to 9 inches: loamy fine sand
Bw - 9 to 25 inches: loamy fine sand
BC - 25 to 33 inches: fine sand
Cg - 33 to 60 inches: sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: About 15 to 37 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Sodium adsorption ratio, maximum: 11.0
Available water capacity: Moderate (about 6.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: A
Ecological site: F144AY027MA - Moist Sandy Outwash
Hydric soil rating: No

Minor Components

Windsor

Percent of map unit: 7 percent
Landform: Outwash deltas, kame terraces, outwash terraces, outwash plains
Landform position (three-dimensional): Tread
Down-slope shape: Linear, concave, convex
Across-slope shape: Concave, linear, convex
Hydric soil rating: No

Wareham

Percent of map unit: 5 percent
Landform: Drainageways, depressions
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Sudbury

Percent of map unit: 2 percent
Landform: Kame terraces, outwash plains, outwash terraces, outwash deltas
Landform position (three-dimensional): Tread

Down-slope shape: Convex, linear, concave
Across-slope shape: Concave, linear, convex
Hydric soil rating: No

Ninigret

Percent of map unit: 1 percent
Landform: Outwash terraces, outwash plains, kame terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear, convex
Across-slope shape: Concave, convex
Hydric soil rating: No

260B—Sudbury fine sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: v5rk
Elevation: 0 to 2,100 feet
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 145 to 240 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Sudbury and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Sudbury

Setting

Landform: Outwash plains
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Riser
Down-slope shape: Linear
Across-slope shape: Concave
Parent material: Friable coarse-loamy eolian deposits over loose sandy glaciofluvial deposits derived from granite and gneiss

Typical profile

H1 - 0 to 4 inches: fine sandy loam
H2 - 4 to 18 inches: sandy loam
H3 - 18 to 28 inches: gravelly coarse sandy loam
H4 - 28 to 60 inches: stratified sand and gravel, gravelly coarse sand
H4 - 28 to 60 inches:

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)

Depth to water table: About 18 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 5.9 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: B
Ecological site: F144AY027MA - Moist Sandy Outwash
Hydric soil rating: No

Minor Components

Merrimack
Percent of map unit: 5 percent
Hydric soil rating: No

Ninigret
Percent of map unit: 5 percent
Hydric soil rating: No

Walpole
Percent of map unit: 5 percent
Landform: Terraces
Hydric soil rating: Yes

Deerfield
Percent of map unit: 5 percent
Hydric soil rating: No

306B—Paxton fine sandy loam, 0 to 8 percent slopes, very stony

Map Unit Setting
National map unit symbol: 2w673
Elevation: 0 to 1,340 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition
Paxton, very stony, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Paxton, Very Stony

Setting
Landform: Drumlins, hills, ground moraines
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Crest, side slope

Down-slope shape: Linear, convex
Across-slope shape: Convex, linear
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Oe - 0 to 2 inches: moderately decomposed plant material
A - 2 to 10 inches: fine sandy loam
Bw1 - 10 to 17 inches: fine sandy loam
Bw2 - 17 to 28 inches: fine sandy loam
Cd - 28 to 67 inches: gravelly fine sandy loam

Properties and qualities

Slope: 0 to 8 percent
Surface area covered with cobbles, stones or boulders: 1.6 percent
Depth to restrictive feature: 20 to 43 inches to densic material
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 18 to 37 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water capacity: Low (about 4.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: C
Ecological site: F144AY007CT - Well Drained Dense Till Uplands
Hydric soil rating: No

Minor Components

Woodbridge, very stony

Percent of map unit: 8 percent
Landform: Ground moraines, drumlins, hills
Landform position (two-dimensional): Backslope, footslope, summit
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Ridgebury, very stony

Percent of map unit: 4 percent
Landform: Drumlins, ground moraines, hills, depressions, drainageways
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Base slope, head slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Charlton, very stony

Percent of map unit: 3 percent
Landform: Hills
Landform position (two-dimensional): Shoulder, summit, backslope

Landform position (three-dimensional): Crest, side slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

307B—Paxton fine sandy loam, 0 to 8 percent slopes, extremely stony

Map Unit Setting

National map unit symbol: 2w675
Elevation: 0 to 1,580 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Paxton, extremely stony, and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Paxton, Extremely Stony

Setting

Landform: Drumlins, hills, ground moraines
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Crest, side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex, linear
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Oe - 0 to 2 inches: moderately decomposed plant material
A - 2 to 10 inches: fine sandy loam
Bw1 - 10 to 17 inches: fine sandy loam
Bw2 - 17 to 28 inches: fine sandy loam
Cd - 28 to 67 inches: gravelly fine sandy loam

Properties and qualities

Slope: 0 to 8 percent
Surface area covered with cobbles, stones or boulders: 9.0 percent
Depth to restrictive feature: 20 to 43 inches to densic material
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 18 to 37 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)

Available water capacity: Low (about 4.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: C
Ecological site: F144AY007CT - Well Drained Dense Till Uplands
Hydric soil rating: No

Minor Components

Woodbridge, extremely stony

Percent of map unit: 10 percent
Landform: Drumlins, hills, ground moraines
Landform position (two-dimensional): Backslope, footslope, summit
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Charlton, extremely stony

Percent of map unit: 5 percent
Landform: Hills
Landform position (two-dimensional): Shoulder, summit, backslope
Landform position (three-dimensional): Crest, side slope
Down-slope shape: Convex
Across-slope shape: Convex
Hydric soil rating: No

Ridgebury, extremely stony

Percent of map unit: 4 percent
Landform: Hills, ground moraines, depressions, drainageways, drumlins
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Base slope, head slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Whitman, extremely stony

Percent of map unit: 1 percent
Landform: Depressions
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

307C—Paxton fine sandy loam, 8 to 15 percent slopes, extremely stony

Map Unit Setting

National map unit symbol: 2w676
Elevation: 0 to 1,490 feet
Mean annual precipitation: 36 to 71 inches

Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Paxton, extremely stony, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Paxton, Extremely Stony

Setting

Landform: Drumlins, hills, ground moraines
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex, linear
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Oe - 0 to 2 inches: moderately decomposed plant material
A - 2 to 10 inches: fine sandy loam
Bw1 - 10 to 17 inches: fine sandy loam
Bw2 - 17 to 28 inches: fine sandy loam
Cd - 28 to 67 inches: gravelly fine sandy loam

Properties and qualities

Slope: 8 to 15 percent
Surface area covered with cobbles, stones or boulders: 9.0 percent
Depth to restrictive feature: 20 to 43 inches to densic material
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 18 to 37 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water capacity: Low (about 4.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: C
Ecological site: F144AY007CT - Well Drained Dense Till Uplands
Hydric soil rating: No

Minor Components

Charlton, extremely stony

Percent of map unit: 8 percent
Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex

Hydric soil rating: No

Woodbridge, extremely stony

Percent of map unit: 6 percent
Landform: Drumlins, hills, ground moraines
Landform position (two-dimensional): Backslope, footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Ridgebury, extremely stony

Percent of map unit: 1 percent
Landform: Drumlins, drainageways, hills, ground moraines, depressions
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Base slope, head slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

310A—Woodbridge fine sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2w686
Elevation: 0 to 1,420 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Woodbridge and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Woodbridge

Setting

Landform: Drumlins, hills, ground moraines
Landform position (two-dimensional): Footslope, summit
Landform position (three-dimensional): Crest
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Ap - 0 to 7 inches: fine sandy loam
Bw1 - 7 to 18 inches: fine sandy loam
Bw2 - 18 to 30 inches: fine sandy loam
Cd - 30 to 65 inches: gravelly fine sandy loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: 20 to 39 inches to densic material
Drainage class: Moderately well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 18 to 30 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water capacity: Low (about 4.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: C/D
Ecological site: F144AY037MA - Moist Dense Till Uplands
Hydric soil rating: No

Minor Components

Paxton

Percent of map unit: 7 percent
Landform: Drumlins, hills, ground moraines
Landform position (two-dimensional): Summit, shoulder
Landform position (three-dimensional): Crest
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Ridgebury

Percent of map unit: 6 percent
Landform: Drumlins, drainageways, ground moraines, depressions, hills
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Base slope, head slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Sutton

Percent of map unit: 1 percent
Landform: Hills, ground moraines
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Linear
Hydric soil rating: No

Whitman, extremely stony

Percent of map unit: 1 percent
Landform: Depressions, drainageways
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

311B—Woodbridge fine sandy loam, 0 to 8 percent slopes, very stony

Map Unit Setting

National map unit symbol: 2t2qr
Elevation: 0 to 1,440 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Woodbridge, very stony, and similar soils: 82 percent
Minor components: 18 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Woodbridge, Very Stony

Setting

Landform: Drumlins, hills, ground moraines
Landform position (two-dimensional): Backslope, footslope, summit
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Oe - 0 to 2 inches: moderately decomposed plant material
A - 2 to 9 inches: fine sandy loam
Bw1 - 9 to 20 inches: fine sandy loam
Bw2 - 20 to 32 inches: fine sandy loam
Cd - 32 to 67 inches: gravelly fine sandy loam

Properties and qualities

Slope: 0 to 8 percent
Surface area covered with cobbles, stones or boulders: 1.6 percent
Depth to restrictive feature: 20 to 43 inches to densic material
Drainage class: Moderately well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 19 to 27 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water capacity: Low (about 4.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s

Hydrologic Soil Group: C/D
Ecological site: F144AY037MA - Moist Dense Till Uplands
Hydric soil rating: No

Minor Components

Paxton, very stony

Percent of map unit: 10 percent
Landform: Ground moraines, drumlins, hills
Landform position (two-dimensional): Shoulder, backslope, summit
Landform position (three-dimensional): Crest, side slope
Down-slope shape: Convex, linear
Across-slope shape: Convex, linear
Hydric soil rating: No

Ridgebury, very stony

Percent of map unit: 8 percent
Landform: Ground moraines, depressions, drumlins, drainageways, hills
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Head slope, base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

312B—Woodbridge fine sandy loam, 0 to 8 percent slopes, extremely stony

Map Unit Setting

National map unit symbol: 2t2qs
Elevation: 0 to 1,580 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Woodbridge, extremely stony, and similar soils: 82 percent
Minor components: 18 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Woodbridge, Extremely Stony

Setting

Landform: Ground moraines, drumlins, hills
Landform position (two-dimensional): Backslope, footslope, summit
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Coarse-loamy lodgment till derived from gneiss, granite, and/or schist

Typical profile

Oe - 0 to 2 inches: moderately decomposed plant material
A - 2 to 9 inches: fine sandy loam
Bw1 - 9 to 20 inches: fine sandy loam
Bw2 - 20 to 32 inches: fine sandy loam
Cd - 32 to 67 inches: gravelly fine sandy loam

Properties and qualities

Slope: 0 to 8 percent
Surface area covered with cobbles, stones or boulders: 9.0 percent
Depth to restrictive feature: 20 to 43 inches to densic material
Drainage class: Moderately well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: About 19 to 27 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water capacity: Low (about 4.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: C/D
Ecological site: F144AY037MA - Moist Dense Till Uplands
Hydric soil rating: No

Minor Components

Paxton, extremely stony

Percent of map unit: 10 percent
Landform: Drumlins, hills, ground moraines
Landform position (two-dimensional): Shoulder, backslope, summit
Landform position (three-dimensional): Crest, side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex, linear
Hydric soil rating: No

Ridgebury, extremely stony

Percent of map unit: 8 percent
Landform: Hills, ground moraines, depressions, drumlins, drainageways
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, head slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

446B—Gloucester-Hinckley complex, 3 to 8 percent slopes, very stony

Map Unit Setting

National map unit symbol: 2svln
Elevation: 0 to 270 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 145 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Gloucester, very stony, and similar soils: 35 percent
Hinckley, very stony, and similar soils: 25 percent
Minor components: 40 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Gloucester, Very Stony

Setting

Landform: Ridges, hills, moraines
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex, linear
Across-slope shape: Convex
Parent material: Sandy melt-out till derived from gneiss, granite, and/or schist

Typical profile

Oa - 0 to 2 inches: highly decomposed plant material
A - 2 to 6 inches: sandy loam
Bw1 - 6 to 15 inches: gravelly sandy loam
Bw2 - 15 to 29 inches: very gravelly loamy coarse sand
C - 29 to 65 inches: very gravelly loamy coarse sand

Properties and qualities

Slope: 15 to 35 percent
Surface area covered with cobbles, stones or boulders: 1.6 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 2 percent
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Sodium adsorption ratio, maximum: 1.0
Available water capacity: Low (about 5.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: A
Ecological site: F144AY032NH - Dry Till Uplands
Hydric soil rating: No

Description of Hinckley, Very Stony

Setting

Landform: Eskers, moraines, outwash terraces, outwash deltas, kame terraces, outwash plains, kames
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Crest, head slope, nose slope, side slope, riser
Down-slope shape: Convex, concave, linear
Across-slope shape: Concave, linear, convex
Parent material: Sandy and gravelly glaciofluvial deposits derived from gneiss and/or granite and/or schist

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
A - 1 to 8 inches: loamy sand
Bw1 - 8 to 11 inches: gravelly loamy sand
Bw2 - 11 to 16 inches: gravelly loamy sand
BC - 16 to 19 inches: very gravelly loamy sand
C - 19 to 65 inches: very gravelly sand

Properties and qualities

Slope: 25 to 35 percent
Surface area covered with cobbles, stones or boulders: 1.6 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water capacity: Low (about 3.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7s
Hydrologic Soil Group: A
Ecological site: F144AY022MA - Dry Outwash
Hydric soil rating: No

Minor Components

Merrimac, very stony

Percent of map unit: 10 percent
Landform: Outwash terraces, outwash plains, kame terraces, kames, eskers, moraines
Landform position (two-dimensional): Backslope

Landform position (three-dimensional): Side slope, crest, head slope, nose slope, riser
Down-slope shape: Linear, convex, concave
Across-slope shape: Convex, linear, concave
Hydric soil rating: No

Paxton, very stony

Percent of map unit: 10 percent
Landform: Hills, drumlins, ground moraines
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex, linear
Across-slope shape: Linear, convex
Hydric soil rating: No

Charlton, very stony

Percent of map unit: 10 percent
Landform: Ridges, hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex, linear
Across-slope shape: Convex
Hydric soil rating: No

Ridgebury, very stony

Percent of map unit: 10 percent
Landform: Drainageways, ground moraines, hills, depressions, drumlins
Landform position (two-dimensional): Footslope, toeslope
Landform position (three-dimensional): Base slope, head slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

446C—Gloucester-Hinckley complex, 8 to 15 percent slopes, very stony

Map Unit Setting

National map unit symbol: 2svlq
Elevation: 0 to 280 feet
Mean annual precipitation: 36 to 71 inches
Mean annual air temperature: 39 to 55 degrees F
Frost-free period: 140 to 240 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Gloucester, very stony, and similar soils: 35 percent
Hinckley, very stony, and similar soils: 25 percent
Minor components: 40 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Gloucester, Very Stony

Setting

Landform: Ridges, hills, moraines
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex, linear
Across-slope shape: Convex
Parent material: Sandy melt-out till derived from gneiss, granite, and/or schist

Typical profile

Oa - 0 to 2 inches: highly decomposed plant material
A - 2 to 6 inches: sandy loam
Bw1 - 6 to 15 inches: gravelly sandy loam
Bw2 - 15 to 29 inches: very gravelly loamy coarse sand
C - 29 to 65 inches: very gravelly loamy coarse sand

Properties and qualities

Slope: 8 to 15 percent
Surface area covered with cobbles, stones or boulders: 1.6 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 2 percent
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Sodium adsorption ratio, maximum: 1.0
Available water capacity: Low (about 5.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A
Ecological site: F144AY032NH - Dry Till Uplands
Hydric soil rating: No

Description of Hinckley, Very Stony

Setting

Landform: Moraines, outwash terraces, outwash deltas, kame terraces, outwash plains, kames, eskers
Landform position (two-dimensional): Backslope, shoulder, footslope
Landform position (three-dimensional): Nose slope, side slope, crest, head slope, riser
Down-slope shape: Convex, linear, concave
Across-slope shape: Linear, convex, concave
Parent material: Sandy and gravelly glaciofluvial deposits derived from gneiss and/or granite and/or schist

Typical profile

Oe - 0 to 1 inches: moderately decomposed plant material
A - 1 to 8 inches: loamy sand

Bw1 - 8 to 11 inches: gravelly loamy sand
Bw2 - 11 to 16 inches: gravelly loamy sand
BC - 16 to 19 inches: very gravelly loamy sand
C - 19 to 65 inches: very gravelly sand

Properties and qualities

Slope: 8 to 15 percent
Surface area covered with cobbles, stones or boulders: 1.6 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to very high (1.42 to 99.90 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Available water capacity: Low (about 3.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A
Ecological site: F144AY022MA - Dry Outwash
Hydric soil rating: No

Minor Components

Merrimac, very stony

Percent of map unit: 15 percent
Landform: Kame terraces, kames, eskers, moraines, outwash terraces, outwash plains
Landform position (two-dimensional): Backslope, shoulder, footslope
Landform position (three-dimensional): Side slope, crest, head slope, nose slope, riser
Down-slope shape: Linear, convex, concave
Across-slope shape: Convex, linear, concave
Hydric soil rating: No

Charlton, very stony

Percent of map unit: 10 percent
Landform: Hills, ridges
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex
Hydric soil rating: No

Paxton, very stony

Percent of map unit: 10 percent
Landform: Drumlins, ground moraines, hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex, linear
Across-slope shape: Linear, convex
Hydric soil rating: No

Ridgebury, very stony

Percent of map unit: 5 percent
Landform: Depressions, drumlins, drainageways, ground moraines, hills
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Head slope, base slope
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

617—Pits - Udorthents complex, gravelly

Map Unit Setting

National map unit symbol: v5qf
Elevation: 0 to 3,000 feet
Mean annual precipitation: 45 to 54 inches
Mean annual air temperature: 43 to 54 degrees F
Frost-free period: 120 to 240 days
Farmland classification: Not prime farmland

Map Unit Composition

Pits, gravelly: 60 percent
Udorthents, gravelly, and similar soils: 40 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pits, Gravelly

Typical profile

H1 - 0 to 6 inches: extremely gravelly sand
H2 - 6 to 60 inches: very gravelly coarse sand

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8s
Hydric soil rating: Unranked

Description of Udorthents, Gravelly

Typical profile

H1 - 0 to 6 inches: variable
H2 - 6 to 60 inches: variable

Properties and qualities

Slope: 0 to 25 percent
Depth to restrictive feature: More than 80 inches
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to very high (0.06 to 20.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A
Hydric soil rating: Unranked

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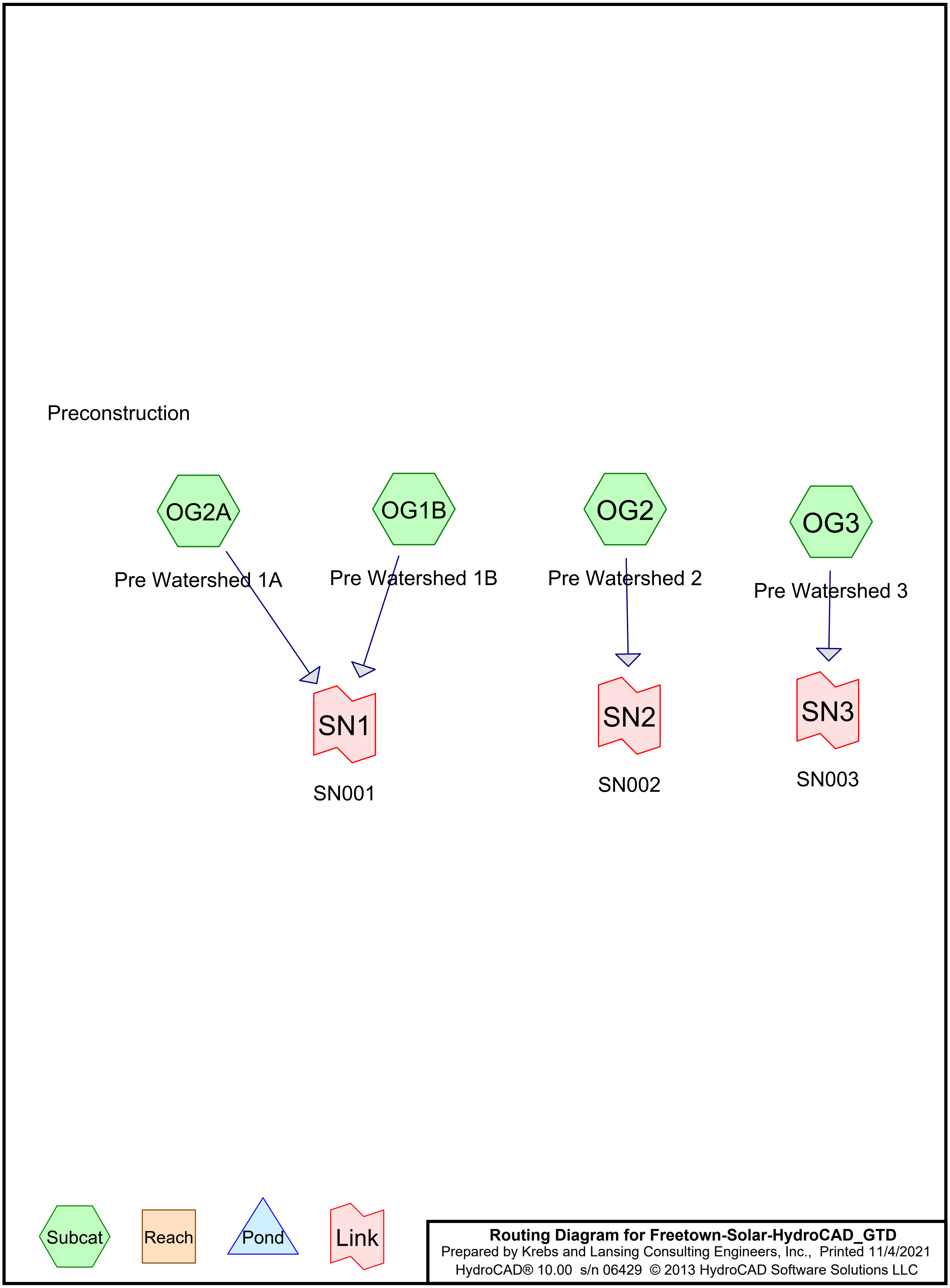
Appendix B

HydroCAD Reports



Routing Diagram for Freetown-Solar-HydroCAD_GTD
Prepared by Krebs and Lansing Consulting Engineers, Inc., Printed 11/4/2021
HydroCAD® 10.00 s/n 06429 © 2013 HydroCAD Software Solutions LLC

Summary for Subcatchment OG1B: Pre Watershed 1B

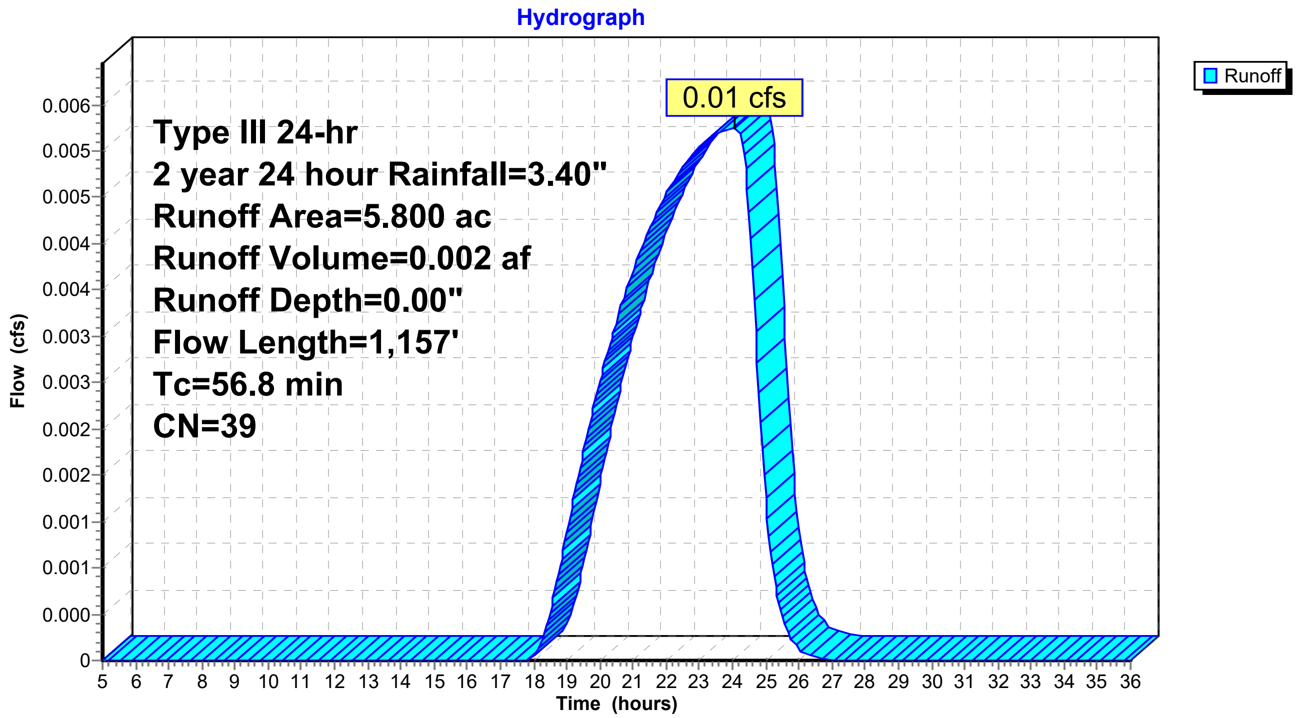
Runoff = 0.01 cfs @ 24.06 hrs, Volume= 0.002 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 year 24 hour Rainfall=3.40"

Area (ac)	CN	Description
4.430	30	Woods, Good, HSG A
0.810	77	Woods, Good, HSG D
0.400	39	Pasture/grassland/range, Good, HSG A
0.160	80	Pasture/grassland/range, Good, HSG D
5.800	39	Weighted Average
5.800		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
24.8	150	0.0290	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.40"
32.0	1,007	0.0110	0.52		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
56.8	1,157	Total			

Subcatchment OG1B: Pre Watershed 1B



Summary for Subcatchment OG2: Pre Watershed 2

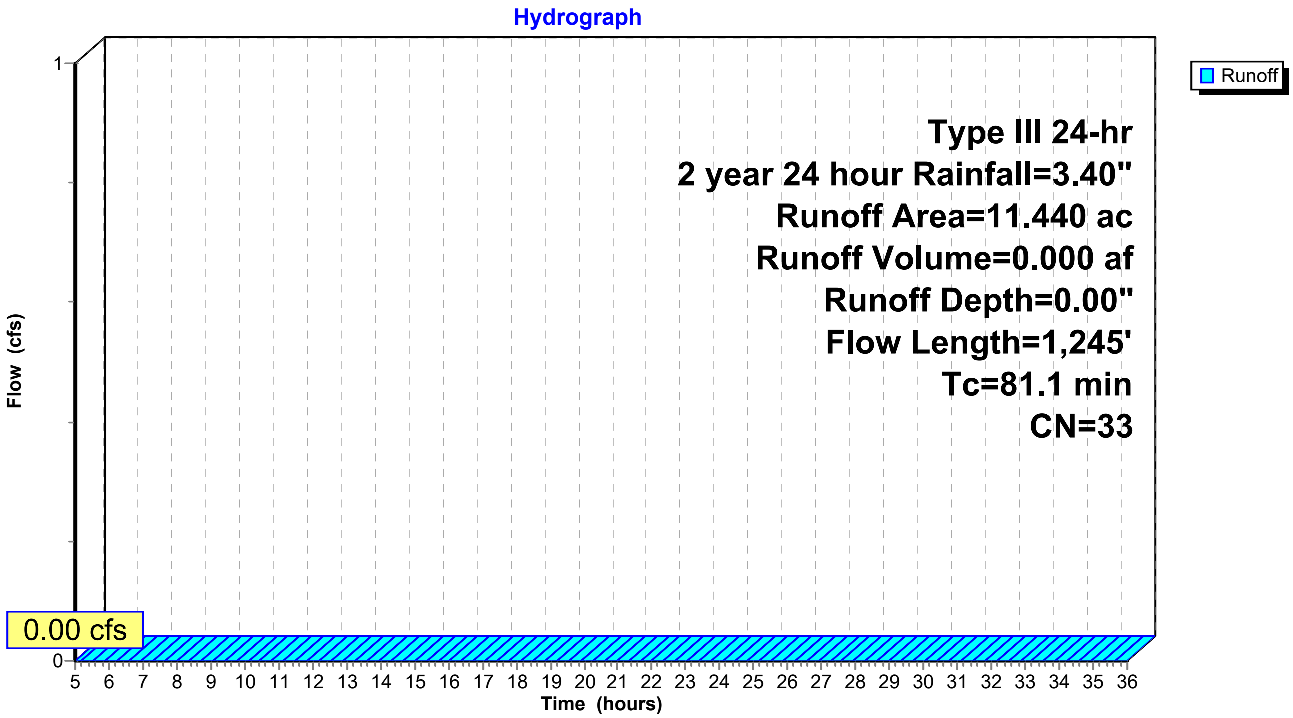
Runoff = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 year 24 hour Rainfall=3.40"

Area (ac)	CN	Description
10.050	30	Woods, Good, HSG A
0.650	77	Woods, Good, HSG D
0.730	39	Pasture/grassland/range, Good, HSG A
0.010	80	Pasture/grassland/range, Good, HSG D
11.440	33	Weighted Average
11.440		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
50.2	150	0.0050	0.05		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.40"
11.5	500	0.0210	0.72		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
16.3	345	0.0050	0.35		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
3.1	250	0.0050	1.36	10.20	**Channel Flow,** Area= 7.5 sf Perim= 8.7' r= 0.86' n= 0.070 Sluggish weedy reaches w/pools
81.1	1,245	Total			

Subcatchment OG2: Pre Watershed 2



Summary for Subcatchment OG2A: Pre Watershed 1A

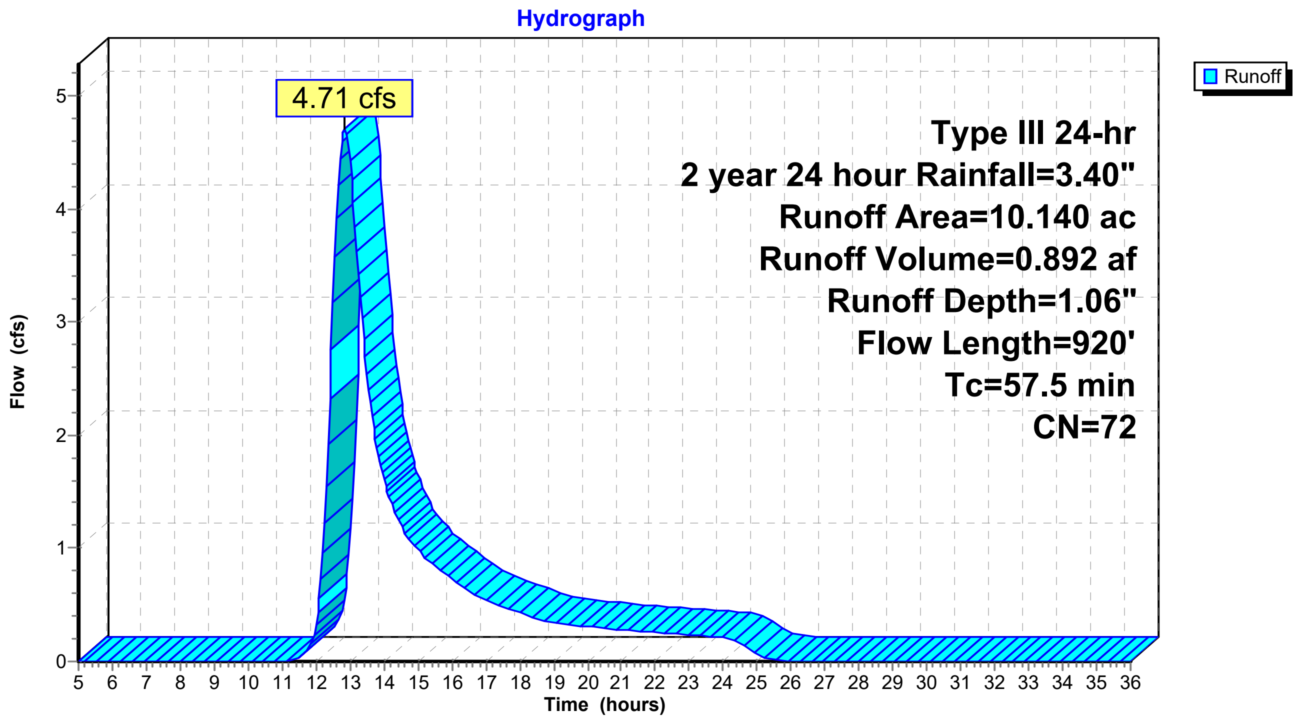
Runoff = 4.71 cfs @ 12.85 hrs, Volume= 0.892 af, Depth= 1.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 year 24 hour Rainfall=3.40"

Area (ac)	CN	Description
0.510	30	Woods, Good, HSG A
0.300	55	Woods, Good, HSG B
8.240	77	Woods, Good, HSG D
0.300	39	Pasture/grassland/range, Good, HSG A
0.420	61	Pasture/grassland/range, Good, HSG B
0.370	80	Pasture/grassland/range, Good, HSG D
10.140	72	Weighted Average
10.140		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.8	150	0.0200	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.40"
28.7	770	0.0080	0.45		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
57.5	920	Total			

Subcatchment OG2A: Pre Watershed 1A



Summary for Subcatchment OG3: Pre Watershed 3

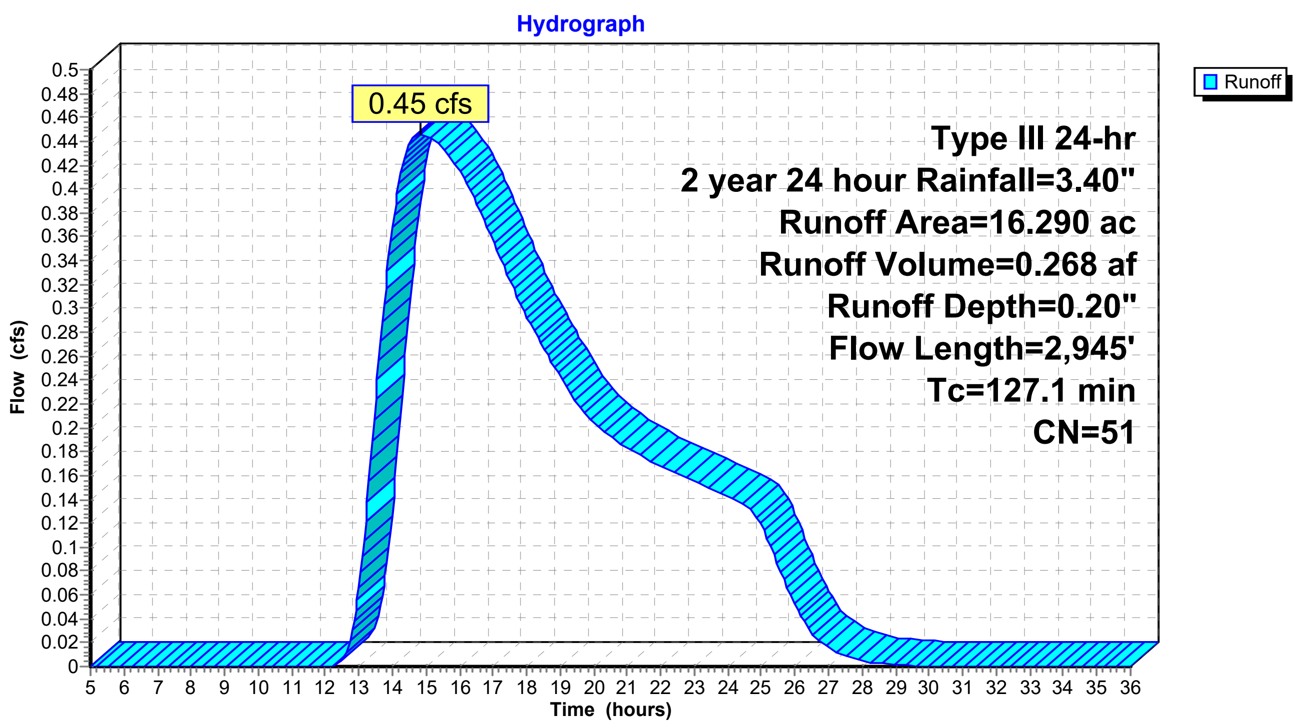
Runoff = 0.45 cfs @ 14.84 hrs, Volume= 0.268 af, Depth= 0.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 year 24 hour Rainfall=3.40"

Area (ac)	CN	Description
8.500	30	Woods, Good, HSG A
6.850	77	Woods, Good, HSG D
0.810	39	Pasture/grassland/range, Good, HSG A
0.130	80	Pasture/grassland/range, Good, HSG D
16.290	51	Weighted Average
16.290		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
34.2	150	0.0130	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.40"
18.5	825	0.0220	0.74		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
67.9	1,440	0.0050	0.35		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
6.5	530	0.0050	1.36	10.20	**Channel Flow,** Area= 7.5 sf Perim= 8.7' r= 0.86' n= 0.070
127.1	2,945	Total			

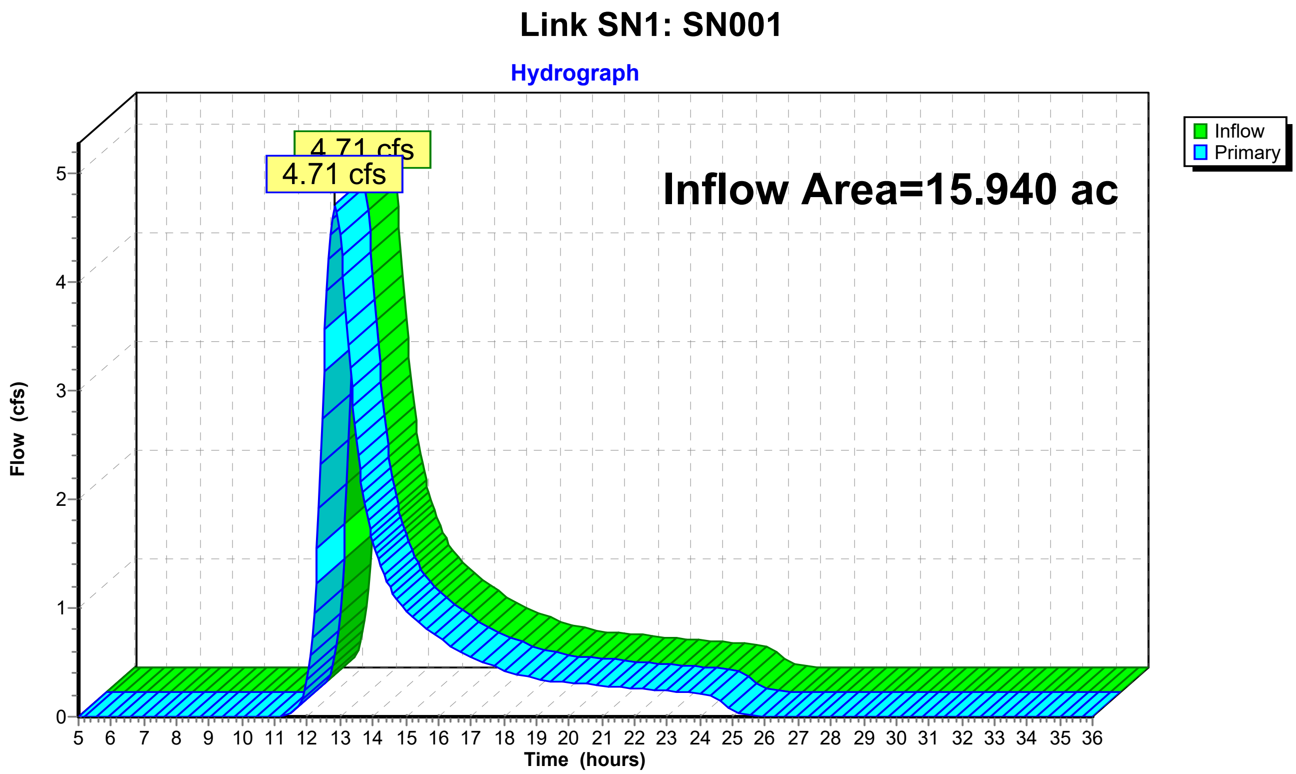
Subcatchment OG3: Pre Watershed 3



Summary for Link SN1: SN001

Inflow Area =	15.940 ac,	0.00% Impervious,	Inflow Depth = 0.67"	for 2 year 24 hour event	
Inflow =	4.71 cfs @	12.85 hrs,	Volume=	0.895 af	
Primary =	4.71 cfs @	12.85 hrs,	Volume=	0.895 af,	Atten= 0%, Lag= 0.0 min

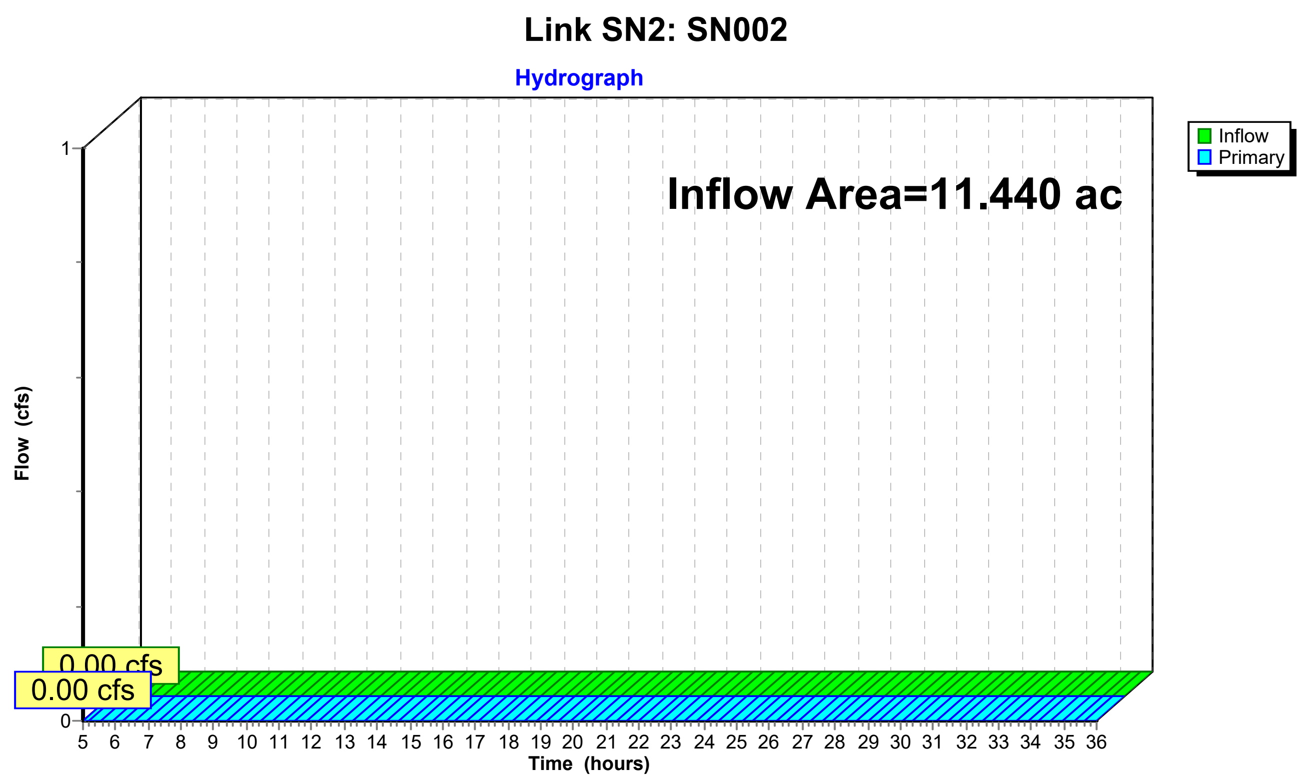
Primary outflow = Inflow, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs



Summary for Link SN2: SN002

Inflow Area =	11.440 ac,	0.00% Impervious,	Inflow Depth = 0.00"	for 2 year 24 hour event
Inflow =	0.00 cfs @	5.00 hrs, Volume=	0.000 af	
Primary =	0.00 cfs @	5.00 hrs, Volume=	0.000 af, Atten= 0%, Lag= 0.0 min	

Primary outflow = Inflow, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs

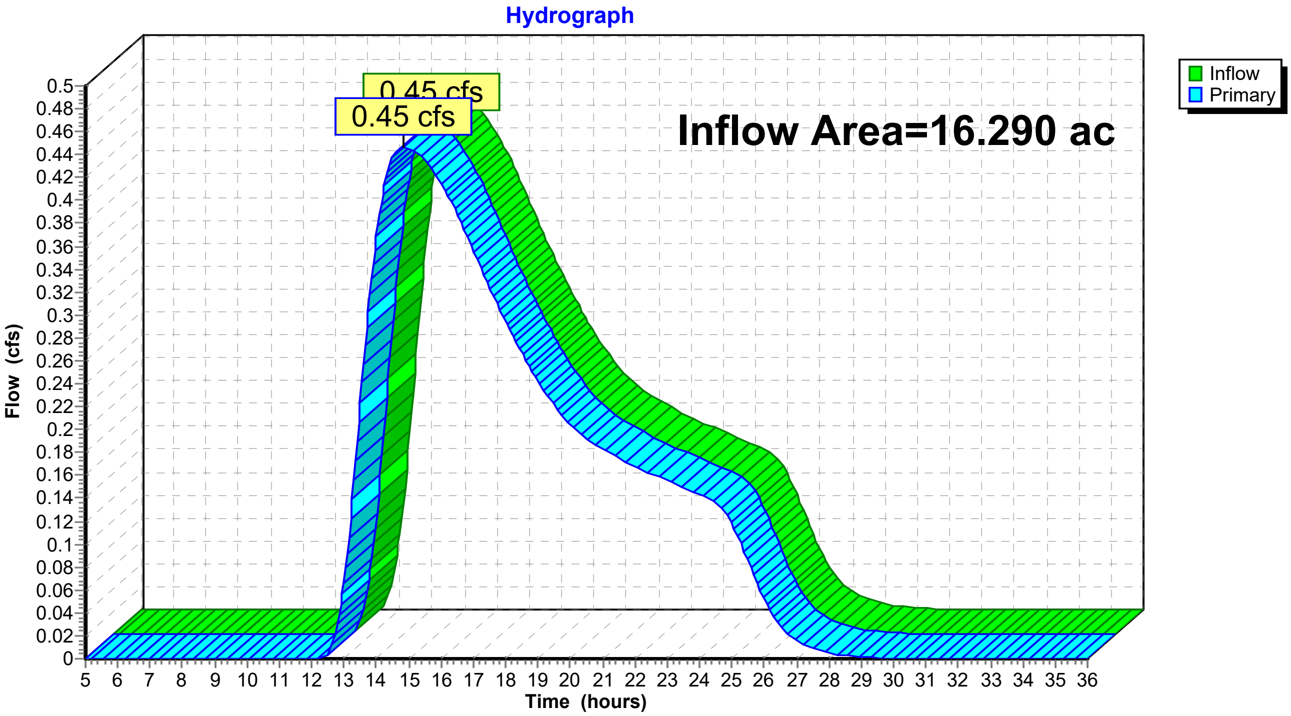


Summary for Link SN3: SN003

Inflow Area = 16.290 ac, 0.00% Impervious, Inflow Depth = 0.20" for 2 year 24 hour event
Inflow = 0.45 cfs @ 14.84 hrs, Volume= 0.268 af
Primary = 0.45 cfs @ 14.84 hrs, Volume= 0.268 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs

Link SN3: SN003



Summary for Subcatchment OG1B: Pre Watershed 1B

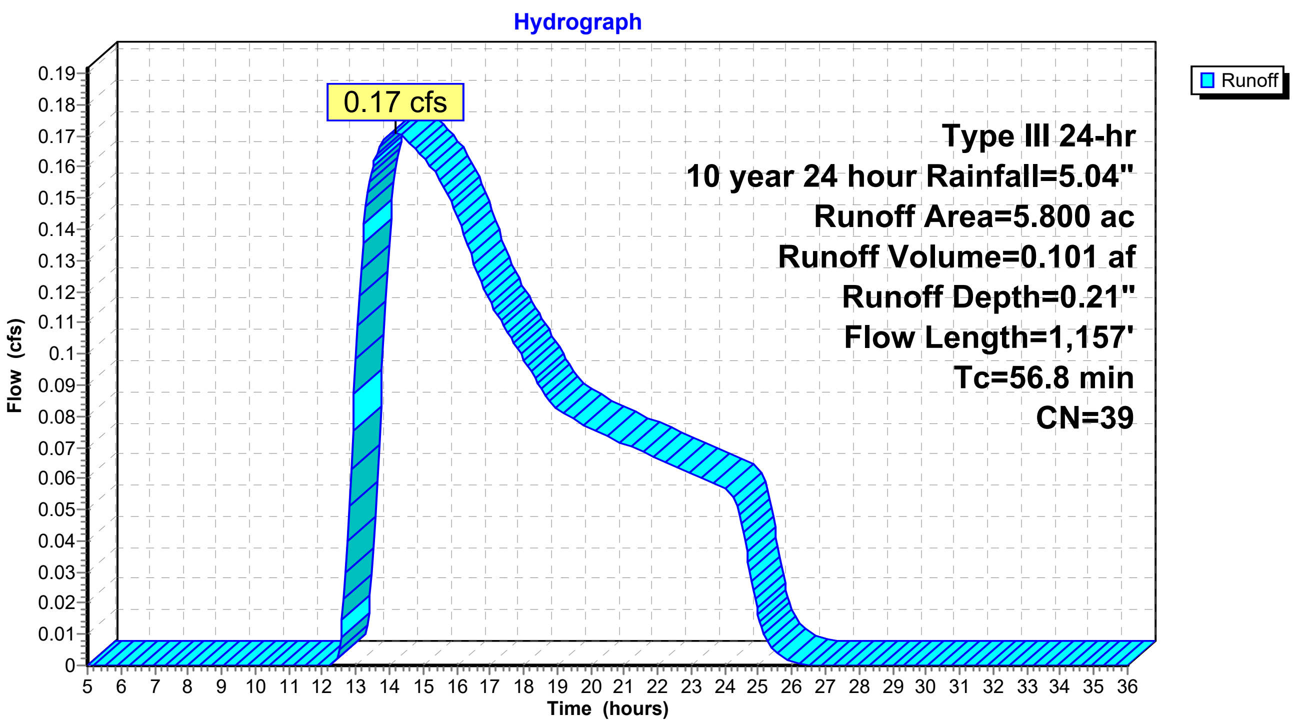
Runoff = 0.17 cfs @ 14.19 hrs, Volume= 0.101 af, Depth= 0.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year 24 hour Rainfall=5.04"

Area (ac)	CN	Description
4.430	30	Woods, Good, HSG A
0.810	77	Woods, Good, HSG D
0.400	39	Pasture/grassland/range, Good, HSG A
0.160	80	Pasture/grassland/range, Good, HSG D
5.800	39	Weighted Average
5.800		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
24.8	150	0.0290	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.40"
32.0	1,007	0.0110	0.52		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
56.8	1,157	Total			

Subcatchment OG1B: Pre Watershed 1B



Summary for Subcatchment OG2: Pre Watershed 2

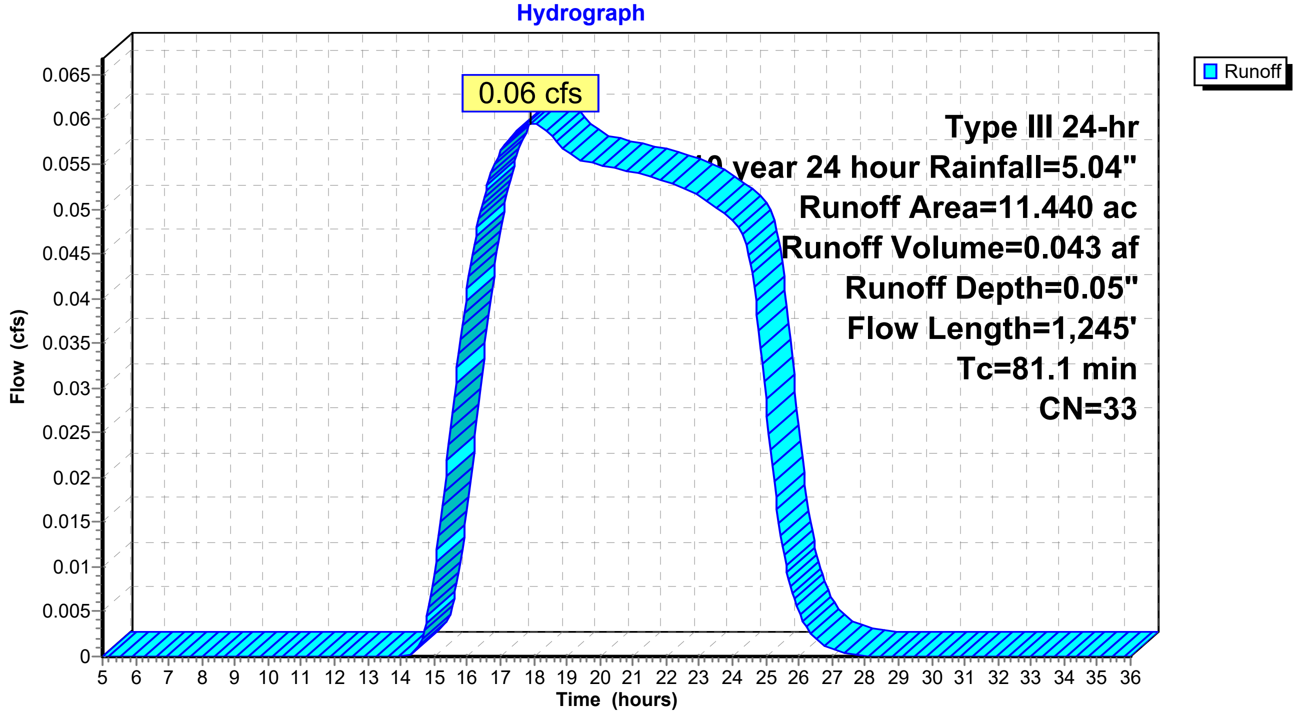
Runoff = 0.06 cfs @ 17.93 hrs, Volume= 0.043 af, Depth= 0.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year 24 hour Rainfall=5.04"

Area (ac)	CN	Description
10.050	30	Woods, Good, HSG A
0.650	77	Woods, Good, HSG D
0.730	39	Pasture/grassland/range, Good, HSG A
0.010	80	Pasture/grassland/range, Good, HSG D
11.440	33	Weighted Average
11.440		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
50.2	150	0.0050	0.05		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.40"
11.5	500	0.0210	0.72		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
16.3	345	0.0050	0.35		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
3.1	250	0.0050	1.36	10.20	**Channel Flow,** Area= 7.5 sf Perim= 8.7' r= 0.86' n= 0.070 Sluggish weedy reaches w/pools
81.1	1,245	Total			

Subcatchment OG2: Pre Watershed 2



Summary for Subcatchment OG2A: Pre Watershed 1A

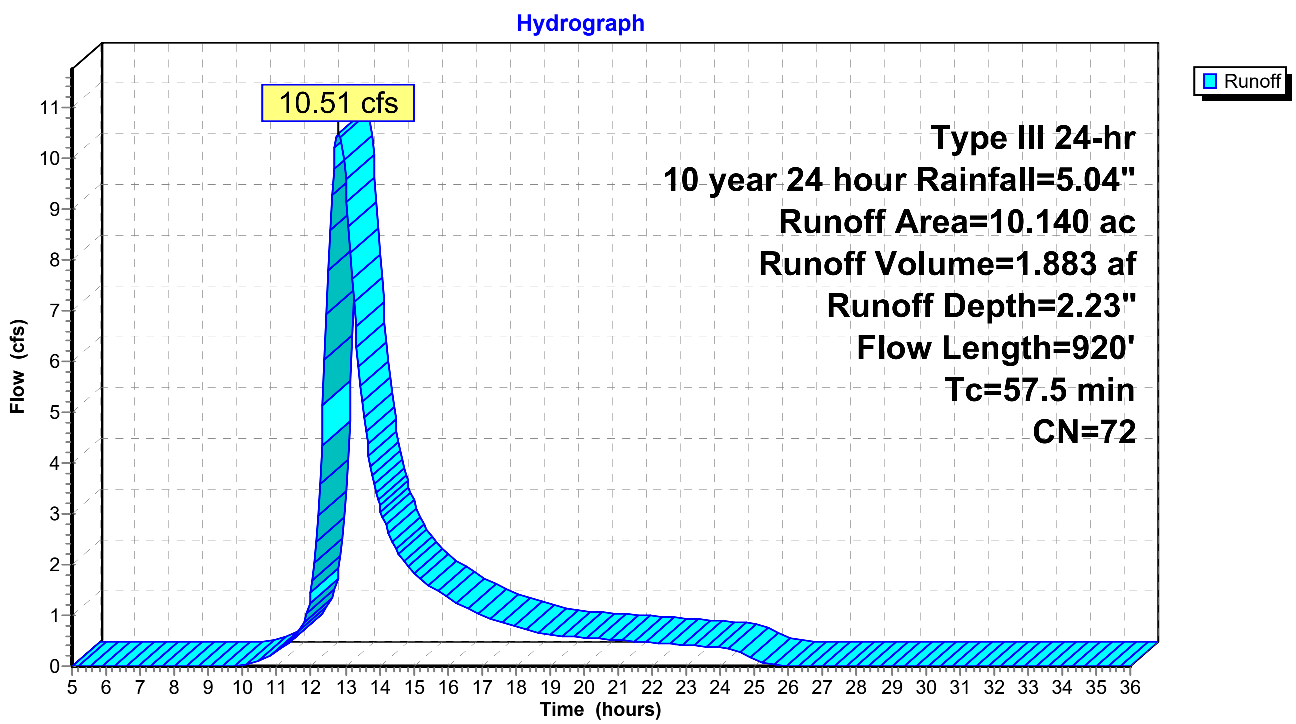
Runoff = 10.51 cfs @ 12.81 hrs, Volume= 1.883 af, Depth= 2.23"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year 24 hour Rainfall=5.04"

Area (ac)	CN	Description
0.510	30	Woods, Good, HSG A
0.300	55	Woods, Good, HSG B
8.240	77	Woods, Good, HSG D
0.300	39	Pasture/grassland/range, Good, HSG A
0.420	61	Pasture/grassland/range, Good, HSG B
0.370	80	Pasture/grassland/range, Good, HSG D
10.140	72	Weighted Average
10.140		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.8	150	0.0200	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.40"
28.7	770	0.0080	0.45		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
57.5	920	Total			

Subcatchment OG2A: Pre Watershed 1A



Summary for Subcatchment OG3: Pre Watershed 3

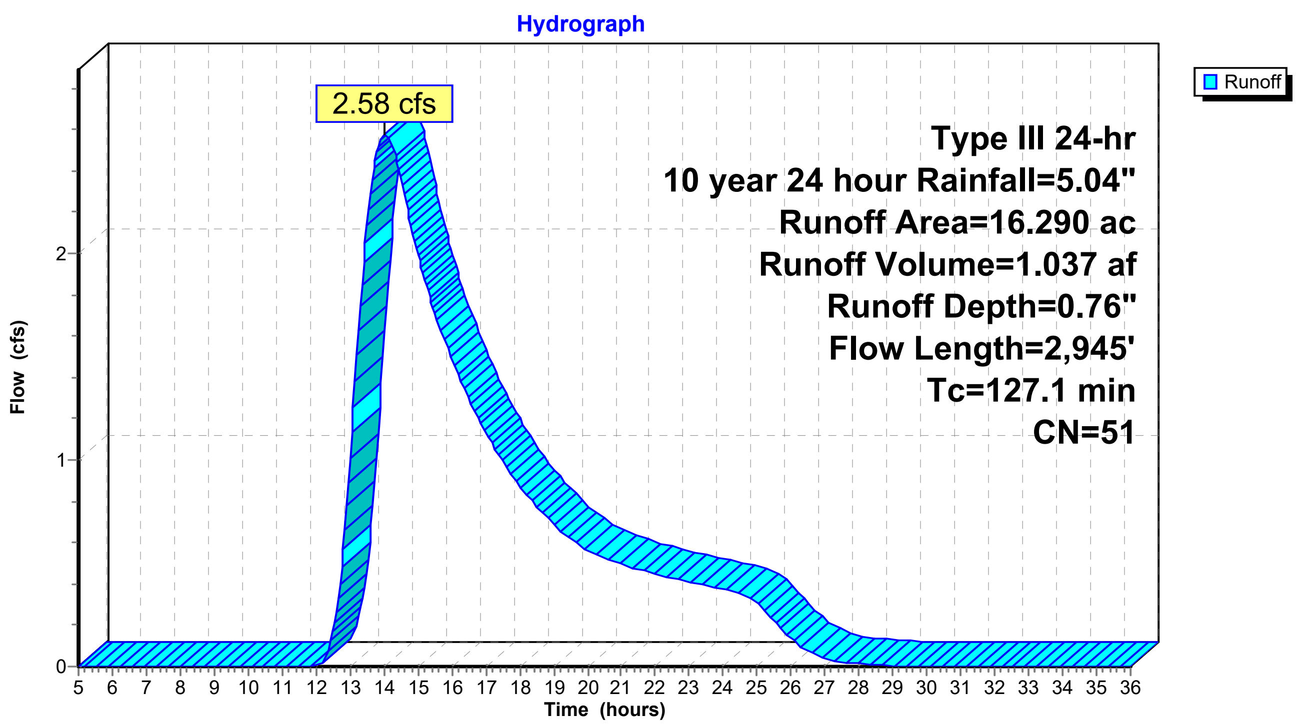
Runoff = 2.58 cfs @ 14.00 hrs, Volume= 1.037 af, Depth= 0.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year 24 hour Rainfall=5.04"

Area (ac)	CN	Description
8.500	30	Woods, Good, HSG A
6.850	77	Woods, Good, HSG D
0.810	39	Pasture/grassland/range, Good, HSG A
0.130	80	Pasture/grassland/range, Good, HSG D
16.290	51	Weighted Average
16.290		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
34.2	150	0.0130	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.40"
18.5	825	0.0220	0.74		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
67.9	1,440	0.0050	0.35		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
6.5	530	0.0050	1.36	10.20	**Channel Flow,** Area= 7.5 sf Perim= 8.7' r= 0.86' n= 0.070
127.1	2,945	Total			

Subcatchment OG3: Pre Watershed 3

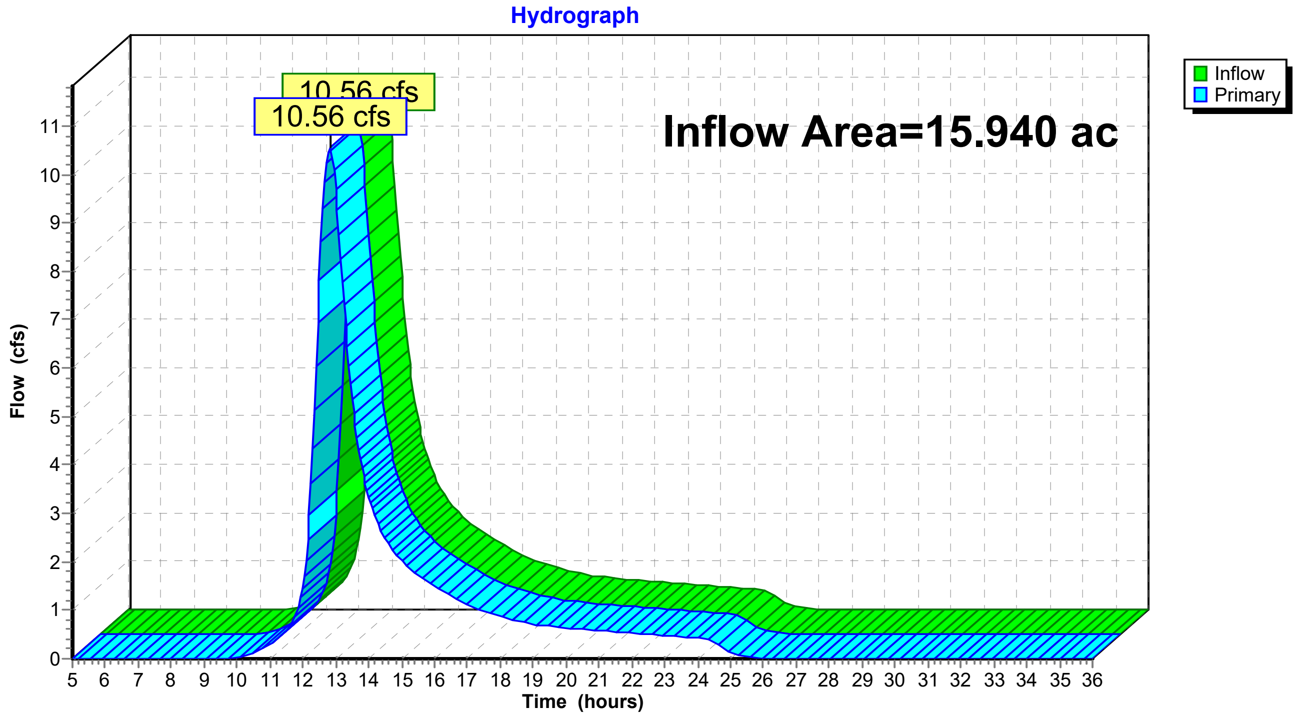


Summary for Link SN1: SN001

Inflow Area =	15.940 ac,	0.00% Impervious, Inflow Depth =	1.49"	for 10 year 24 hour event
Inflow =	10.56 cfs @	12.82 hrs, Volume=	1.984 af	
Primary =	10.56 cfs @	12.82 hrs, Volume=	1.984 af, Atten= 0%, Lag= 0.0 min	

Primary outflow = Inflow, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs

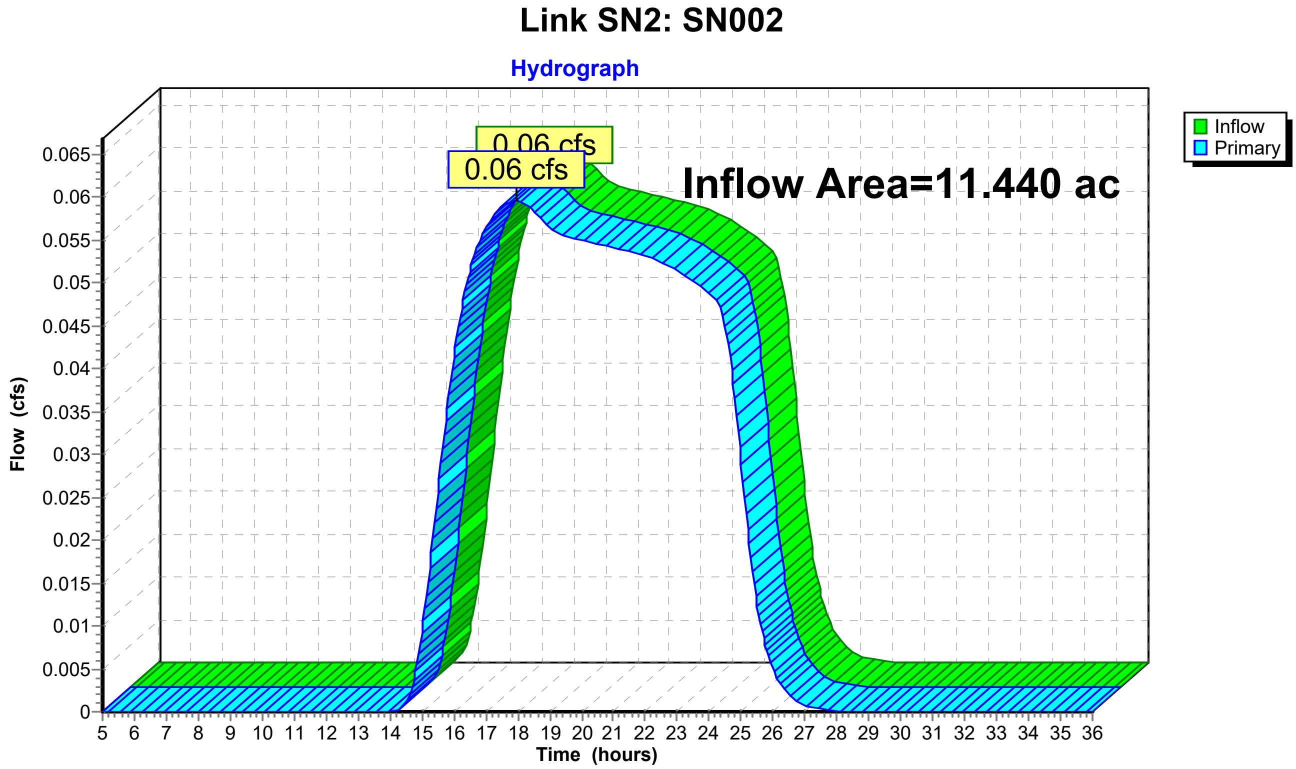
Link SN1: SN001



Summary for Link SN2: SN002

Inflow Area =	11.440 ac,	0.00% Impervious,	Inflow Depth = 0.05"	for 10 year 24 hour event
Inflow =	0.06 cfs @	17.93 hrs, Volume=	0.043 af	
Primary =	0.06 cfs @	17.93 hrs, Volume=	0.043 af, Atten= 0%, Lag= 0.0 min	

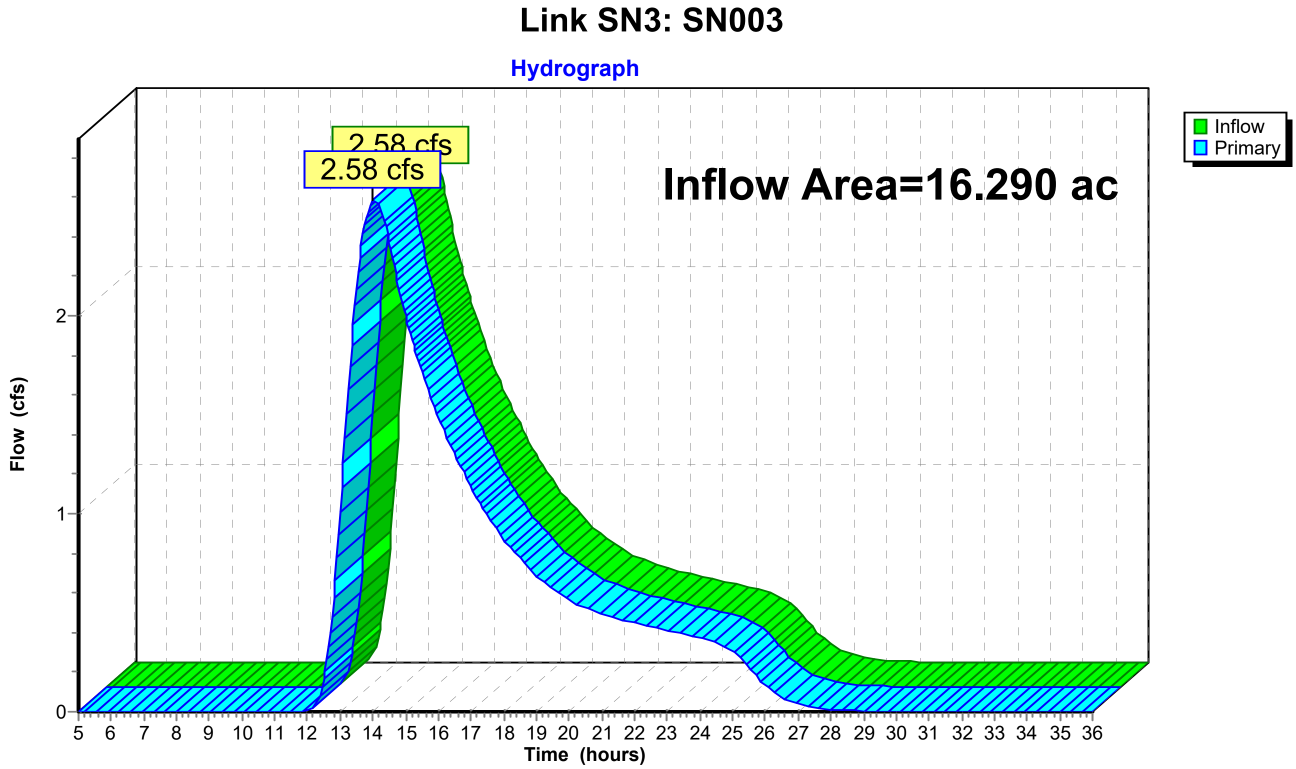
Primary outflow = Inflow, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs



Summary for Link SN3: SN003

Inflow Area =	16.290 ac,	0.00% Impervious, Inflow Depth = 0.76"	for 10 year 24 hour event
Inflow =	2.58 cfs @	14.00 hrs, Volume=	1.037 af
Primary =	2.58 cfs @	14.00 hrs, Volume=	1.037 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs



Summary for Subcatchment OG1B: Pre Watershed 1B

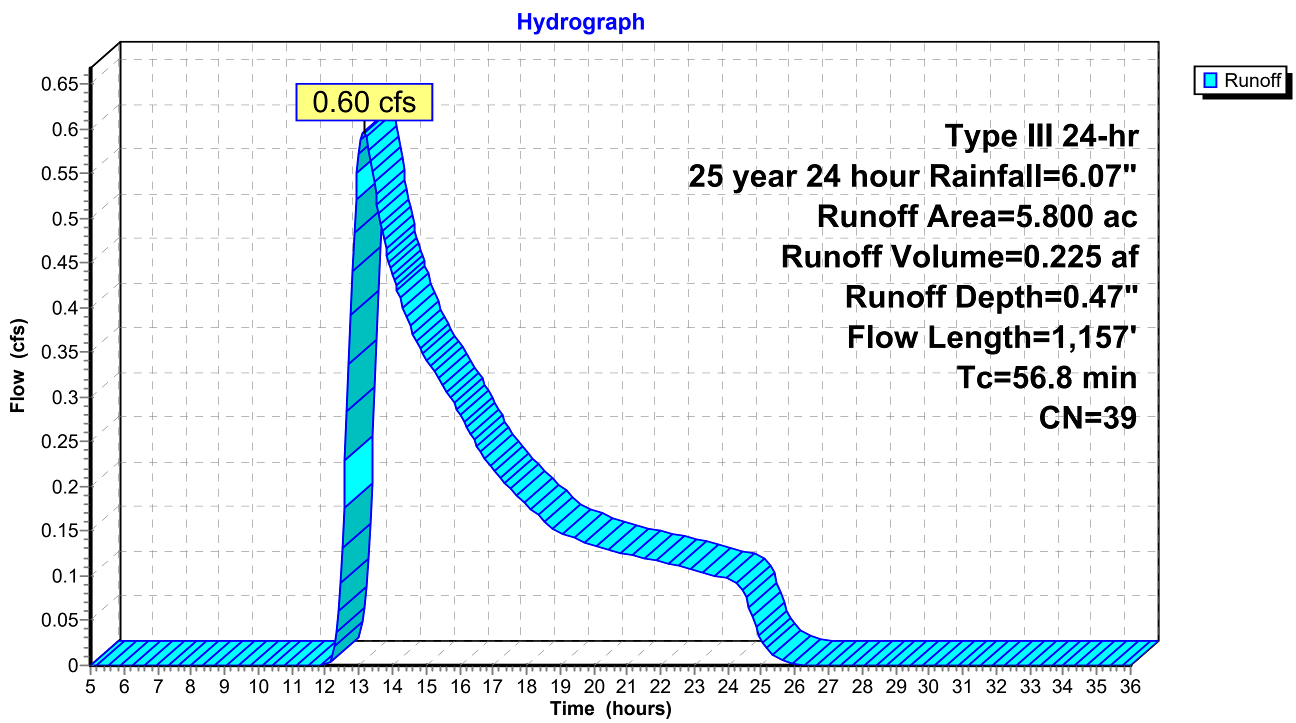
Runoff = 0.60 cfs @ 13.15 hrs, Volume= 0.225 af, Depth= 0.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 year 24 hour Rainfall=6.07"

Area (ac)	CN	Description
4.430	30	Woods, Good, HSG A
0.810	77	Woods, Good, HSG D
0.400	39	Pasture/grassland/range, Good, HSG A
0.160	80	Pasture/grassland/range, Good, HSG D
5.800	39	Weighted Average
5.800		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
24.8	150	0.0290	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.40"
32.0	1,007	0.0110	0.52		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
56.8	1,157	Total			

Subcatchment OG1B: Pre Watershed 1B



Summary for Subcatchment OG2: Pre Watershed 2

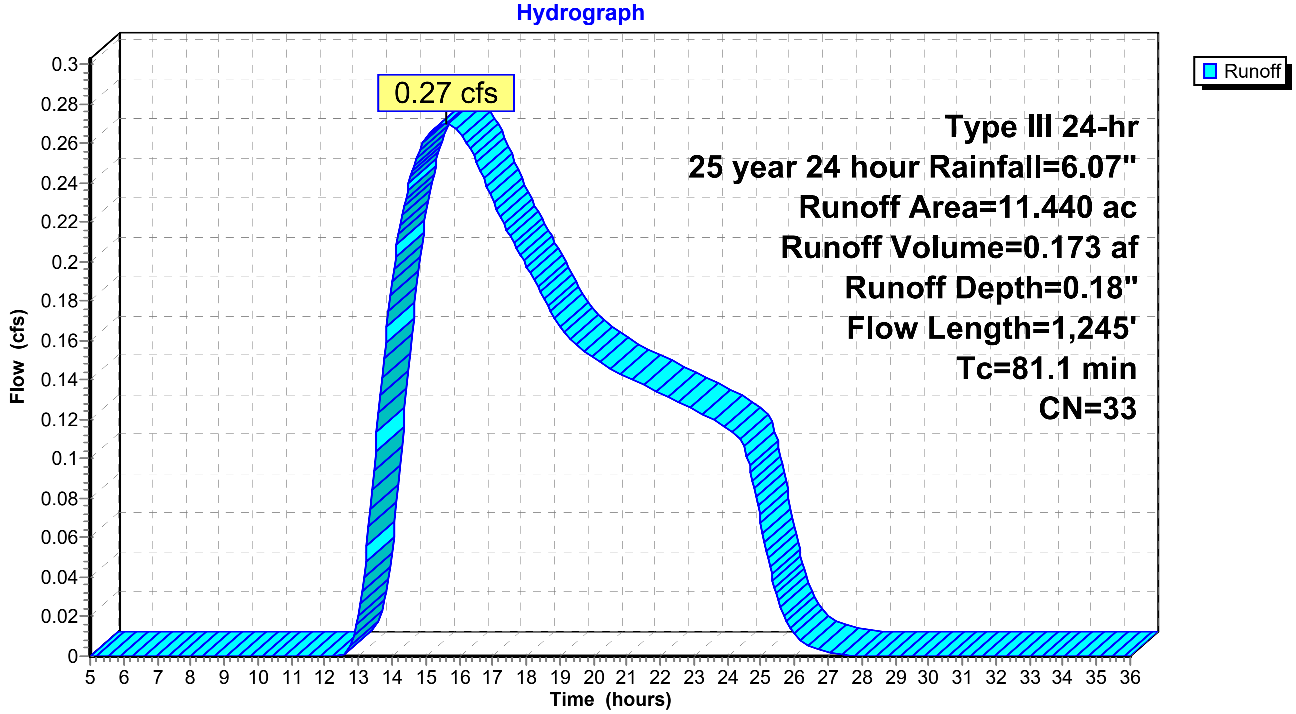
Runoff = 0.27 cfs @ 15.59 hrs, Volume= 0.173 af, Depth= 0.18"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 year 24 hour Rainfall=6.07"

Area (ac)	CN	Description
10.050	30	Woods, Good, HSG A
0.650	77	Woods, Good, HSG D
0.730	39	Pasture/grassland/range, Good, HSG A
0.010	80	Pasture/grassland/range, Good, HSG D
11.440	33	Weighted Average
11.440		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
50.2	150	0.0050	0.05		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.40"
11.5	500	0.0210	0.72		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
16.3	345	0.0050	0.35		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
3.1	250	0.0050	1.36	10.20	**Channel Flow,** Area= 7.5 sf Perim= 8.7' r= 0.86' n= 0.070 Sluggish weedy reaches w/pools
81.1	1,245	Total			

Subcatchment OG2: Pre Watershed 2



Summary for Subcatchment OG2A: Pre Watershed 1A

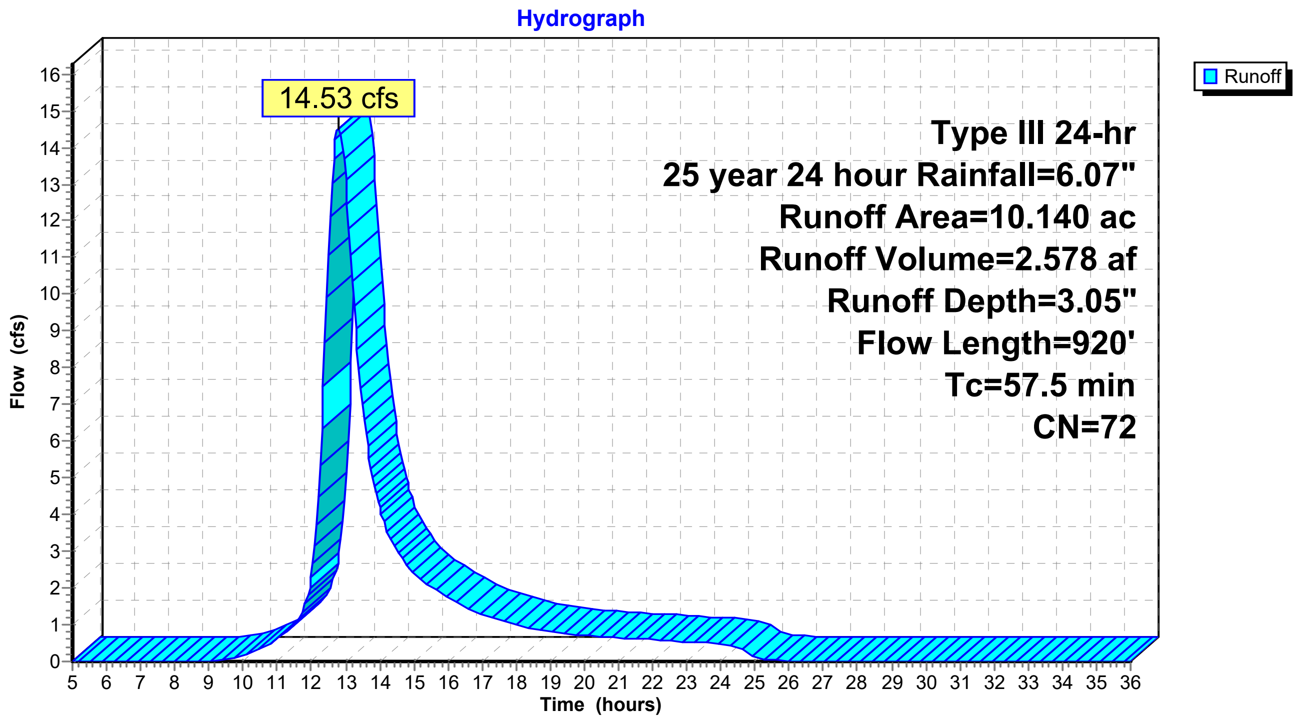
Runoff = 14.53 cfs @ 12.80 hrs, Volume= 2.578 af, Depth= 3.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 year 24 hour Rainfall=6.07"

Area (ac)	CN	Description
0.510	30	Woods, Good, HSG A
0.300	55	Woods, Good, HSG B
8.240	77	Woods, Good, HSG D
0.300	39	Pasture/grassland/range, Good, HSG A
0.420	61	Pasture/grassland/range, Good, HSG B
0.370	80	Pasture/grassland/range, Good, HSG D
10.140	72	Weighted Average
10.140		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.8	150	0.0200	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.40"
28.7	770	0.0080	0.45		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
57.5	920	Total			

Subcatchment OG2A: Pre Watershed 1A



Summary for Subcatchment OG3: Pre Watershed 3

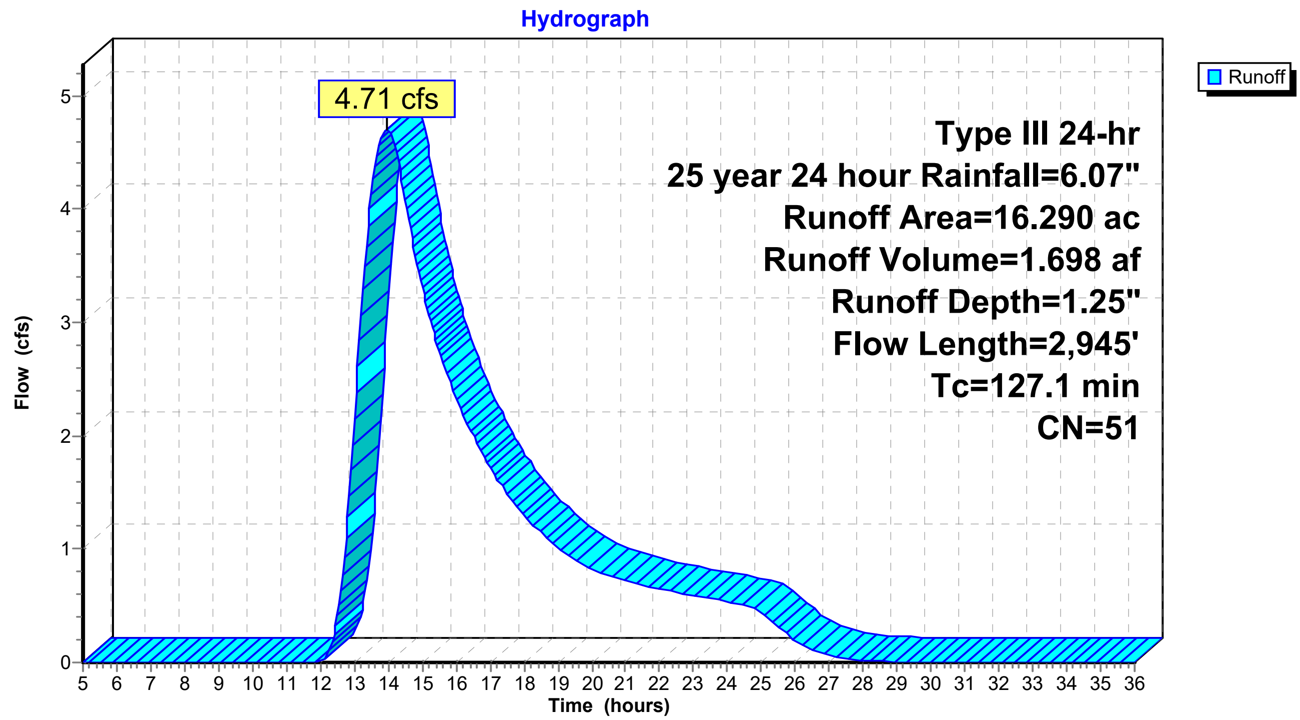
Runoff = 4.71 cfs @ 13.97 hrs, Volume= 1.698 af, Depth= 1.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 year 24 hour Rainfall=6.07"

Area (ac)	CN	Description
8.500	30	Woods, Good, HSG A
6.850	77	Woods, Good, HSG D
0.810	39	Pasture/grassland/range, Good, HSG A
0.130	80	Pasture/grassland/range, Good, HSG D
16.290	51	Weighted Average
16.290		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
34.2	150	0.0130	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.40"
18.5	825	0.0220	0.74		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
67.9	1,440	0.0050	0.35		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
6.5	530	0.0050	1.36	10.20	**Channel Flow,** Area= 7.5 sf Perim= 8.7' r= 0.86' n= 0.070
127.1	2,945	Total			

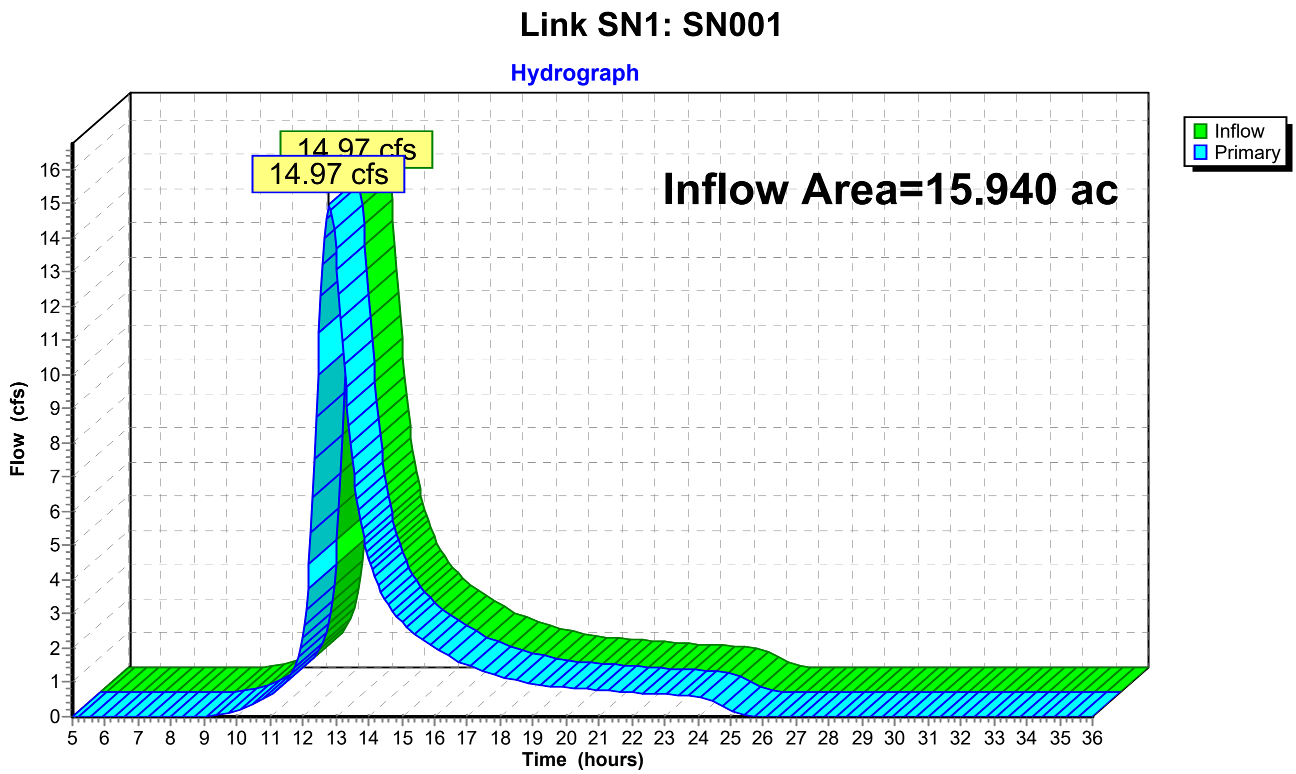
Subcatchment OG3: Pre Watershed 3



Summary for Link SN1: SN001

Inflow Area = 15.940 ac, 0.00% Impervious, Inflow Depth = 2.11" for 25 year 24 hour event
Inflow = 14.97 cfs @ 12.81 hrs, Volume= 2.803 af
Primary = 14.97 cfs @ 12.81 hrs, Volume= 2.803 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs

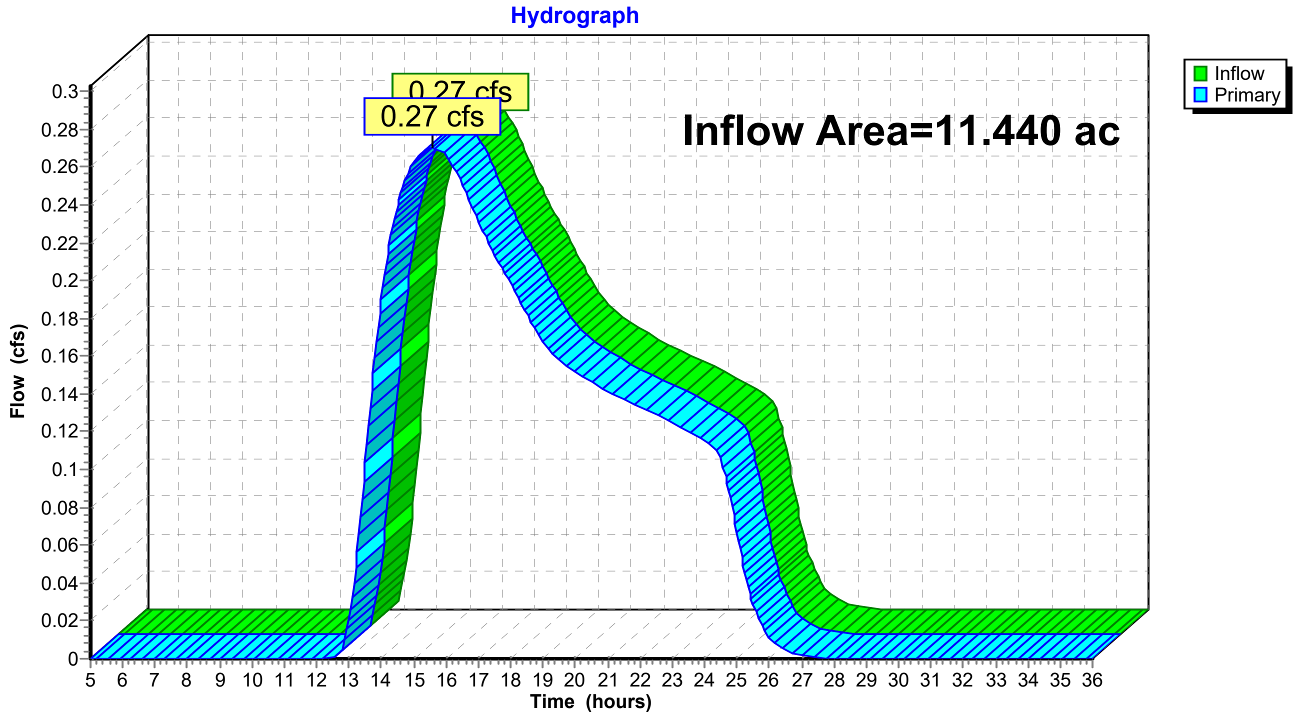


Summary for Link SN2: SN002

Inflow Area =	11.440 ac,	0.00% Impervious,	Inflow Depth = 0.18"	for 25 year 24 hour event
Inflow =	0.27 cfs @	15.59 hrs, Volume=	0.173 af	
Primary =	0.27 cfs @	15.59 hrs, Volume=	0.173 af, Atten= 0%, Lag= 0.0 min	

Primary outflow = Inflow, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs

Link SN2: SN002

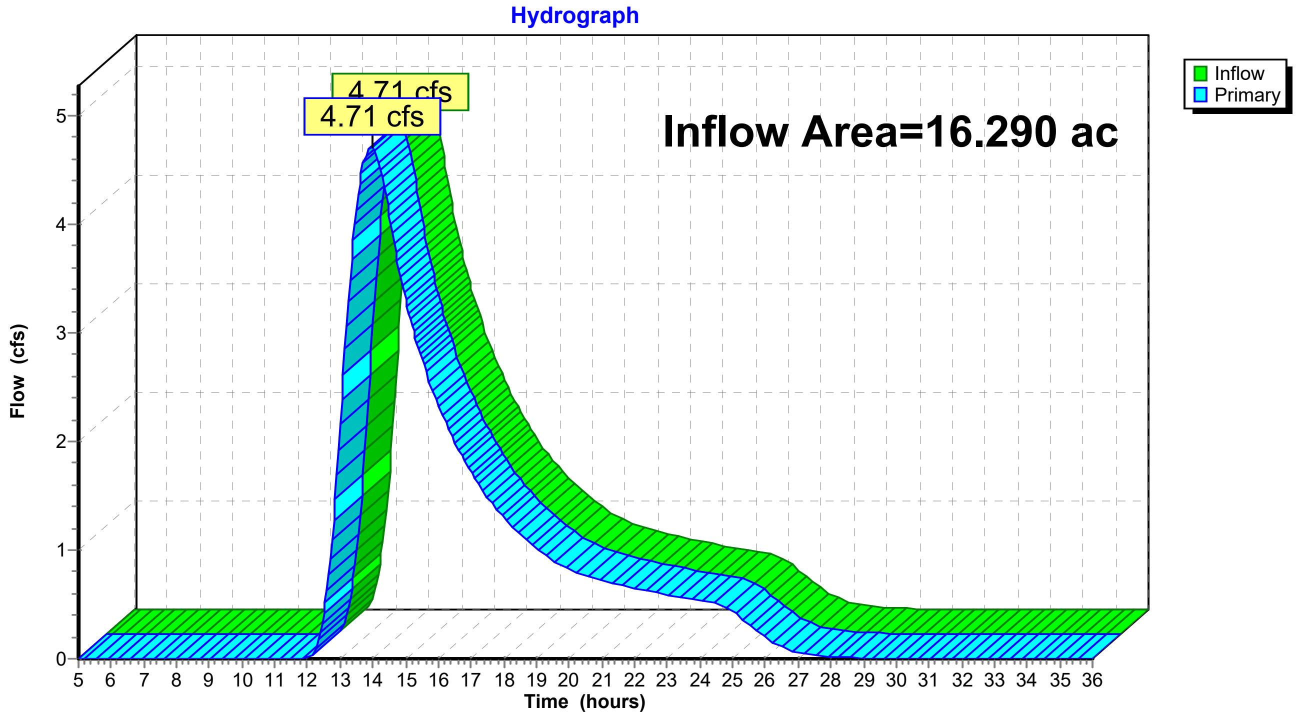


Summary for Link SN3: SN003

Inflow Area = 16.290 ac, 0.00% Impervious, Inflow Depth = 1.25" for 25 year 24 hour event
Inflow = 4.71 cfs @ 13.97 hrs, Volume= 1.698 af
Primary = 4.71 cfs @ 13.97 hrs, Volume= 1.698 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs

Link SN3: SN003



Summary for Subcatchment OG1B: Pre Watershed 1B

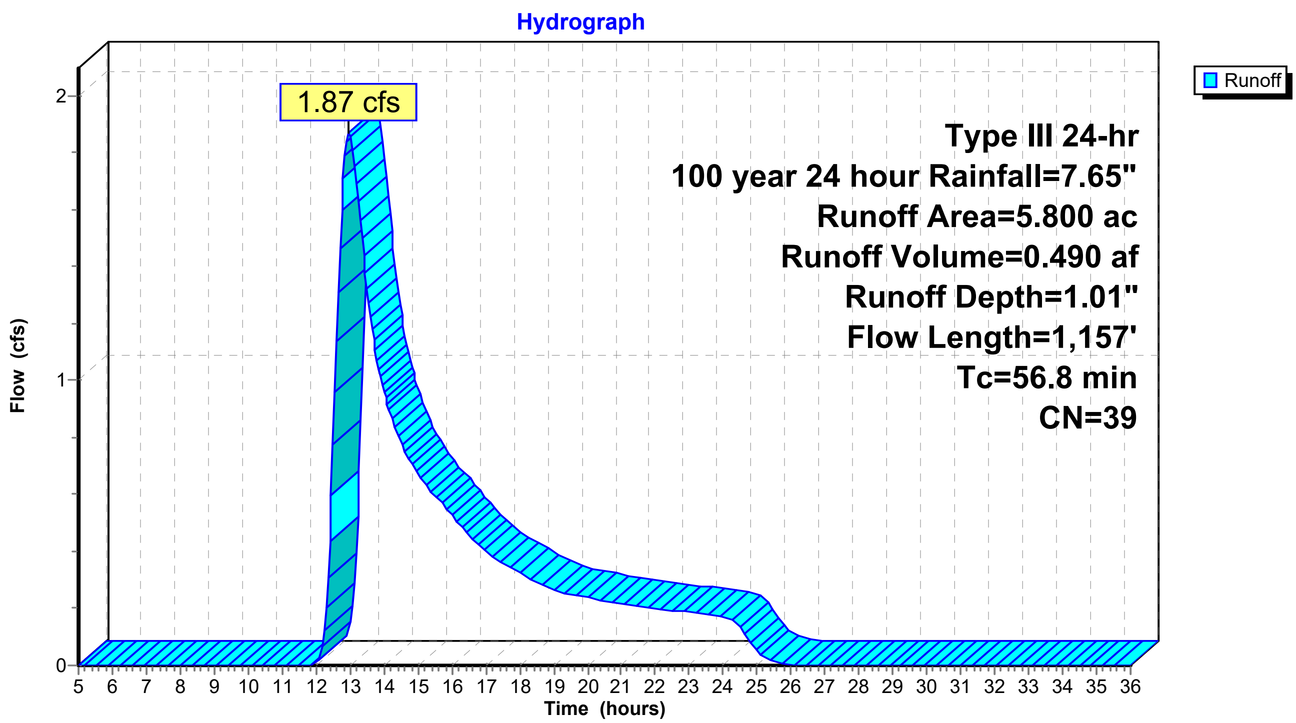
Runoff = 1.87 cfs @ 12.97 hrs, Volume= 0.490 af, Depth= 1.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 year 24 hour Rainfall=7.65"

Area (ac)	CN	Description
4.430	30	Woods, Good, HSG A
0.810	77	Woods, Good, HSG D
0.400	39	Pasture/grassland/range, Good, HSG A
0.160	80	Pasture/grassland/range, Good, HSG D
5.800	39	Weighted Average
5.800		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
24.8	150	0.0290	0.10		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.40"
32.0	1,007	0.0110	0.52		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
56.8	1,157	Total			

Subcatchment OG1B: Pre Watershed 1B



Summary for Subcatchment OG2: Pre Watershed 2

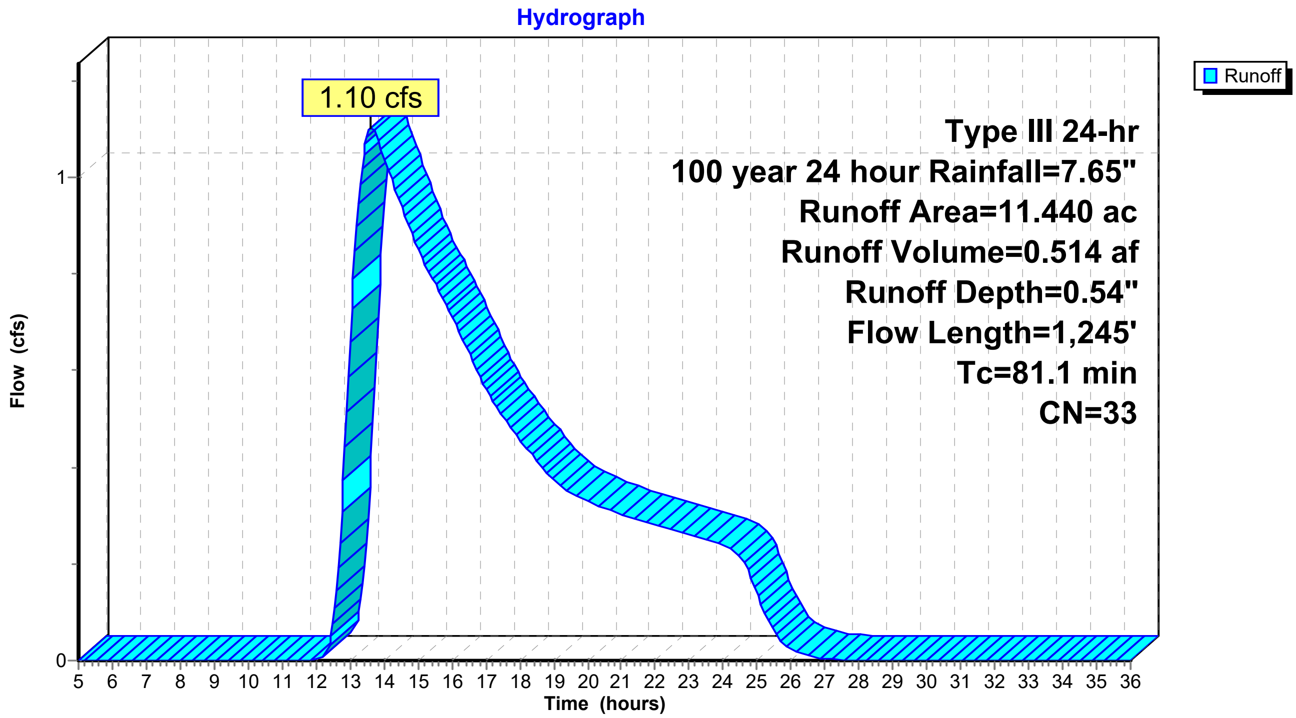
Runoff = 1.10 cfs @ 13.62 hrs, Volume= 0.514 af, Depth= 0.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 year 24 hour Rainfall=7.65"

Area (ac)	CN	Description
10.050	30	Woods, Good, HSG A
0.650	77	Woods, Good, HSG D
0.730	39	Pasture/grassland/range, Good, HSG A
0.010	80	Pasture/grassland/range, Good, HSG D
11.440	33	Weighted Average
11.440		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
50.2	150	0.0050	0.05		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.40"
11.5	500	0.0210	0.72		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
16.3	345	0.0050	0.35		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
3.1	250	0.0050	1.36	10.20	**Channel Flow,** Area= 7.5 sf Perim= 8.7' r= 0.86' n= 0.070 Sluggish weedy reaches w/pools
81.1	1,245	Total			

Subcatchment OG2: Pre Watershed 2



Summary for Subcatchment OG2A: Pre Watershed 1A

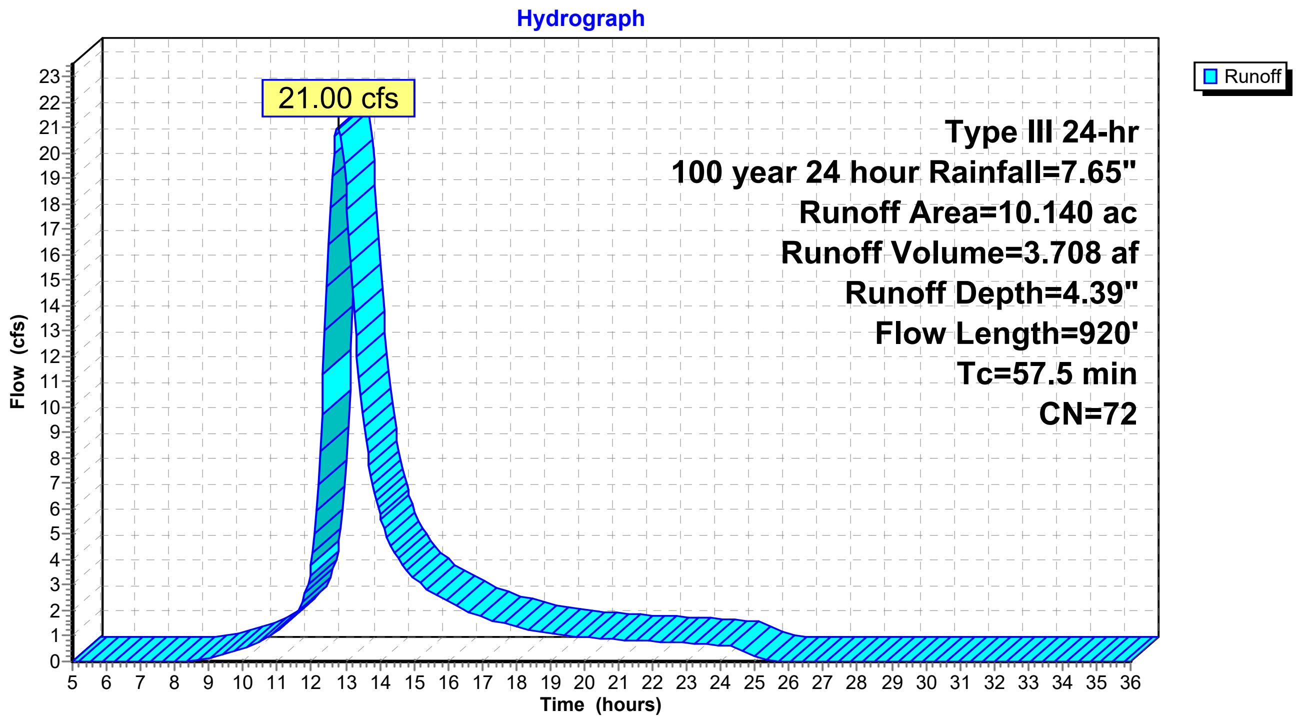
Runoff = 21.00 cfs @ 12.78 hrs, Volume= 3.708 af, Depth= 4.39"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 year 24 hour Rainfall=7.65"

Area (ac)	CN	Description
0.510	30	Woods, Good, HSG A
0.300	55	Woods, Good, HSG B
8.240	77	Woods, Good, HSG D
0.300	39	Pasture/grassland/range, Good, HSG A
0.420	61	Pasture/grassland/range, Good, HSG B
0.370	80	Pasture/grassland/range, Good, HSG D
10.140	72	Weighted Average
10.140		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.8	150	0.0200	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.40"
28.7	770	0.0080	0.45		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
57.5	920	Total			

Subcatchment OG2A: Pre Watershed 1A



Summary for Subcatchment OG3: Pre Watershed 3

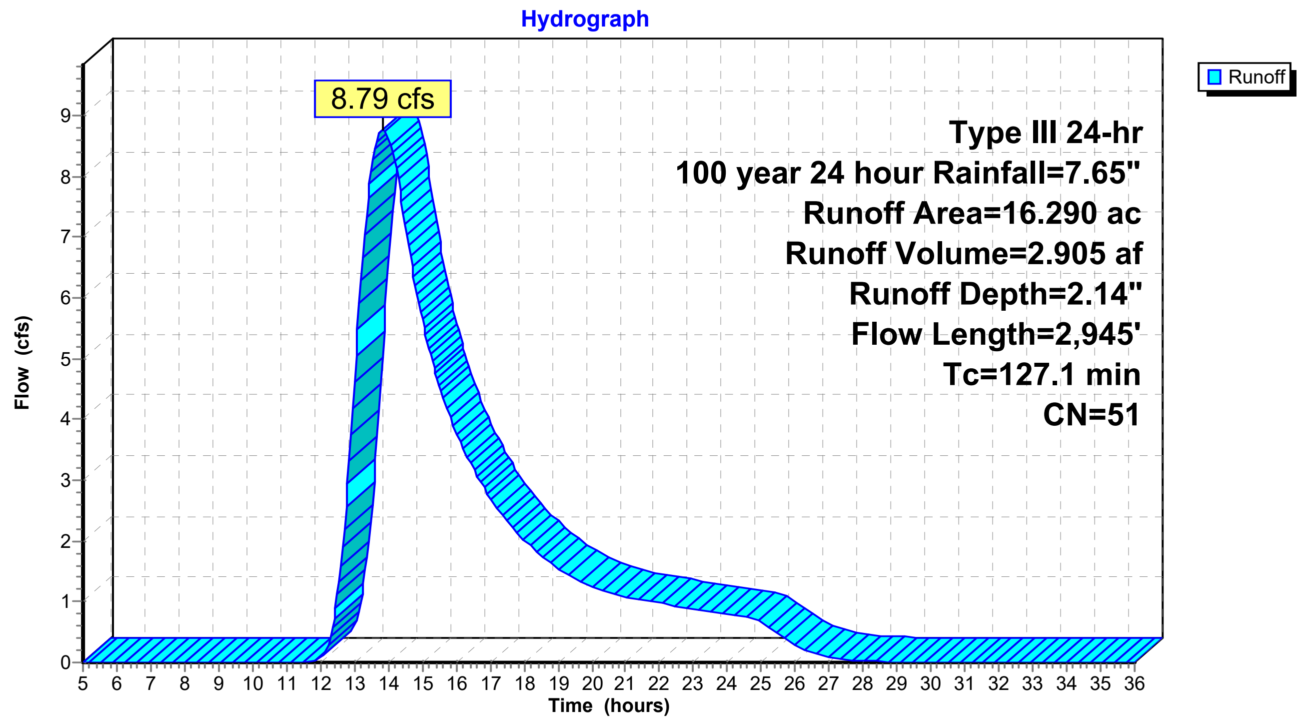
Runoff = 8.79 cfs @ 13.85 hrs, Volume= 2.905 af, Depth= 2.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 year 24 hour Rainfall=7.65"

Area (ac)	CN	Description
8.500	30	Woods, Good, HSG A
6.850	77	Woods, Good, HSG D
0.810	39	Pasture/grassland/range, Good, HSG A
0.130	80	Pasture/grassland/range, Good, HSG D
16.290	51	Weighted Average
16.290		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
34.2	150	0.0130	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.40"
18.5	825	0.0220	0.74		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
67.9	1,440	0.0050	0.35		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
6.5	530	0.0050	1.36	10.20	**Channel Flow,** Area= 7.5 sf Perim= 8.7' r= 0.86' n= 0.070
127.1	2,945	Total			

Subcatchment OG3: Pre Watershed 3

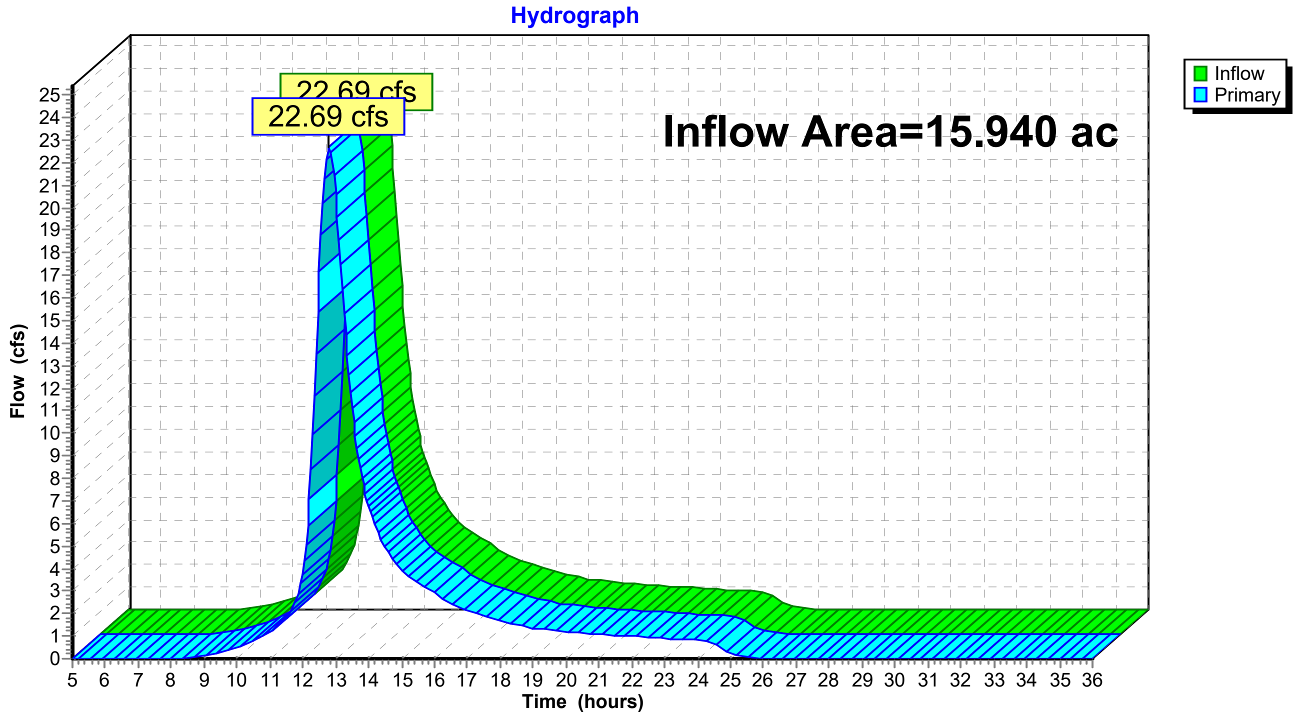


Summary for Link SN1: SN001

Inflow Area =	15.940 ac,	0.00% Impervious, Inflow Depth = 3.16"	for 100 year 24 hour event	
Inflow =	22.69 cfs @	12.80 hrs, Volume=	4.199 af	
Primary =	22.69 cfs @	12.80 hrs, Volume=	4.199 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs

Link SN1: SN001

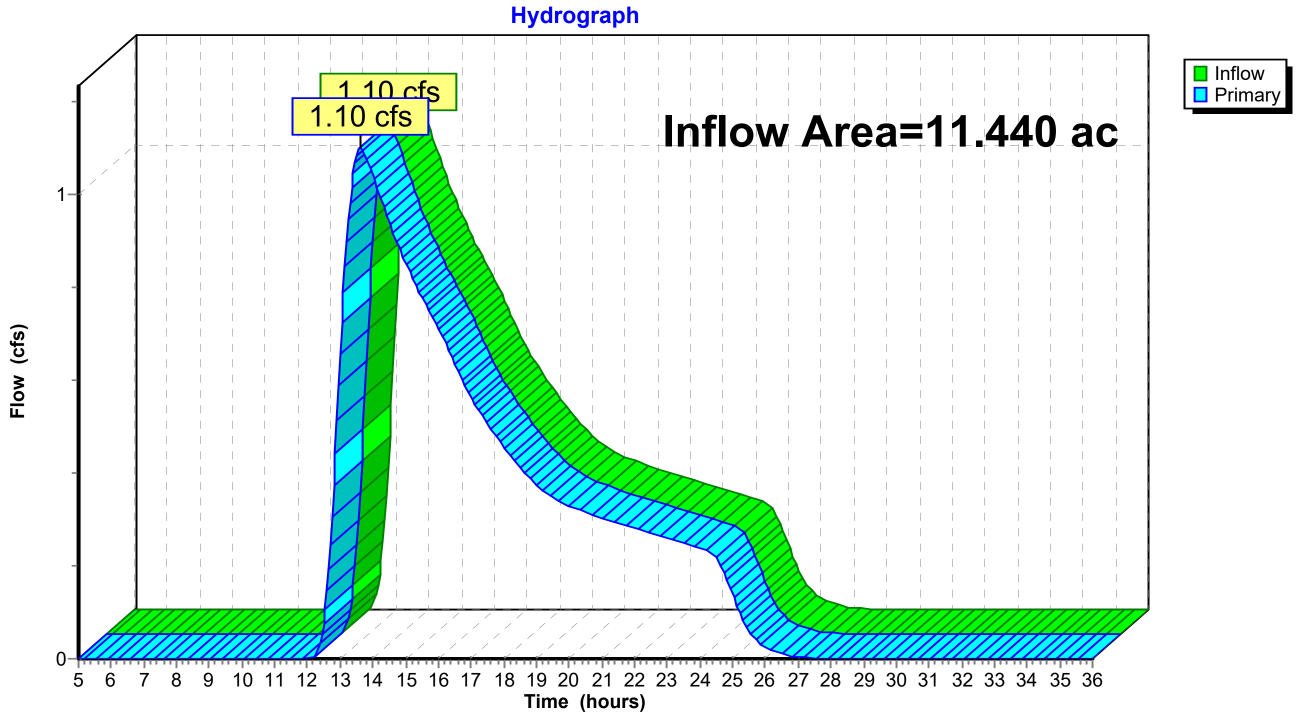


Summary for Link SN2: SN002

Inflow Area = 11.440 ac, 0.00% Impervious, Inflow Depth = 0.54" for 100 year 24 hour event
Inflow = 1.10 cfs @ 13.62 hrs, Volume= 0.514 af
Primary = 1.10 cfs @ 13.62 hrs, Volume= 0.514 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs

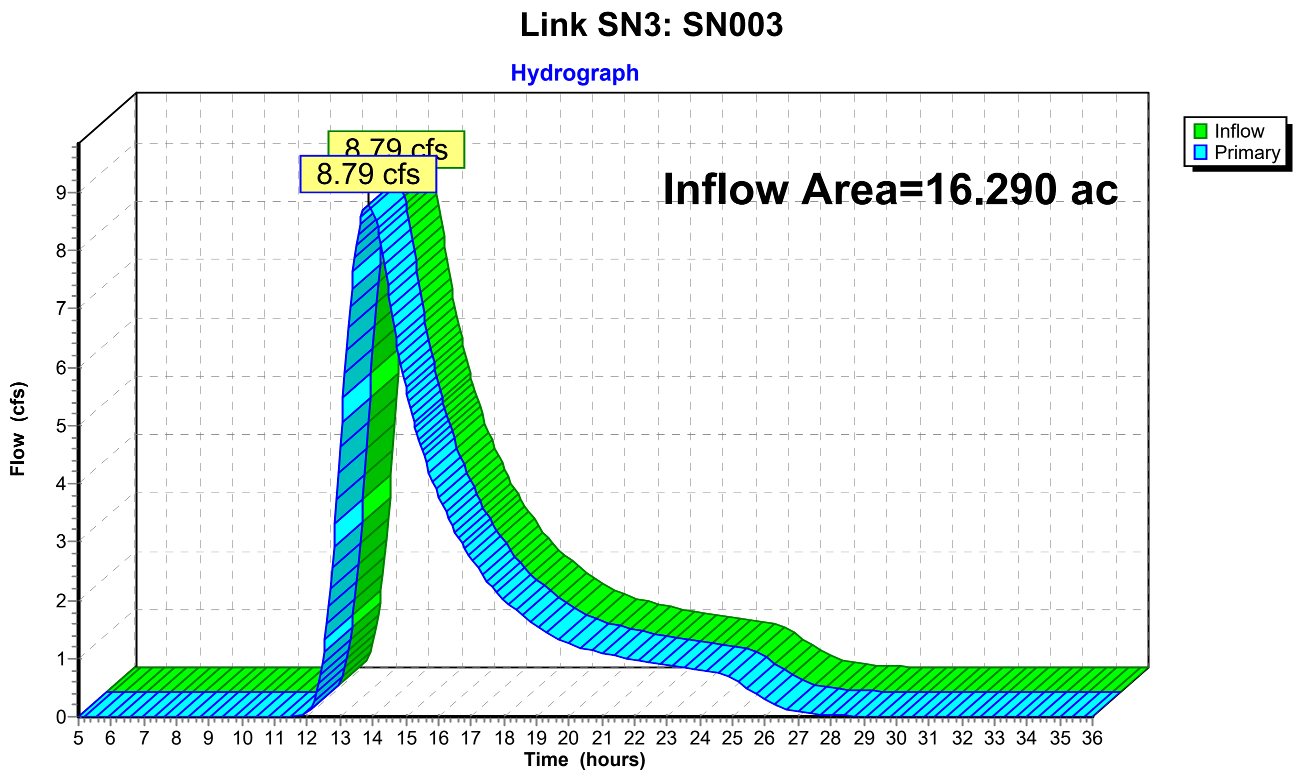
Link SN2: SN002

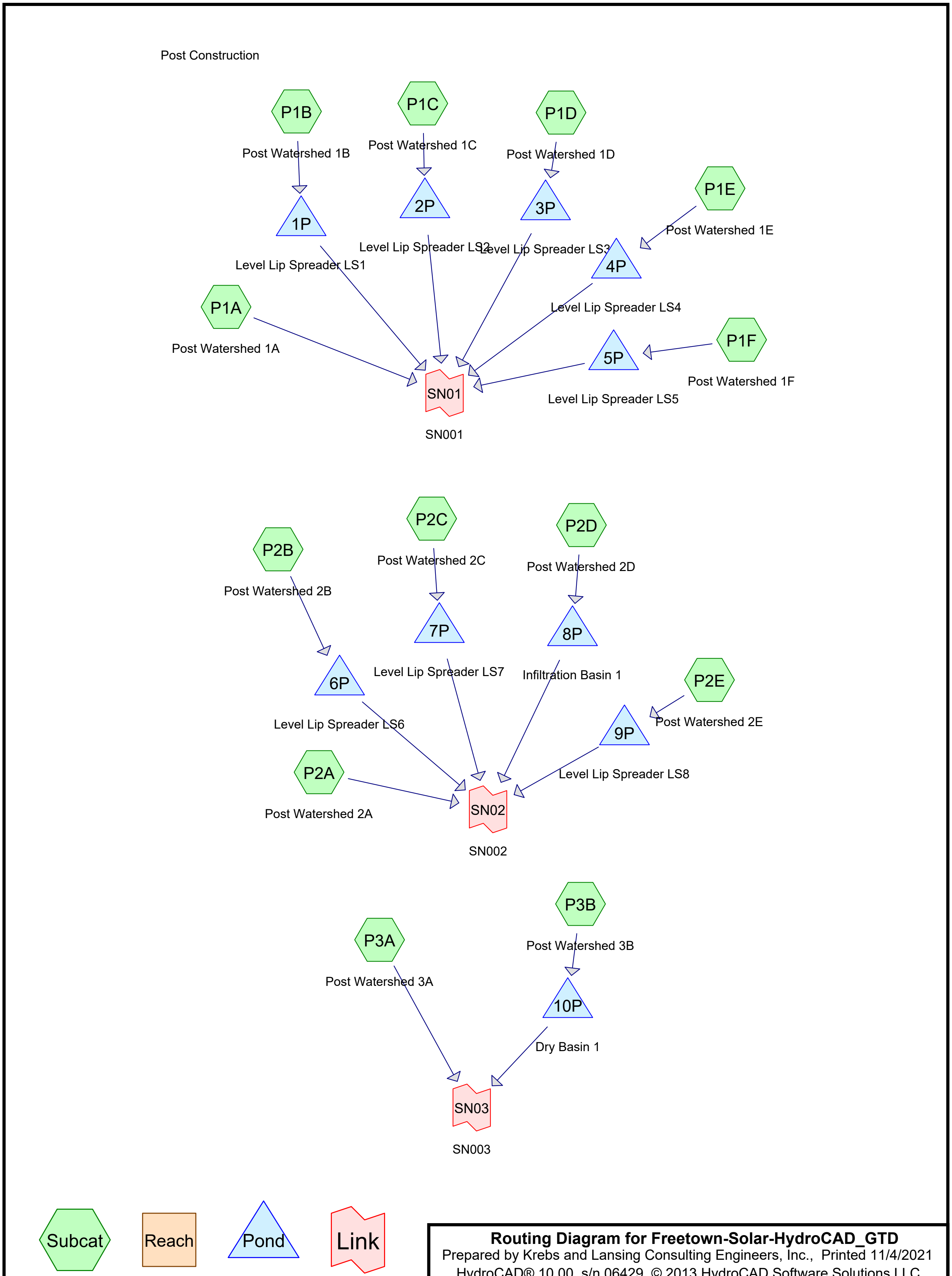


Summary for Link SN3: SN003

Inflow Area = 16.290 ac, 0.00% Impervious, Inflow Depth = 2.14" for 100 year 24 hour event
Inflow = 8.79 cfs @ 13.85 hrs, Volume= 2.905 af
Primary = 8.79 cfs @ 13.85 hrs, Volume= 2.905 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs





Routing Diagram for Freetown-Solar-HydroCAD_GTD
Prepared by Krebs and Lansing Consulting Engineers, Inc., Printed 11/4/2021
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Summary for Subcatchment P1A: Post Watershed 1A

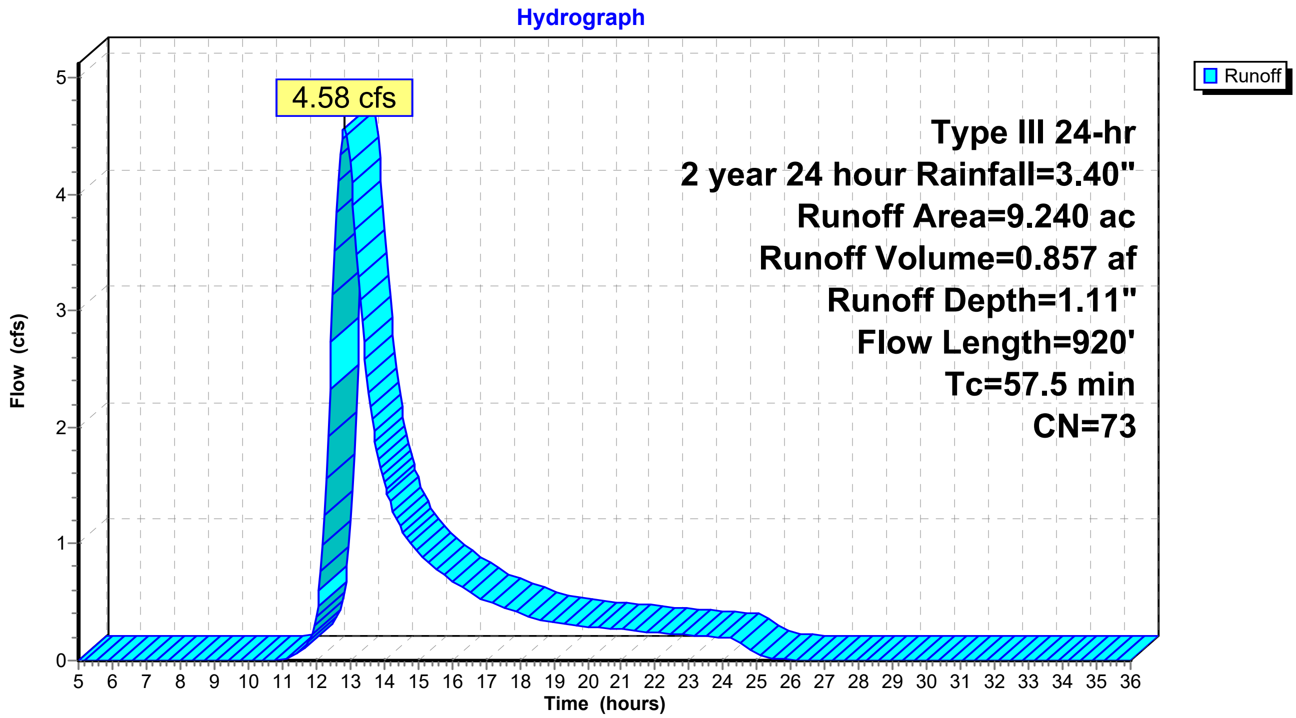
Runoff = 4.58 cfs @ 12.84 hrs, Volume= 0.857 af, Depth= 1.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 year 24 hour Rainfall=3.40"

	Area (ac)	CN	Description
	0.270	30	Woods, Good, HSG A
	0.230	55	Woods, Good, HSG B
	6.790	77	Woods, Good, HSG D
	0.060	39	Pasture/grassland/range, Good, HSG A
	0.420	61	Pasture/grassland/range, Good, HSG B
	0.210	80	Pasture/grassland/range, Good, HSG D
	0.250	30	Meadow, non-grazed, HSG A
	0.070	58	Meadow, non-grazed, HSG B
	0.890	78	Meadow, non-grazed, HSG D
*	0.050	98	New Impervious
	9.240	73	Weighted Average
	9.190		99.46% Pervious Area
	0.050		0.54% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.8	150	0.0200	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.40"
28.7	770	0.0080	0.45		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
57.5	920	Total			

Subcatchment P1A: Post Watershed 1A



Summary for Subcatchment P1B: Post Watershed 1B

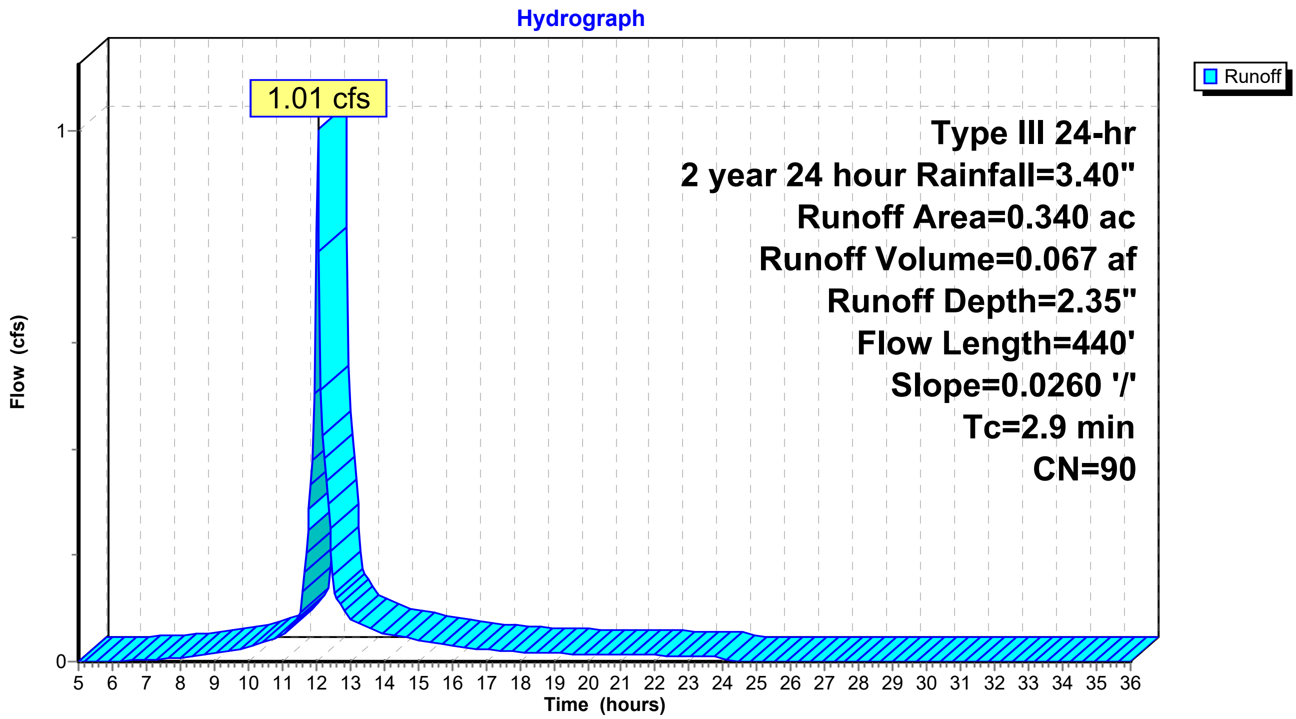
Runoff = 1.01 cfs @ 12.05 hrs, Volume= 0.067 af, Depth= 2.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 year 24 hour Rainfall=3.40"

	Area (ac)	CN	Description
	0.140	78	Meadow, non-grazed, HSG D
*	0.200	98	New Impervious
	0.340	90	Weighted Average
	0.140		41.18% Pervious Area
	0.200		58.82% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.9	440	0.0260	2.55	30.66	**Channel Flow,** Area= 12.0 sf Perim= 10.9' r= 1.10' n= 0.100 Earth, dense brush, high stage

Subcatchment P1B: Post Watershed 1B



Summary for Subcatchment P1C: Post Watershed 1C

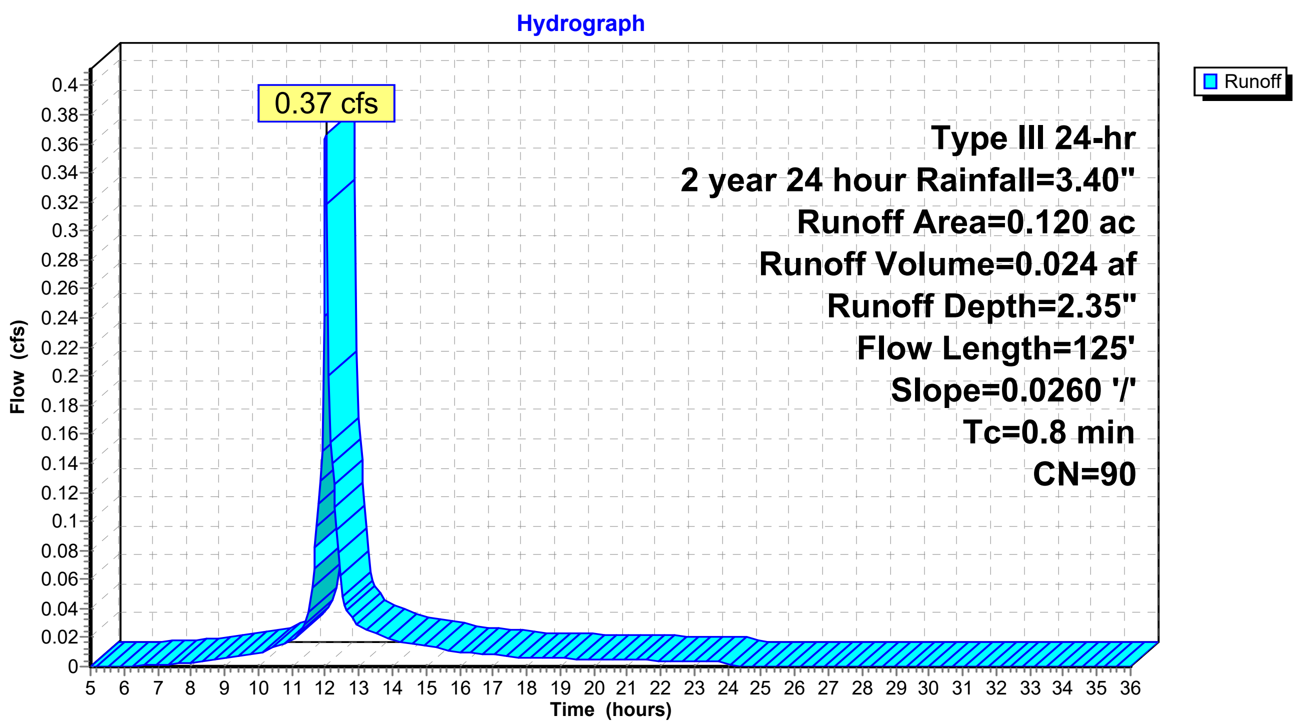
Runoff = 0.37 cfs @ 12.01 hrs, Volume= 0.024 af, Depth= 2.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 year 24 hour Rainfall=3.40"

	Area (ac)	CN	Description
	0.050	78	Meadow, non-grazed, HSG D
*	0.070	98	New Impervious
	0.120	90	Weighted Average
	0.050		41.67% Pervious Area
	0.070		58.33% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	125	0.0260	2.55	30.66	**Channel Flow,** Area= 12.0 sf Perim= 10.9' r= 1.10' n= 0.100 Earth, dense brush, high stage

Subcatchment P1C: Post Watershed 1C



Summary for Subcatchment P1D: Post Watershed 1D

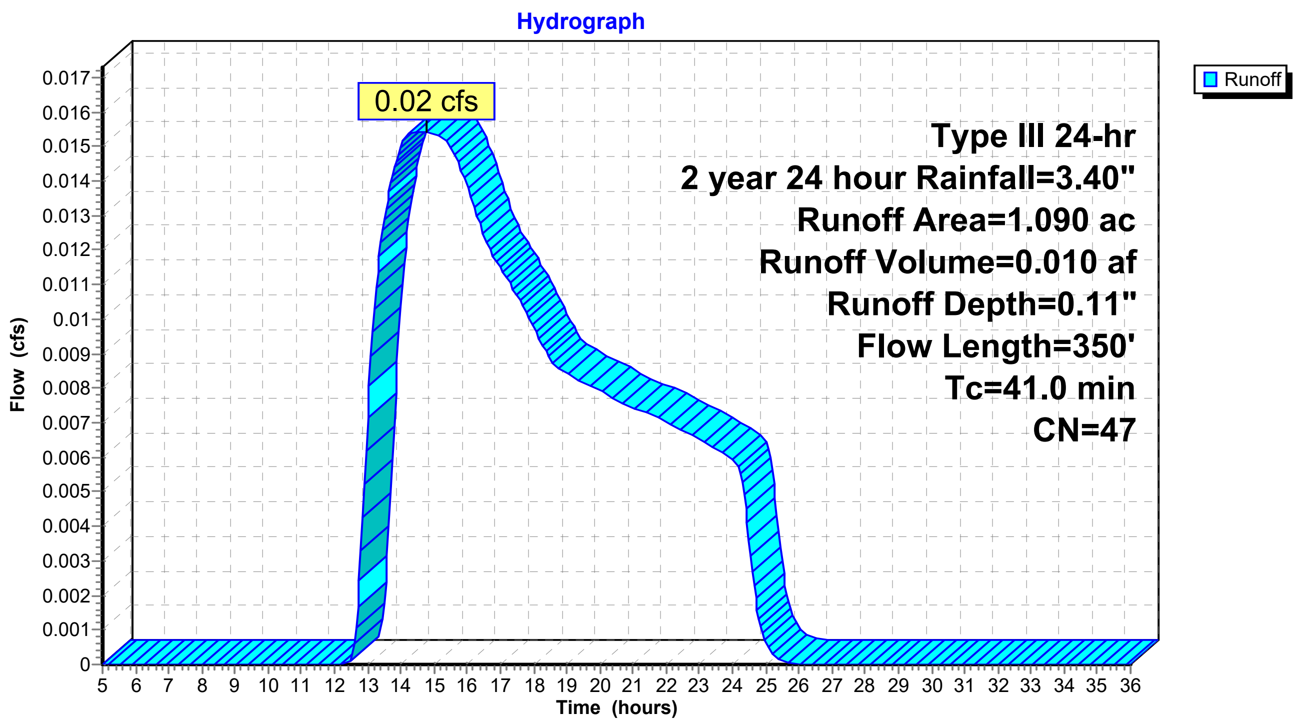
Runoff = 0.02 cfs @ 14.80 hrs, Volume= 0.010 af, Depth= 0.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 year 24 hour Rainfall=3.40"

	Area (ac)	CN	Description
	0.790	30	Meadow, non-grazed, HSG A
	0.070	78	Meadow, non-grazed, HSG D
*	0.230	98	New Impervious
	1.090	47	Weighted Average
	0.860		78.90% Pervious Area
	0.230		21.10% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
24.2	150	0.0310	0.10		**Sheet Flow, Meadow** n= 0.400 P2= 3.40"
16.3	155	0.0010	0.16		**Shallow Concentrated Flow, Meadow** Kv= 5.0 fps
0.5	45	0.0100	1.58	19.01	**Channel Flow,** Area= 12.0 sf Perim= 10.9' r= 1.10' n= 0.100 Earth, dense brush, high stage
41.0	350	Total			

Subcatchment P1D: Post Watershed 1D



Summary for Subcatchment P1E: Post Watershed 1E

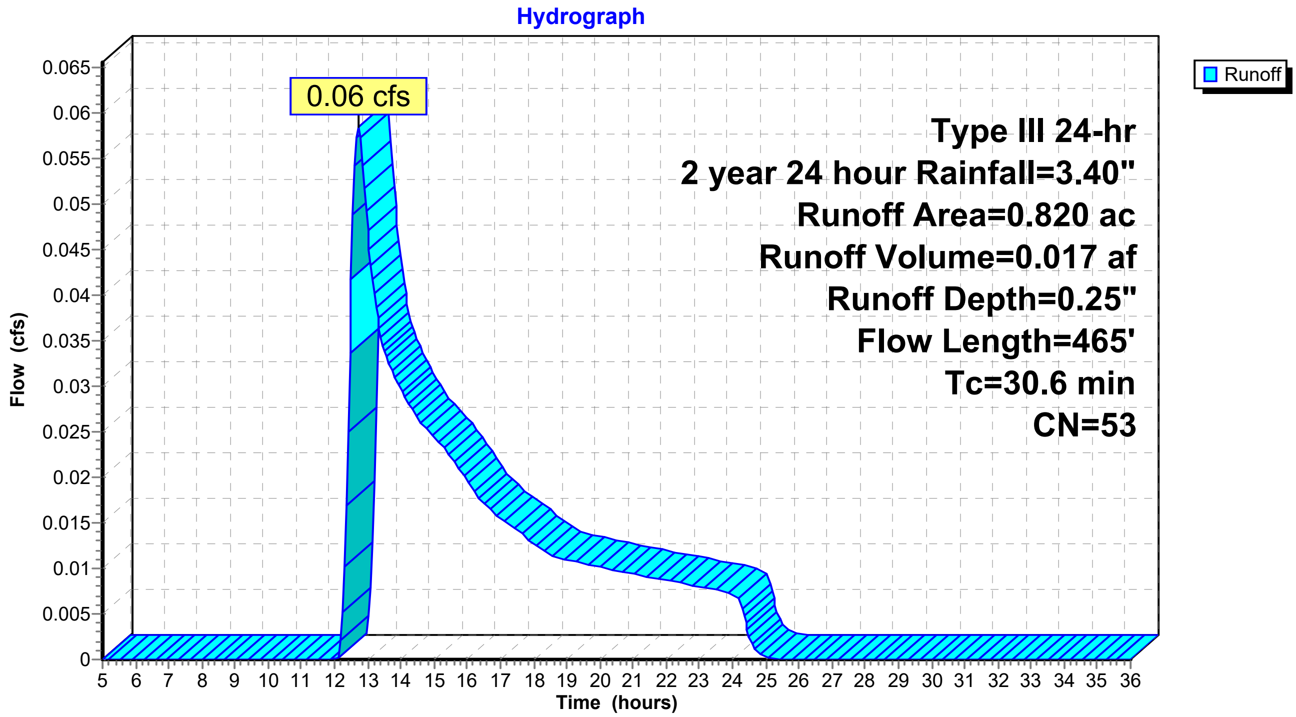
Runoff = 0.06 cfs @ 12.71 hrs, Volume= 0.017 af, Depth= 0.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 year 24 hour Rainfall=3.40"

	Area (ac)	CN	Description
	0.500	30	Meadow, non-grazed, HSG A
	0.150	78	Meadow, non-grazed, HSG D
*	0.170	98	New Impervious
	0.820	53	Weighted Average
	0.650		79.27% Pervious Area
	0.170		20.73% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
24.2	150	0.0310	0.10		**Sheet Flow, Meadow** n= 0.400 P2= 3.40"
4.7	45	0.0010	0.16		**Shallow Concentrated Flow, Meadow** Kv= 5.0 fps
1.7	270	0.0280	2.65	31.81	**Channel Flow,** Area= 12.0 sf Perim= 10.9' r= 1.10' n= 0.100 Earth, dense brush, high stage
30.6	465	Total			

Subcatchment P1E: Post Watershed 1E



Summary for Subcatchment P1F: Post Watershed 1F

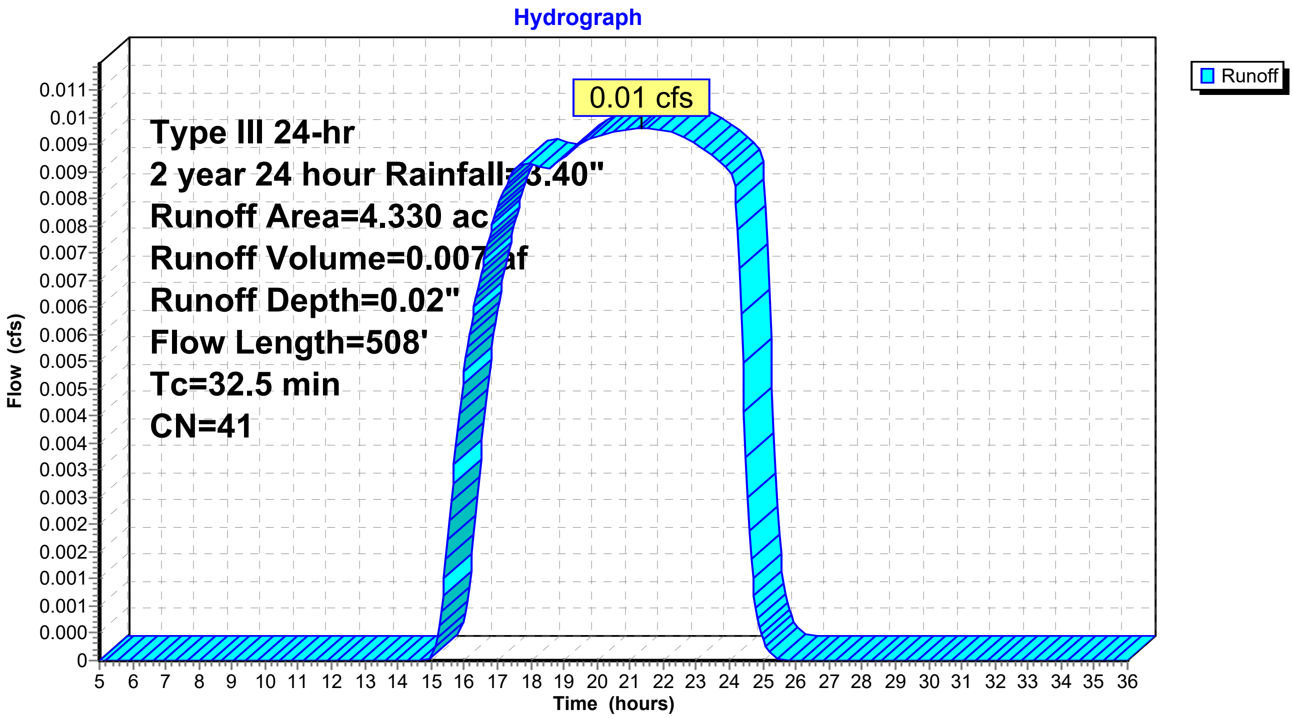
Runoff = 0.01 cfs @ 21.37 hrs, Volume= 0.007 af, Depth= 0.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 year 24 hour Rainfall=3.40"

	Area (ac)	CN	Description
	0.730	30	Woods, Good, HSG A
	0.260	77	Woods, Good, HSG D
	0.170	39	Pasture/grassland/range, Good, HSG A
	0.100	80	Pasture/grassland/range, Good, HSG D
	2.530	30	Meadow, non-grazed, HSG A
	0.490	78	Meadow, non-grazed, HSG D
*	0.050	98	New Impervious
	4.330	41	Weighted Average
	4.280		98.85% Pervious Area
	0.050		1.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.4	150	0.0420	0.12		**Sheet Flow, Meadow** n= 0.400 P2= 3.40"
1.8	108	0.0420	1.02		**Shallow Concentrated Flow, Meadow** Kv= 5.0 fps
9.3	250	0.0080	0.45		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
32.5	508	Total			

Subcatchment P1F: Post Watershed 1F



Summary for Subcatchment P2A: Post Watershed 2A

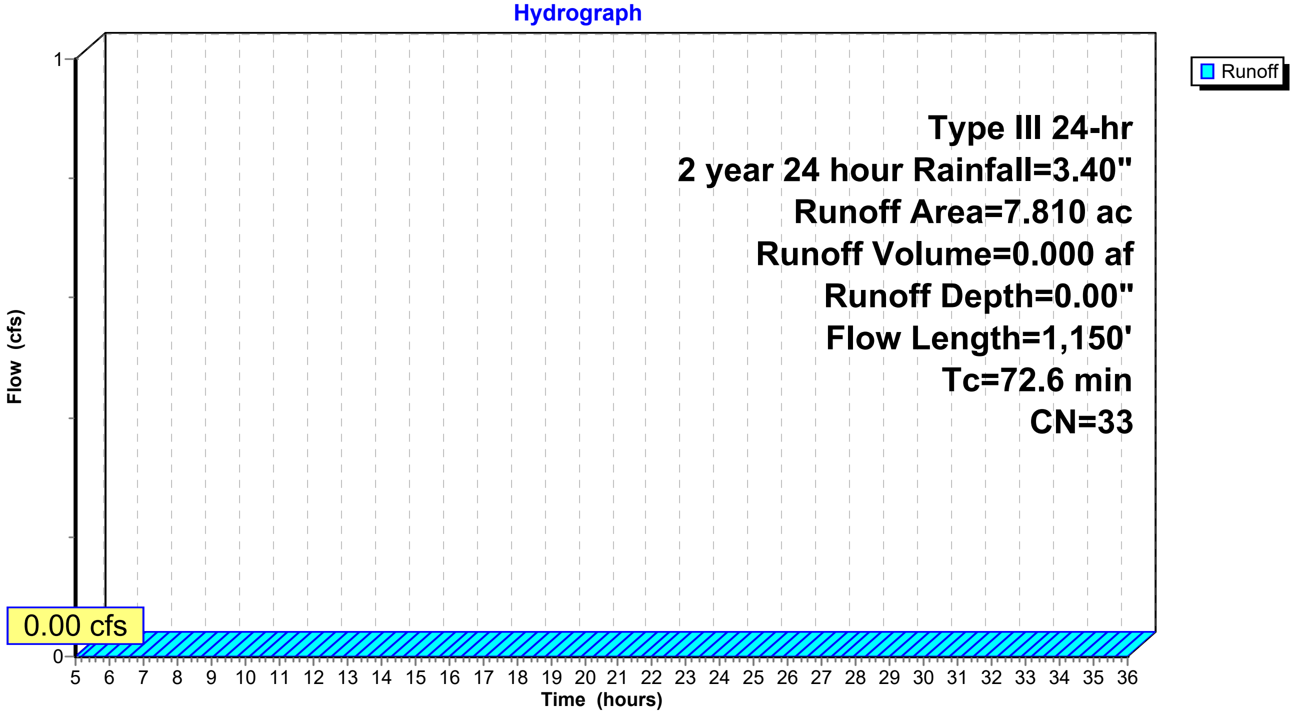
Runoff = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 year 24 hour Rainfall=3.40"

Area (ac)	CN	Description
1.050	30	Woods, Good, HSG A
0.500	77	Woods, Good, HSG D
0.050	39	Pasture/grassland/range, Good, HSG A
0.010	80	Pasture/grassland/range, Good, HSG D
6.140	30	Meadow, non-grazed, HSG A
0.060	78	Meadow, non-grazed, HSG D
7.810	33	Weighted Average
7.810		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
43.9	150	0.0070	0.06		**Sheet Flow, Meadow** n= 0.400 P2= 3.40"
9.3	405	0.0210	0.72		**Shallow Concentrated Flow, Meadow** Kv= 5.0 fps
16.3	345	0.0050	0.35		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
3.1	250	0.0050	1.36	10.20	**Channel Flow,** Area= 7.5 sf Perim= 8.7' r= 0.86' n= 0.070 Sluggish weedy reaches w/pools
72.6	1,150	Total			

Subcatchment P2A: Post Watershed 2A



Summary for Subcatchment P2B: Post Watershed 2B

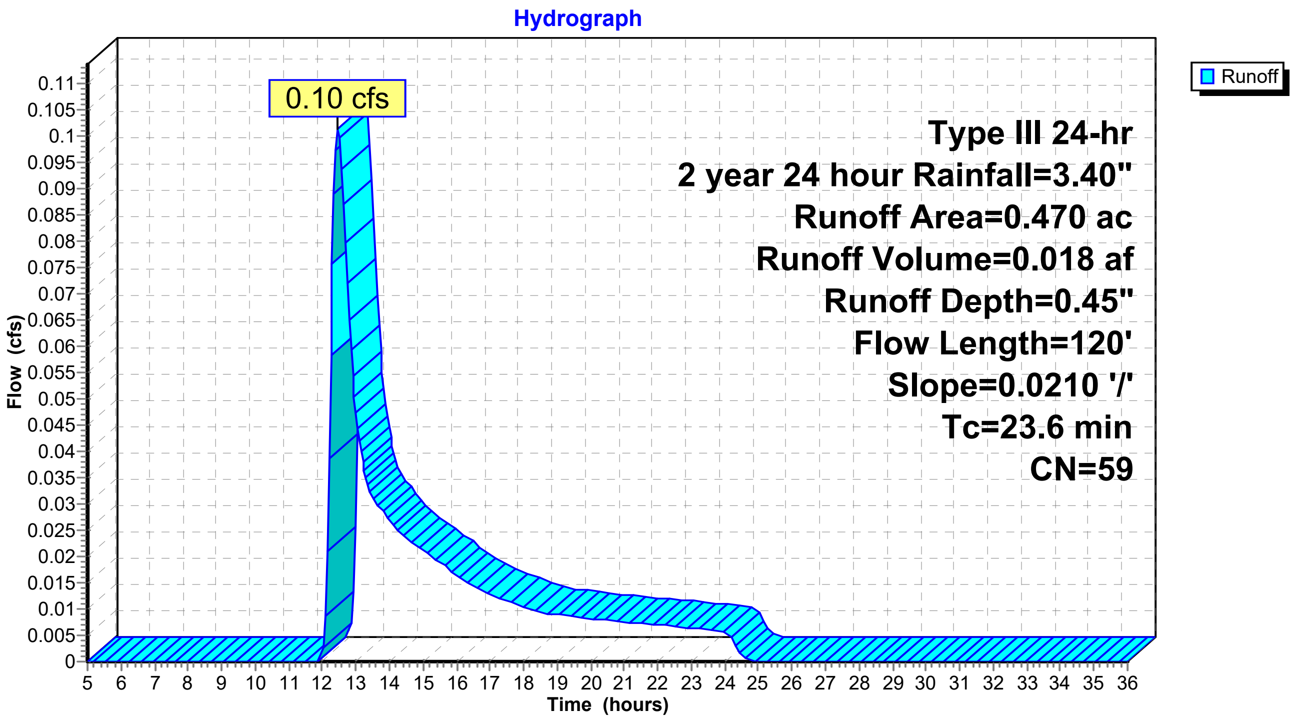
Runoff = 0.10 cfs @ 12.47 hrs, Volume= 0.018 af, Depth= 0.45"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 year 24 hour Rainfall=3.40"

	Area (ac)	CN	Description
	0.260	30	Meadow, non-grazed, HSG A
	0.010	30	Woods, Good, HSG A
*	0.200	98	New Impervious
	0.470	59	Weighted Average
	0.270		57.45% Pervious Area
	0.200		42.55% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.6	120	0.0210	0.08		**Sheet Flow, Meadow** n= 0.400 P2= 3.40"

Subcatchment P2B: Post Watershed 2B



Summary for Subcatchment P2C: Post Watershed 2C

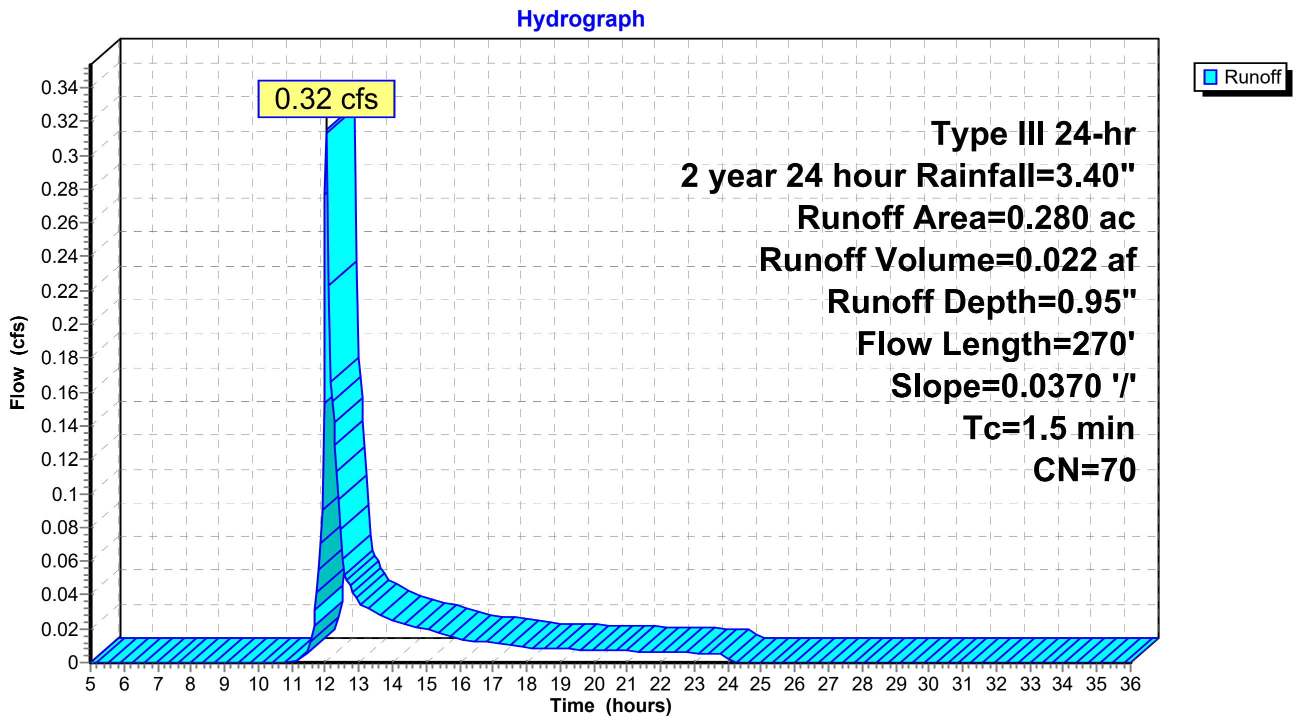
Runoff = 0.32 cfs @ 12.04 hrs, Volume= 0.022 af, Depth= 0.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 year 24 hour Rainfall=3.40"

	Area (ac)	CN	Description
	0.100	30	Meadow, non-grazed, HSG A
	0.020	78	Meadow, non-grazed, HSG D
	0.010	30	Woods, Good, HSG A
*	0.150	98	New Impervious
	0.280	70	Weighted Average
	0.130		46.43% Pervious Area
	0.150		53.57% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.5	270	0.0370	3.05	36.57	**Channel Flow,** Area= 12.0 sf Perim= 10.9' r= 1.10' n= 0.100 Earth, dense brush, high stage

Subcatchment P2C: Post Watershed 2C



Summary for Subcatchment P2D: Post Watershed 2D

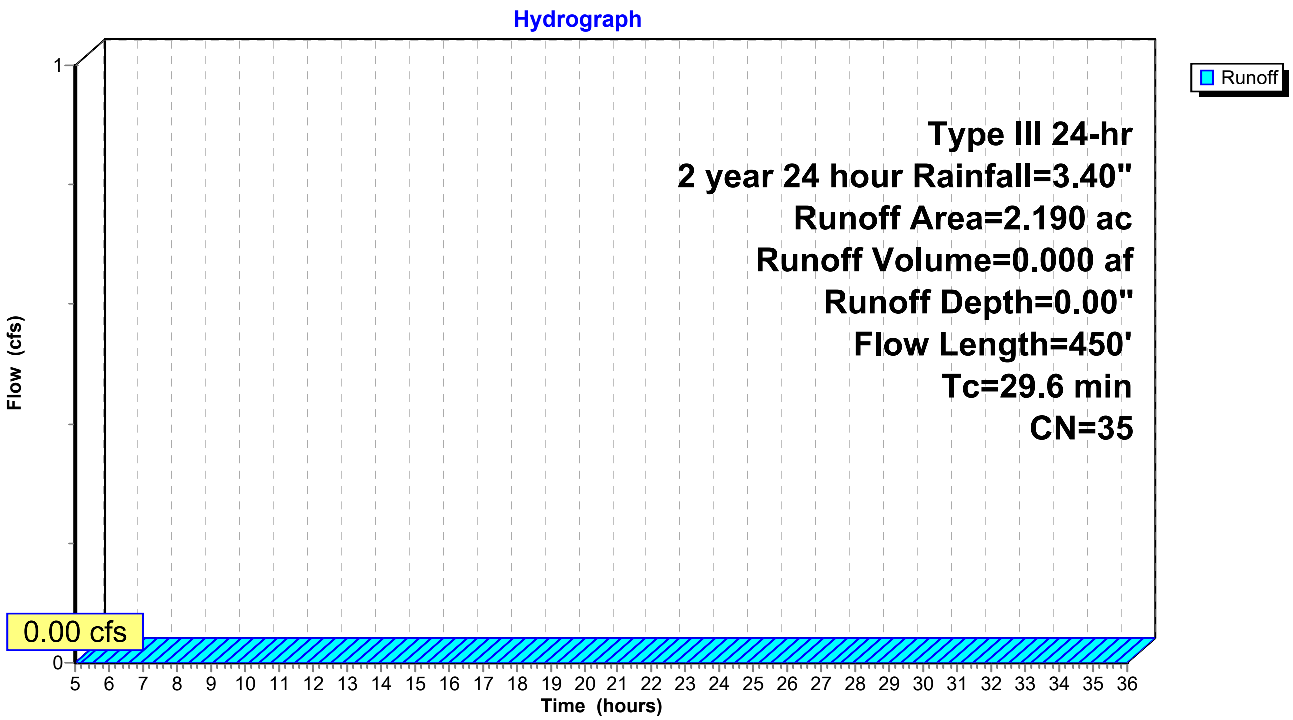
Runoff = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 year 24 hour Rainfall=3.40"

	Area (ac)	CN	Description
	2.030	30	Meadow, non-grazed, HSG A
	0.010	78	Meadow, non-grazed, HSG D
*	0.150	98	New Impervious
	2.190	35	Weighted Average
	2.040		93.15% Pervious Area
	0.150		6.85% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
24.5	150	0.0300	0.10		**Sheet Flow, Meadow** n= 0.400 P2= 3.40"
5.1	300	0.0380	0.97		**Shallow Concentrated Flow, Meadow** Kv= 5.0 fps
29.6	450	Total			

Subcatchment P2D: Post Watershed 2D



Summary for Subcatchment P2E: Post Watershed 2E

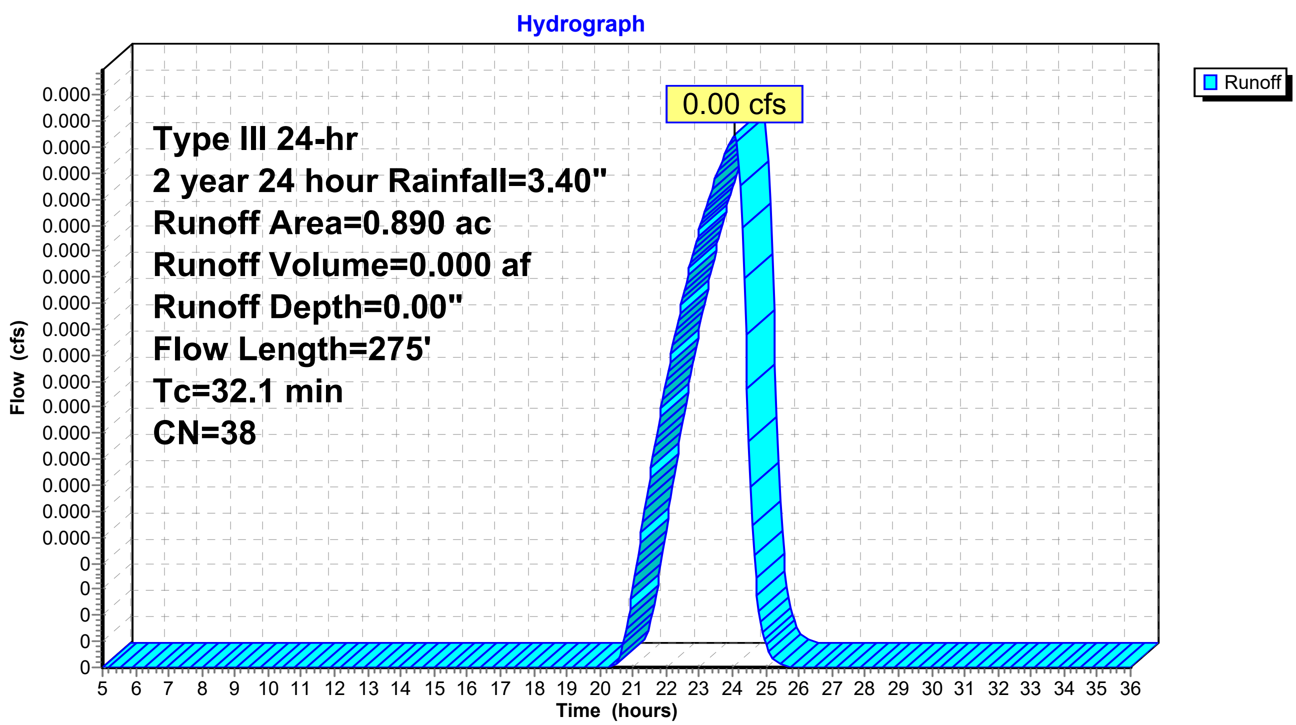
Runoff = 0.00 cfs @ 24.07 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 year 24 hour Rainfall=3.40"

	Area (ac)	CN	Description
	0.790	30	Meadow, non-grazed, HSG A
*	0.100	98	New Impervious
	0.890	38	Weighted Average
	0.790		88.76% Pervious Area
	0.100		11.24% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
30.1	150	0.0180	0.08		**Sheet Flow, Meadow** n= 0.400 P2= 3.40"
2.0	125	0.0450	1.06		**Shallow Concentrated Flow, Meadow** Kv= 5.0 fps
32.1	275	Total			

Subcatchment P2E: Post Watershed 2E



Summary for Subcatchment P3A: Post Watershed 3A

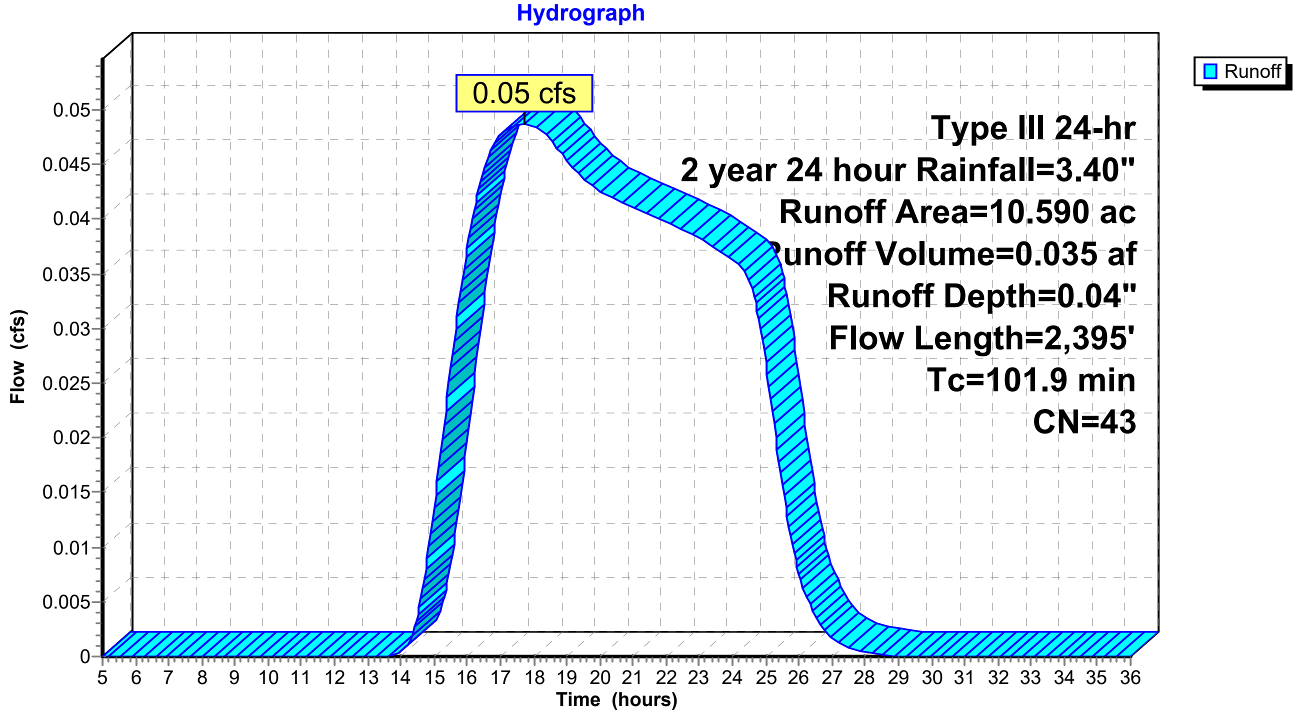
Runoff = 0.05 cfs @ 17.75 hrs, Volume= 0.035 af, Depth= 0.04"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 year 24 hour Rainfall=3.40"

	Area (ac)	CN	Description
	0.090	30	Woods, Good, HSG A
	0.860	77	Woods, Good, HSG D
	7.680	30	Meadow, non-grazed, HSG A
	1.880	78	Meadow, non-grazed, HSG D
*	0.080	98	New Impervious
	10.590	43	Weighted Average
	10.510		99.24% Pervious Area
	0.080		0.76% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.8	150	0.0400	0.11		**Sheet Flow, Meadow** n= 0.400 P2= 3.40"
3.3	170	0.0290	0.85		**Shallow Concentrated Flow, Meadow** Kv= 5.0 fps
2.4	105	0.0220	0.74		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
67.9	1,440	0.0050	0.35		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
6.5	530	0.0050	1.36	10.20	**Channel Flow,** Area= 7.5 sf Perim= 8.7' r= 0.86' n= 0.070
101.9	2,395	Total			

Subcatchment P3A: Post Watershed 3A



Summary for Subcatchment P3B: Post Watershed 3B

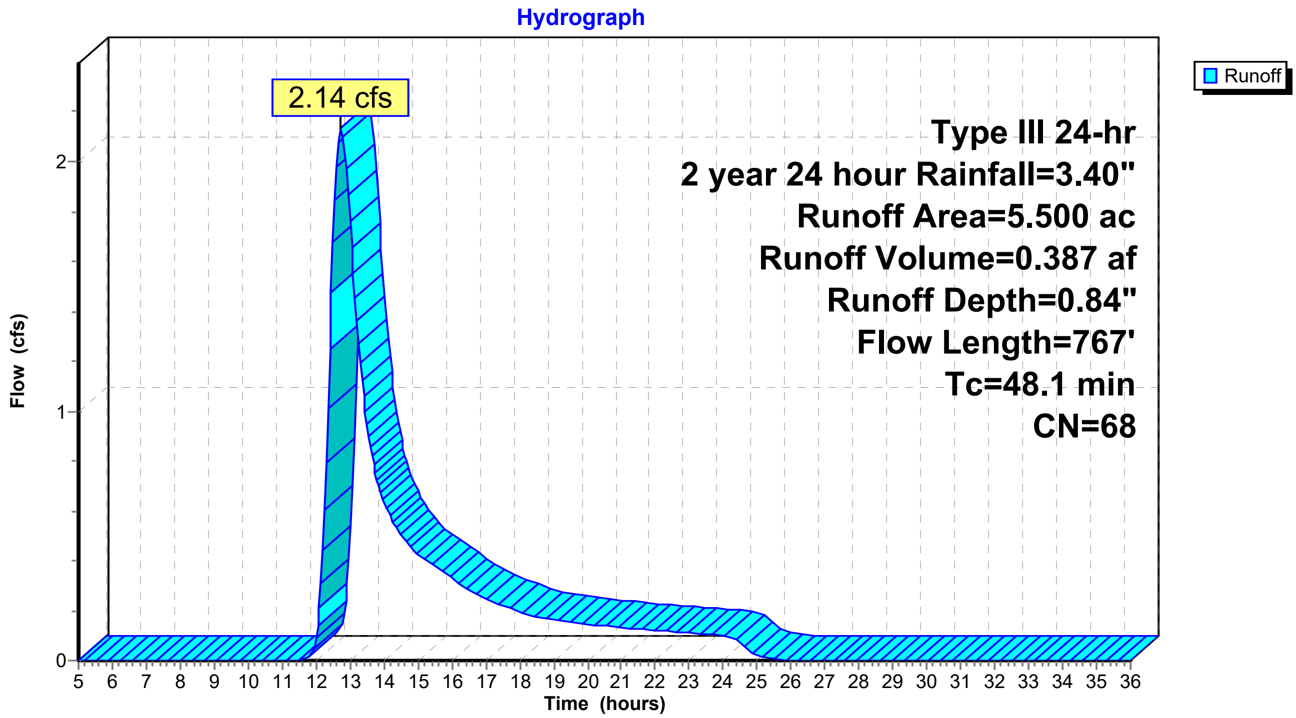
Runoff = 2.14 cfs @ 12.74 hrs, Volume= 0.387 af, Depth= 0.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 2 year 24 hour Rainfall=3.40"

	Area (ac)	CN	Description
	0.260	30	Woods, Good, HSG A
	0.720	77	Woods, Good, HSG D
	0.190	39	Pasture/grassland/range, Good, HSG A
	0.120	80	Pasture/grassland/range, Good, HSG D
	0.770	30	Meadow, non-grazed, HSG A
	3.370	78	Meadow, non-grazed, HSG D
*	0.070	98	New Impervious
	5.500	68	Weighted Average
	5.430		98.73% Pervious Area
	0.070		1.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
34.2	150	0.0130	0.07		**Sheet Flow, Meadow** n= 0.400 P2= 3.40"
3.4	152	0.0220	0.74		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
10.5	465	0.0220	0.74		**Shallow Concentrated Flow, Meadow** Kv= 5.0 fps
48.1	767	Total			

Subcatchment P3B: Post Watershed 3B



Summary for Pond 1P: Level Lip Spreader LS1

Inflow Area = 0.340 ac, 58.82% Impervious, Inflow Depth = 2.35" for 2 year 24 hour event
Inflow = 1.01 cfs @ 12.05 hrs, Volume= 0.067 af
Outflow = 0.04 cfs @ 15.14 hrs, Volume= 0.014 af, Atten= 96%, Lag= 185.7 min
Primary = 0.04 cfs @ 15.14 hrs, Volume= 0.014 af

Routing by Stor-Ind method, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 116.26' @ 15.14 hrs Surf.Area= 2,572 sf Storage= 2,302 cf

Plug-Flow detention time= 455.0 min calculated for 0.014 af (21% of inflow)
Center-of-Mass det. time= 298.0 min (1,099.7 - 801.7)

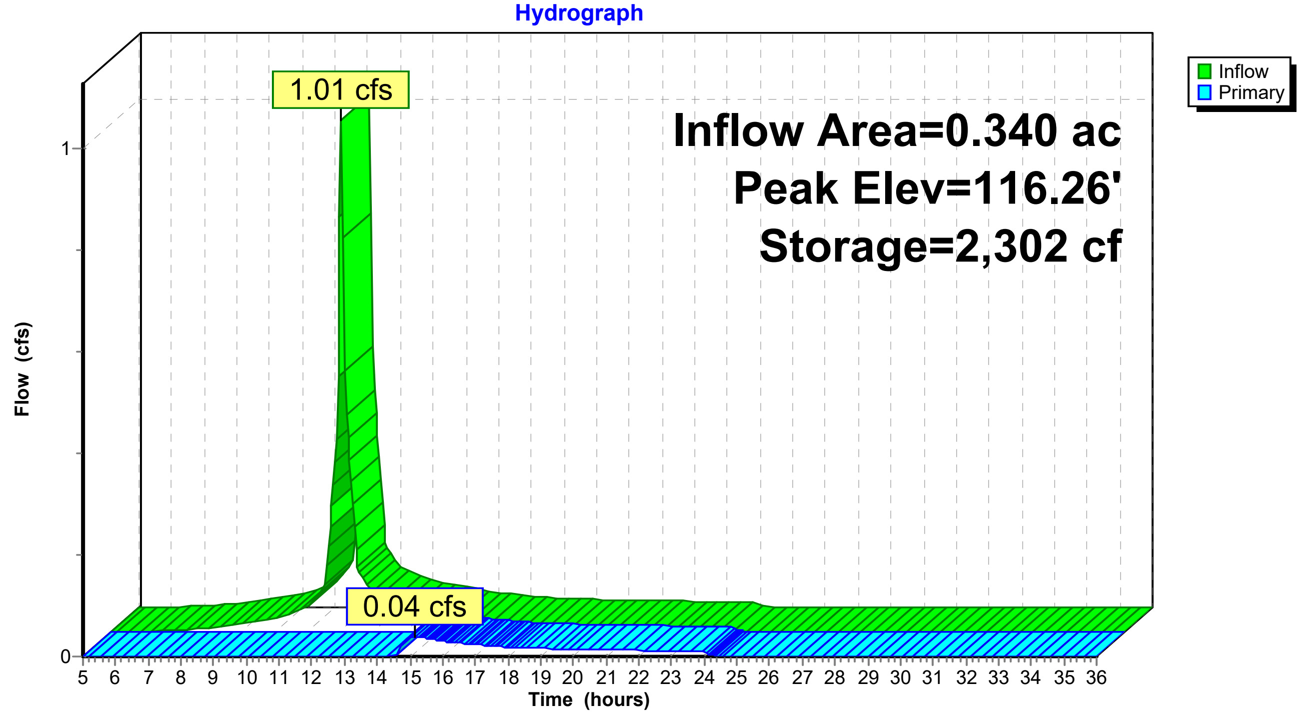
Volume	Invert	Avail.Storage	Storage Description
#1	114.50'	2,971 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
114.50	229	0	0
115.00	739	242	242
116.00	2,160	1,450	1,692
116.50	2,958	1,280	2,971

Device	Routing	Invert	Outlet Devices
#1	Primary	116.25'	**20.0' long x 4.0' 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) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Primary OutFlow Max=0.04 cfs @ 15.14 hrs HW=116.26' (Free Discharge)
1=Broad-Crested Rectangular Weir (Weir Controls 0.04 cfs @ 0.21 fps)

Pond 1P: Level Lip Spreader LS1



Summary for Pond 2P: Level Lip Spreader LS2

Inflow Area = 0.120 ac, 58.33% Impervious, Inflow Depth = 2.35" for 2 year 24 hour event
Inflow = 0.37 cfs @ 12.01 hrs, Volume= 0.024 af
Outflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 115.16' @ 24.10 hrs Surf.Area= 679 sf Storage= 1,026 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

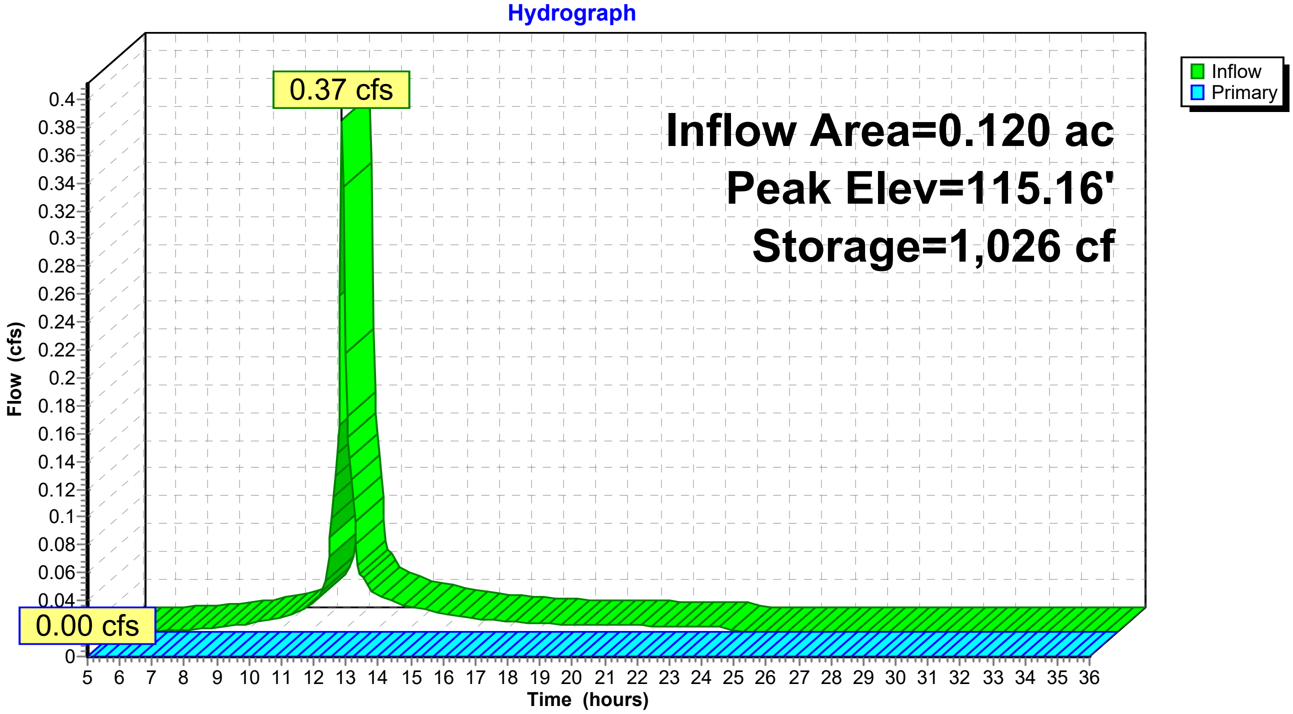
Volume	Invert	Avail.Storage	Storage Description
#1	112.00'	2,357 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
112.00	104	0	0
113.00	210	157	157
114.00	357	284	441
115.00	605	481	922
116.00	1,061	833	1,755
116.50	1,350	603	2,357

Device	Routing	Invert	Outlet Devices
#1	Primary	116.25'	**20.0' long x 4.0' 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) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=112.00' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 2P: Level Lip Spreader LS2



Summary for Pond 3P: Level Lip Spreader LS3

Inflow Area = 1.090 ac, 21.10% Impervious, Inflow Depth = 0.11" for 2 year 24 hour event
Inflow = 0.02 cfs @ 14.80 hrs, Volume= 0.010 af
Outflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 112.95' @ 26.40 hrs Surf.Area= 558 sf Storage= 417 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

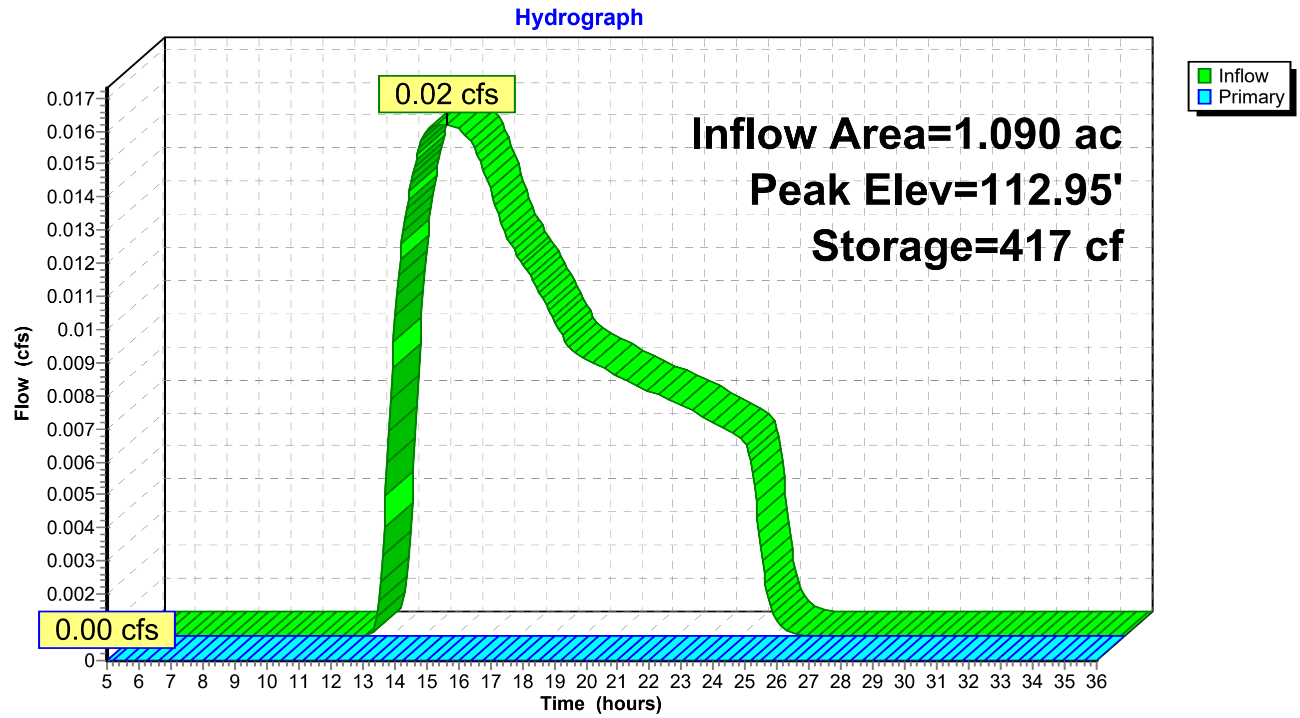
Volume	Invert	Avail.Storage	Storage Description
#1	112.00'	6,496 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
112.00	318	0	0
113.00	570	444	444
114.00	917	744	1,188
115.00	1,722	1,320	2,507
116.00	2,986	2,354	4,861
116.50	3,553	1,635	6,496

Device	Routing	Invert	Outlet Devices
#1	Primary	116.25'	**20.0' long x 4.0' 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) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=112.00' (Free Discharge)
1=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Pond 3P: Level Lip Spreader LS3



Summary for Pond 4P: Level Lip Spreader LS4

Inflow Area = 0.820 ac, 20.73% Impervious, Inflow Depth = 0.25" for 2 year 24 hour event
Inflow = 0.06 cfs @ 12.71 hrs, Volume= 0.017 af
Outflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 107.66' @ 25.75 hrs Surf.Area= 668 sf Storage= 750 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

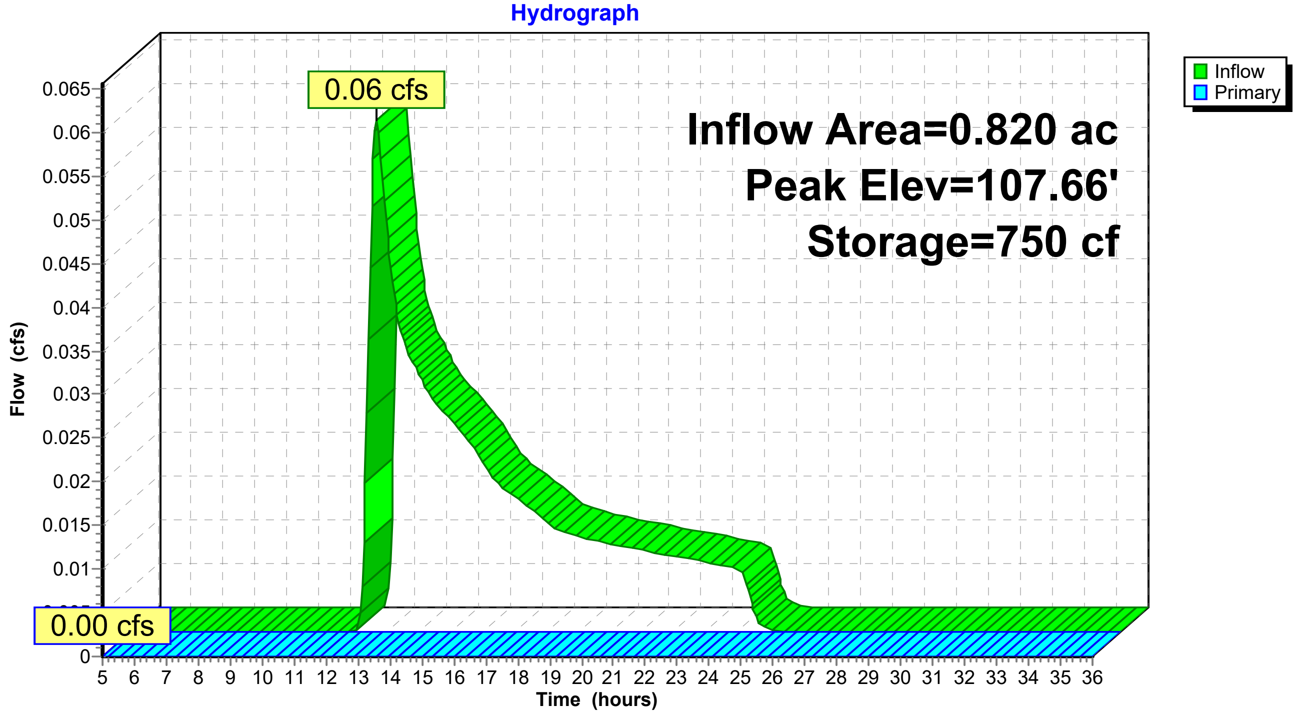
Volume	Invert	Avail.Storage	Storage Description
#1	106.00'	2,535 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
106.00	263	0	0
107.00	483	373	373
108.00	765	624	997
109.00	1,110	938	1,935
109.50	1,293	601	2,535

Device	Routing	Invert	Outlet Devices
#1	Primary	109.25'	**20.0' long x 4.0' 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) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=106.00' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 4P: Level Lip Spreader LS4



Summary for Pond 5P: Level Lip Spreader LS5

Inflow Area = 4.330 ac, 1.15% Impervious, Inflow Depth = 0.02" for 2 year 24 hour event
Inflow = 0.01 cfs @ 21.37 hrs, Volume= 0.007 af
Outflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 106.46' @ 25.90 hrs Surf.Area= 703 sf Storage= 287 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

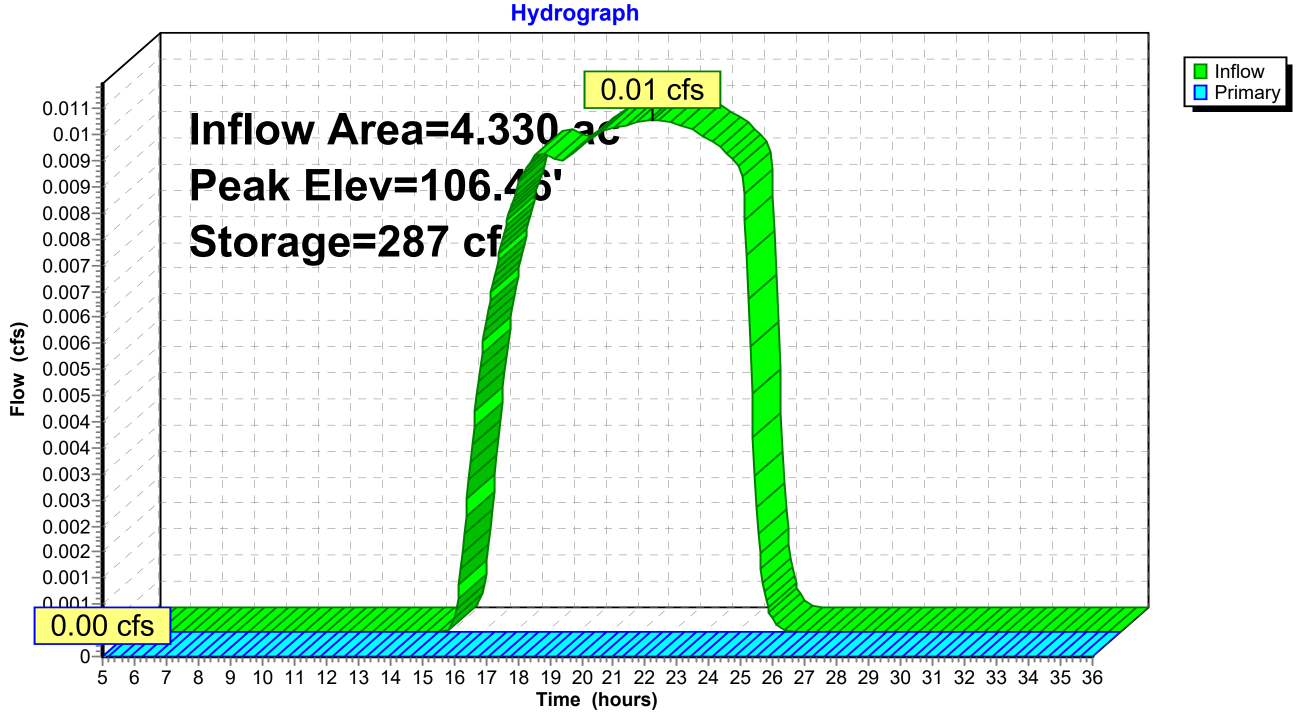
Volume	Invert	Avail.Storage	Storage Description
#1	106.00'	4,568 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
106.00	541	0	0
107.00	892	717	717
108.00	1,326	1,109	1,826
109.00	1,993	1,660	3,485
109.50	2,339	1,083	4,568

Device	Routing	Invert	Outlet Devices
#1	Primary	109.25'	**20.0' long x 18.0' 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

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=106.00' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 5P: Level Lip Spreader LS5



Summary for Pond 6P: Level Lip Spreader LS6

Inflow Area = 0.470 ac, 42.55% Impervious, Inflow Depth = 0.45" for 2 year 24 hour event
Inflow = 0.10 cfs @ 12.47 hrs, Volume= 0.018 af
Outflow = 0.02 cfs @ 14.83 hrs, Volume= 0.018 af, Atten= 78%, Lag= 141.5 min
Discarded = 0.02 cfs @ 14.83 hrs, Volume= 0.018 af
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 101.45' @ 14.83 hrs Surf.Area= 560 sf Storage= 226 cf

Plug-Flow detention time= 116.1 min calculated for 0.018 af (100% of inflow)
Center-of-Mass det. time= 115.8 min (1,049.9 - 934.1)

Volume	Invert	Avail.Storage	Storage Description
#1	101.00'	3,342 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

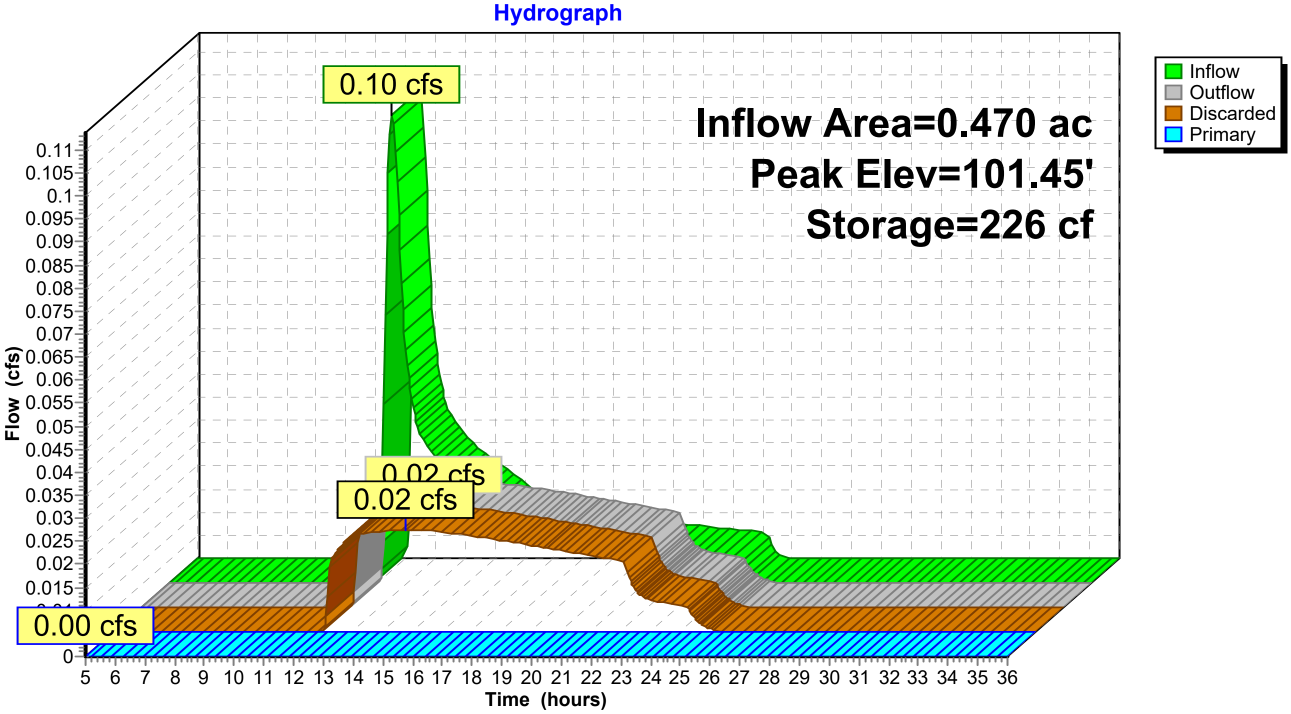
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
101.00	451	0	0
102.00	695	573	573
103.00	998	847	1,420
104.00	1,374	1,186	2,606
104.50	1,570	736	3,342

Device	Routing	Invert	Outlet Devices
#1	Primary	104.25'	**20.0' long x 4.0' 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) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32
#2	Discarded	101.00'	**1.420 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 99.00'

Discarded OutFlow Max=0.02 cfs @ 14.83 hrs HW=101.45' (Free Discharge)
└─**2=Exfiltration** (Controls 0.02 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=101.00' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 6P: Level Lip Spreader LS6



Summary for Pond 7P: Level Lip Spreader LS7

Inflow Area =	0.280 ac, 53.57% Impervious,	Inflow Depth = 0.95"	for 2 year 24 hour event	
Inflow =	0.32 cfs @	12.04 hrs, Volume=	0.022 af	
Outflow =	0.03 cfs @	13.75 hrs, Volume=	0.022 af,	Atten= 91%, Lag= 102.7 min
Discarded =	0.03 cfs @	13.75 hrs, Volume=	0.022 af	
Primary =	0.00 cfs @	5.00 hrs, Volume=	0.000 af	

Routing by Stor-Ind method, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 93.69' @ 13.75 hrs Surf.Area= 646 sf Storage= 379 cf

Plug-Flow detention time= 160.8 min calculated for 0.022 af (100% of inflow)
Center-of-Mass det. time= 160.6 min (1,027.7 - 867.1)

Volume	Invert	Avail.Storage	Storage Description
#1	93.00'	2,037 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

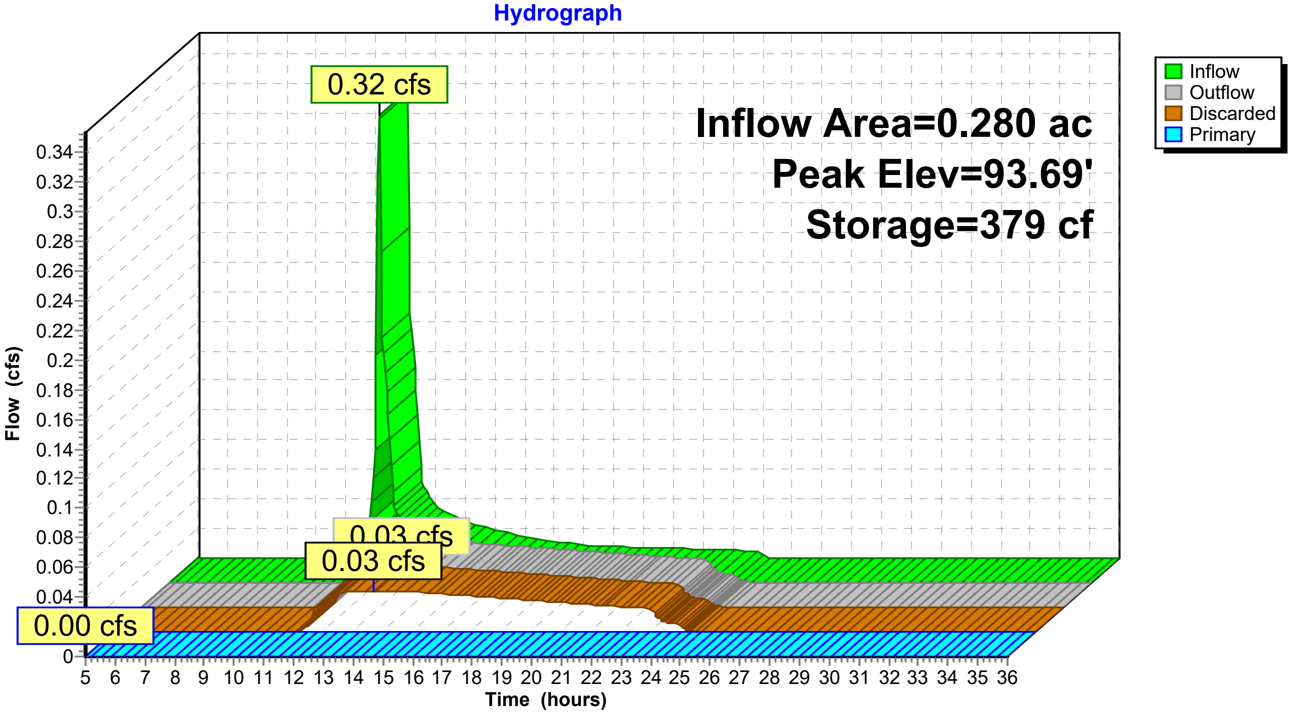
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
93.00	462	0	0
94.00	730	596	596
95.00	1,037	884	1,480
95.50	1,193	558	2,037

Device	Routing	Invert	Outlet Devices
#1	Primary	95.25'	**20.0' long x 4.0' 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) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32
#2	Discarded	93.00'	**1.420 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 91.00'

Discarded OutFlow Max=0.03 cfs @ 13.75 hrs HW=93.69' (Free Discharge)
↑—**2=Exfiltration** (Controls 0.03 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=93.00' (Free Discharge)
↑—**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 7P: Level Lip Spreader LS7



Summary for Pond 8P: Infiltration Basin 1

Inflow Area = 2.190 ac, 6.85% Impervious, Inflow Depth = 0.00" for 2 year 24 hour event
Inflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min
Discarded = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 92.00' @ 5.00 hrs Surf.Area= 123 sf Storage= 0 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	92.00'	2,853 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

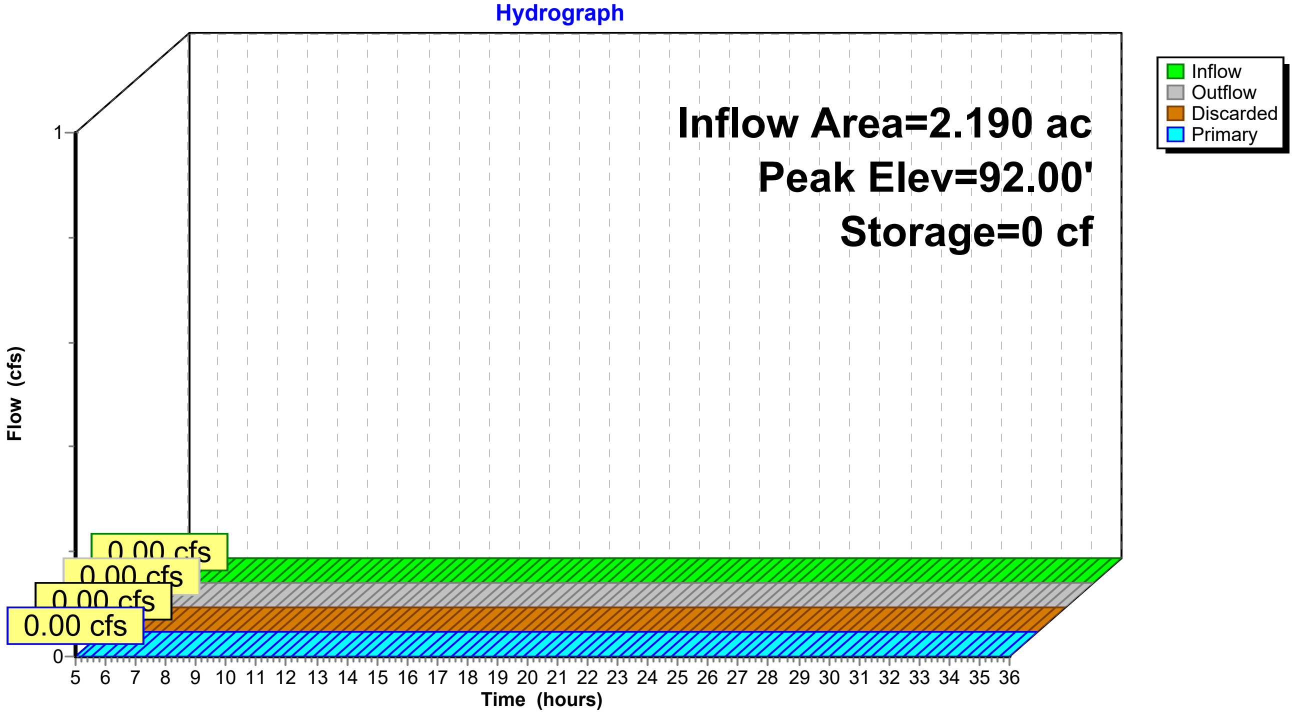
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
92.00	123	0	0
93.00	725	424	424
94.00	1,964	1,345	1,769
94.50	2,375	1,085	2,853

Device	Routing	Invert	Outlet Devices
#1	Discarded	92.00'	**1.420 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 90.00'
#2	Primary	94.25'	**15.0" Round Culvert** L= 40.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 94.25' / 93.50' S= 0.0187 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 1.23 sf

Discarded OutFlow Max=0.00 cfs @ 5.00 hrs HW=92.00' (Free Discharge)
└—**1=Exfiltration** (Passes 0.00 cfs of 0.00 cfs potential flow)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=92.00' (Free Discharge)
└—**2=Culvert** (Controls 0.00 cfs)

Pond 8P: Infiltration Basin 1



Summary for Pond 9P: Level Lip Spreader LS8

Inflow Area = 0.890 ac, 11.24% Impervious, Inflow Depth = 0.00" for 2 year 24 hour event
Inflow = 0.00 cfs @ 24.07 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 24.16 hrs, Volume= 0.000 af, Atten= 2%, Lag= 5.2 min
Discarded = 0.00 cfs @ 24.16 hrs, Volume= 0.000 af
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 90.00' @ 24.16 hrs Surf.Area= 158 sf Storage= 0 cf

Plug-Flow detention time= 12.2 min calculated for 0.000 af (100% of inflow)
Center-of-Mass det. time= 12.3 min (1,398.3 - 1,386.0)

Volume	Invert	Avail.Storage	Storage Description
#1	90.00'	1,730 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

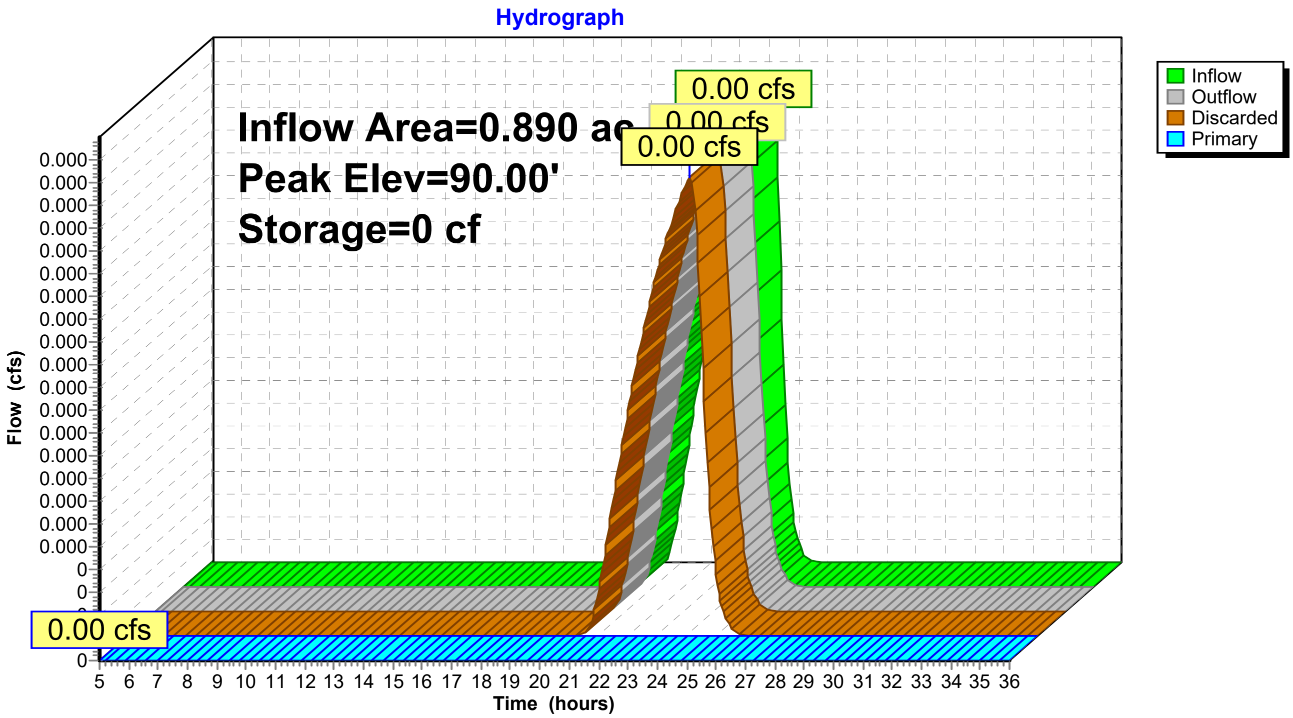
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
90.00	157	0	0
91.00	434	296	296
92.00	1,150	792	1,088
92.50	1,419	642	1,730

Device	Routing	Invert	Outlet Devices
#1	Discarded	90.00'	**1.420 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 88.00'
#2	Primary	92.25'	**20.0' long x 4.0' 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) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Discarded OutFlow Max=0.01 cfs @ 24.16 hrs HW=90.00' (Free Discharge)
└─**1=Exfiltration** (Controls 0.01 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=90.00' (Free Discharge)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 9P: Level Lip Spreader LS8



Summary for Pond 10P: Dry Basin 1

Inflow Area = 5.500 ac, 1.27% Impervious, Inflow Depth = 0.84" for 2 year 24 hour event
Inflow = 2.14 cfs @ 12.74 hrs, Volume= 0.387 af
Outflow = 0.35 cfs @ 15.79 hrs, Volume= 0.370 af, Atten= 84%, Lag= 183.2 min
Primary = 0.35 cfs @ 15.79 hrs, Volume= 0.370 af

Routing by Stor-Ind method, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 92.36' @ 15.79 hrs Surf.Area= 9,915 sf Storage= 7,962 cf

Plug-Flow detention time= 317.9 min calculated for 0.370 af (96% of inflow)
Center-of-Mass det. time= 295.1 min (1,212.4 - 917.3)

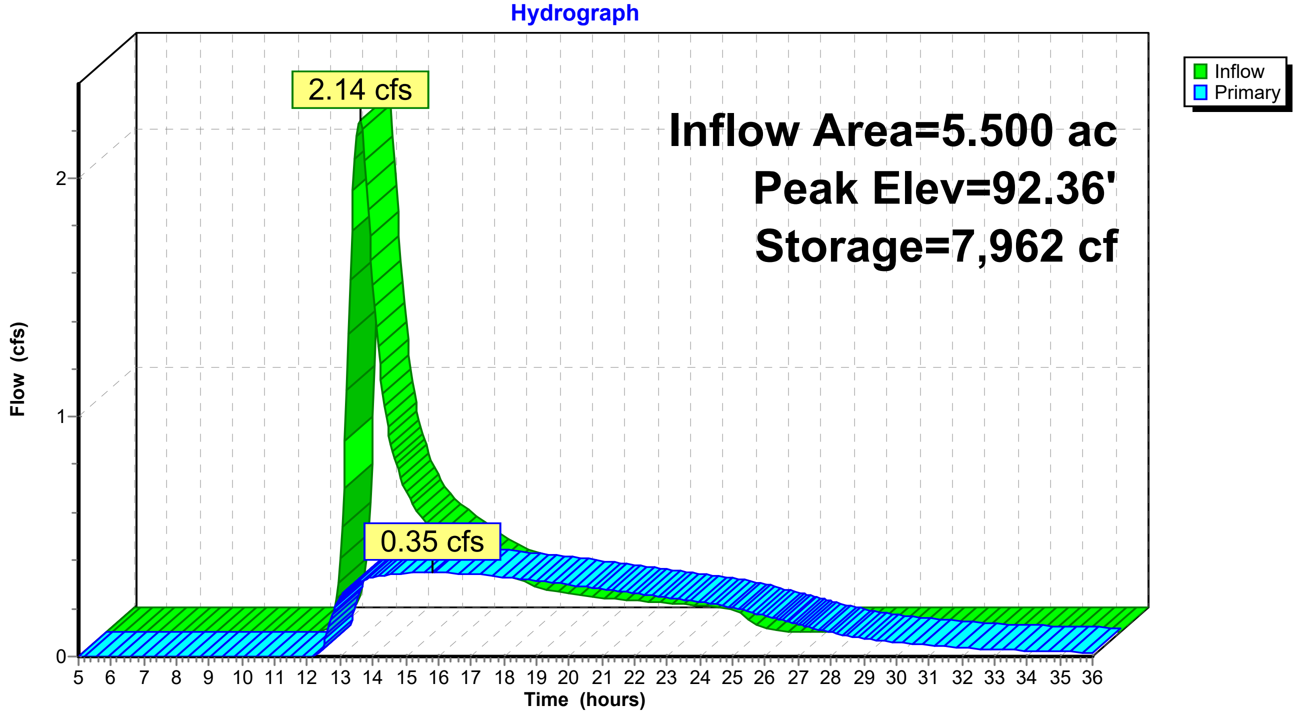
Volume	Invert	Avail.Storage	Storage Description
#1	91.50'	47,418 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
91.50	8,637	0	0
92.00	9,354	4,498	4,498
93.00	10,914	10,134	14,632
94.00	12,635	11,775	26,406
95.00	14,461	13,548	39,954
95.50	15,395	7,464	47,418

Device	Routing	Invert	Outlet Devices
#1	Primary	91.40'	**15.0" Round Culvert** L= 30.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 91.40' / 91.10' S= 0.0100 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 1.23 sf
#2	Device 1	91.50'	**4.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	93.50'	**8.0" Vert. Orifice/Grate** C= 0.600
#4	Primary	94.50'	**20.0' long x 4.0' 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) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Primary OutFlow Max=0.35 cfs @ 15.79 hrs HW=92.36' (Free Discharge)
- **1=Culvert** (Passes 0.35 cfs of 2.66 cfs potential flow)
  - **2=Orifice/Grate** (Orifice Controls 0.35 cfs @ 4.01 fps)
  - **3=Orifice/Grate** (Controls 0.00 cfs)
- **4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 10P: Dry Basin 1

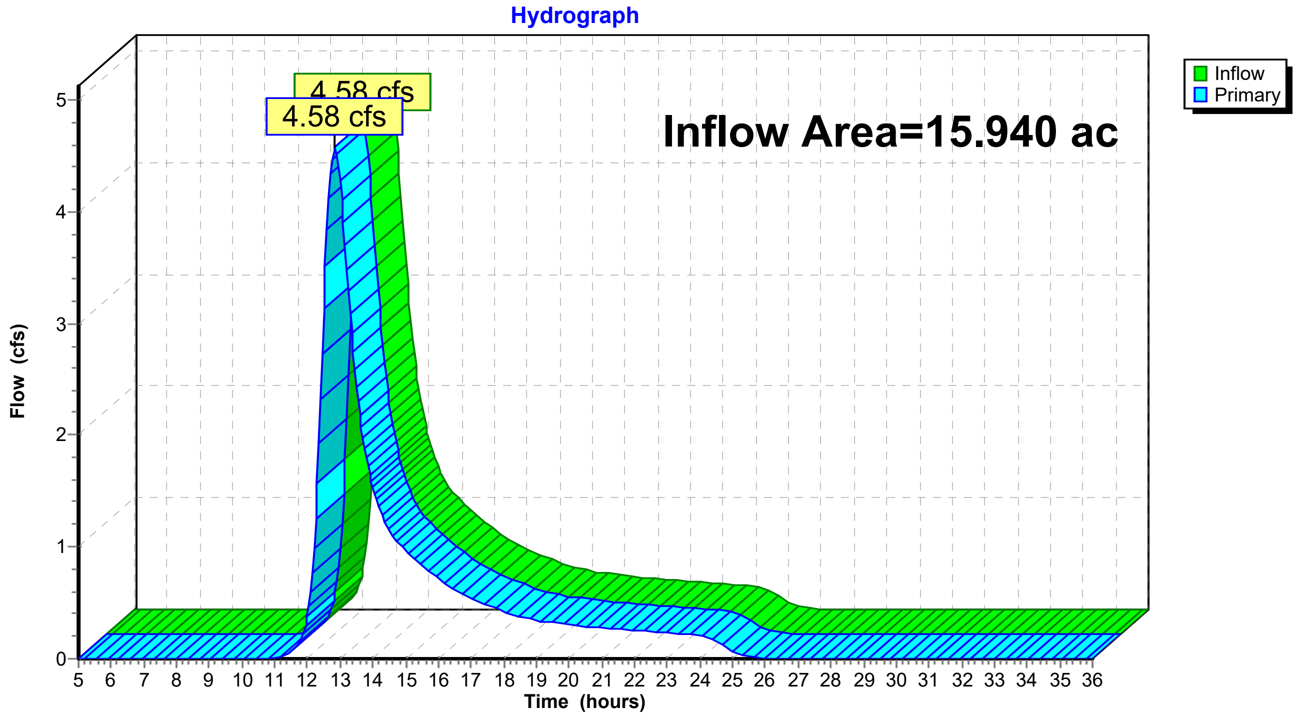


Summary for Link SN01: SN001

Inflow Area = 15.940 ac, 4.83% Impervious, Inflow Depth = 0.66" for 2 year 24 hour event
Inflow = 4.58 cfs @ 12.84 hrs, Volume= 0.871 af
Primary = 4.58 cfs @ 12.84 hrs, Volume= 0.871 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs

Link SN01: SN001

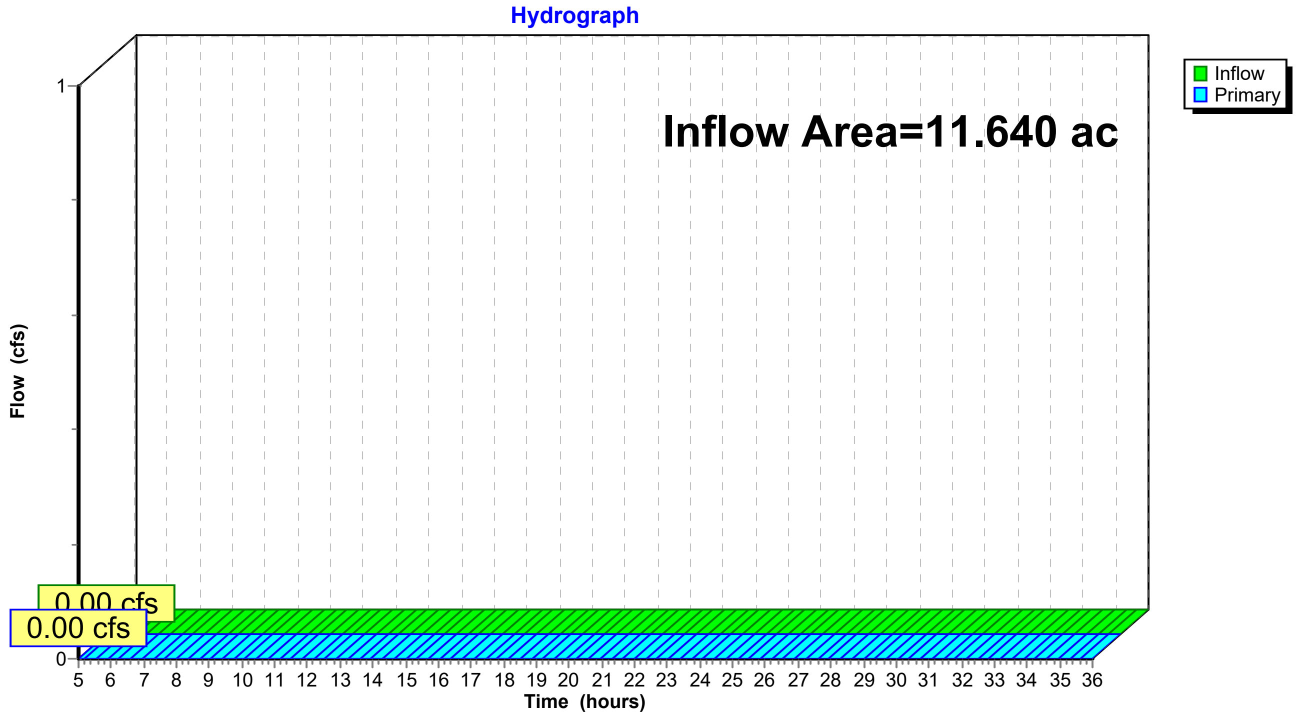


Summary for Link SN02: SN002

Inflow Area = 11.640 ac, 5.15% Impervious, Inflow Depth = 0.00" for 2 year 24 hour event
Inflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs

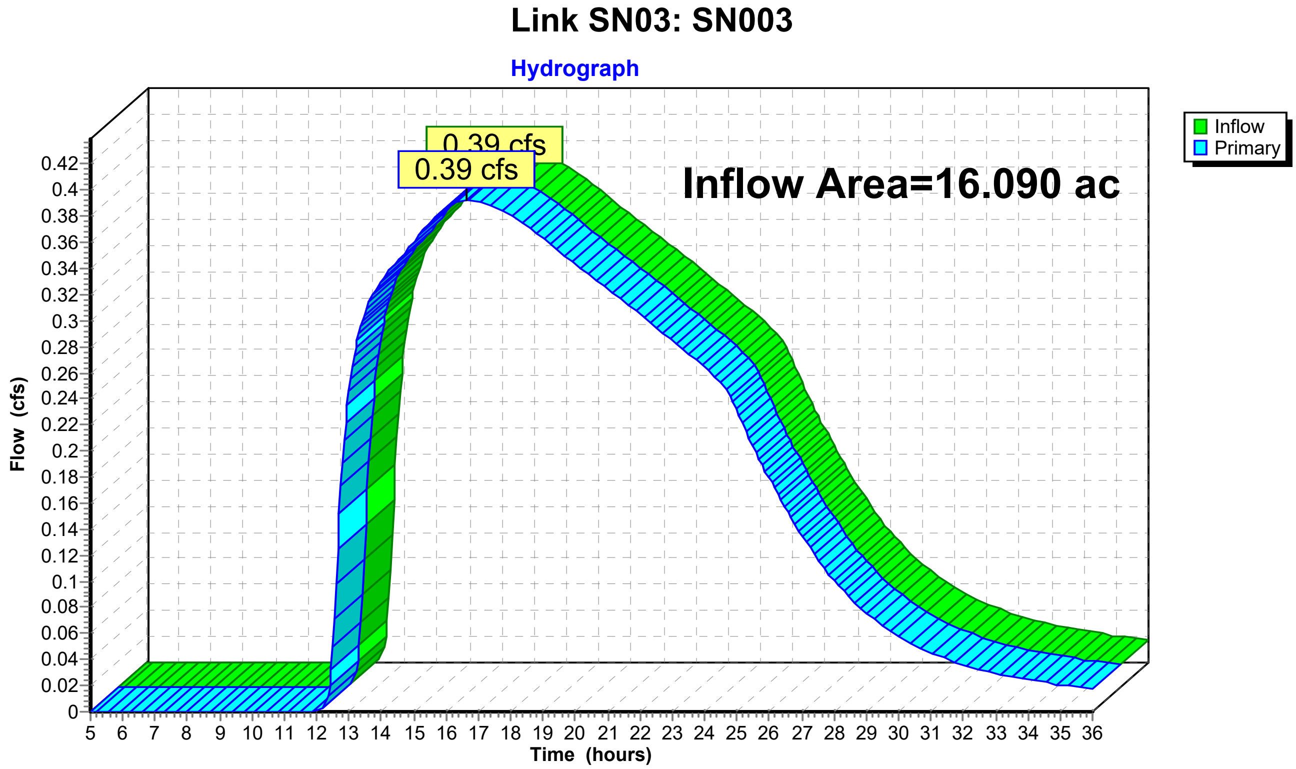
Link SN02: SN002



Summary for Link SN03: SN003

Inflow Area =	16.090 ac,	0.93% Impervious, Inflow Depth > 0.30"	for 2 year 24 hour event	
Inflow =	0.39 cfs @	16.66 hrs, Volume=	0.405 af	
Primary =	0.39 cfs @	16.66 hrs, Volume=	0.405 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs



Summary for Subcatchment P1A: Post Watershed 1A

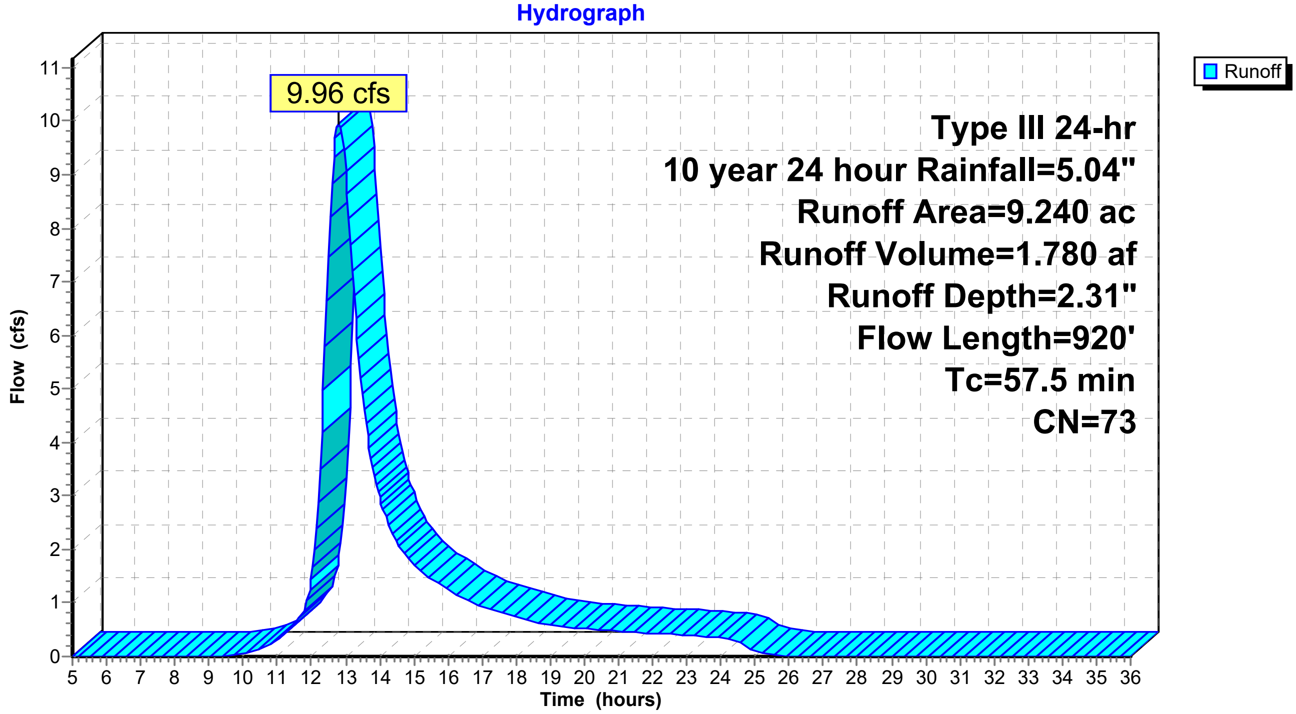
Runoff = 9.96 cfs @ 12.81 hrs, Volume= 1.780 af, Depth= 2.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year 24 hour Rainfall=5.04"

	Area (ac)	CN	Description
	0.270	30	Woods, Good, HSG A
	0.230	55	Woods, Good, HSG B
	6.790	77	Woods, Good, HSG D
	0.060	39	Pasture/grassland/range, Good, HSG A
	0.420	61	Pasture/grassland/range, Good, HSG B
	0.210	80	Pasture/grassland/range, Good, HSG D
	0.250	30	Meadow, non-grazed, HSG A
	0.070	58	Meadow, non-grazed, HSG B
	0.890	78	Meadow, non-grazed, HSG D
*	0.050	98	New Impervious
	9.240	73	Weighted Average
	9.190		99.46% Pervious Area
	0.050		0.54% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.8	150	0.0200	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.40"
28.7	770	0.0080	0.45		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
57.5	920	Total			

Subcatchment P1A: Post Watershed 1A



Summary for Subcatchment P1B: Post Watershed 1B

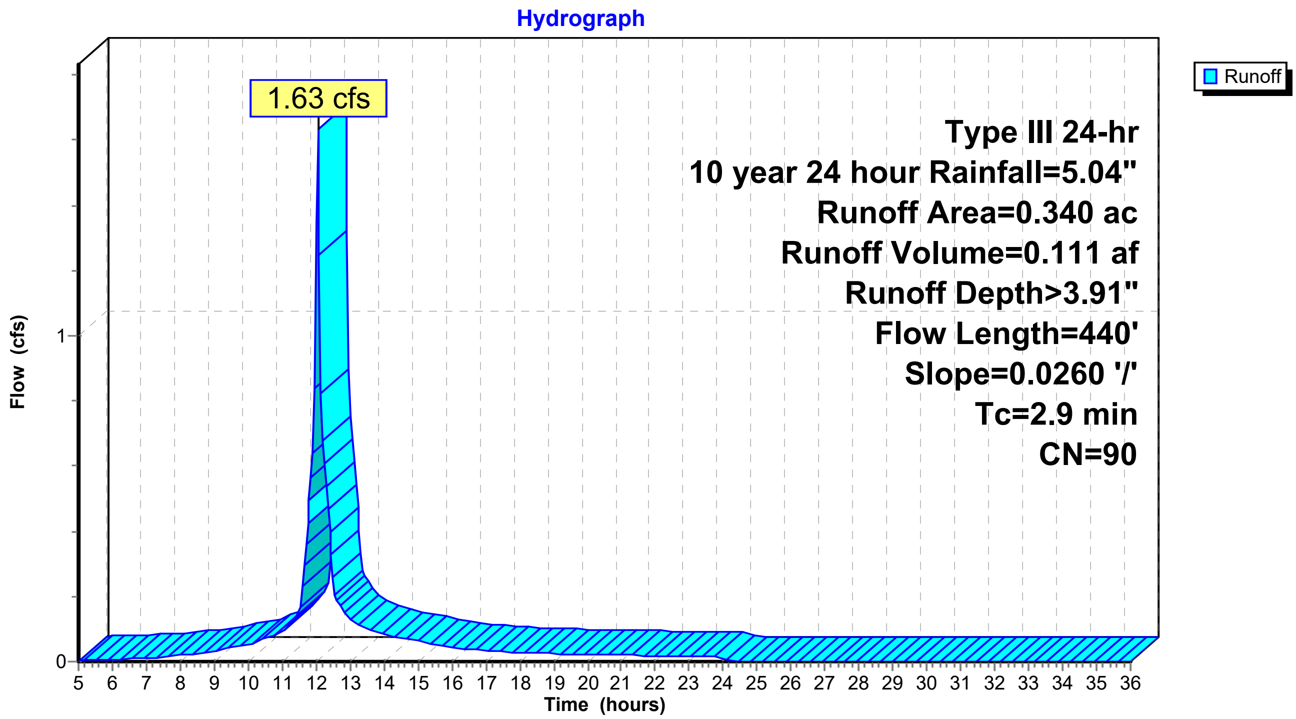
Runoff = 1.63 cfs @ 12.05 hrs, Volume= 0.111 af, Depth> 3.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year 24 hour Rainfall=5.04"

	Area (ac)	CN	Description
	0.140	78	Meadow, non-grazed, HSG D
*	0.200	98	New Impervious
	0.340	90	Weighted Average
	0.140		41.18% Pervious Area
	0.200		58.82% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.9	440	0.0260	2.55	30.66	**Channel Flow,** Area= 12.0 sf Perim= 10.9' r= 1.10' n= 0.100 Earth, dense brush, high stage

Subcatchment P1B: Post Watershed 1B



Summary for Subcatchment P1C: Post Watershed 1C

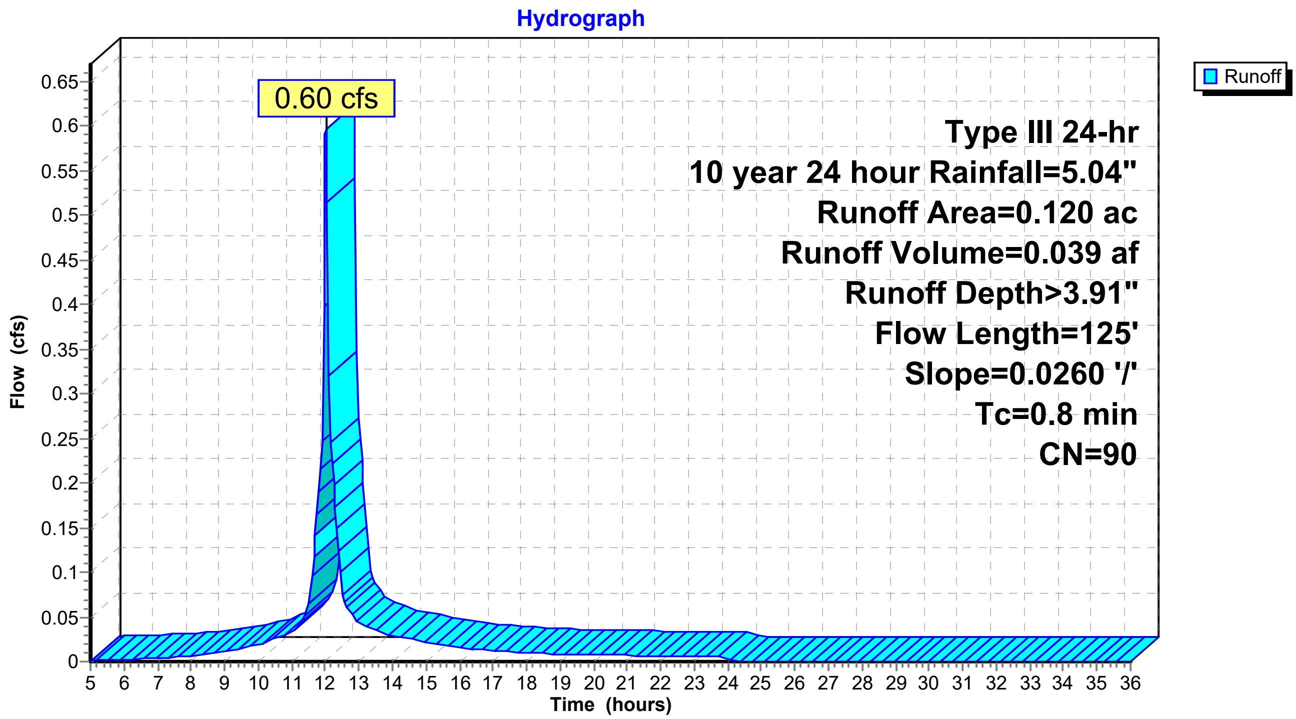
Runoff = 0.60 cfs @ 12.01 hrs, Volume= 0.039 af, Depth> 3.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year 24 hour Rainfall=5.04"

	Area (ac)	CN	Description
	0.050	78	Meadow, non-grazed, HSG D
*	0.070	98	New Impervious
	0.120	90	Weighted Average
	0.050		41.67% Pervious Area
	0.070		58.33% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	125	0.0260	2.55	30.66	**Channel Flow,** Area= 12.0 sf Perim= 10.9' r= 1.10' n= 0.100 Earth, dense brush, high stage

Subcatchment P1C: Post Watershed 1C



Summary for Subcatchment P1D: Post Watershed 1D

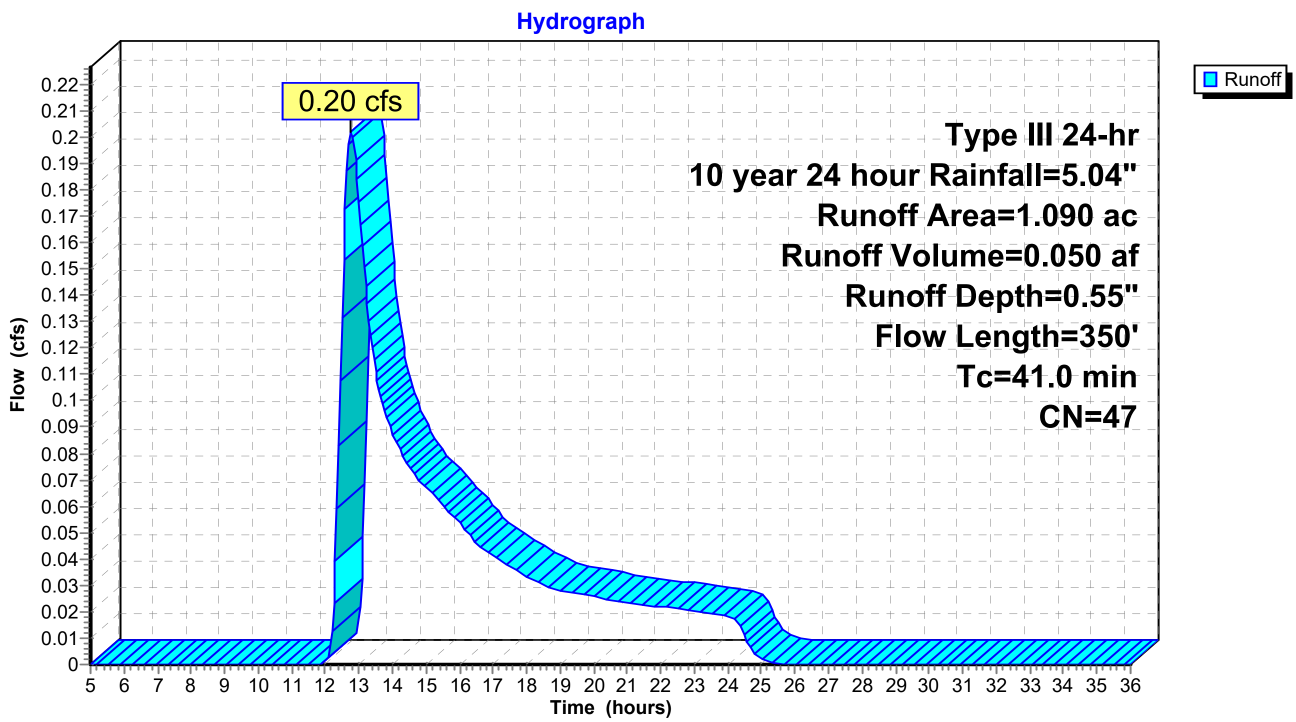
Runoff = 0.20 cfs @ 12.78 hrs, Volume= 0.050 af, Depth= 0.55"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year 24 hour Rainfall=5.04"

	Area (ac)	CN	Description
	0.790	30	Meadow, non-grazed, HSG A
	0.070	78	Meadow, non-grazed, HSG D
*	0.230	98	New Impervious
	1.090	47	Weighted Average
	0.860		78.90% Pervious Area
	0.230		21.10% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
24.2	150	0.0310	0.10		**Sheet Flow, Meadow** n= 0.400 P2= 3.40"
16.3	155	0.0010	0.16		**Shallow Concentrated Flow, Meadow** Kv= 5.0 fps
0.5	45	0.0100	1.58	19.01	**Channel Flow,** Area= 12.0 sf Perim= 10.9' r= 1.10' n= 0.100 Earth, dense brush, high stage
41.0	350	Total			

Subcatchment P1D: Post Watershed 1D



Summary for Subcatchment P1E: Post Watershed 1E

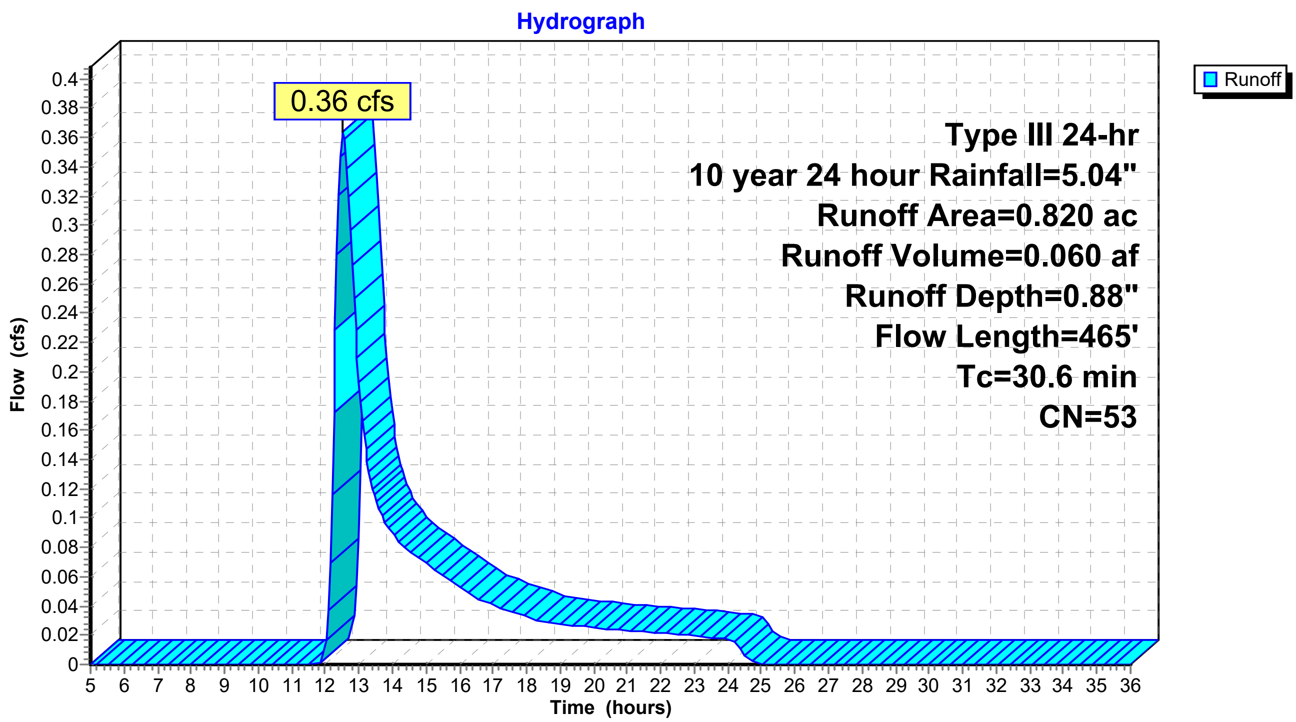
Runoff = 0.36 cfs @ 12.53 hrs, Volume= 0.060 af, Depth= 0.88"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year 24 hour Rainfall=5.04"

	Area (ac)	CN	Description
	0.500	30	Meadow, non-grazed, HSG A
	0.150	78	Meadow, non-grazed, HSG D
*	0.170	98	New Impervious
	0.820	53	Weighted Average
	0.650		79.27% Pervious Area
	0.170		20.73% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
24.2	150	0.0310	0.10		**Sheet Flow, Meadow** n= 0.400 P2= 3.40"
4.7	45	0.0010	0.16		**Shallow Concentrated Flow, Meadow** Kv= 5.0 fps
1.7	270	0.0280	2.65	31.81	**Channel Flow,** Area= 12.0 sf Perim= 10.9' r= 1.10' n= 0.100 Earth, dense brush, high stage
30.6	465	Total			

Subcatchment P1E: Post Watershed 1E



Summary for Subcatchment P1F: Post Watershed 1F

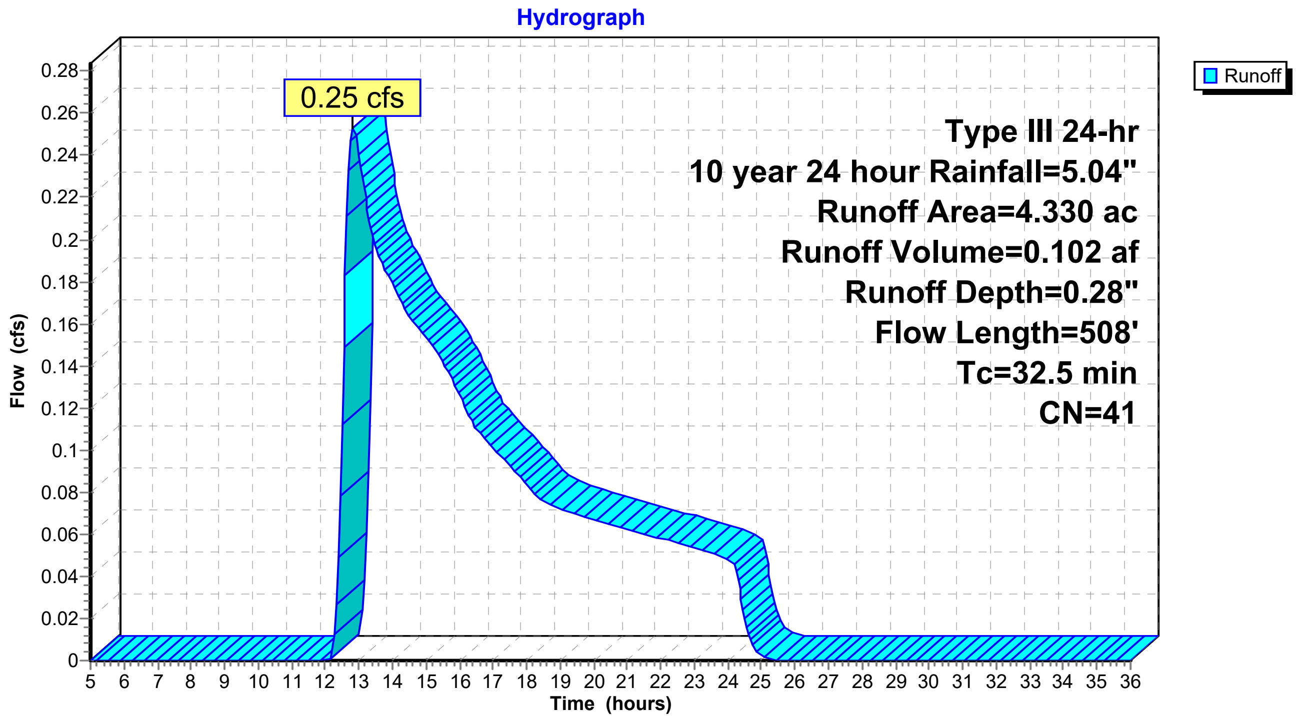
Runoff = 0.25 cfs @ 12.83 hrs, Volume= 0.102 af, Depth= 0.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year 24 hour Rainfall=5.04"

	Area (ac)	CN	Description
	0.730	30	Woods, Good, HSG A
	0.260	77	Woods, Good, HSG D
	0.170	39	Pasture/grassland/range, Good, HSG A
	0.100	80	Pasture/grassland/range, Good, HSG D
	2.530	30	Meadow, non-grazed, HSG A
	0.490	78	Meadow, non-grazed, HSG D
*	0.050	98	New Impervious
	4.330	41	Weighted Average
	4.280		98.85% Pervious Area
	0.050		1.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.4	150	0.0420	0.12		**Sheet Flow, Meadow** n= 0.400 P2= 3.40"
1.8	108	0.0420	1.02		**Shallow Concentrated Flow, Meadow** Kv= 5.0 fps
9.3	250	0.0080	0.45		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
32.5	508	Total			

Subcatchment P1F: Post Watershed 1F



Summary for Subcatchment P2A: Post Watershed 2A

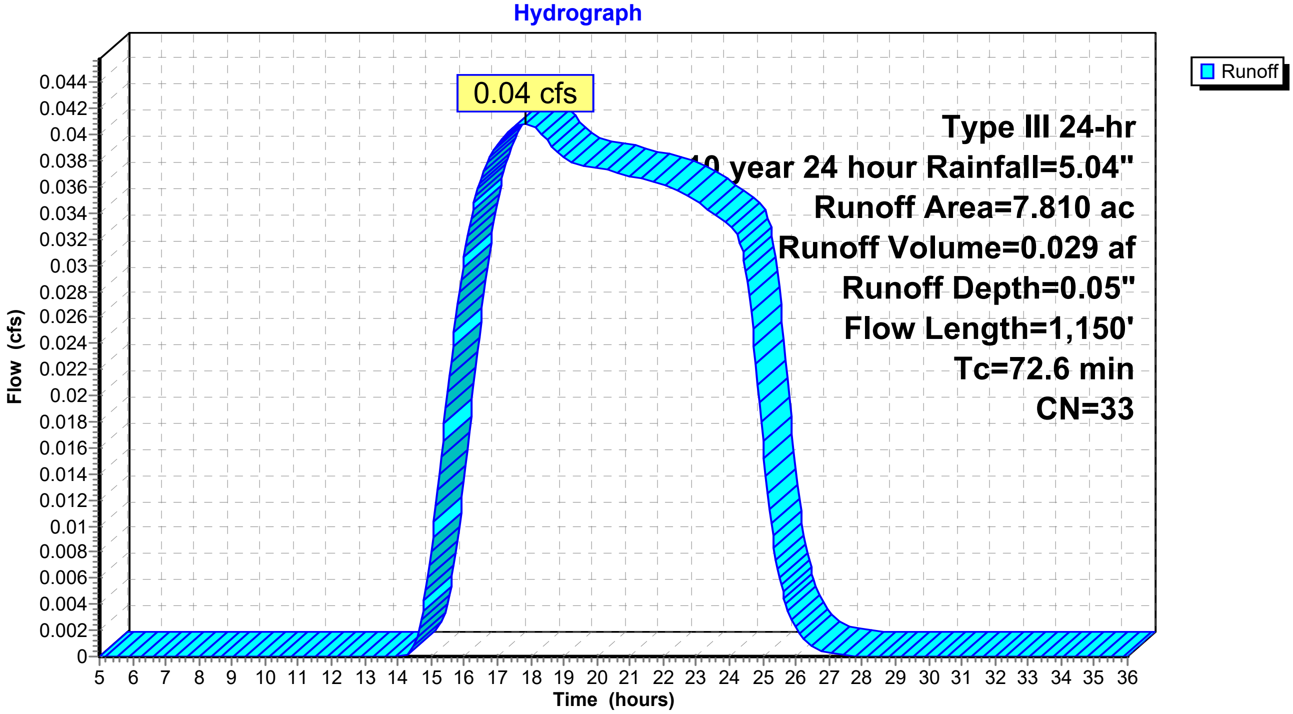
Runoff = 0.04 cfs @ 17.82 hrs, Volume= 0.029 af, Depth= 0.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year 24 hour Rainfall=5.04"

Area (ac)	CN	Description
1.050	30	Woods, Good, HSG A
0.500	77	Woods, Good, HSG D
0.050	39	Pasture/grassland/range, Good, HSG A
0.010	80	Pasture/grassland/range, Good, HSG D
6.140	30	Meadow, non-grazed, HSG A
0.060	78	Meadow, non-grazed, HSG D
7.810	33	Weighted Average
7.810		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
43.9	150	0.0070	0.06		**Sheet Flow, Meadow** n= 0.400 P2= 3.40"
9.3	405	0.0210	0.72		**Shallow Concentrated Flow, Meadow** Kv= 5.0 fps
16.3	345	0.0050	0.35		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
3.1	250	0.0050	1.36	10.20	**Channel Flow,** Area= 7.5 sf Perim= 8.7' r= 0.86' n= 0.070 Sluggish weedy reaches w/pools
72.6	1,150	Total			

Subcatchment P2A: Post Watershed 2A



Summary for Subcatchment P2B: Post Watershed 2B

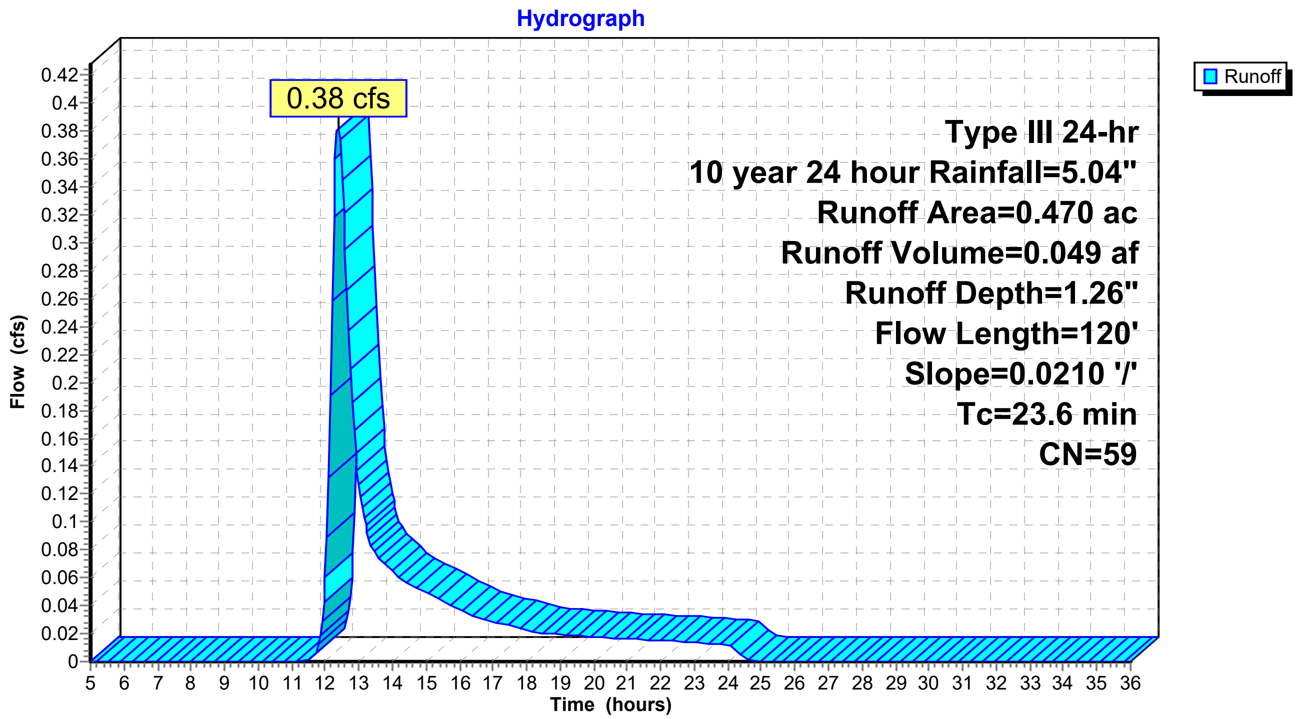
Runoff = 0.38 cfs @ 12.38 hrs, Volume= 0.049 af, Depth= 1.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year 24 hour Rainfall=5.04"

	Area (ac)	CN	Description
	0.260	30	Meadow, non-grazed, HSG A
	0.010	30	Woods, Good, HSG A
*	0.200	98	New Impervious
	0.470	59	Weighted Average
	0.270		57.45% Pervious Area
	0.200		42.55% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.6	120	0.0210	0.08		**Sheet Flow, Meadow** n= 0.400 P2= 3.40"

Subcatchment P2B: Post Watershed 2B



Summary for Subcatchment P2C: Post Watershed 2C

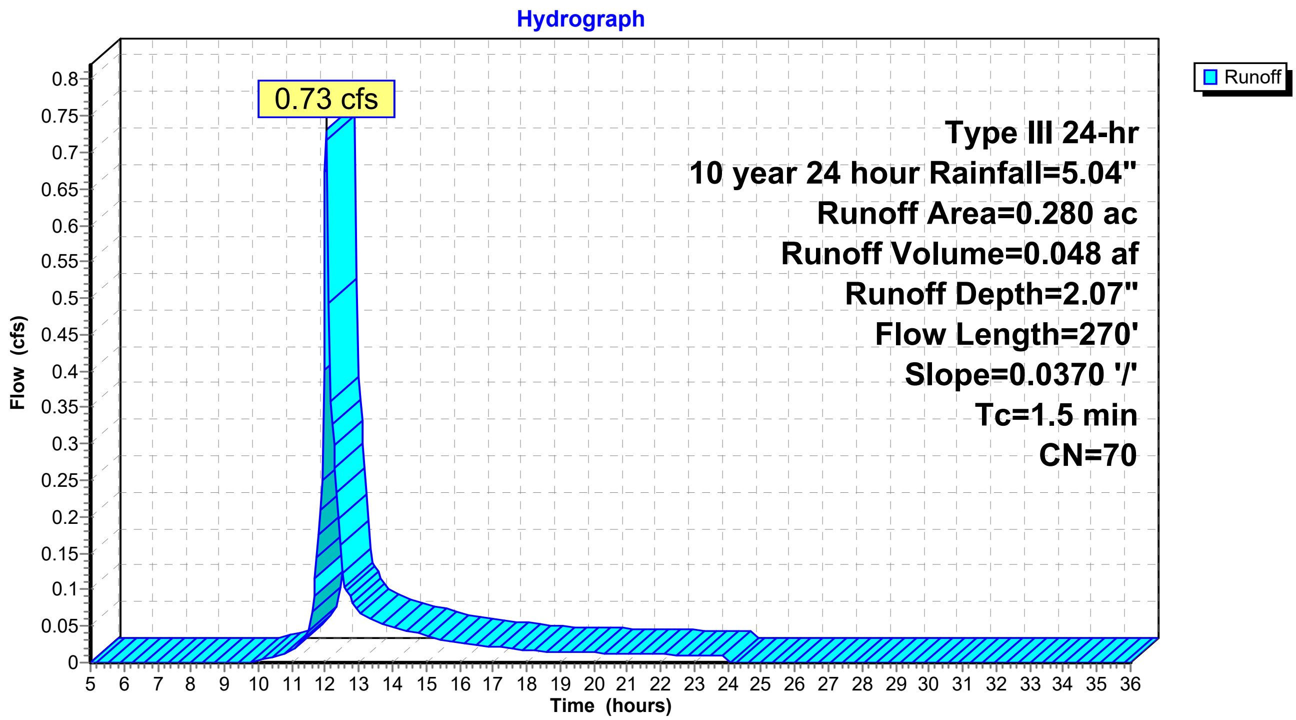
Runoff = 0.73 cfs @ 12.03 hrs, Volume= 0.048 af, Depth= 2.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year 24 hour Rainfall=5.04"

	Area (ac)	CN	Description
	0.100	30	Meadow, non-grazed, HSG A
	0.020	78	Meadow, non-grazed, HSG D
	0.010	30	Woods, Good, HSG A
*	0.150	98	New Impervious
	0.280	70	Weighted Average
	0.130		46.43% Pervious Area
	0.150		53.57% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.5	270	0.0370	3.05	36.57	**Channel Flow,** Area= 12.0 sf Perim= 10.9' r= 1.10' n= 0.100 Earth, dense brush, high stage

Subcatchment P2C: Post Watershed 2C



Summary for Subcatchment P2D: Post Watershed 2D

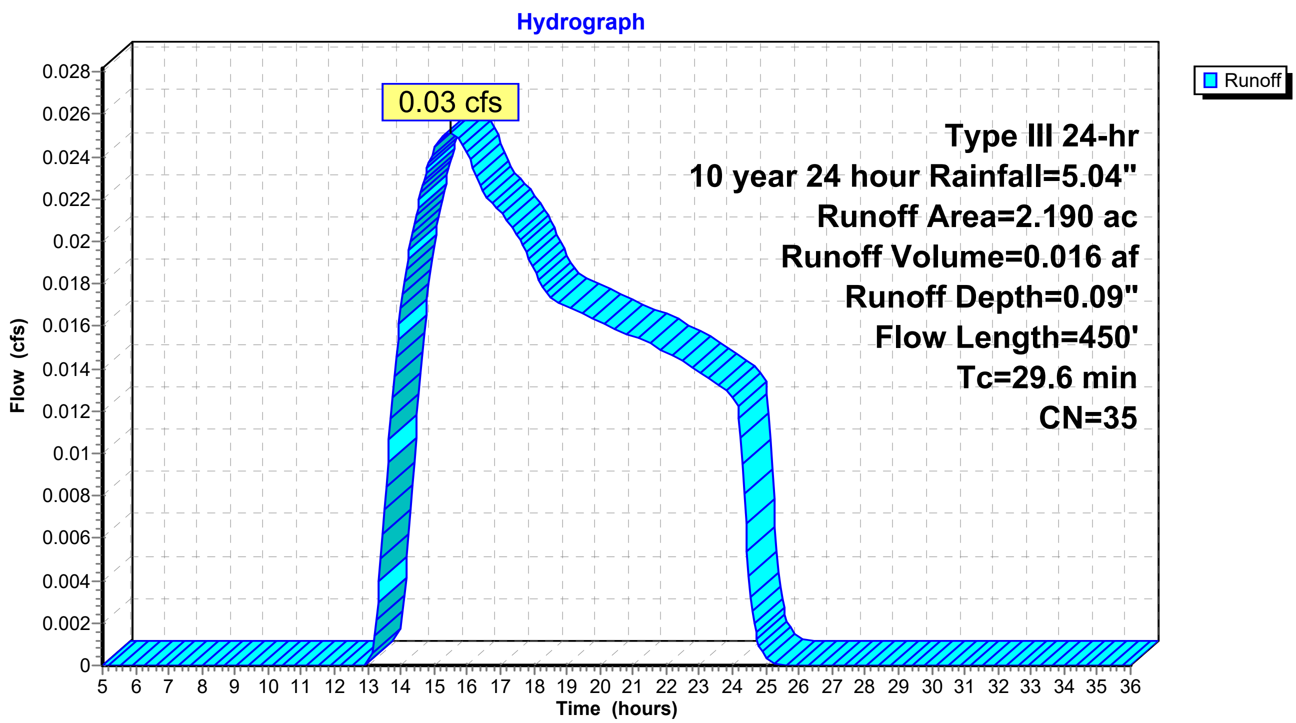
Runoff = 0.03 cfs @ 15.48 hrs, Volume= 0.016 af, Depth= 0.09"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year 24 hour Rainfall=5.04"

	Area (ac)	CN	Description
	2.030	30	Meadow, non-grazed, HSG A
	0.010	78	Meadow, non-grazed, HSG D
*	0.150	98	New Impervious
	2.190	35	Weighted Average
	2.040		93.15% Pervious Area
	0.150		6.85% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
24.5	150	0.0300	0.10		**Sheet Flow, Meadow** n= 0.400 P2= 3.40"
5.1	300	0.0380	0.97		**Shallow Concentrated Flow, Meadow** Kv= 5.0 fps
29.6	450	Total			

Subcatchment P2D: Post Watershed 2D



Summary for Subcatchment P2E: Post Watershed 2E

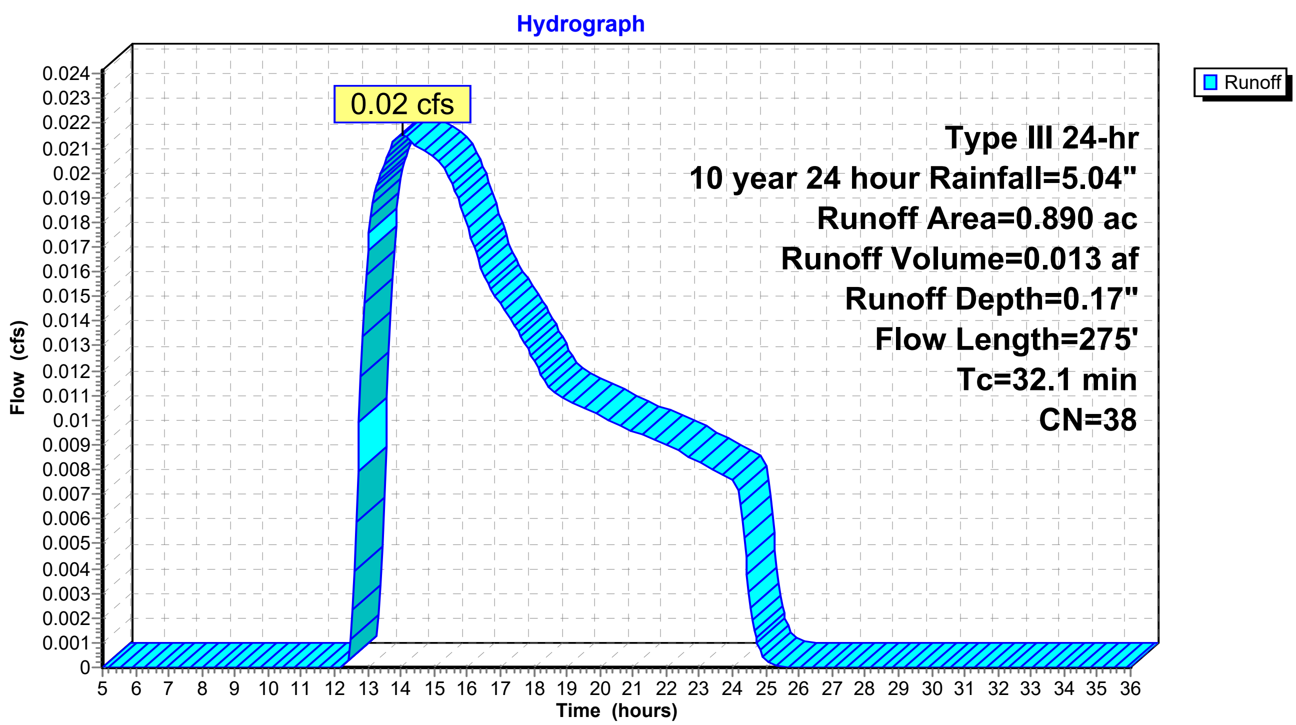
Runoff = 0.02 cfs @ 14.02 hrs, Volume= 0.013 af, Depth= 0.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year 24 hour Rainfall=5.04"

	Area (ac)	CN	Description
	0.790	30	Meadow, non-grazed, HSG A
*	0.100	98	New Impervious
	0.890	38	Weighted Average
	0.790		88.76% Pervious Area
	0.100		11.24% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
30.1	150	0.0180	0.08		**Sheet Flow, Meadow** n= 0.400 P2= 3.40"
2.0	125	0.0450	1.06		**Shallow Concentrated Flow, Meadow** Kv= 5.0 fps
32.1	275	Total			

Subcatchment P2E: Post Watershed 2E



Summary for Subcatchment P3A: Post Watershed 3A

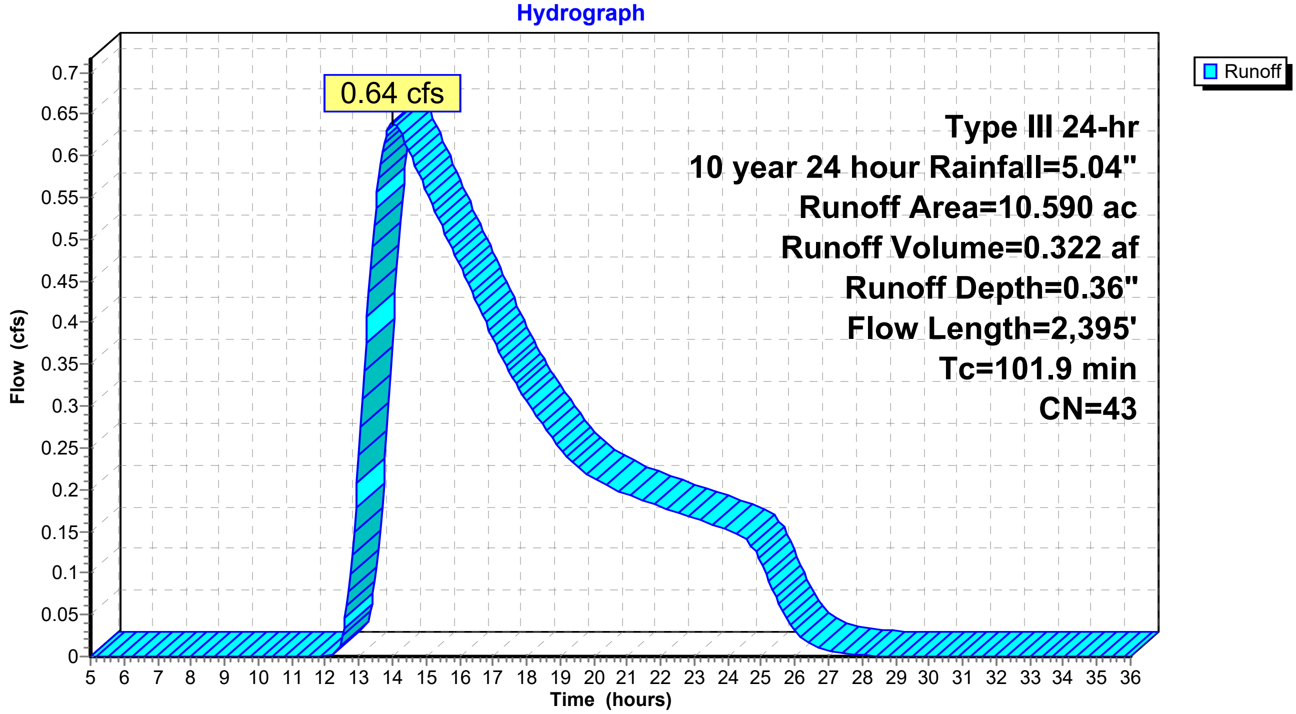
Runoff = 0.64 cfs @ 14.00 hrs, Volume= 0.322 af, Depth= 0.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year 24 hour Rainfall=5.04"

	Area (ac)	CN	Description
	0.090	30	Woods, Good, HSG A
	0.860	77	Woods, Good, HSG D
	7.680	30	Meadow, non-grazed, HSG A
	1.880	78	Meadow, non-grazed, HSG D
*	0.080	98	New Impervious
	10.590	43	Weighted Average
	10.510		99.24% Pervious Area
	0.080		0.76% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.8	150	0.0400	0.11		**Sheet Flow, Meadow** n= 0.400 P2= 3.40"
3.3	170	0.0290	0.85		**Shallow Concentrated Flow, Meadow** Kv= 5.0 fps
2.4	105	0.0220	0.74		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
67.9	1,440	0.0050	0.35		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
6.5	530	0.0050	1.36	10.20	**Channel Flow,** Area= 7.5 sf Perim= 8.7' r= 0.86' n= 0.070
101.9	2,395	Total			

Subcatchment P3A: Post Watershed 3A



Summary for Subcatchment P3B: Post Watershed 3B

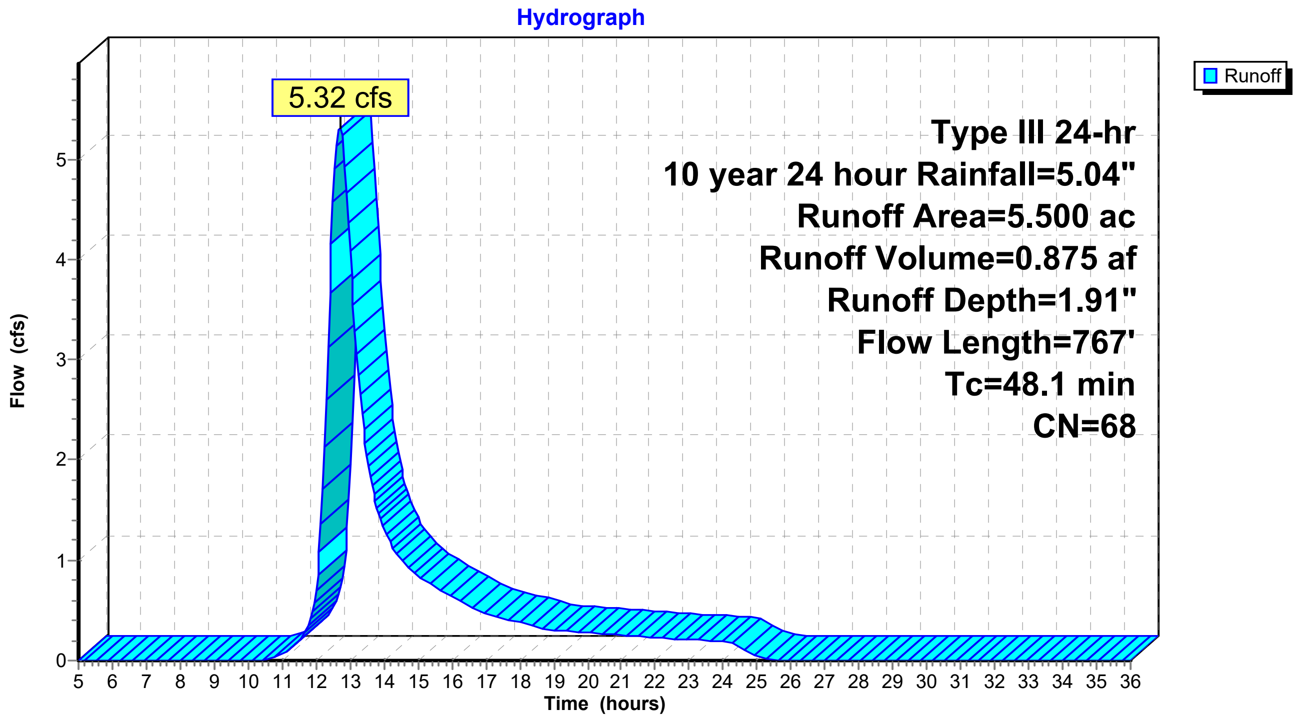
Runoff = 5.32 cfs @ 12.69 hrs, Volume= 0.875 af, Depth= 1.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 10 year 24 hour Rainfall=5.04"

	Area (ac)	CN	Description
	0.260	30	Woods, Good, HSG A
	0.720	77	Woods, Good, HSG D
	0.190	39	Pasture/grassland/range, Good, HSG A
	0.120	80	Pasture/grassland/range, Good, HSG D
	0.770	30	Meadow, non-grazed, HSG A
	3.370	78	Meadow, non-grazed, HSG D
*	0.070	98	New Impervious
	5.500	68	Weighted Average
	5.430		98.73% Pervious Area
	0.070		1.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
34.2	150	0.0130	0.07		**Sheet Flow, Meadow** n= 0.400 P2= 3.40"
3.4	152	0.0220	0.74		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
10.5	465	0.0220	0.74		**Shallow Concentrated Flow, Meadow** Kv= 5.0 fps
48.1	767	Total			

Subcatchment P3B: Post Watershed 3B



Summary for Pond 1P: Level Lip Spreader LS1

Inflow Area = 0.340 ac, 58.82% Impervious, Inflow Depth > 3.91" for 10 year 24 hour event
Inflow = 1.63 cfs @ 12.05 hrs, Volume= 0.111 af
Outflow = 0.63 cfs @ 12.25 hrs, Volume= 0.058 af, Atten= 62%, Lag= 12.2 min
Primary = 0.63 cfs @ 12.25 hrs, Volume= 0.058 af

Routing by Stor-Ind method, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 116.31' @ 12.25 hrs Surf.Area= 2,647 sf Storage= 2,426 cf

Plug-Flow detention time= 221.3 min calculated for 0.058 af (53% of inflow)
Center-of-Mass det. time= 110.8 min (898.8 - 788.0)

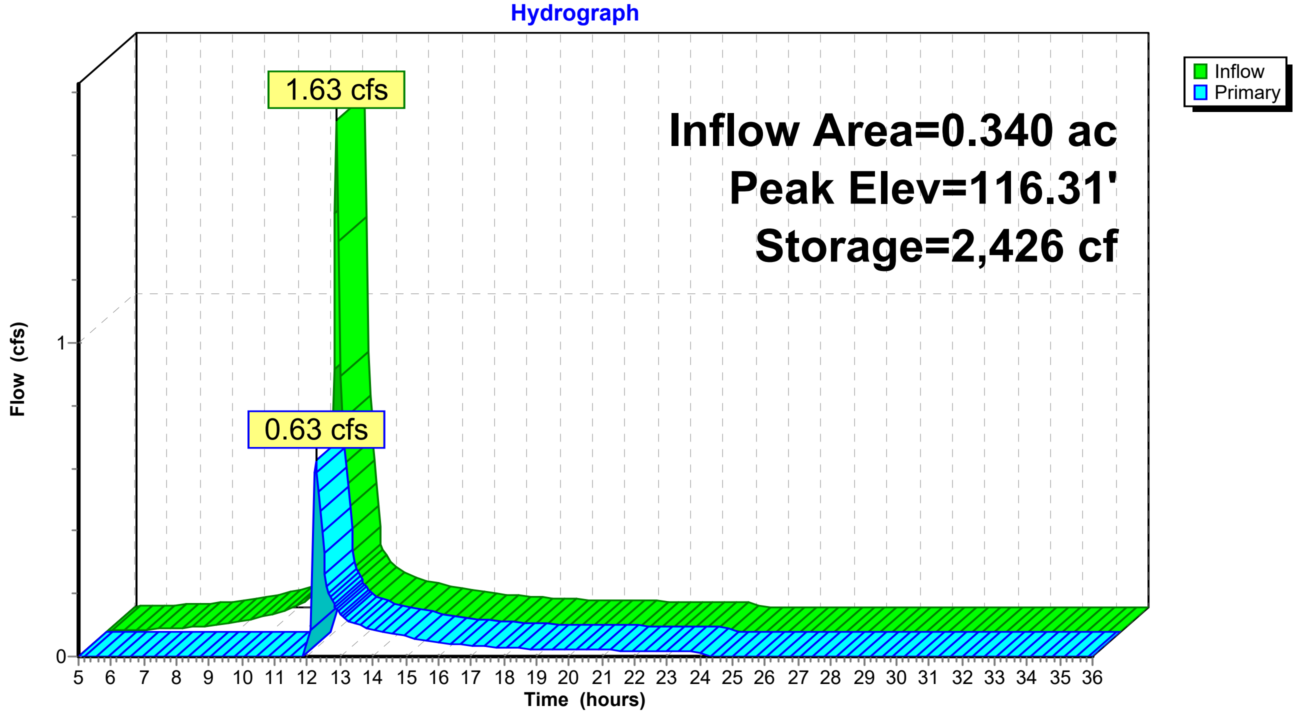
Volume	Invert	Avail.Storage	Storage Description
#1	114.50'	2,971 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
114.50	229	0	0
115.00	739	242	242
116.00	2,160	1,450	1,692
116.50	2,958	1,280	2,971

Device	Routing	Invert	Outlet Devices
#1	Primary	116.25'	**20.0' long x 4.0' 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) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Primary OutFlow Max=0.62 cfs @ 12.25 hrs HW=116.31' (Free Discharge)
1=Broad-Crested Rectangular Weir (Weir Controls 0.62 cfs @ 0.56 fps)

Pond 1P: Level Lip Spreader LS1



Summary for Pond 2P: Level Lip Spreader LS2

Inflow Area = 0.120 ac, 58.33% Impervious, Inflow Depth > 3.91" for 10 year 24 hour event
Inflow = 0.60 cfs @ 12.01 hrs, Volume= 0.039 af
Outflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 115.95' @ 24.10 hrs Surf.Area= 1,039 sf Storage= 1,704 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

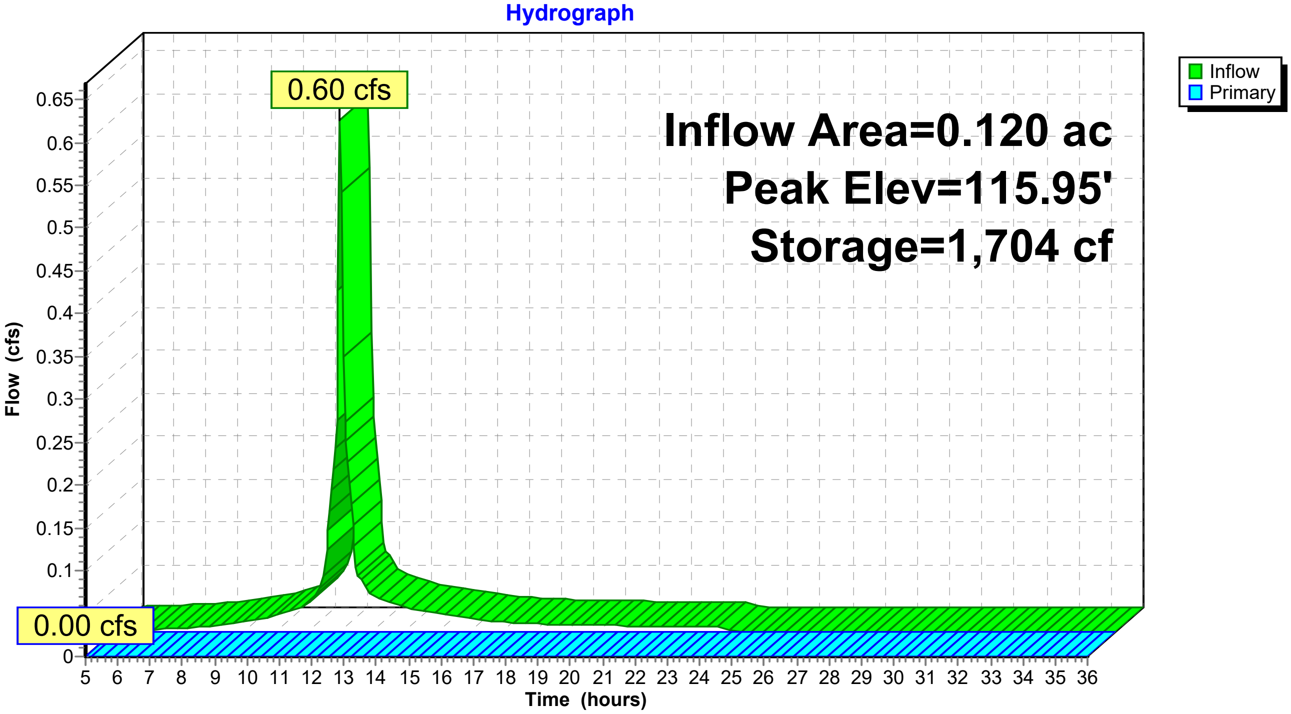
Volume	Invert	Avail.Storage	Storage Description
#1	112.00'	2,357 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
112.00	104	0	0
113.00	210	157	157
114.00	357	284	441
115.00	605	481	922
116.00	1,061	833	1,755
116.50	1,350	603	2,357

Device	Routing	Invert	Outlet Devices
#1	Primary	116.25'	**20.0' long x 4.0' 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) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=112.00' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 2P: Level Lip Spreader LS2



Summary for Pond 3P: Level Lip Spreader LS3

Inflow Area = 1.090 ac, 21.10% Impervious, Inflow Depth = 0.55" for 10 year 24 hour event
Inflow = 0.20 cfs @ 12.78 hrs, Volume= 0.050 af
Outflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 114.80' @ 26.40 hrs Surf.Area= 1,563 sf Storage= 2,182 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

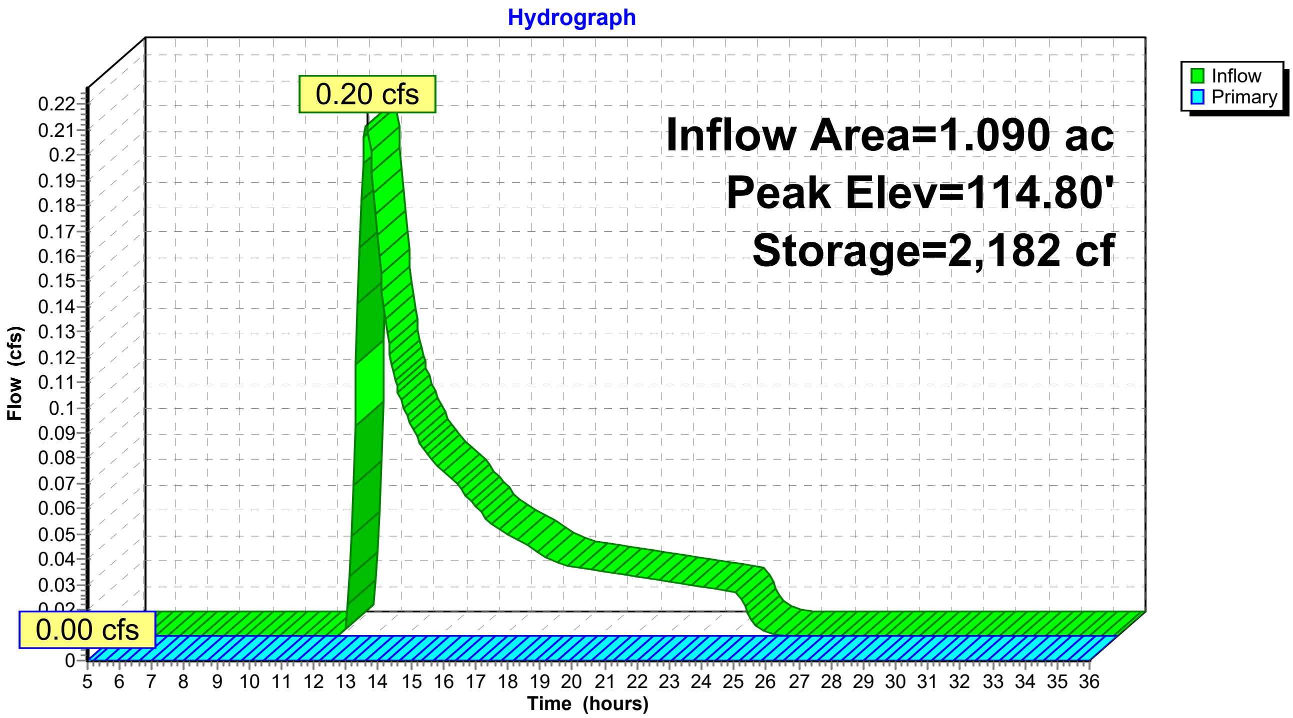
Volume	Invert	Avail.Storage	Storage Description
#1	112.00'	6,496 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
112.00	318	0	0
113.00	570	444	444
114.00	917	744	1,188
115.00	1,722	1,320	2,507
116.00	2,986	2,354	4,861
116.50	3,553	1,635	6,496

Device	Routing	Invert	Outlet Devices
#1	Primary	116.25'	**20.0' long x 4.0' 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) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=112.00' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 3P: Level Lip Spreader LS3



Summary for Pond 4P: Level Lip Spreader LS4

Inflow Area =	0.820 ac, 20.73% Impervious, Inflow Depth = 0.88" for 10 year 24 hour event		
Inflow =	0.36 cfs @ 12.53 hrs, Volume=	0.060 af	
Outflow =	0.03 cfs @ 19.60 hrs, Volume=	0.009 af,	Atten= 93%, Lag= 423.9 min
Primary =	0.03 cfs @ 19.60 hrs, Volume=	0.009 af	

Routing by Stor-Ind method, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 109.26' @ 19.60 hrs Surf.Area= 1,204 sf Storage= 2,231 cf

Plug-Flow detention time= 566.8 min calculated for 0.009 af (15% of inflow)
Center-of-Mass det. time= 386.8 min (1,309.6 - 922.7)

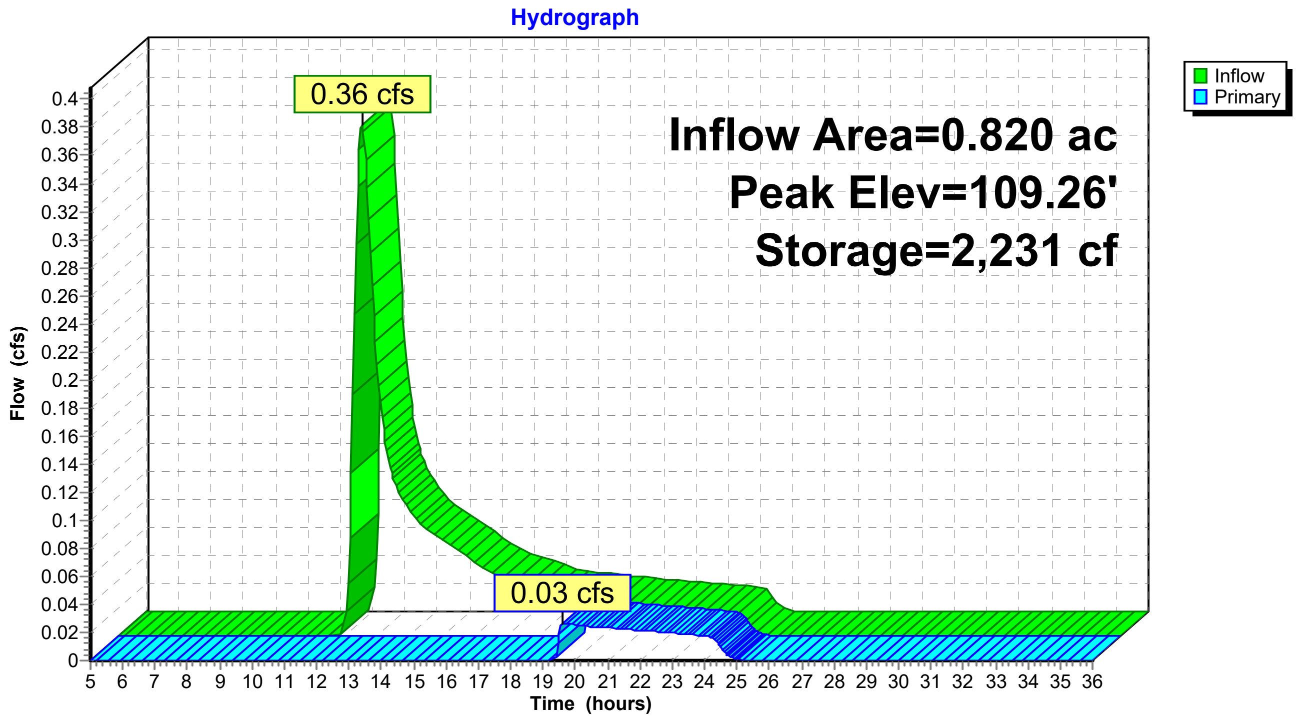
Volume	Invert	Avail.Storage	Storage Description
#1	106.00'	2,535 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
106.00	263	0	0
107.00	483	373	373
108.00	765	624	997
109.00	1,110	938	1,935
109.50	1,293	601	2,535

Device	Routing	Invert	Outlet Devices
#1	Primary	109.25'	**20.0' long x 4.0' 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) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Primary OutFlow Max=0.02 cfs @ 19.60 hrs HW=109.26' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Weir Controls 0.02 cfs @ 0.18 fps)

Pond 4P: Level Lip Spreader LS4



Summary for Pond 5P: Level Lip Spreader LS5

Inflow Area = 4.330 ac, 1.15% Impervious, Inflow Depth = 0.28" for 10 year 24 hour event
Inflow = 0.25 cfs @ 12.83 hrs, Volume= 0.102 af
Outflow = 0.06 cfs @ 22.49 hrs, Volume= 0.010 af, Atten= 78%, Lag= 579.5 min
Primary = 0.06 cfs @ 22.49 hrs, Volume= 0.010 af

Routing by Stor-Ind method, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 109.26' @ 22.49 hrs Surf.Area= 2,172 sf Storage= 4,023 cf

Plug-Flow detention time= 639.2 min calculated for 0.010 af (10% of inflow)
Center-of-Mass det. time= 397.6 min (1,404.2 - 1,006.5)

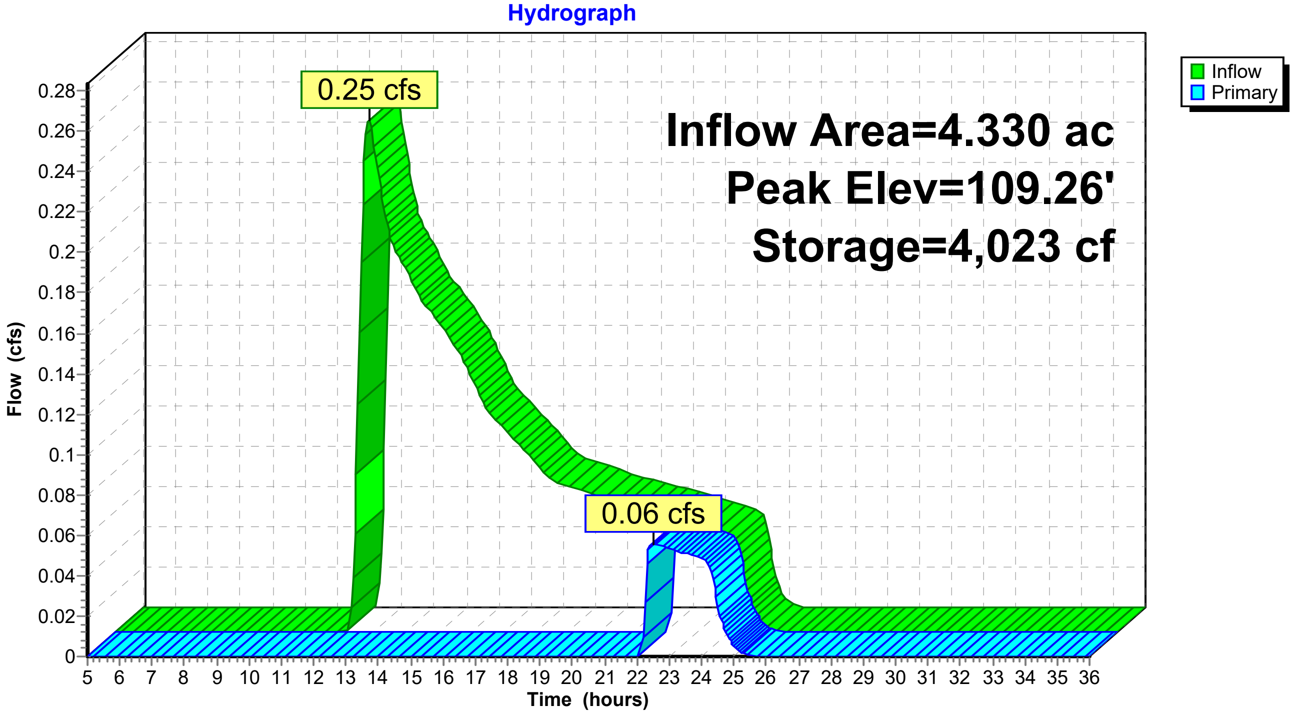
Volume	Invert	Avail.Storage	Storage Description
#1	106.00'	4,568 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
106.00	541	0	0
107.00	892	717	717
108.00	1,326	1,109	1,826
109.00	1,993	1,660	3,485
109.50	2,339	1,083	4,568

Device	Routing	Invert	Outlet Devices
#1	Primary	109.25'	**20.0' long x 18.0' 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

Primary OutFlow Max=0.04 cfs @ 22.49 hrs HW=109.26' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Weir Controls 0.04 cfs @ 0.24 fps)

Pond 5P: Level Lip Spreader LS5



Summary for Pond 6P: Level Lip Spreader LS6

Inflow Area = 0.470 ac, 42.55% Impervious, Inflow Depth = 1.26" for 10 year 24 hour event
Inflow = 0.38 cfs @ 12.38 hrs, Volume= 0.049 af
Outflow = 0.04 cfs @ 15.48 hrs, Volume= 0.049 af, Atten= 89%, Lag= 185.9 min
Discarded = 0.04 cfs @ 15.48 hrs, Volume= 0.049 af
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 102.55' @ 15.48 hrs Surf.Area= 862 sf Storage= 1,003 cf

Plug-Flow detention time= 302.9 min calculated for 0.049 af (100% of inflow)
Center-of-Mass det. time= 302.7 min (1,197.0 - 894.3)

Volume	Invert	Avail.Storage	Storage Description
#1	101.00'	3,342 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

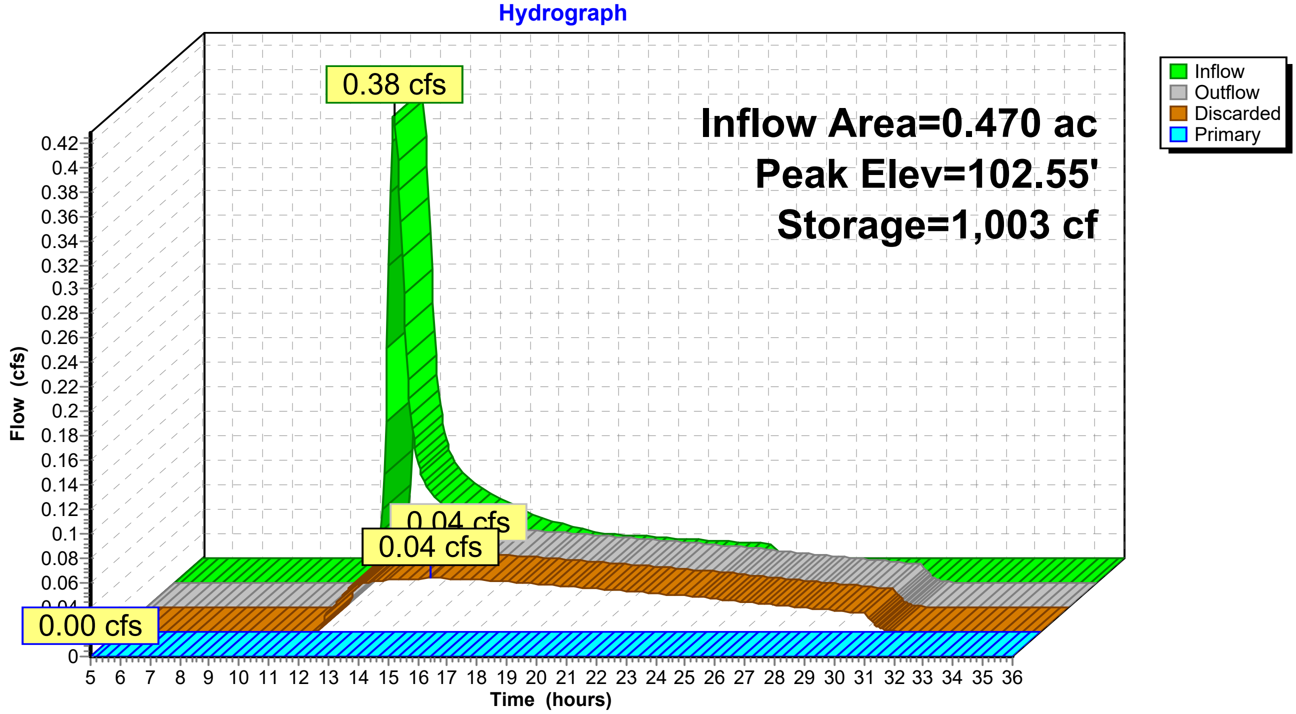
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
101.00	451	0	0
102.00	695	573	573
103.00	998	847	1,420
104.00	1,374	1,186	2,606
104.50	1,570	736	3,342

Device	Routing	Invert	Outlet Devices
#1	Primary	104.25'	**20.0' long x 4.0' 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) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32
#2	Discarded	101.00'	**1.420 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 99.00'

Discarded OutFlow Max=0.04 cfs @ 15.48 hrs HW=102.55' (Free Discharge)
└─**2=Exfiltration** (Controls 0.04 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=101.00' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 6P: Level Lip Spreader LS6



Summary for Pond 7P: Level Lip Spreader LS7

Inflow Area = 0.280 ac, 53.57% Impervious, Inflow Depth = 2.07" for 10 year 24 hour event
Inflow = 0.73 cfs @ 12.03 hrs, Volume= 0.048 af
Outflow = 0.04 cfs @ 14.24 hrs, Volume= 0.048 af, Atten= 94%, Lag= 132.4 min
Discarded = 0.04 cfs @ 14.24 hrs, Volume= 0.048 af
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 94.52' @ 14.24 hrs Surf.Area= 891 sf Storage= 1,020 cf

Plug-Flow detention time= 287.0 min calculated for 0.048 af (100% of inflow)
Center-of-Mass det. time= 287.1 min (1,130.1 - 843.1)

Volume	Invert	Avail.Storage	Storage Description
#1	93.00'	2,037 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

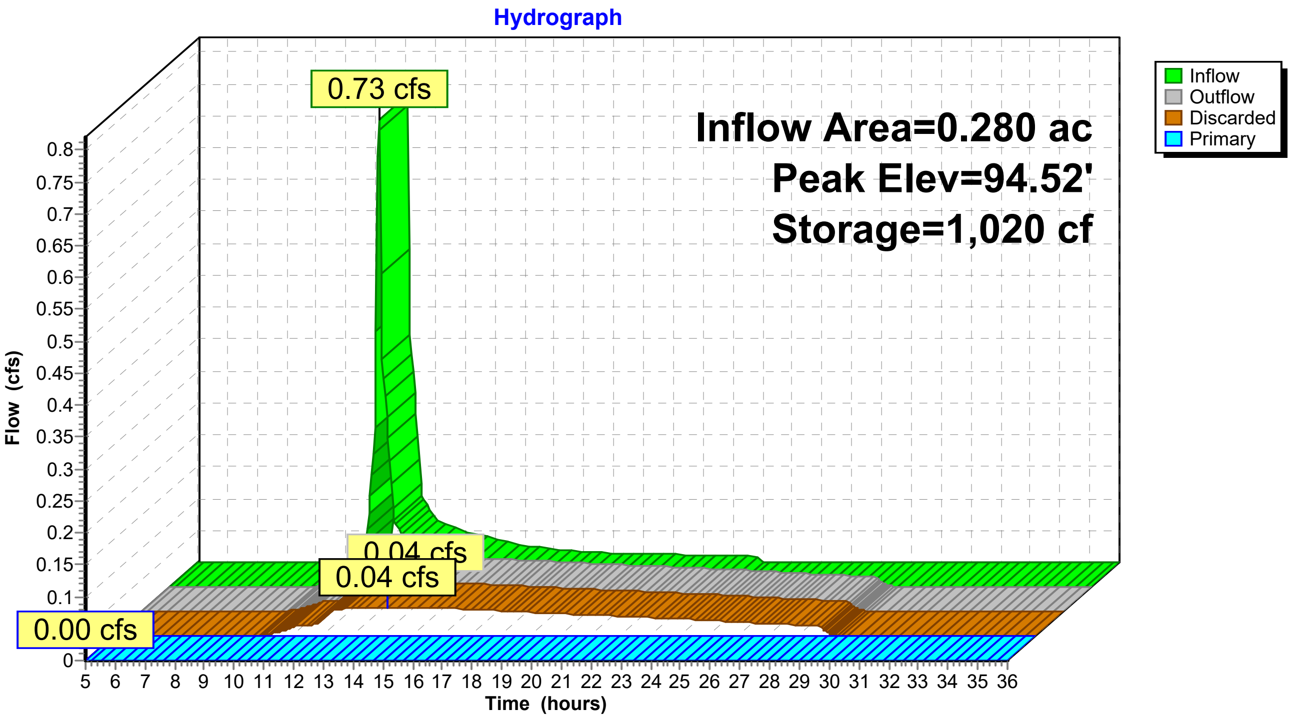
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
93.00	462	0	0
94.00	730	596	596
95.00	1,037	884	1,480
95.50	1,193	558	2,037

Device	Routing	Invert	Outlet Devices
#1	Primary	95.25'	**20.0' long x 4.0' 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) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32
#2	Discarded	93.00'	**1.420 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 91.00'

Discarded OutFlow Max=0.04 cfs @ 14.24 hrs HW=94.52' (Free Discharge)
└─**2=Exfiltration** (Controls 0.04 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=93.00' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 7P: Level Lip Spreader LS7



Summary for Pond 8P: Infiltration Basin 1

Inflow Area = 2.190 ac, 6.85% Impervious, Inflow Depth = 0.09" for 10 year 24 hour event
Inflow = 0.03 cfs @ 15.48 hrs, Volume= 0.016 af
Outflow = 0.02 cfs @ 19.16 hrs, Volume= 0.016 af, Atten= 33%, Lag= 221.2 min
Discarded = 0.02 cfs @ 19.16 hrs, Volume= 0.016 af
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 92.53' @ 19.16 hrs Surf.Area= 442 sf Storage= 150 cf

Plug-Flow detention time= 126.8 min calculated for 0.016 af (100% of inflow)
Center-of-Mass det. time= 126.9 min (1,233.6 - 1,106.7)

Volume	Invert	Avail.Storage	Storage Description
#1	92.00'	2,853 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

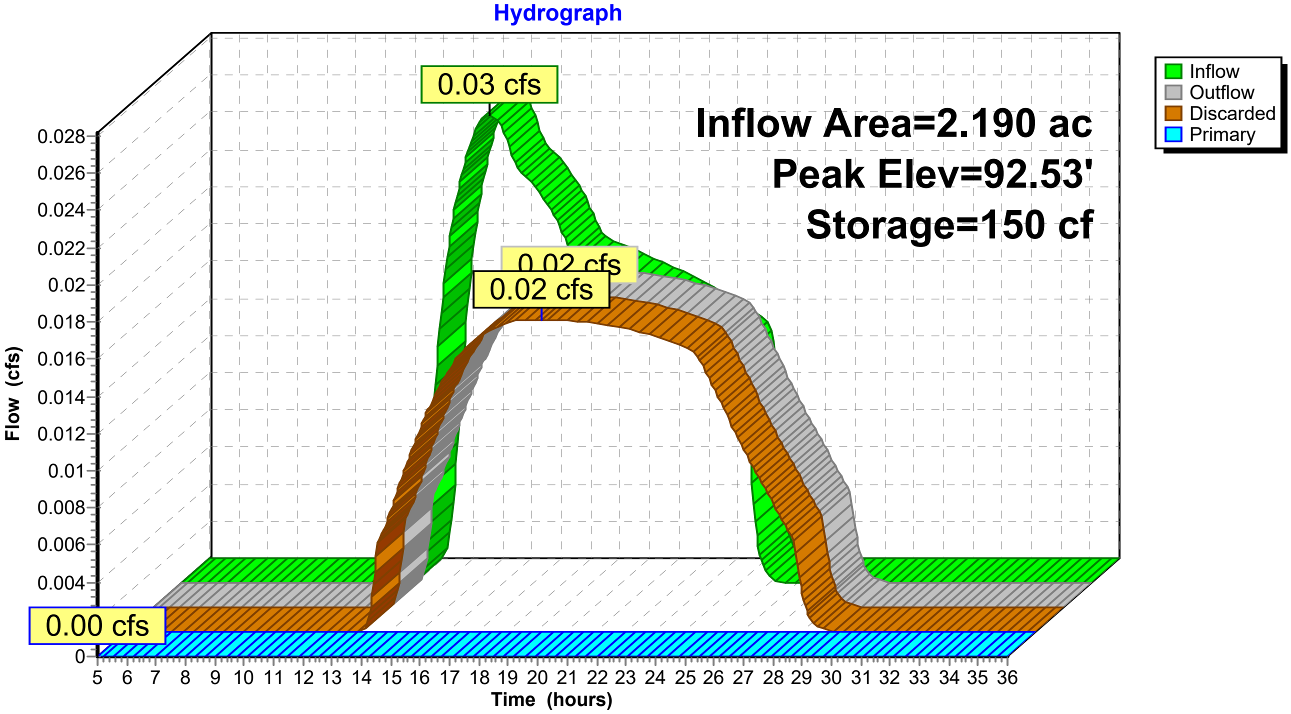
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
92.00	123	0	0
93.00	725	424	424
94.00	1,964	1,345	1,769
94.50	2,375	1,085	2,853

Device	Routing	Invert	Outlet Devices
#1	Discarded	92.00'	**1.420 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 90.00'
#2	Primary	94.25'	**15.0" Round Culvert** L= 40.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 94.25' / 93.50' S= 0.0187 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 1.23 sf

Discarded OutFlow Max=0.02 cfs @ 19.16 hrs HW=92.53' (Free Discharge)
└─**1=Exfiltration** (Controls 0.02 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=92.00' (Free Discharge)
└─**2=Culvert** (Controls 0.00 cfs)

Pond 8P: Infiltration Basin 1



Summary for Pond 9P: Level Lip Spreader LS8

Inflow Area = 0.890 ac, 11.24% Impervious, Inflow Depth = 0.17" for 10 year 24 hour event
Inflow = 0.02 cfs @ 14.02 hrs, Volume= 0.013 af
Outflow = 0.01 cfs @ 17.85 hrs, Volume= 0.013 af, Atten= 41%, Lag= 229.6 min
Discarded = 0.01 cfs @ 17.85 hrs, Volume= 0.013 af
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 90.60' @ 17.85 hrs Surf.Area= 322 sf Storage= 143 cf

Plug-Flow detention time= 149.1 min calculated for 0.013 af (100% of inflow)
Center-of-Mass det. time= 149.1 min (1,196.3 - 1,047.2)

Volume	Invert	Avail.Storage	Storage Description
#1	90.00'	1,730 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

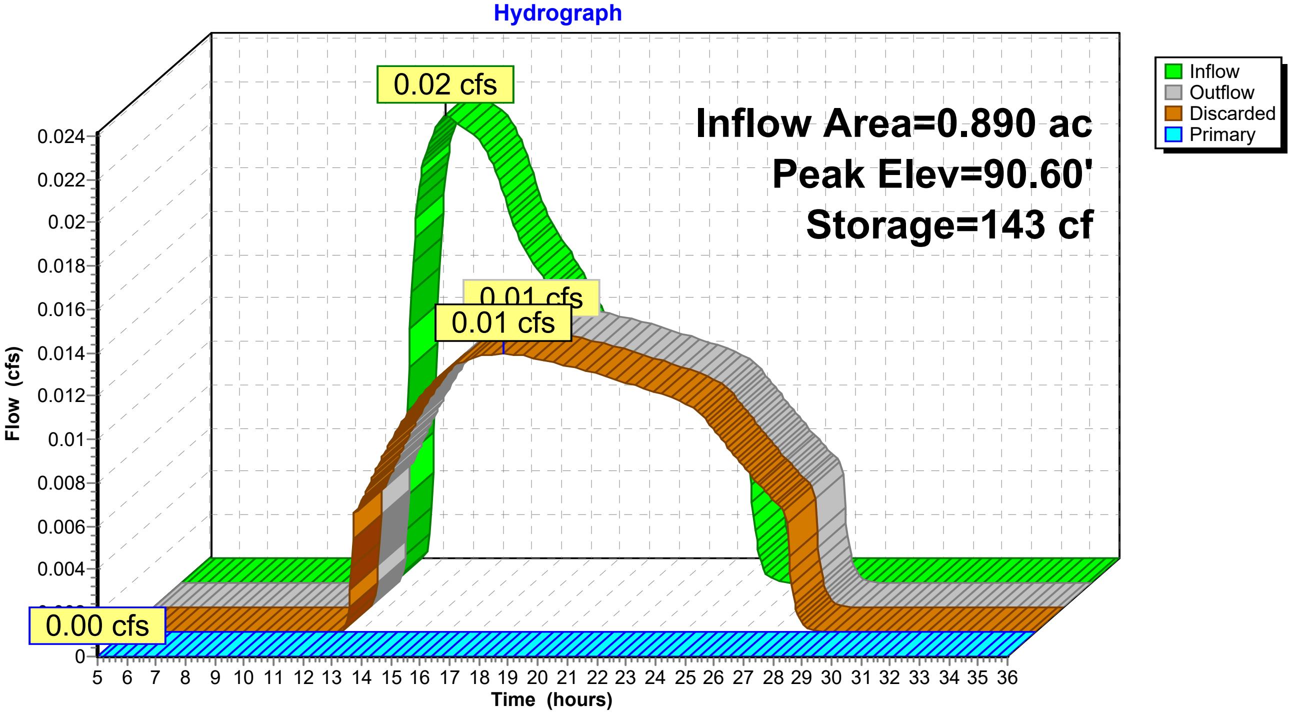
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
90.00	157	0	0
91.00	434	296	296
92.00	1,150	792	1,088
92.50	1,419	642	1,730

Device	Routing	Invert	Outlet Devices
#1	Discarded	90.00'	**1.420 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 88.00'
#2	Primary	92.25'	**20.0' long x 4.0' 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) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Discarded OutFlow Max=0.01 cfs @ 17.85 hrs HW=90.60' (Free Discharge)
└─**1=Exfiltration** (Controls 0.01 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=90.00' (Free Discharge)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 9P: Level Lip Spreader LS8



Summary for Pond 10P: Dry Basin 1

Inflow Area = 5.500 ac, 1.27% Impervious, Inflow Depth = 1.91" for 10 year 24 hour event
Inflow = 5.32 cfs @ 12.69 hrs, Volume= 0.875 af
Outflow = 0.62 cfs @ 16.09 hrs, Volume= 0.829 af, Atten= 88%, Lag= 203.7 min
Primary = 0.62 cfs @ 16.09 hrs, Volume= 0.829 af

Routing by Stor-Ind method, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 93.60' @ 16.09 hrs Surf.Area= 11,950 sf Storage= 21,516 cf

Plug-Flow detention time= 456.5 min calculated for 0.829 af (95% of inflow)
Center-of-Mass det. time= 428.6 min (1,320.0 - 891.4)

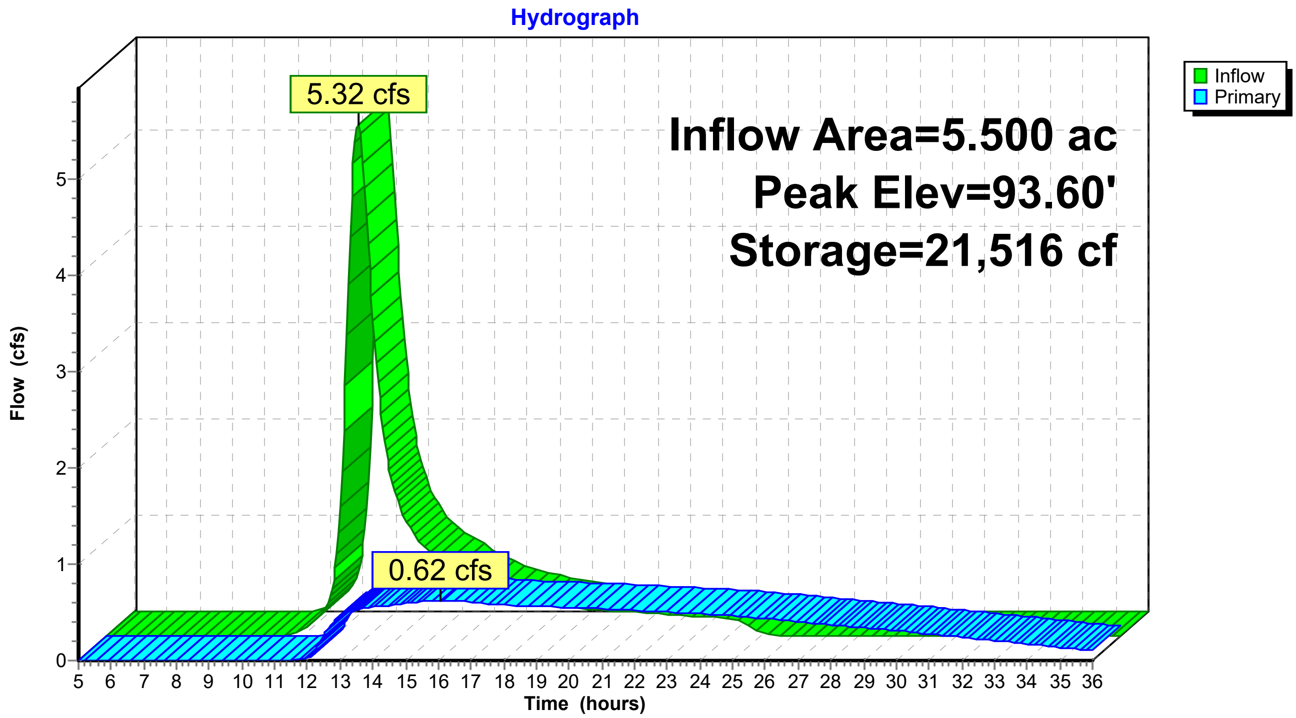
Volume	Invert	Avail.Storage	Storage Description
#1	91.50'	47,418 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
91.50	8,637	0	0
92.00	9,354	4,498	4,498
93.00	10,914	10,134	14,632
94.00	12,635	11,775	26,406
95.00	14,461	13,548	39,954
95.50	15,395	7,464	47,418

Device	Routing	Invert	Outlet Devices
#1	Primary	91.40'	**15.0" Round Culvert** L= 30.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 91.40' / 91.10' S= 0.0100 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 1.23 sf
#2	Device 1	91.50'	**4.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	93.50'	**8.0" Vert. Orifice/Grate** C= 0.600
#4	Primary	94.50'	**20.0' long x 4.0' 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) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Primary OutFlow Max=0.62 cfs @ 16.09 hrs HW=93.60' (Free Discharge)
1=Culvert (Passes 0.62 cfs of 5.86 cfs potential flow)
2=Orifice/Grate (Orifice Controls 0.58 cfs @ 6.70 fps)
3=Orifice/Grate (Orifice Controls 0.04 cfs @ 1.09 fps)
4=Broad-Crested Rectangular Weir (Controls 0.00 cfs)

Pond 10P: Dry Basin 1

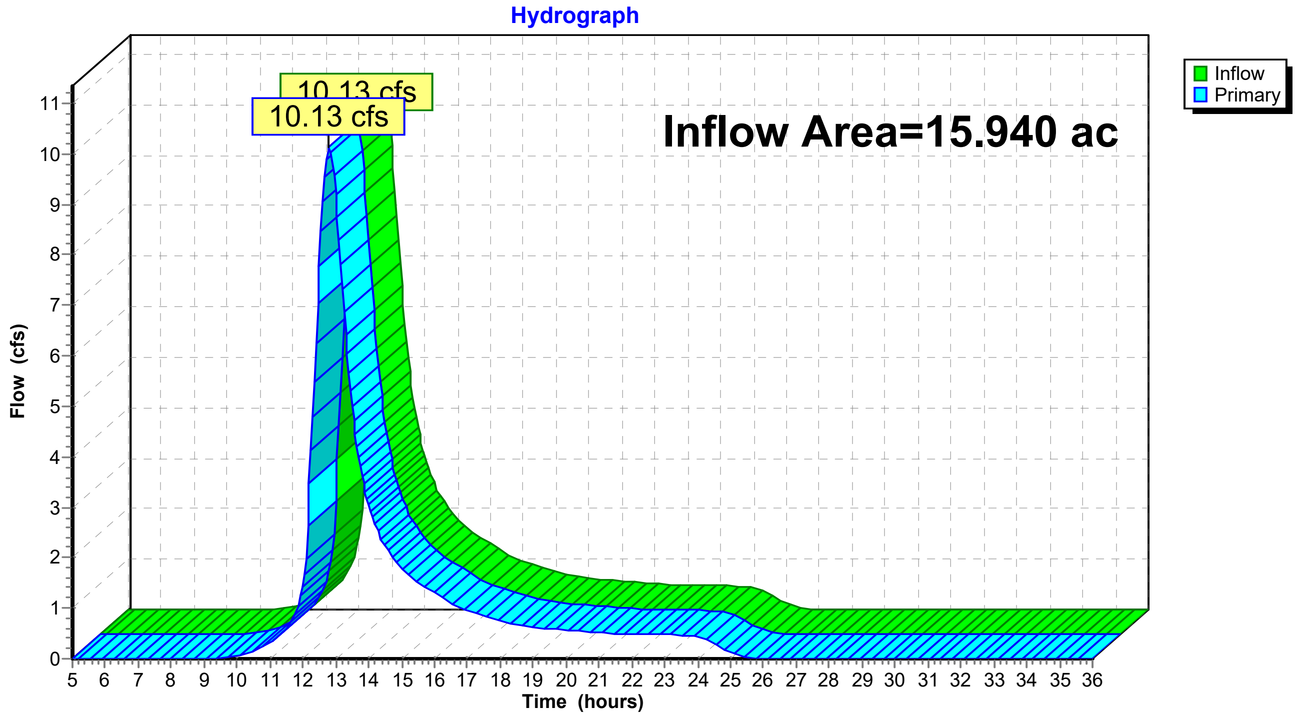


Summary for Link SN01: SN001

Inflow Area = 15.940 ac, 4.83% Impervious, Inflow Depth = 1.40" for 10 year 24 hour event
Inflow = 10.13 cfs @ 12.80 hrs, Volume= 1.858 af
Primary = 10.13 cfs @ 12.80 hrs, Volume= 1.858 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs

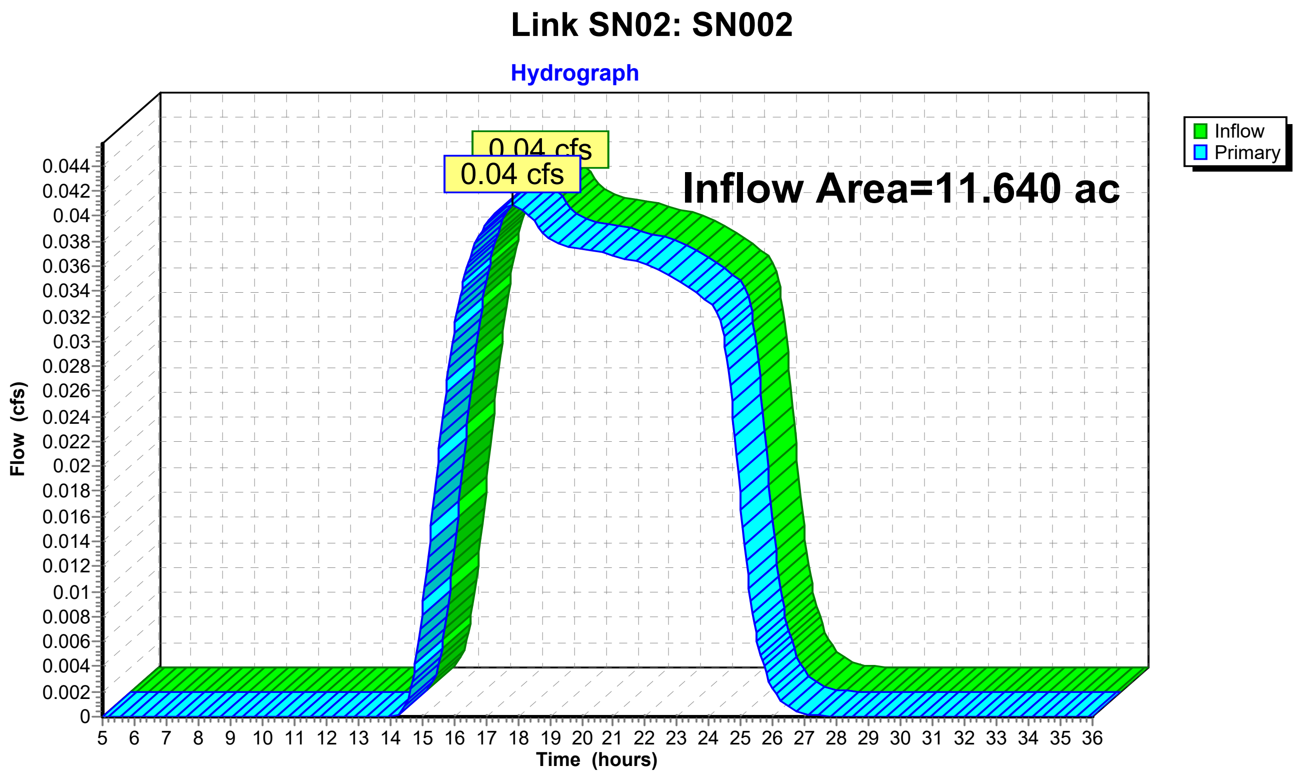
Link SN01: SN001



Summary for Link SN02: SN002

Inflow Area =	11.640 ac,	5.15% Impervious, Inflow Depth = 0.03"	for 10 year 24 hour event	
Inflow =	0.04 cfs @	17.82 hrs, Volume=	0.029 af	
Primary =	0.04 cfs @	17.82 hrs, Volume=	0.029 af, Atten= 0%, Lag= 0.0 min	

Primary outflow = Inflow, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs

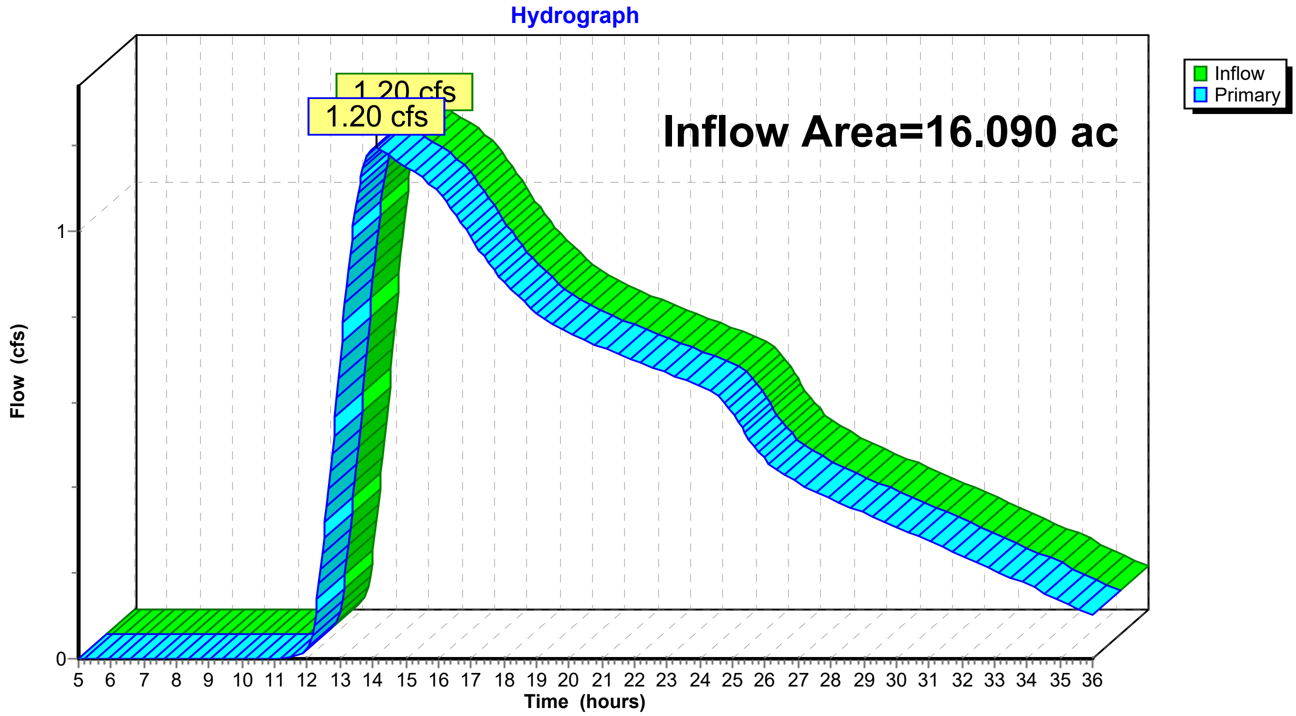


Summary for Link SN03: SN003

Inflow Area =	16.090 ac,	0.93% Impervious,	Inflow Depth > 0.86"	for 10 year 24 hour event	
Inflow =	1.20 cfs @	14.09 hrs,	Volume=	1.151 af	
Primary =	1.20 cfs @	14.09 hrs,	Volume=	1.151 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs

Link SN03: SN003



Summary for Subcatchment P1A: Post Watershed 1A

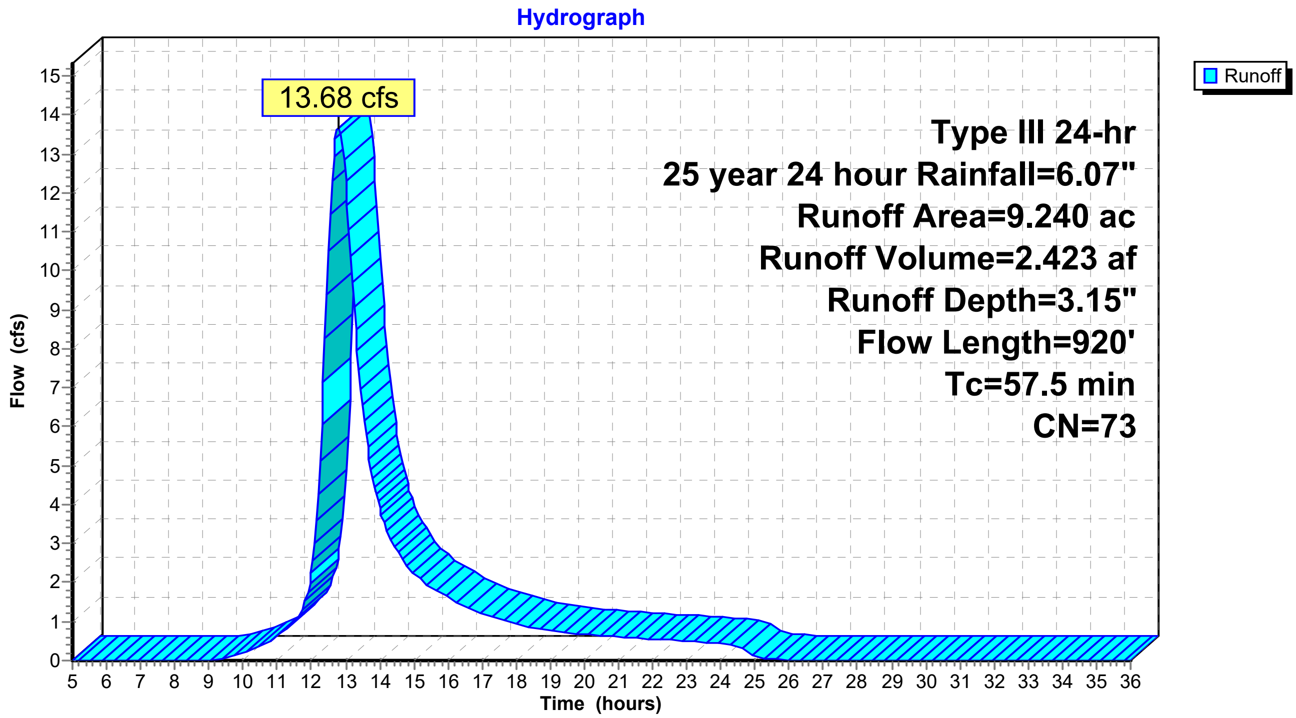
Runoff = 13.68 cfs @ 12.79 hrs, Volume= 2.423 af, Depth= 3.15"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 year 24 hour Rainfall=6.07"

	Area (ac)	CN	Description
	0.270	30	Woods, Good, HSG A
	0.230	55	Woods, Good, HSG B
	6.790	77	Woods, Good, HSG D
	0.060	39	Pasture/grassland/range, Good, HSG A
	0.420	61	Pasture/grassland/range, Good, HSG B
	0.210	80	Pasture/grassland/range, Good, HSG D
	0.250	30	Meadow, non-grazed, HSG A
	0.070	58	Meadow, non-grazed, HSG B
	0.890	78	Meadow, non-grazed, HSG D
*	0.050	98	New Impervious
	9.240	73	Weighted Average
	9.190		99.46% Pervious Area
	0.050		0.54% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.8	150	0.0200	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.40"
28.7	770	0.0080	0.45		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
57.5	920	Total			

Subcatchment P1A: Post Watershed 1A



Summary for Subcatchment P1B: Post Watershed 1B

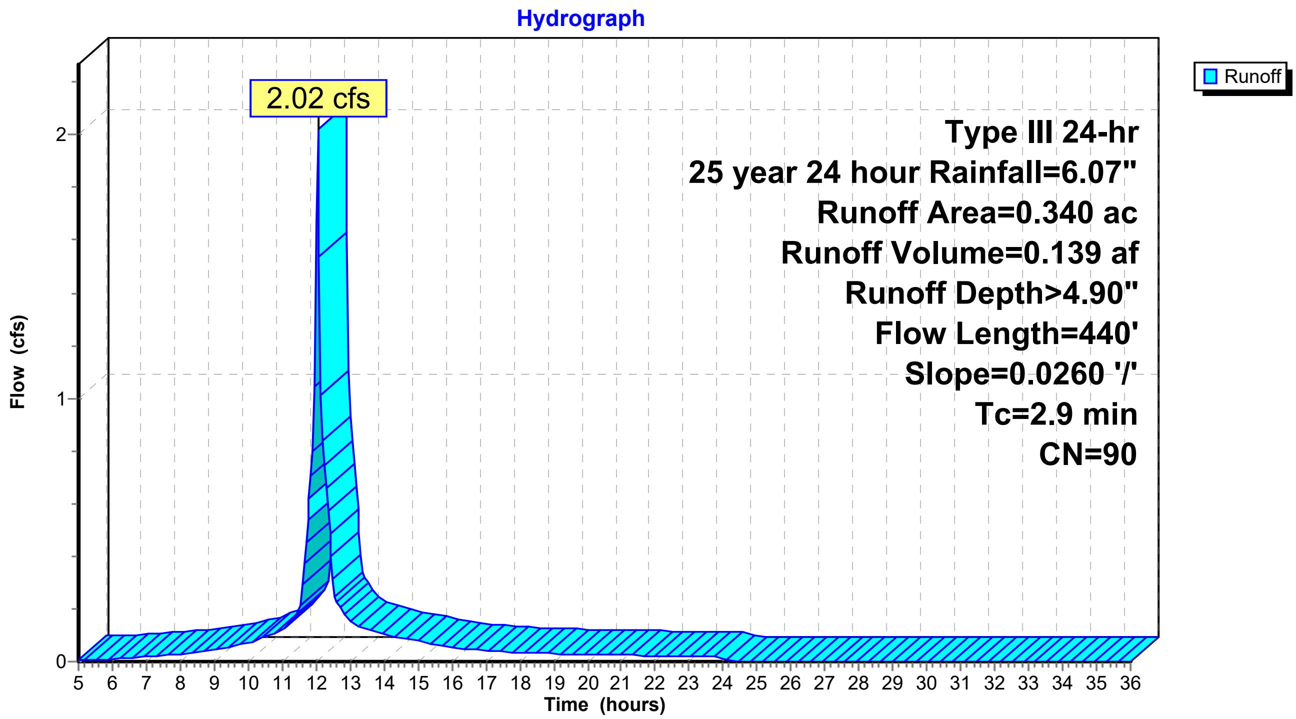
Runoff = 2.02 cfs @ 12.05 hrs, Volume= 0.139 af, Depth> 4.90"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 year 24 hour Rainfall=6.07"

	Area (ac)	CN	Description
	0.140	78	Meadow, non-grazed, HSG D
*	0.200	98	New Impervious
	0.340	90	Weighted Average
	0.140		41.18% Pervious Area
	0.200		58.82% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.9	440	0.0260	2.55	30.66	**Channel Flow,** Area= 12.0 sf Perim= 10.9' r= 1.10' n= 0.100 Earth, dense brush, high stage

Subcatchment P1B: Post Watershed 1B



Summary for Subcatchment P1C: Post Watershed 1C

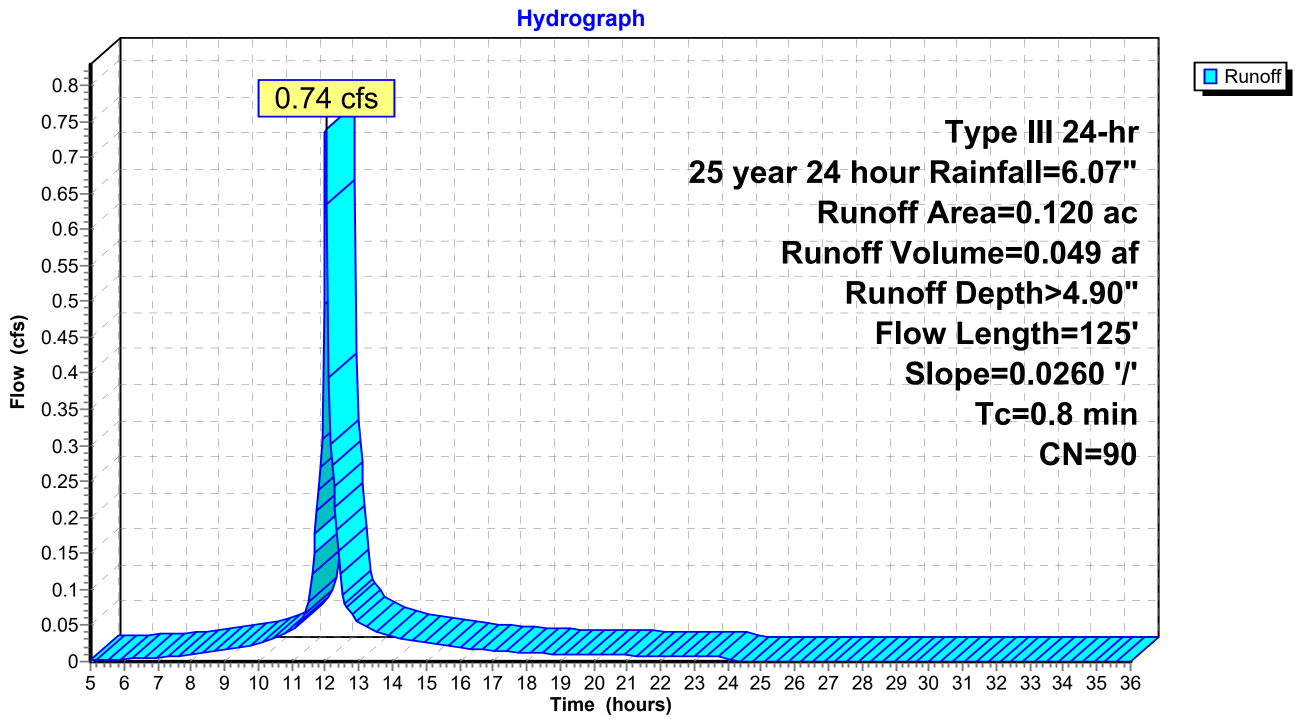
Runoff = 0.74 cfs @ 12.01 hrs, Volume= 0.049 af, Depth> 4.90"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 year 24 hour Rainfall=6.07"

	Area (ac)	CN	Description
	0.050	78	Meadow, non-grazed, HSG D
*	0.070	98	New Impervious
	0.120	90	Weighted Average
	0.050		41.67% Pervious Area
	0.070		58.33% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	125	0.0260	2.55	30.66	**Channel Flow,** Area= 12.0 sf Perim= 10.9' r= 1.10' n= 0.100 Earth, dense brush, high stage

Subcatchment P1C: Post Watershed 1C



Summary for Subcatchment P1D: Post Watershed 1D

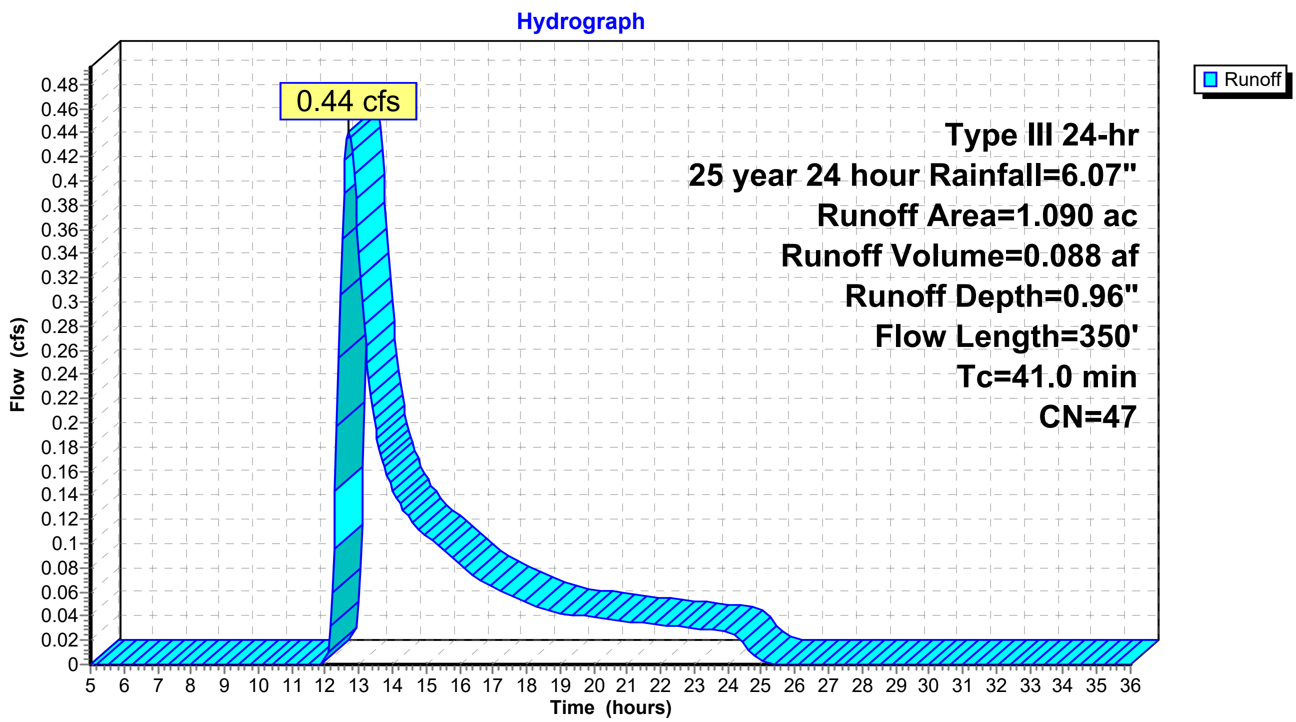
Runoff = 0.44 cfs @ 12.70 hrs, Volume= 0.088 af, Depth= 0.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 year 24 hour Rainfall=6.07"

	Area (ac)	CN	Description
	0.790	30	Meadow, non-grazed, HSG A
	0.070	78	Meadow, non-grazed, HSG D
*	0.230	98	New Impervious
	1.090	47	Weighted Average
	0.860		78.90% Pervious Area
	0.230		21.10% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
24.2	150	0.0310	0.10		**Sheet Flow, Meadow** n= 0.400 P2= 3.40"
16.3	155	0.0010	0.16		**Shallow Concentrated Flow, Meadow** Kv= 5.0 fps
0.5	45	0.0100	1.58	19.01	**Channel Flow,** Area= 12.0 sf Perim= 10.9' r= 1.10' n= 0.100 Earth, dense brush, high stage
41.0	350	Total			

Subcatchment P1D: Post Watershed 1D



Summary for Subcatchment P1E: Post Watershed 1E

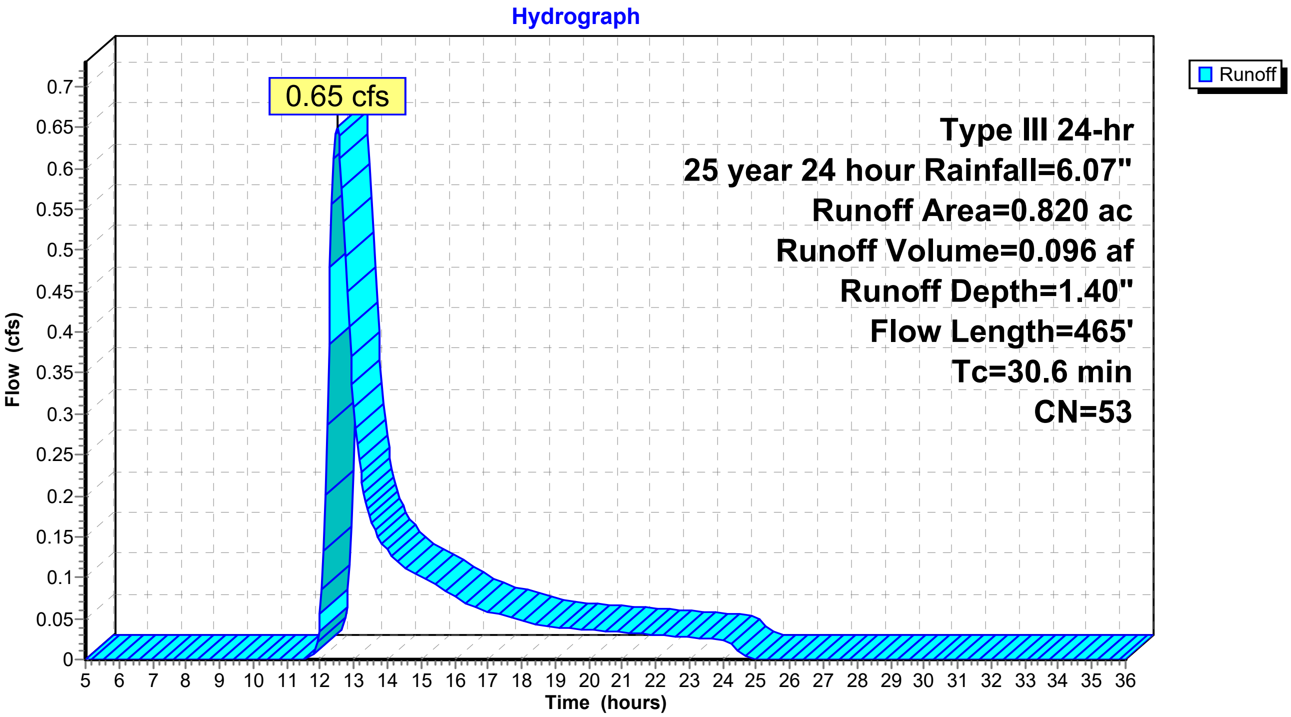
Runoff = 0.65 cfs @ 12.50 hrs, Volume= 0.096 af, Depth= 1.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 year 24 hour Rainfall=6.07"

	Area (ac)	CN	Description
	0.500	30	Meadow, non-grazed, HSG A
	0.150	78	Meadow, non-grazed, HSG D
*	0.170	98	New Impervious
	0.820	53	Weighted Average
	0.650		79.27% Pervious Area
	0.170		20.73% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
24.2	150	0.0310	0.10		**Sheet Flow, Meadow** n= 0.400 P2= 3.40"
4.7	45	0.0010	0.16		**Shallow Concentrated Flow, Meadow** Kv= 5.0 fps
1.7	270	0.0280	2.65	31.81	**Channel Flow,** Area= 12.0 sf Perim= 10.9' r= 1.10' n= 0.100 Earth, dense brush, high stage
30.6	465	Total			

Subcatchment P1E: Post Watershed 1E



Summary for Subcatchment P1F: Post Watershed 1F

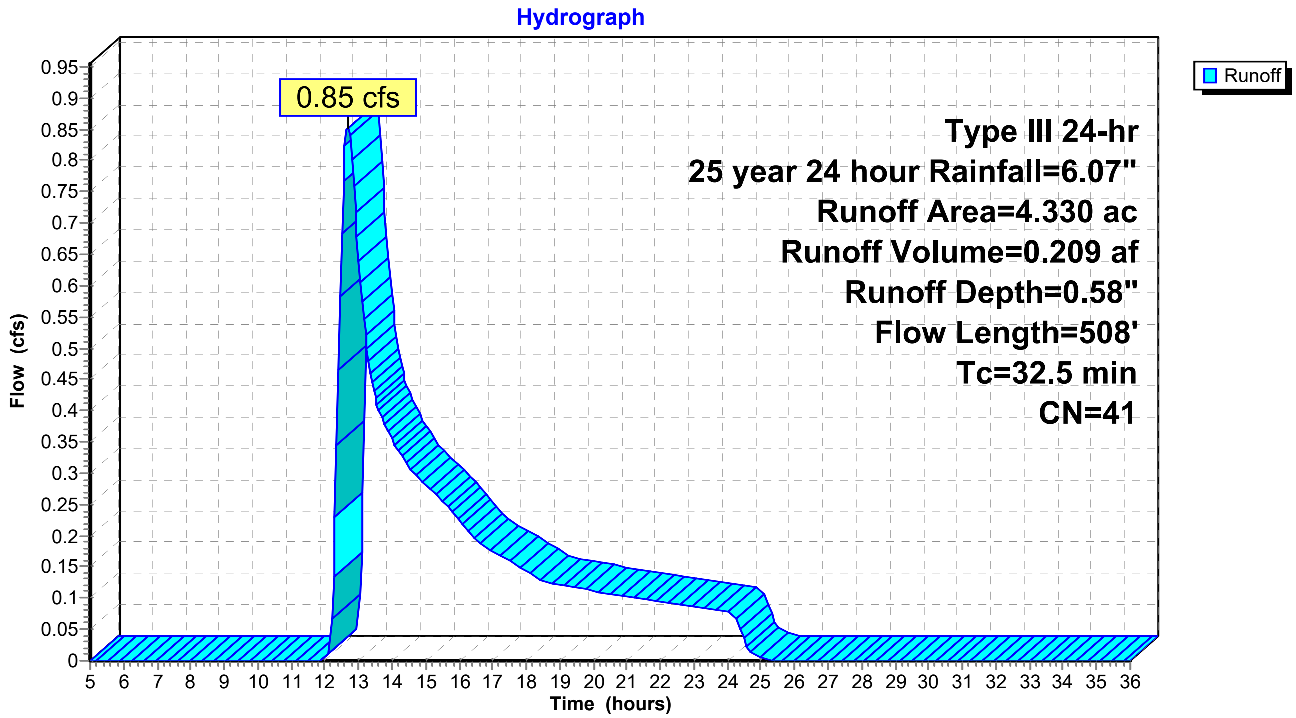
Runoff = 0.85 cfs @ 12.68 hrs, Volume= 0.209 af, Depth= 0.58"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 year 24 hour Rainfall=6.07"

	Area (ac)	CN	Description
	0.730	30	Woods, Good, HSG A
	0.260	77	Woods, Good, HSG D
	0.170	39	Pasture/grassland/range, Good, HSG A
	0.100	80	Pasture/grassland/range, Good, HSG D
	2.530	30	Meadow, non-grazed, HSG A
	0.490	78	Meadow, non-grazed, HSG D
*	0.050	98	New Impervious
	4.330	41	Weighted Average
	4.280		98.85% Pervious Area
	0.050		1.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.4	150	0.0420	0.12		**Sheet Flow, Meadow** n= 0.400 P2= 3.40"
1.8	108	0.0420	1.02		**Shallow Concentrated Flow, Meadow** Kv= 5.0 fps
9.3	250	0.0080	0.45		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
32.5	508	Total			

Subcatchment P1F: Post Watershed 1F



Summary for Subcatchment P2A: Post Watershed 2A

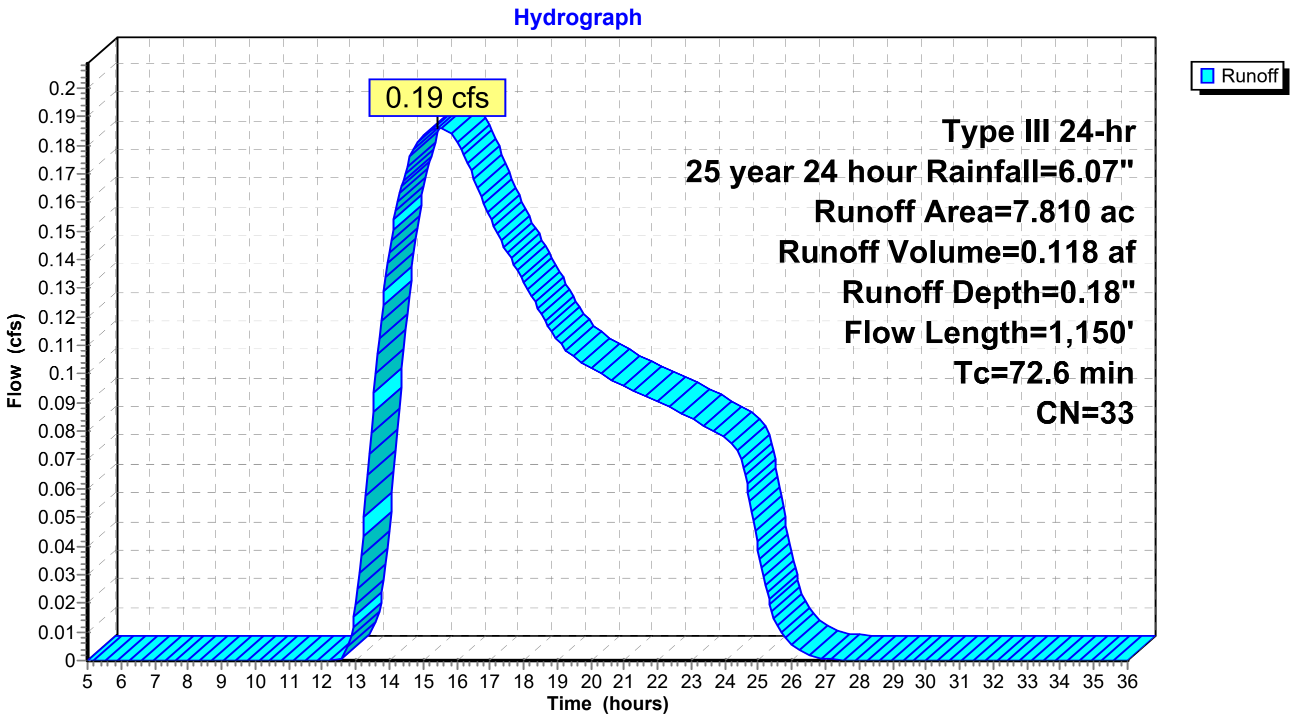
Runoff = 0.19 cfs @ 15.41 hrs, Volume= 0.118 af, Depth= 0.18"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 year 24 hour Rainfall=6.07"

Area (ac)	CN	Description
1.050	30	Woods, Good, HSG A
0.500	77	Woods, Good, HSG D
0.050	39	Pasture/grassland/range, Good, HSG A
0.010	80	Pasture/grassland/range, Good, HSG D
6.140	30	Meadow, non-grazed, HSG A
0.060	78	Meadow, non-grazed, HSG D
7.810	33	Weighted Average
7.810		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
43.9	150	0.0070	0.06		**Sheet Flow, Meadow** n= 0.400 P2= 3.40"
9.3	405	0.0210	0.72		**Shallow Concentrated Flow, Meadow** Kv= 5.0 fps
16.3	345	0.0050	0.35		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
3.1	250	0.0050	1.36	10.20	**Channel Flow,** Area= 7.5 sf Perim= 8.7' r= 0.86' n= 0.070 Sluggish weedy reaches w/pools
72.6	1,150	Total			

Subcatchment P2A: Post Watershed 2A



Summary for Subcatchment P2B: Post Watershed 2B

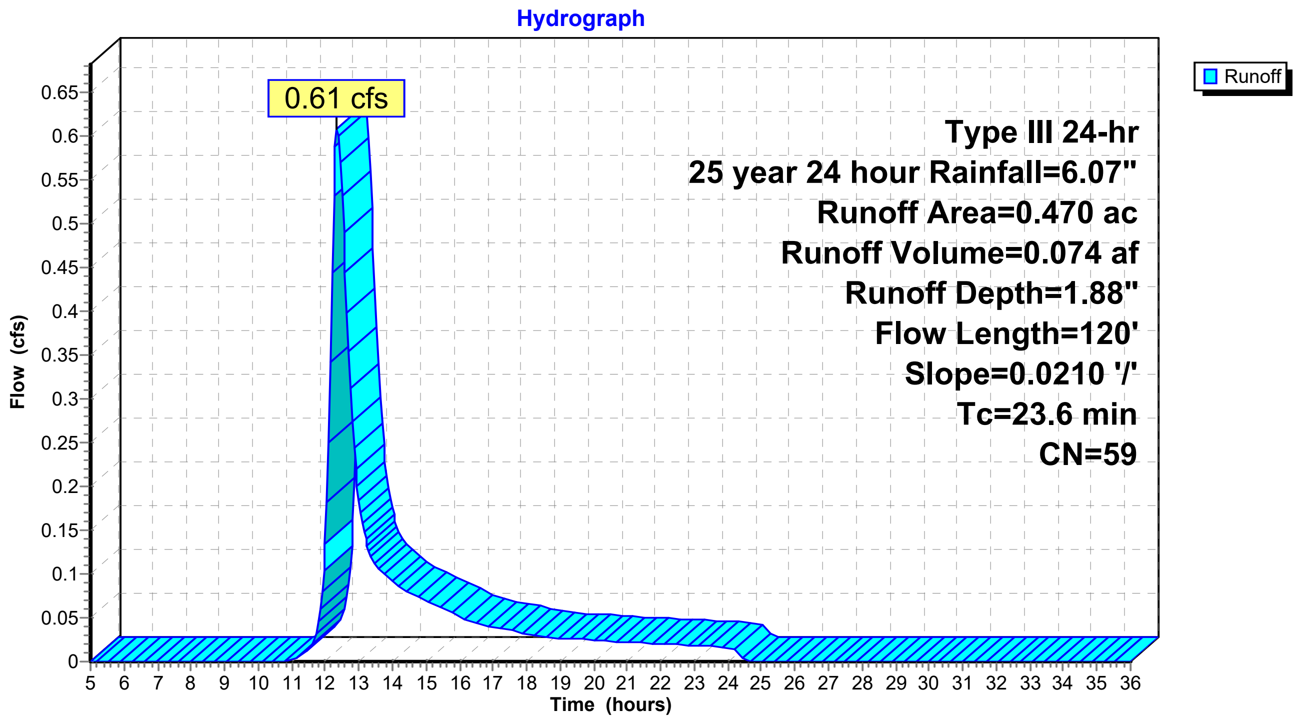
Runoff = 0.61 cfs @ 12.36 hrs, Volume= 0.074 af, Depth= 1.88"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 year 24 hour Rainfall=6.07"

	Area (ac)	CN	Description
	0.260	30	Meadow, non-grazed, HSG A
	0.010	30	Woods, Good, HSG A
*	0.200	98	New Impervious
	0.470	59	Weighted Average
	0.270		57.45% Pervious Area
	0.200		42.55% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.6	120	0.0210	0.08		**Sheet Flow, Meadow** n= 0.400 P2= 3.40"

Subcatchment P2B: Post Watershed 2B



Summary for Subcatchment P2C: Post Watershed 2C

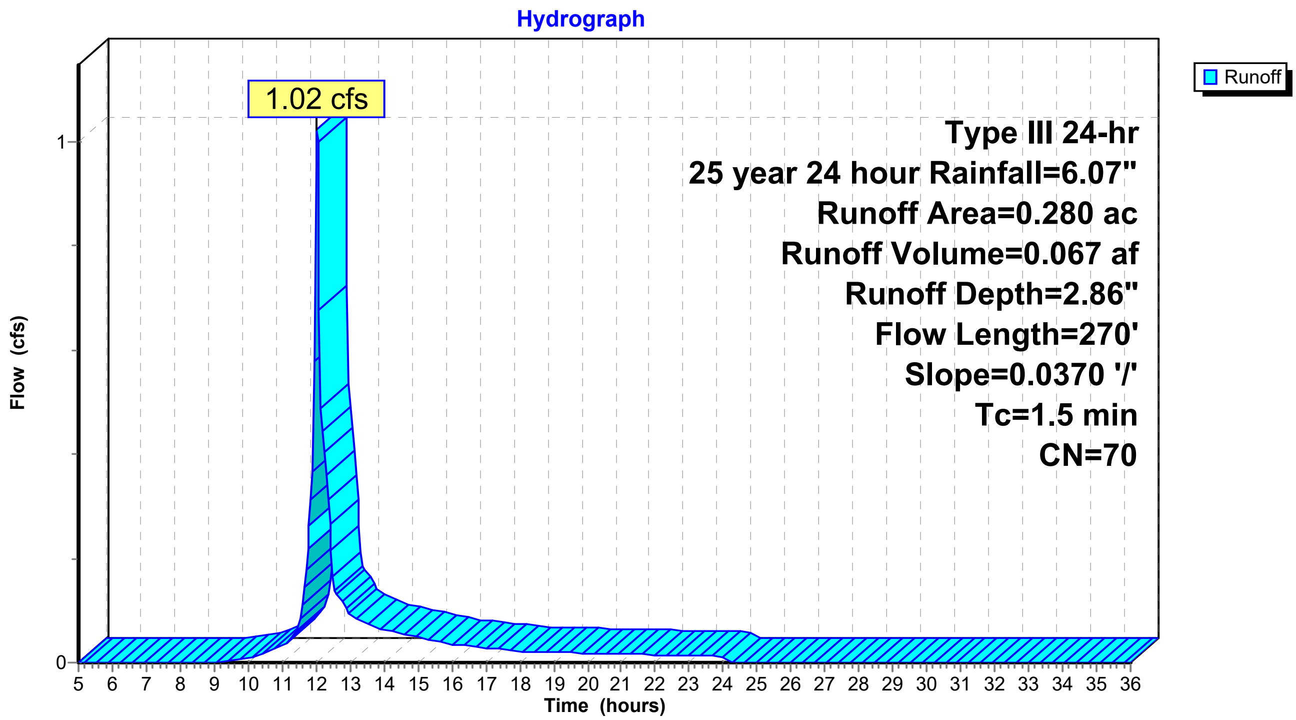
Runoff = 1.02 cfs @ 12.03 hrs, Volume= 0.067 af, Depth= 2.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 year 24 hour Rainfall=6.07"

	Area (ac)	CN	Description
	0.100	30	Meadow, non-grazed, HSG A
	0.020	78	Meadow, non-grazed, HSG D
	0.010	30	Woods, Good, HSG A
*	0.150	98	New Impervious
	0.280	70	Weighted Average
	0.130		46.43% Pervious Area
	0.150		53.57% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.5	270	0.0370	3.05	36.57	**Channel Flow,** Area= 12.0 sf Perim= 10.9' r= 1.10' n= 0.100 Earth, dense brush, high stage

Subcatchment P2C: Post Watershed 2C



Summary for Subcatchment P2D: Post Watershed 2D

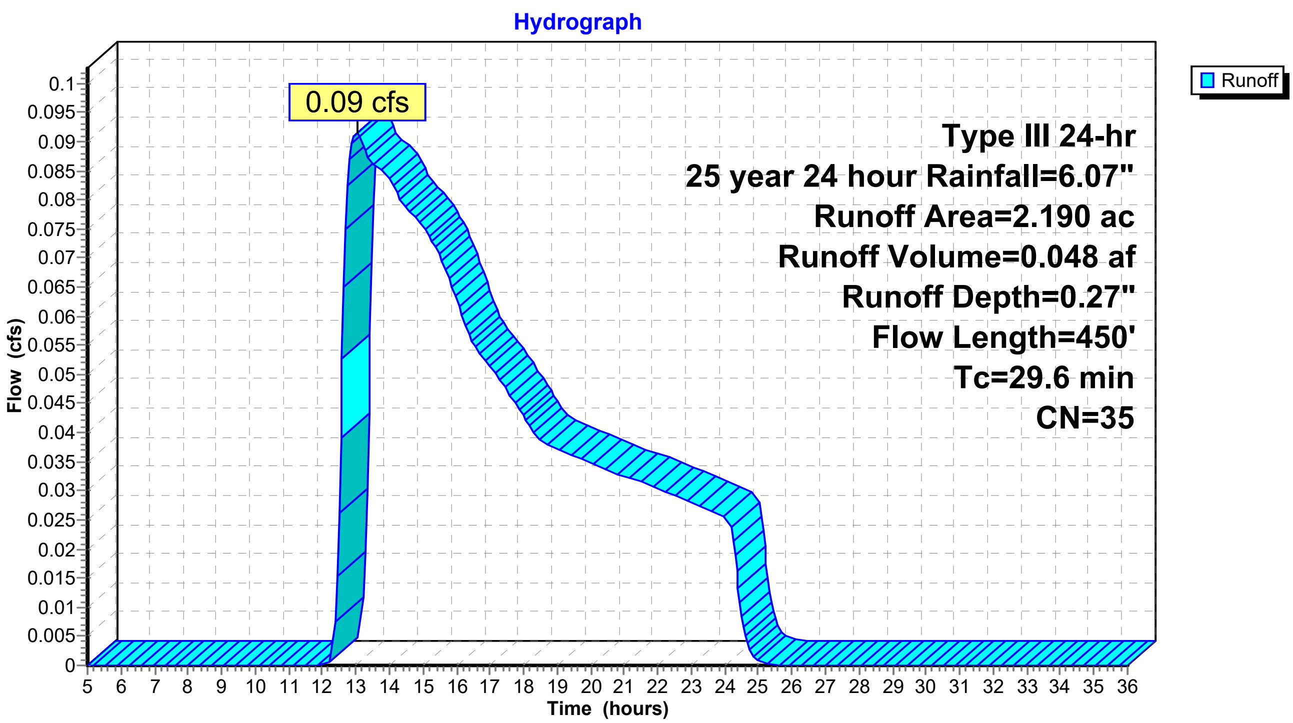
Runoff = 0.09 cfs @ 13.02 hrs, Volume= 0.048 af, Depth= 0.27"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 year 24 hour Rainfall=6.07"

	Area (ac)	CN	Description
	2.030	30	Meadow, non-grazed, HSG A
	0.010	78	Meadow, non-grazed, HSG D
*	0.150	98	New Impervious
	2.190	35	Weighted Average
	2.040		93.15% Pervious Area
	0.150		6.85% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
24.5	150	0.0300	0.10		**Sheet Flow, Meadow** n= 0.400 P2= 3.40"
5.1	300	0.0380	0.97		**Shallow Concentrated Flow, Meadow** Kv= 5.0 fps
29.6	450	Total			

Subcatchment P2D: Post Watershed 2D



Summary for Subcatchment P2E: Post Watershed 2E

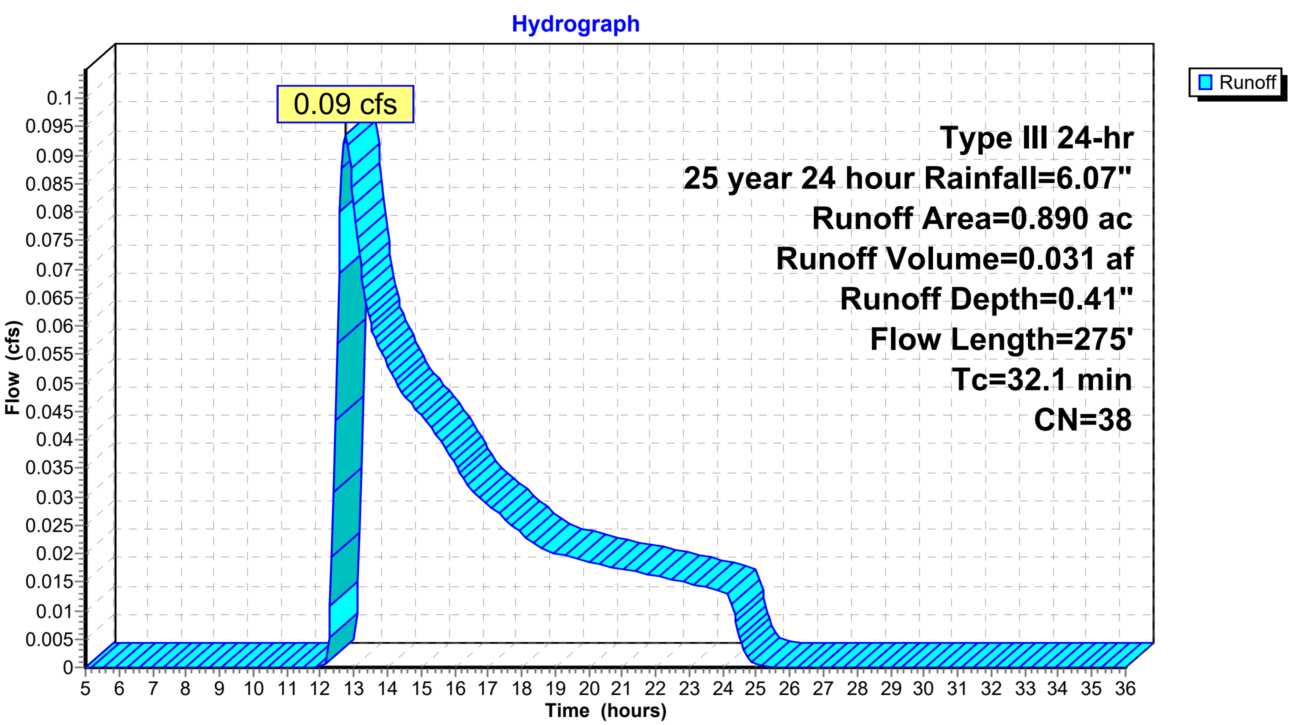
Runoff = 0.09 cfs @ 12.76 hrs, Volume= 0.031 af, Depth= 0.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 year 24 hour Rainfall=6.07"

	Area (ac)	CN	Description
	0.790	30	Meadow, non-grazed, HSG A
*	0.100	98	New Impervious
	0.890	38	Weighted Average
	0.790		88.76% Pervious Area
	0.100		11.24% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
30.1	150	0.0180	0.08		**Sheet Flow, Meadow** n= 0.400 P2= 3.40"
2.0	125	0.0450	1.06		**Shallow Concentrated Flow, Meadow** Kv= 5.0 fps
32.1	275	Total			

Subcatchment P2E: Post Watershed 2E



Summary for Subcatchment P3A: Post Watershed 3A

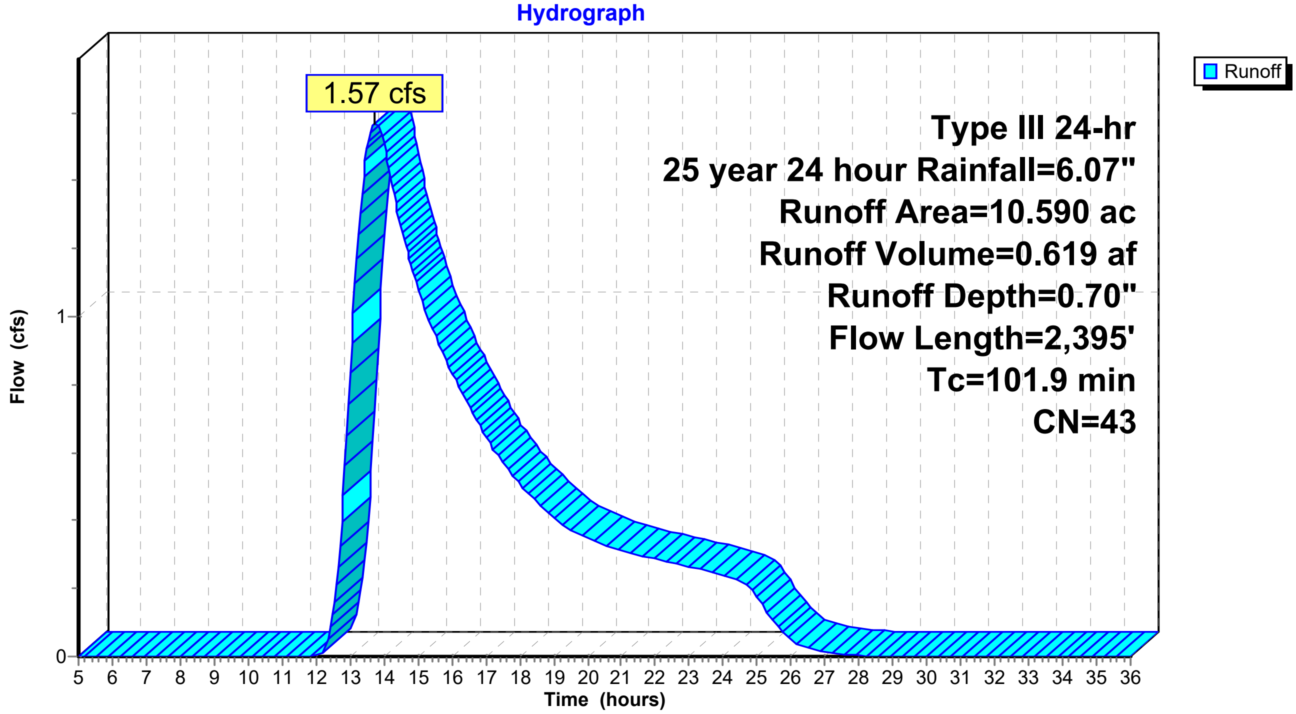
Runoff = 1.57 cfs @ 13.75 hrs, Volume= 0.619 af, Depth= 0.70"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 year 24 hour Rainfall=6.07"

	Area (ac)	CN	Description
	0.090	30	Woods, Good, HSG A
	0.860	77	Woods, Good, HSG D
	7.680	30	Meadow, non-grazed, HSG A
	1.880	78	Meadow, non-grazed, HSG D
*	0.080	98	New Impervious
	10.590	43	Weighted Average
	10.510		99.24% Pervious Area
	0.080		0.76% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.8	150	0.0400	0.11		**Sheet Flow, Meadow** n= 0.400 P2= 3.40"
3.3	170	0.0290	0.85		**Shallow Concentrated Flow, Meadow** Kv= 5.0 fps
2.4	105	0.0220	0.74		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
67.9	1,440	0.0050	0.35		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
6.5	530	0.0050	1.36	10.20	**Channel Flow,** Area= 7.5 sf Perim= 8.7' r= 0.86' n= 0.070
101.9	2,395	Total			

Subcatchment P3A: Post Watershed 3A



Summary for Subcatchment P3B: Post Watershed 3B

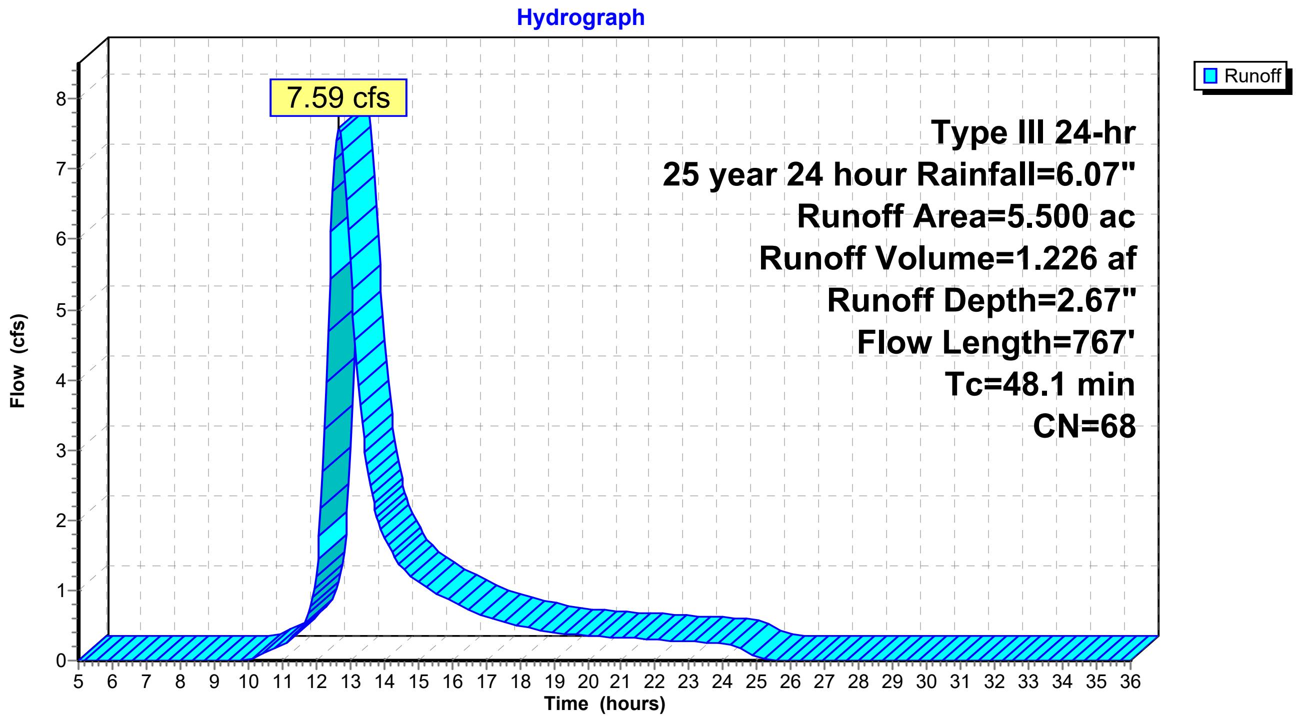
Runoff = 7.59 cfs @ 12.68 hrs, Volume= 1.226 af, Depth= 2.67"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 25 year 24 hour Rainfall=6.07"

	Area (ac)	CN	Description
	0.260	30	Woods, Good, HSG A
	0.720	77	Woods, Good, HSG D
	0.190	39	Pasture/grassland/range, Good, HSG A
	0.120	80	Pasture/grassland/range, Good, HSG D
	0.770	30	Meadow, non-grazed, HSG A
	3.370	78	Meadow, non-grazed, HSG D
*	0.070	98	New Impervious
	5.500	68	Weighted Average
	5.430		98.73% Pervious Area
	0.070		1.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
34.2	150	0.0130	0.07		**Sheet Flow, Meadow** n= 0.400 P2= 3.40"
3.4	152	0.0220	0.74		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
10.5	465	0.0220	0.74		**Shallow Concentrated Flow, Meadow** Kv= 5.0 fps
48.1	767	Total			

Subcatchment P3B: Post Watershed 3B



Summary for Pond 1P: Level Lip Spreader LS1

Inflow Area = 0.340 ac, 58.82% Impervious, Inflow Depth > 4.90" for 25 year 24 hour event
Inflow = 2.02 cfs @ 12.05 hrs, Volume= 0.139 af
Outflow = 1.62 cfs @ 12.11 hrs, Volume= 0.087 af, Atten= 20%, Lag= 4.0 min
Primary = 1.62 cfs @ 12.11 hrs, Volume= 0.087 af

Routing by Stor-Ind method, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 116.36' @ 12.11 hrs Surf.Area= 2,727 sf Storage= 2,560 cf

Plug-Flow detention time= 185.2 min calculated for 0.086 af (62% of inflow)
Center-of-Mass det. time= 85.6 min (868.2 - 782.6)

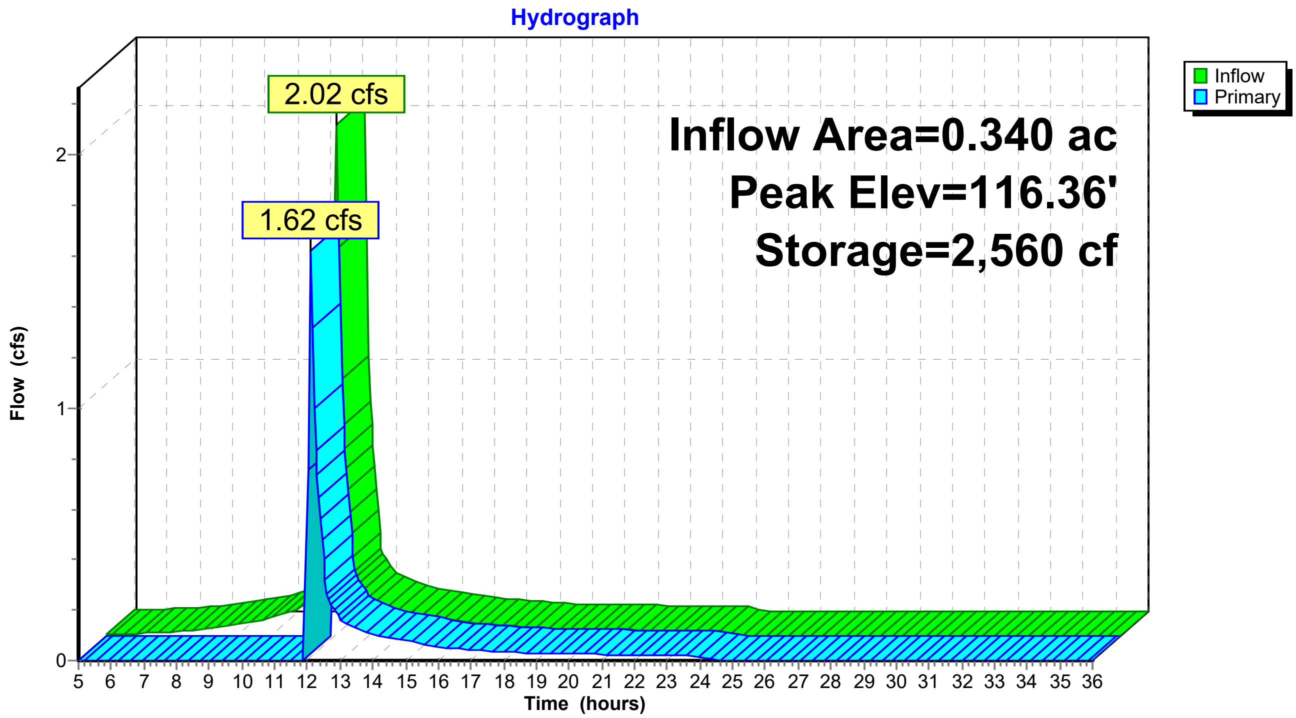
Volume	Invert	Avail.Storage	Storage Description
#1	114.50'	2,971 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
114.50	229	0	0
115.00	739	242	242
116.00	2,160	1,450	1,692
116.50	2,958	1,280	2,971

Device	Routing	Invert	Outlet Devices
#1	Primary	116.25'	**20.0' long x 4.0' 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) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Primary OutFlow Max=1.51 cfs @ 12.11 hrs HW=116.35' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Weir Controls 1.51 cfs @ 0.75 fps)

Pond 1P: Level Lip Spreader LS1



Summary for Pond 2P: Level Lip Spreader LS2

Inflow Area = 0.120 ac, 58.33% Impervious, Inflow Depth > 4.90" for 25 year 24 hour event
Inflow = 0.74 cfs @ 12.01 hrs, Volume= 0.049 af
Outflow = 0.01 cfs @ 20.64 hrs, Volume= 0.002 af, Atten= 99%, Lag= 518.0 min
Primary = 0.01 cfs @ 20.64 hrs, Volume= 0.002 af

Routing by Stor-Ind method, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 116.25' @ 20.64 hrs Surf.Area= 1,206 sf Storage= 2,039 cf

Plug-Flow detention time= 873.9 min calculated for 0.002 af (5% of inflow)
Center-of-Mass det. time= 547.6 min (1,328.3 - 780.7)

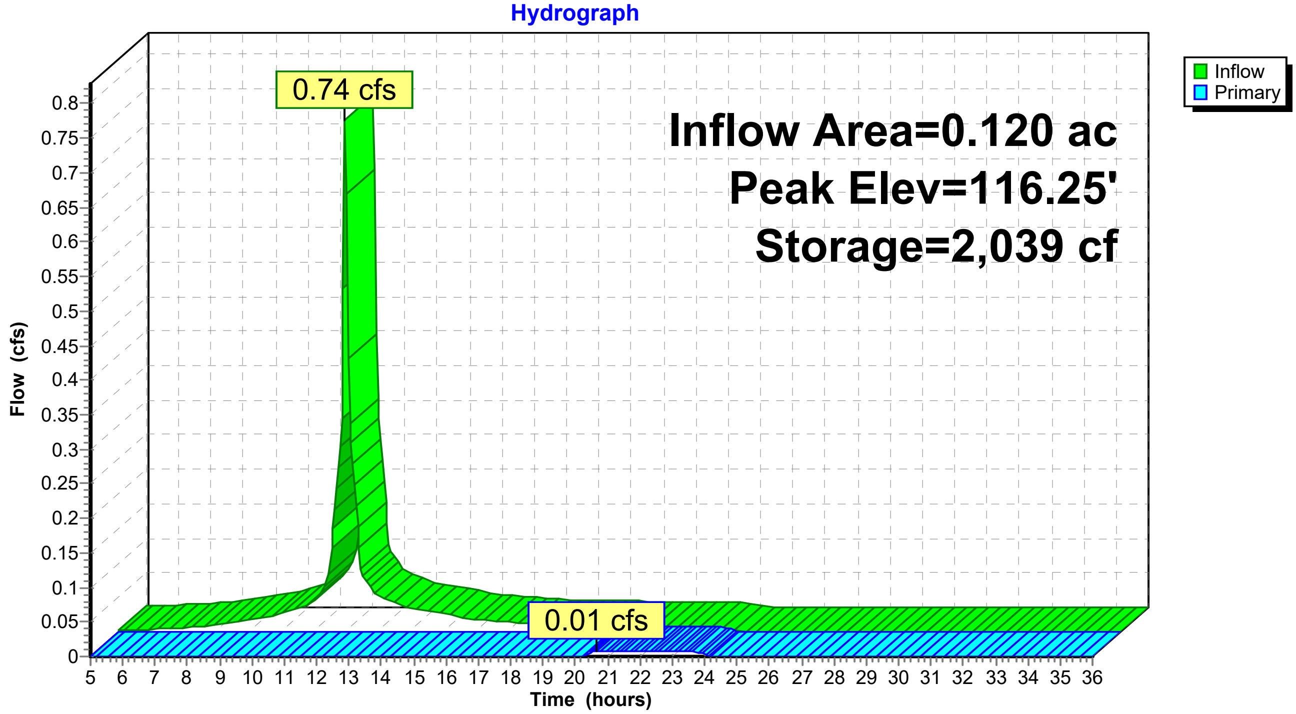
Volume	Invert	Avail.Storage	Storage Description
#1	112.00'	2,357 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
112.00	104	0	0
113.00	210	157	157
114.00	357	284	441
115.00	605	481	922
116.00	1,061	833	1,755
116.50	1,350	603	2,357

Device	Routing	Invert	Outlet Devices
#1	Primary	116.25'	**20.0' long x 4.0' 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) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Primary OutFlow Max=0.00 cfs @ 20.64 hrs HW=116.25' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Weir Controls 0.00 cfs @ 0.08 fps)

Pond 2P: Level Lip Spreader LS2



Summary for Pond 3P: Level Lip Spreader LS3

Inflow Area = 1.090 ac, 21.10% Impervious, Inflow Depth = 0.96" for 25 year 24 hour event
Inflow = 0.44 cfs @ 12.70 hrs, Volume= 0.088 af
Outflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 115.62' @ 26.40 hrs Surf.Area= 2,504 sf Storage= 3,815 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

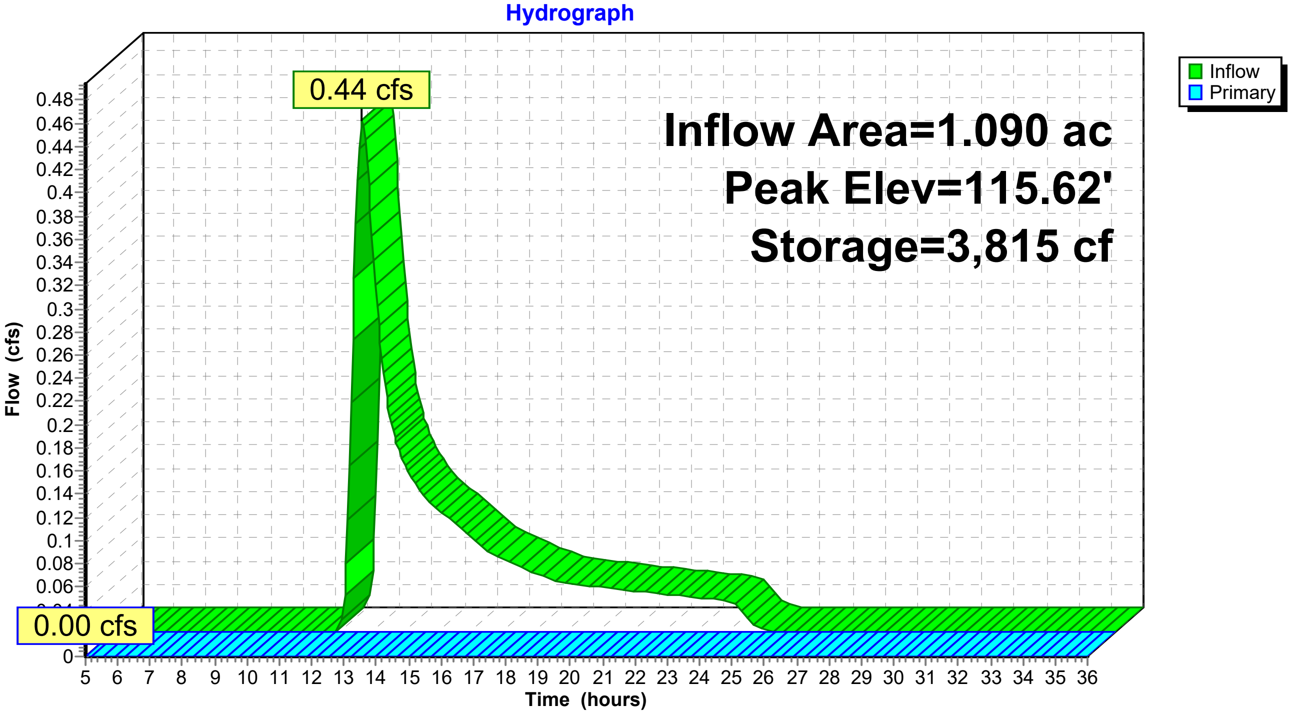
Volume	Invert	Avail.Storage	Storage Description
#1	112.00'	6,496 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
112.00	318	0	0
113.00	570	444	444
114.00	917	744	1,188
115.00	1,722	1,320	2,507
116.00	2,986	2,354	4,861
116.50	3,553	1,635	6,496

Device	Routing	Invert	Outlet Devices
#1	Primary	116.25'	**20.0' long x 4.0' 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) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=112.00' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 3P: Level Lip Spreader LS3



Summary for Pond 4P: Level Lip Spreader LS4

Inflow Area = 0.820 ac, 20.73% Impervious, Inflow Depth = 1.40" for 25 year 24 hour event
Inflow = 0.65 cfs @ 12.50 hrs, Volume= 0.096 af
Outflow = 0.13 cfs @ 14.11 hrs, Volume= 0.045 af, Atten= 80%, Lag= 96.9 min
Primary = 0.13 cfs @ 14.11 hrs, Volume= 0.045 af

Routing by Stor-Ind method, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 109.27' @ 14.11 hrs Surf.Area= 1,207 sf Storage= 2,243 cf

Plug-Flow detention time= 304.4 min calculated for 0.045 af (47% of inflow)
Center-of-Mass det. time= 160.0 min (1,065.4 - 905.4)

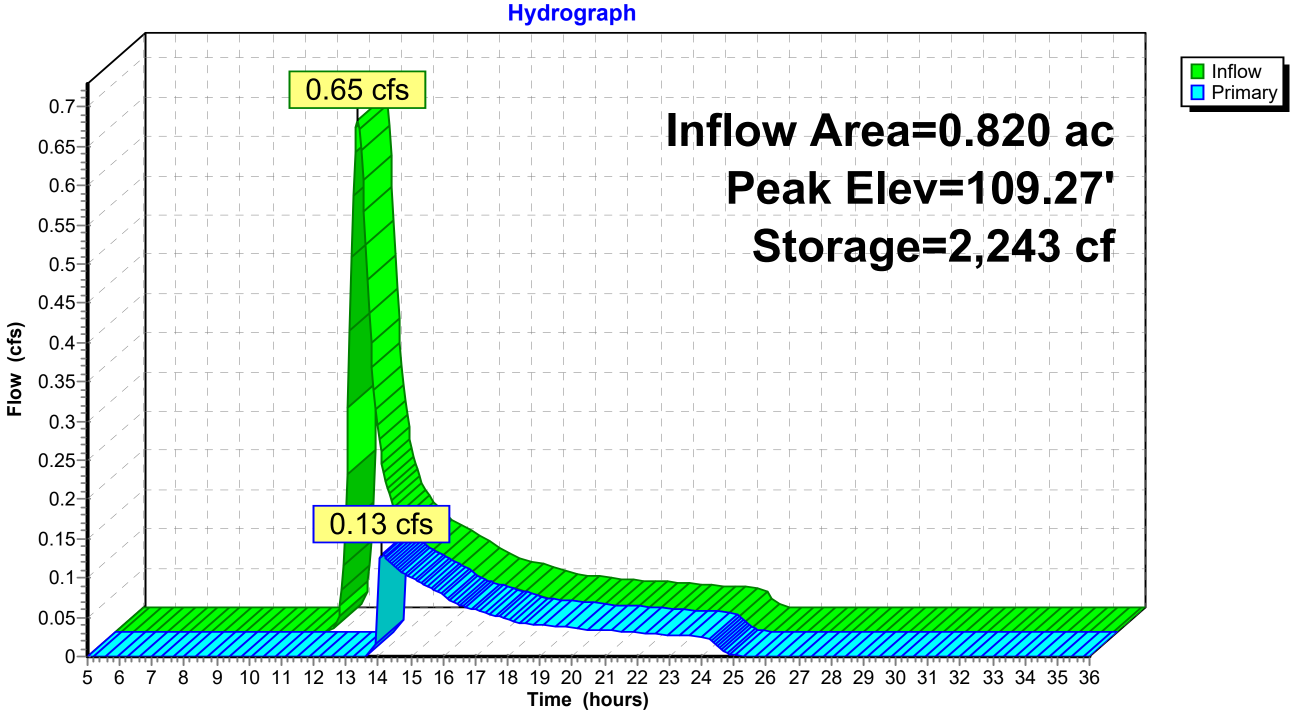
Volume	Invert	Avail.Storage	Storage Description
#1	106.00'	2,535 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
106.00	263	0	0
107.00	483	373	373
108.00	765	624	997
109.00	1,110	938	1,935
109.50	1,293	601	2,535

Device	Routing	Invert	Outlet Devices
#1	Primary	109.25'	**20.0' long x 4.0' 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) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Primary OutFlow Max=0.09 cfs @ 14.11 hrs HW=109.27' (Free Discharge)
1=Broad-Crested Rectangular Weir (Weir Controls 0.09 cfs @ 0.30 fps)

Pond 4P: Level Lip Spreader LS4



Summary for Pond 5P: Level Lip Spreader LS5

Inflow Area = 4.330 ac, 1.15% Impervious, Inflow Depth = 0.58" for 25 year 24 hour event
Inflow = 0.85 cfs @ 12.68 hrs, Volume= 0.209 af
Outflow = 0.29 cfs @ 14.76 hrs, Volume= 0.117 af, Atten= 65%, Lag= 125.2 min
Primary = 0.29 cfs @ 14.76 hrs, Volume= 0.117 af

Routing by Stor-Ind method, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 109.28' @ 14.76 hrs Surf.Area= 2,186 sf Storage= 4,067 cf

Plug-Flow detention time= 286.9 min calculated for 0.117 af (56% of inflow)
Center-of-Mass det. time= 139.0 min (1,104.3 - 965.3)

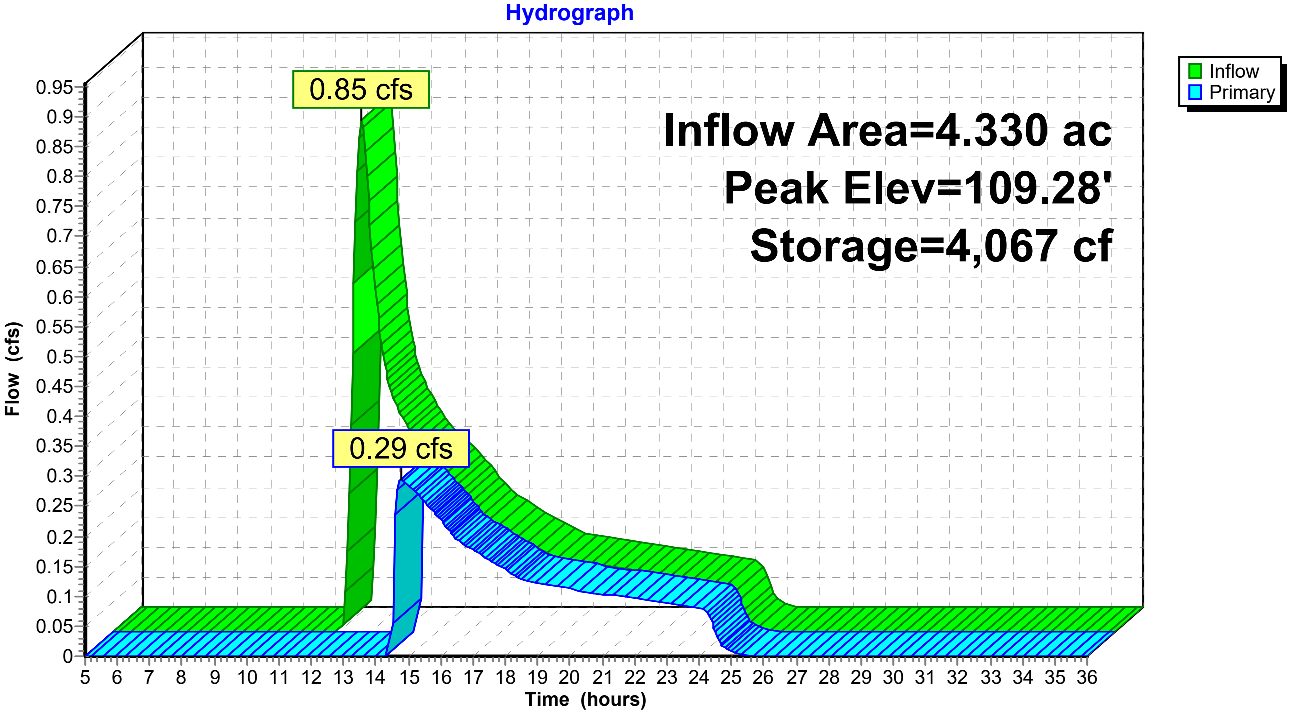
Volume	Invert	Avail.Storage	Storage Description
#1	106.00'	4,568 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
106.00	541	0	0
107.00	892	717	717
108.00	1,326	1,109	1,826
109.00	1,993	1,660	3,485
109.50	2,339	1,083	4,568

Device	Routing	Invert	Outlet Devices
#1	Primary	109.25'	**20.0' long x 18.0' 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

Primary OutFlow Max=0.26 cfs @ 14.76 hrs HW=109.28' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Weir Controls 0.26 cfs @ 0.45 fps)

Pond 5P: Level Lip Spreader LS5



Summary for Pond 6P: Level Lip Spreader LS6

Inflow Area = 0.470 ac, 42.55% Impervious, Inflow Depth = 1.88" for 25 year 24 hour event
Inflow = 0.61 cfs @ 12.36 hrs, Volume= 0.074 af
Outflow = 0.06 cfs @ 15.55 hrs, Volume= 0.074 af, Atten= 90%, Lag= 191.3 min
Discarded = 0.06 cfs @ 15.55 hrs, Volume= 0.074 af
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 103.21' @ 15.55 hrs Surf.Area= 1,078 sf Storage= 1,639 cf

Plug-Flow detention time= 370.0 min calculated for 0.074 af (100% of inflow)
Center-of-Mass det. time= 370.3 min (1,251.4 - 881.1)

Volume	Invert	Avail.Storage	Storage Description
#1	101.00'	3,342 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

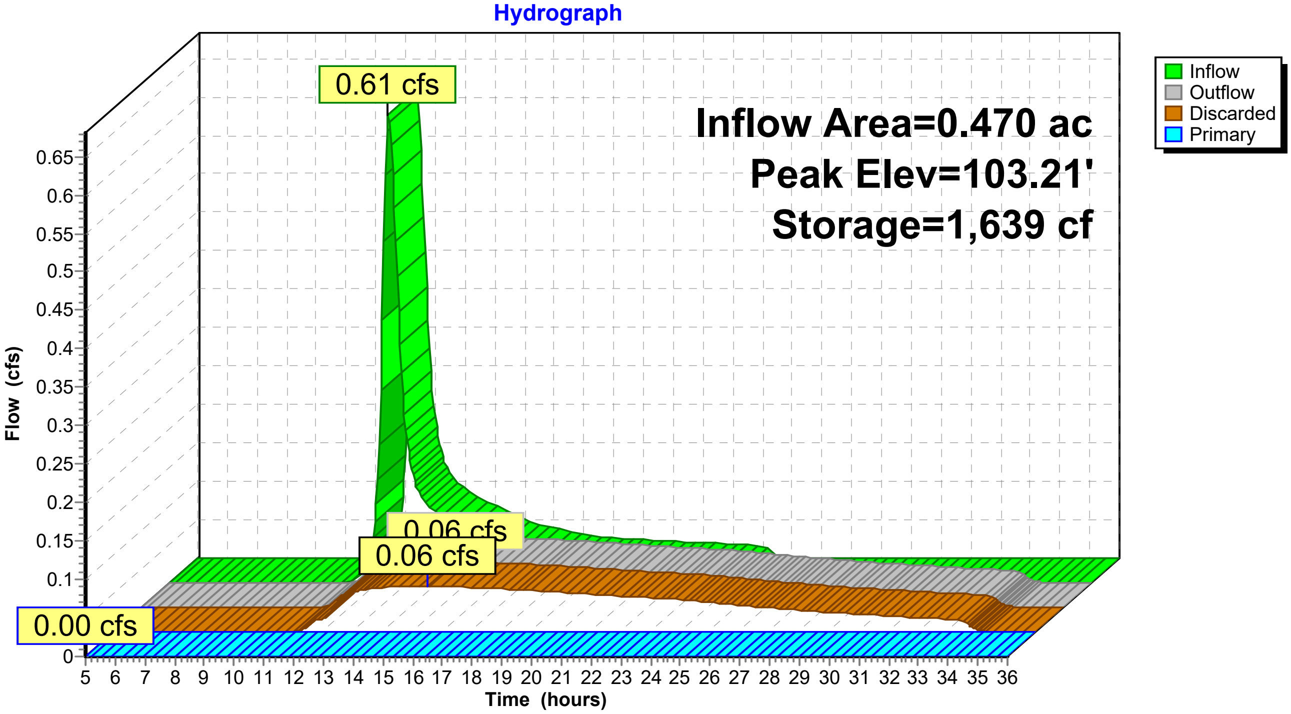
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
101.00	451	0	0
102.00	695	573	573
103.00	998	847	1,420
104.00	1,374	1,186	2,606
104.50	1,570	736	3,342

Device	Routing	Invert	Outlet Devices
#1	Primary	104.25'	**20.0' long x 4.0' 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) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32
#2	Discarded	101.00'	**1.420 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 99.00'

Discarded OutFlow Max=0.06 cfs @ 15.55 hrs HW=103.21' (Free Discharge)
└─**2=Exfiltration** (Controls 0.06 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=101.00' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 6P: Level Lip Spreader LS6



Summary for Pond 7P: Level Lip Spreader LS7

Inflow Area =	0.280 ac, 53.57% Impervious,	Inflow Depth = 2.86"	for 25 year 24 hour event	
Inflow =	1.02 cfs @	12.03 hrs, Volume=	0.067 af	
Outflow =	0.06 cfs @	14.42 hrs, Volume=	0.067 af,	Atten= 94%, Lag= 143.3 min
Discarded =	0.06 cfs @	14.42 hrs, Volume=	0.067 af	
Primary =	0.00 cfs @	5.00 hrs, Volume=	0.000 af	

Routing by Stor-Ind method, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 95.02' @ 14.42 hrs Surf.Area= 1,043 sf Storage= 1,500 cf

Plug-Flow detention time= 340.1 min calculated for 0.067 af (100% of inflow)
Center-of-Mass det. time= 339.9 min (1,173.4 - 833.5)

Volume	Invert	Avail.Storage	Storage Description
#1	93.00'	2,037 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

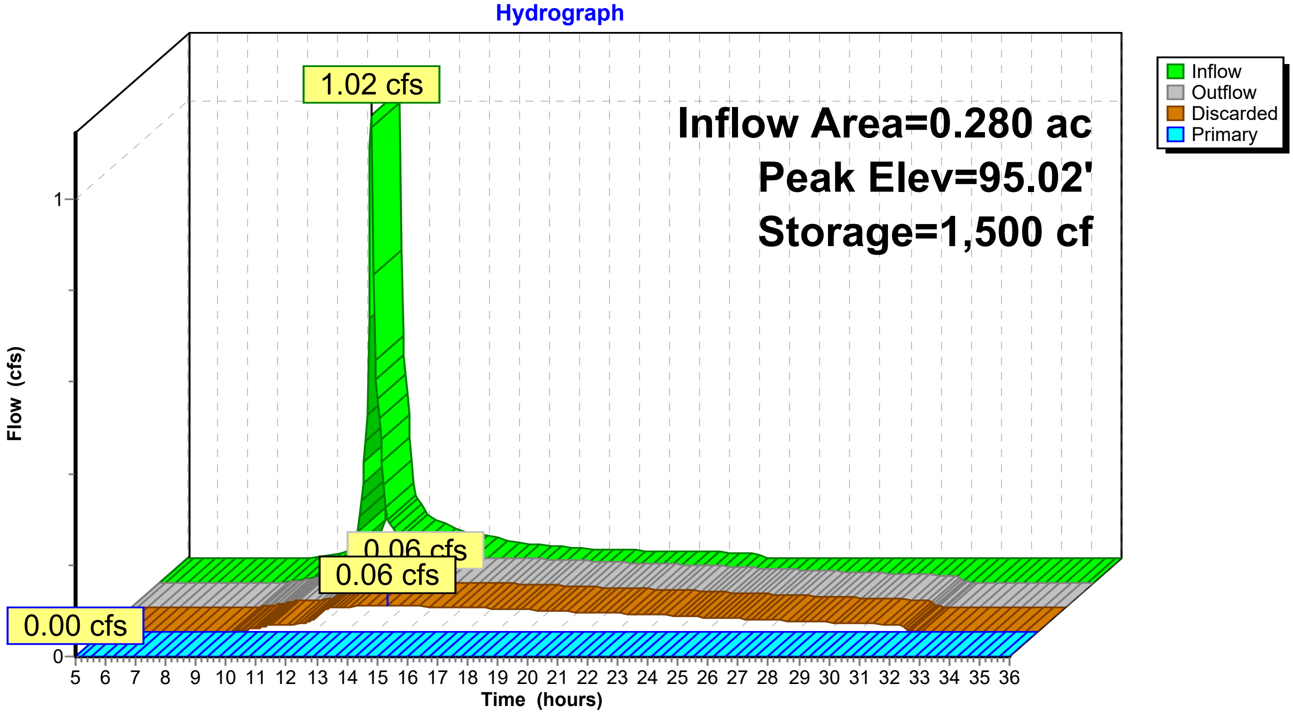
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
93.00	462	0	0
94.00	730	596	596
95.00	1,037	884	1,480
95.50	1,193	558	2,037

Device	Routing	Invert	Outlet Devices
#1	Primary	95.25'	**20.0' long x 4.0' 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) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32
#2	Discarded	93.00'	**1.420 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 91.00'

Discarded OutFlow Max=0.06 cfs @ 14.42 hrs HW=95.02' (Free Discharge)
└─**2=Exfiltration** (Controls 0.06 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=93.00' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 7P: Level Lip Spreader LS7



Summary for Pond 8P: Infiltration Basin 1

Inflow Area = 2.190 ac, 6.85% Impervious, Inflow Depth = 0.27" for 25 year 24 hour event
Inflow = 0.09 cfs @ 13.02 hrs, Volume= 0.048 af
Outflow = 0.05 cfs @ 17.73 hrs, Volume= 0.048 af, Atten= 51%, Lag= 282.8 min
Discarded = 0.05 cfs @ 17.73 hrs, Volume= 0.048 af
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 93.29' @ 17.73 hrs Surf.Area= 1,084 sf Storage= 686 cf

Plug-Flow detention time= 224.9 min calculated for 0.048 af (100% of inflow)
Center-of-Mass det. time= 225.3 min (1,249.9 - 1,024.6)

Volume	Invert	Avail.Storage	Storage Description
#1	92.00'	2,853 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

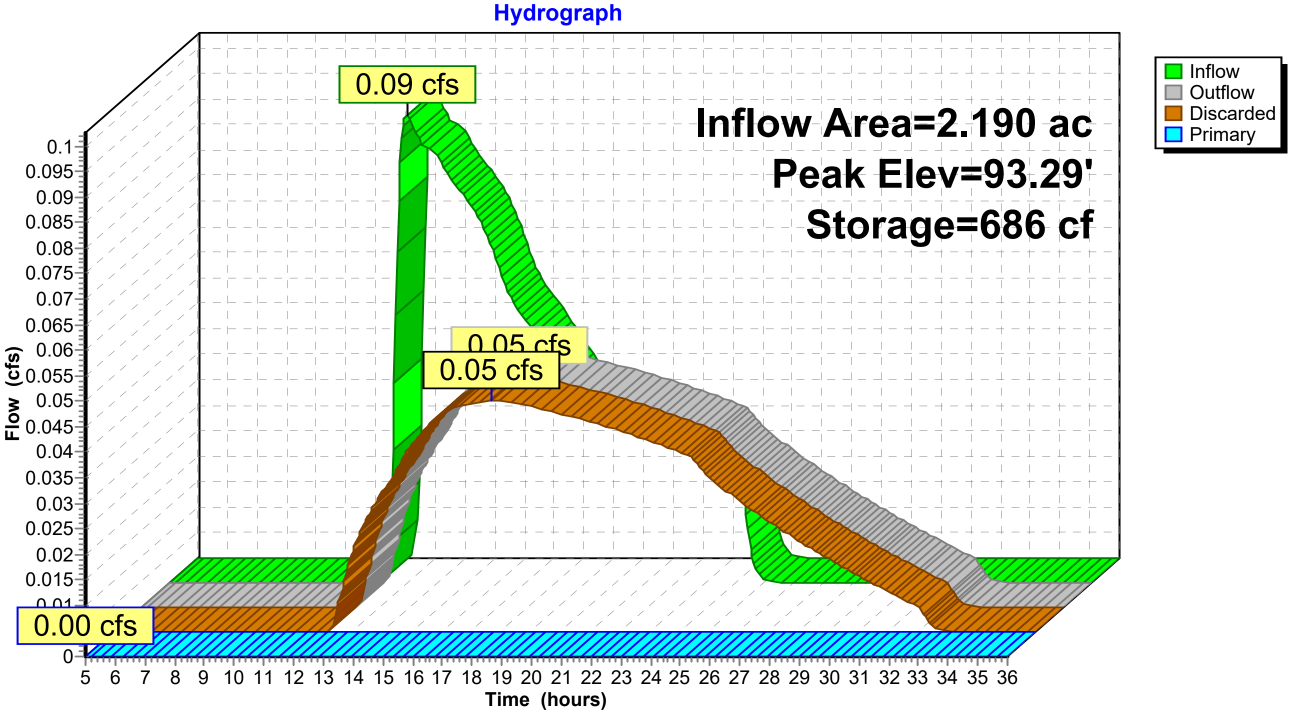
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
92.00	123	0	0
93.00	725	424	424
94.00	1,964	1,345	1,769
94.50	2,375	1,085	2,853

Device	Routing	Invert	Outlet Devices
#1	Discarded	92.00'	**1.420 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 90.00'
#2	Primary	94.25'	**15.0" Round Culvert** L= 40.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 94.25' / 93.50' S= 0.0187 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 1.23 sf

Discarded OutFlow Max=0.05 cfs @ 17.73 hrs HW=93.29' (Free Discharge)
└─**1=Exfiltration** (Controls 0.05 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=92.00' (Free Discharge)
└─**2=Culvert** (Controls 0.00 cfs)

Pond 8P: Infiltration Basin 1



Summary for Pond 9P: Level Lip Spreader LS8

Inflow Area = 0.890 ac, 11.24% Impervious, Inflow Depth = 0.41" for 25 year 24 hour event
Inflow = 0.09 cfs @ 12.76 hrs, Volume= 0.031 af
Outflow = 0.03 cfs @ 16.98 hrs, Volume= 0.031 af, Atten= 69%, Lag= 253.5 min
Discarded = 0.03 cfs @ 16.98 hrs, Volume= 0.031 af
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 91.32' @ 16.98 hrs Surf.Area= 662 sf Storage= 470 cf

Plug-Flow detention time= 243.4 min calculated for 0.031 af (100% of inflow)
Center-of-Mass det. time= 243.3 min (1,234.0 - 990.7)

Volume	Invert	Avail.Storage	Storage Description
#1	90.00'	1,730 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

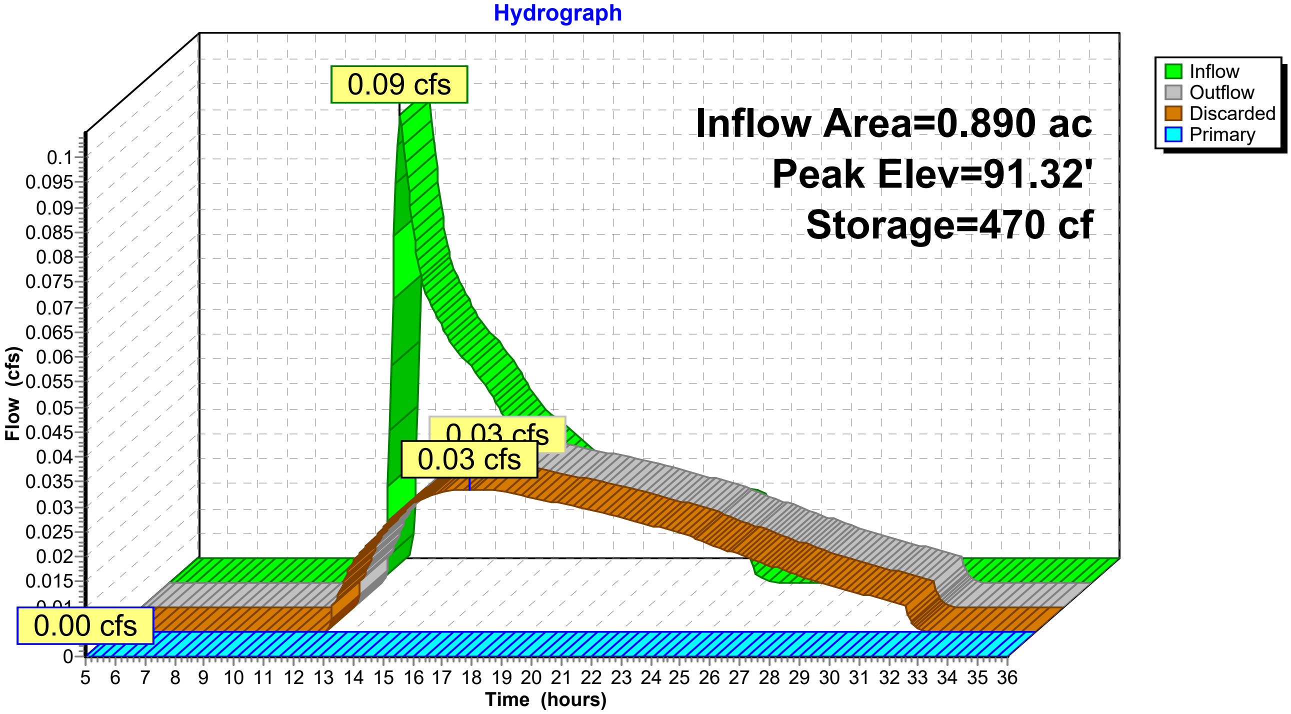
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
90.00	157	0	0
91.00	434	296	296
92.00	1,150	792	1,088
92.50	1,419	642	1,730

Device	Routing	Invert	Outlet Devices
#1	Discarded	90.00'	**1.420 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 88.00'
#2	Primary	92.25'	**20.0' long x 4.0' 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) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Discarded OutFlow Max=0.03 cfs @ 16.98 hrs HW=91.32' (Free Discharge)
↑—**1=Exfiltration** (Controls 0.03 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=90.00' (Free Discharge)
↑—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 9P: Level Lip Spreader LS8



Summary for Pond 10P: Dry Basin 1

Inflow Area = 5.500 ac, 1.27% Impervious, Inflow Depth = 2.67" for 25 year 24 hour event
Inflow = 7.59 cfs @ 12.68 hrs, Volume= 1.226 af
Outflow = 1.47 cfs @ 14.33 hrs, Volume= 1.163 af, Atten= 81%, Lag= 98.8 min
Primary = 1.47 cfs @ 14.33 hrs, Volume= 1.163 af

Routing by Stor-Ind method, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 94.07' @ 14.33 hrs Surf.Area= 12,763 sf Storage= 27,295 cf

Plug-Flow detention time= 393.9 min calculated for 1.162 af (95% of inflow)
Center-of-Mass det. time= 367.1 min (1,248.5 - 881.4)

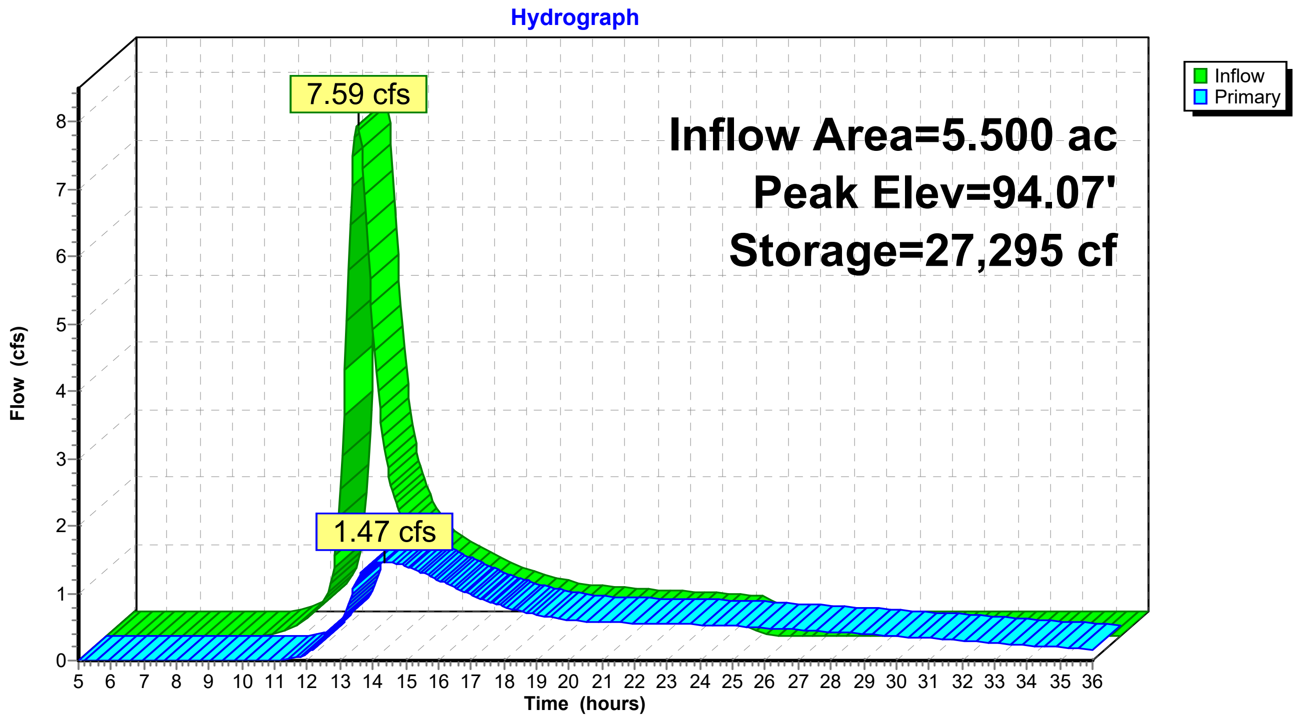
Volume	Invert	Avail.Storage	Storage Description
#1	91.50'	47,418 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
91.50	8,637	0	0
92.00	9,354	4,498	4,498
93.00	10,914	10,134	14,632
94.00	12,635	11,775	26,406
95.00	14,461	13,548	39,954
95.50	15,395	7,464	47,418

Device	Routing	Invert	Outlet Devices
#1	Primary	91.40'	**15.0" Round Culvert** L= 30.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 91.40' / 91.10' S= 0.0100 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 1.23 sf
#2	Device 1	91.50'	**4.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	93.50'	**8.0" Vert. Orifice/Grate** C= 0.600
#4	Primary	94.50'	**20.0' long x 4.0' 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) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Primary OutFlow Max=1.47 cfs @ 14.33 hrs HW=94.07' (Free Discharge)
├─**1=Culvert** (Passes 1.47 cfs of 6.67 cfs potential flow)
│ ├─**2=Orifice/Grate** (Orifice Controls 0.65 cfs @ 7.46 fps)
│ └─**3=Orifice/Grate** (Orifice Controls 0.82 cfs @ 2.57 fps)
└─**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 10P: Dry Basin 1

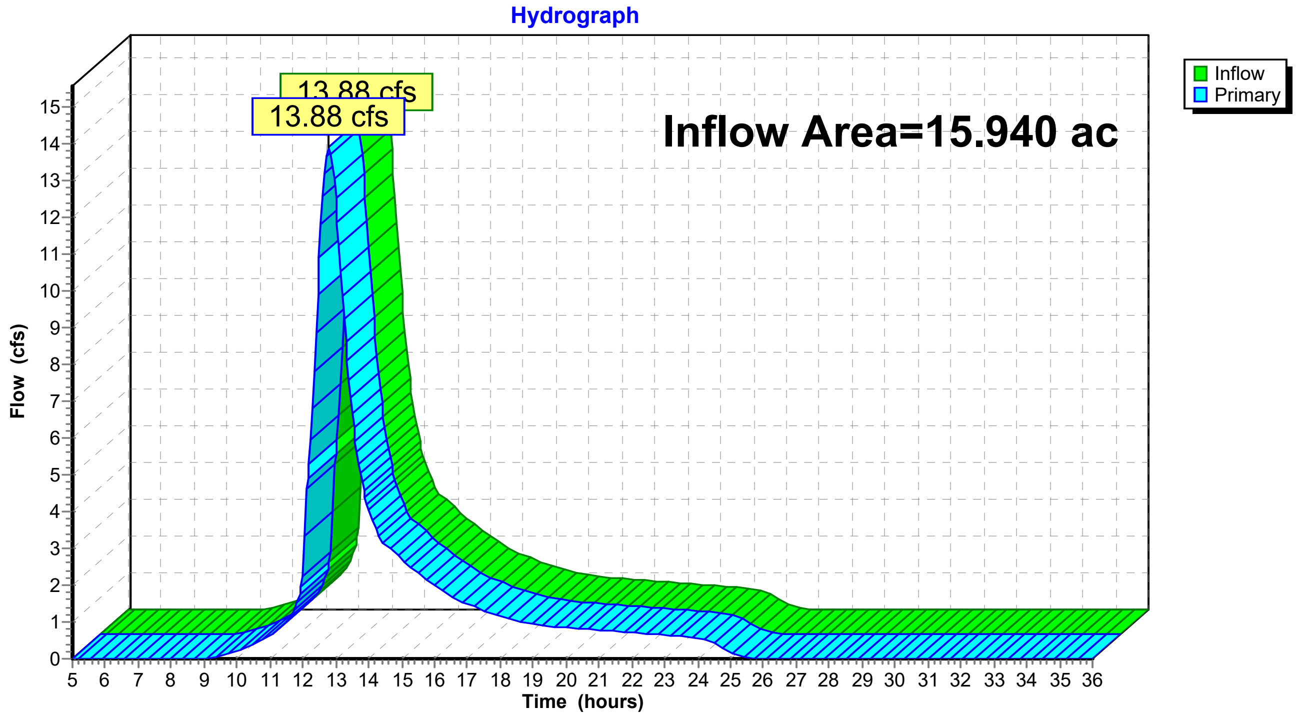


Summary for Link SN01: SN001

Inflow Area =	15.940 ac,	4.83% Impervious,	Inflow Depth = 2.01"	for 25 year 24 hour event	
Inflow =	13.88 cfs @	12.79 hrs,	Volume=	2.674 af	
Primary =	13.88 cfs @	12.79 hrs,	Volume=	2.674 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs

Link SN01: SN001

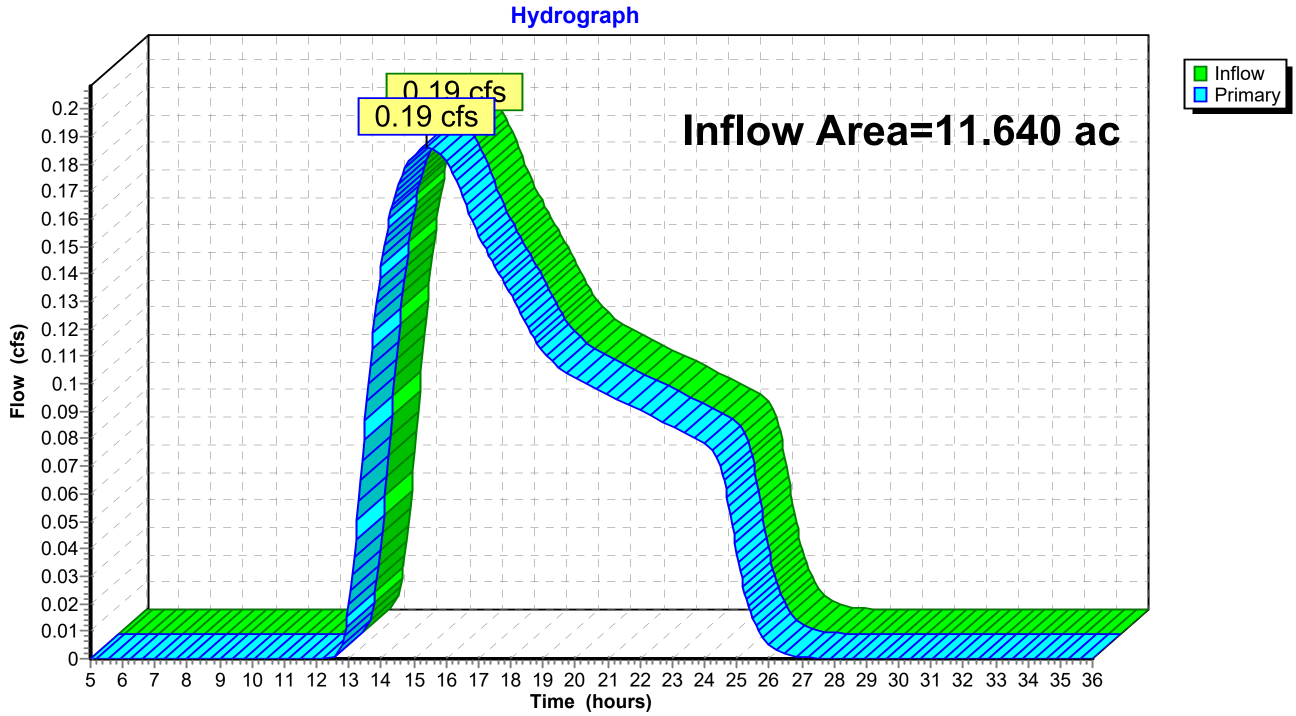


Summary for Link SN02: SN002

Inflow Area =	11.640 ac,	5.15% Impervious, Inflow Depth = 0.12"	for 25 year 24 hour event
Inflow =	0.19 cfs @	15.41 hrs, Volume=	0.118 af
Primary =	0.19 cfs @	15.41 hrs, Volume=	0.118 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs

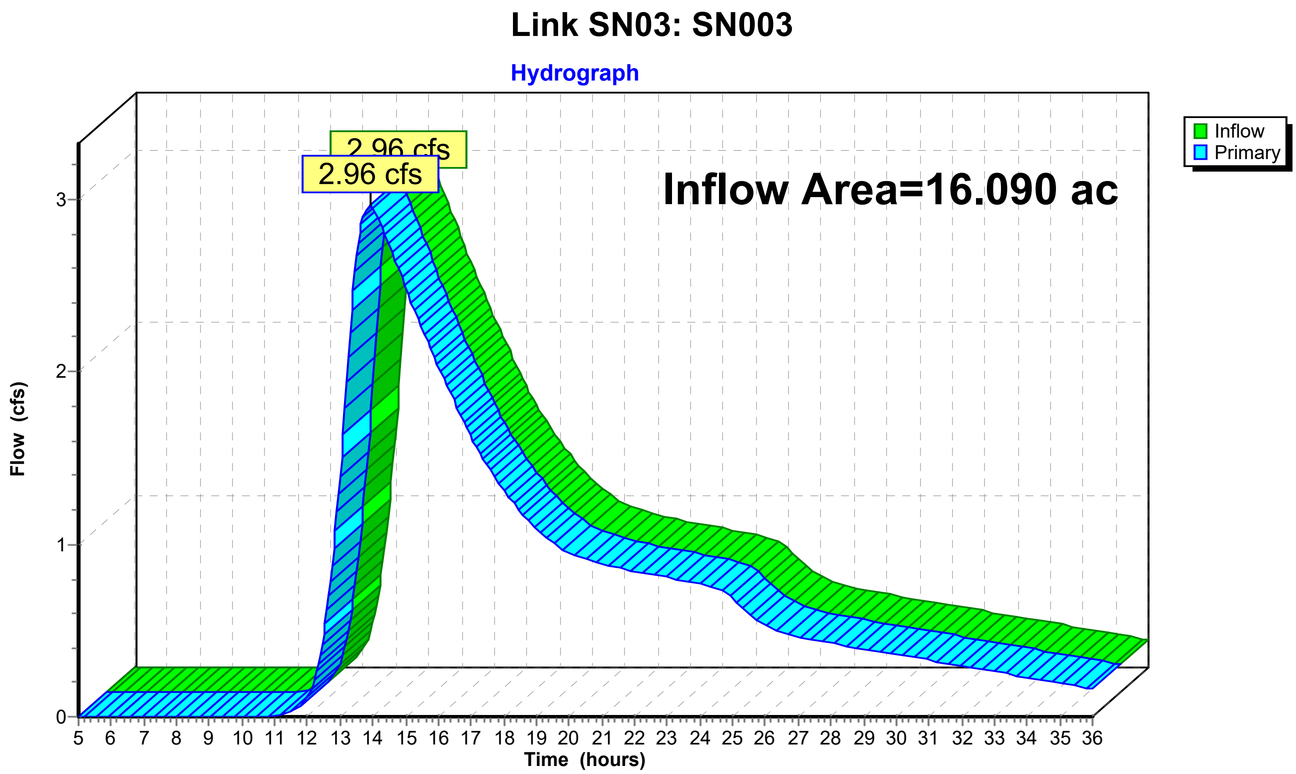
Link SN02: SN002



Summary for Link SN03: SN003

Inflow Area =	16.090 ac,	0.93% Impervious, Inflow Depth >	1.33"	for 25 year 24 hour event
Inflow =	2.96 cfs @	13.91 hrs, Volume=	1.782 af	
Primary =	2.96 cfs @	13.91 hrs, Volume=	1.782 af, Atten= 0%, Lag= 0.0 min	

Primary outflow = Inflow, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs



Summary for Subcatchment P1A: Post Watershed 1A

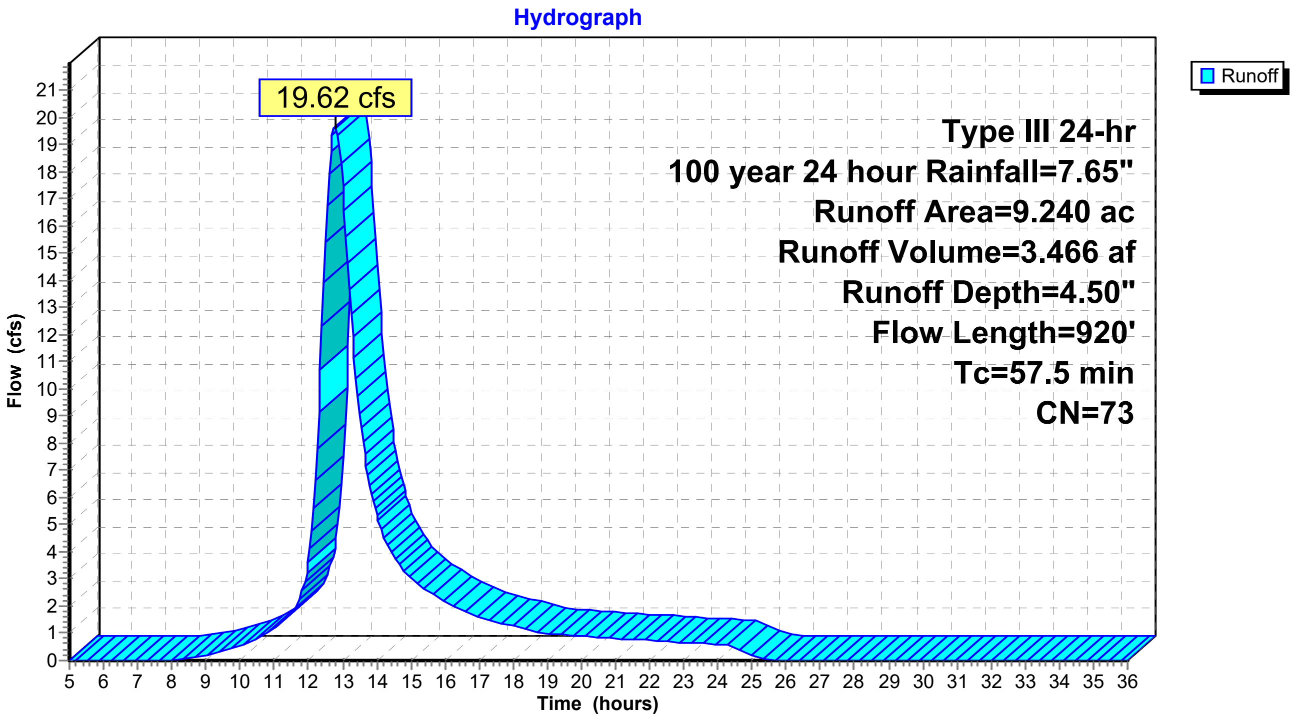
Runoff = 19.62 cfs @ 12.78 hrs, Volume= 3.466 af, Depth= 4.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 year 24 hour Rainfall=7.65"

	Area (ac)	CN	Description
	0.270	30	Woods, Good, HSG A
	0.230	55	Woods, Good, HSG B
	6.790	77	Woods, Good, HSG D
	0.060	39	Pasture/grassland/range, Good, HSG A
	0.420	61	Pasture/grassland/range, Good, HSG B
	0.210	80	Pasture/grassland/range, Good, HSG D
	0.250	30	Meadow, non-grazed, HSG A
	0.070	58	Meadow, non-grazed, HSG B
	0.890	78	Meadow, non-grazed, HSG D
*	0.050	98	New Impervious
	9.240	73	Weighted Average
	9.190		99.46% Pervious Area
	0.050		0.54% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
28.8	150	0.0200	0.09		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.40"
28.7	770	0.0080	0.45		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
57.5	920	Total			

Subcatchment P1A: Post Watershed 1A



Summary for Subcatchment P1B: Post Watershed 1B

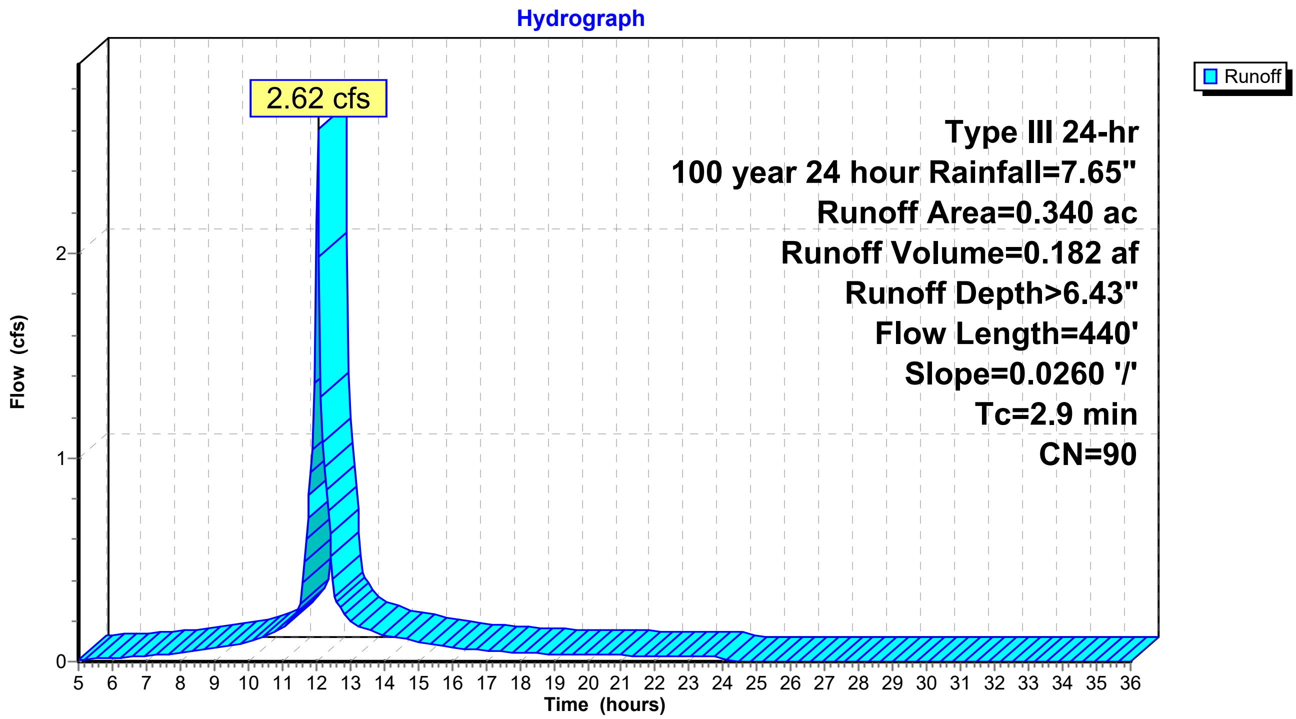
Runoff = 2.62 cfs @ 12.05 hrs, Volume= 0.182 af, Depth> 6.43"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 year 24 hour Rainfall=7.65"

	Area (ac)	CN	Description
	0.140	78	Meadow, non-grazed, HSG D
*	0.200	98	New Impervious
	0.340	90	Weighted Average
	0.140		41.18% Pervious Area
	0.200		58.82% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.9	440	0.0260	2.55	30.66	**Channel Flow,** Area= 12.0 sf Perim= 10.9' r= 1.10' n= 0.100 Earth, dense brush, high stage

Subcatchment P1B: Post Watershed 1B



Summary for Subcatchment P1C: Post Watershed 1C

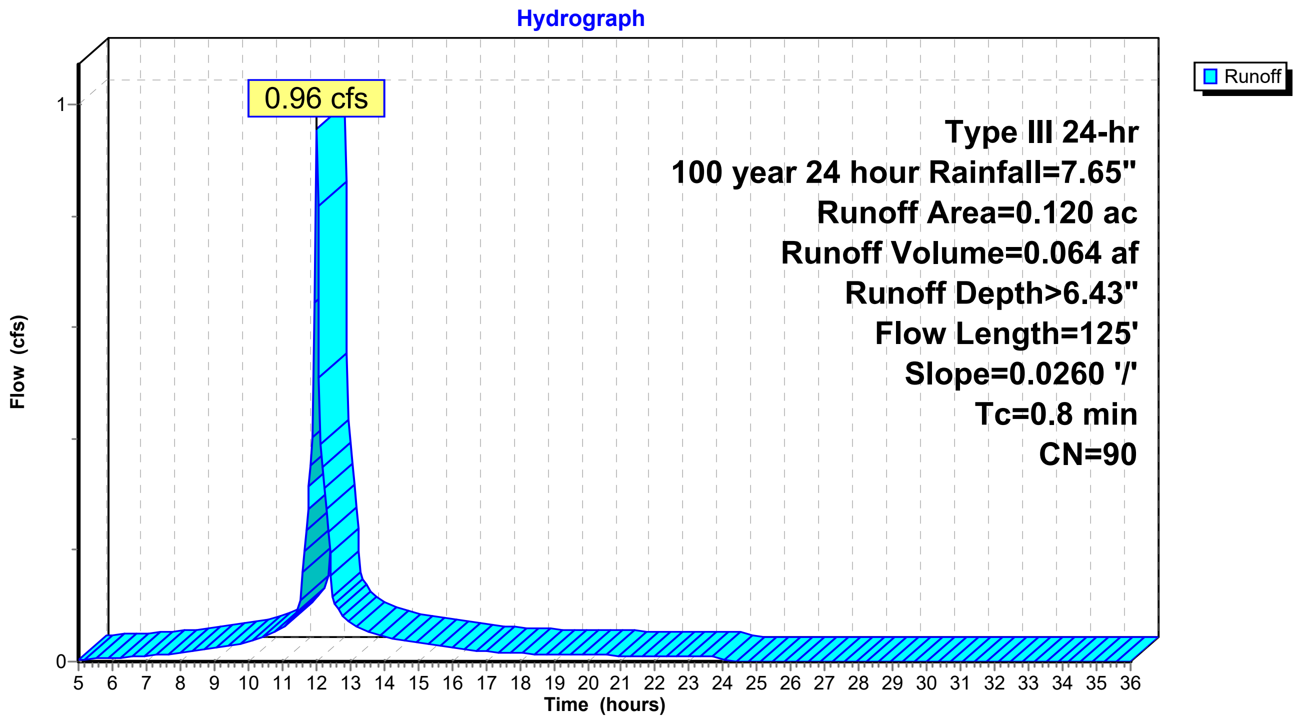
Runoff = 0.96 cfs @ 12.01 hrs, Volume= 0.064 af, Depth> 6.43"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 year 24 hour Rainfall=7.65"

	Area (ac)	CN	Description
	0.050	78	Meadow, non-grazed, HSG D
*	0.070	98	New Impervious
	0.120	90	Weighted Average
	0.050		41.67% Pervious Area
	0.070		58.33% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.8	125	0.0260	2.55	30.66	**Channel Flow,** Area= 12.0 sf Perim= 10.9' r= 1.10' n= 0.100 Earth, dense brush, high stage

Subcatchment P1C: Post Watershed 1C



Summary for Subcatchment P1D: Post Watershed 1D

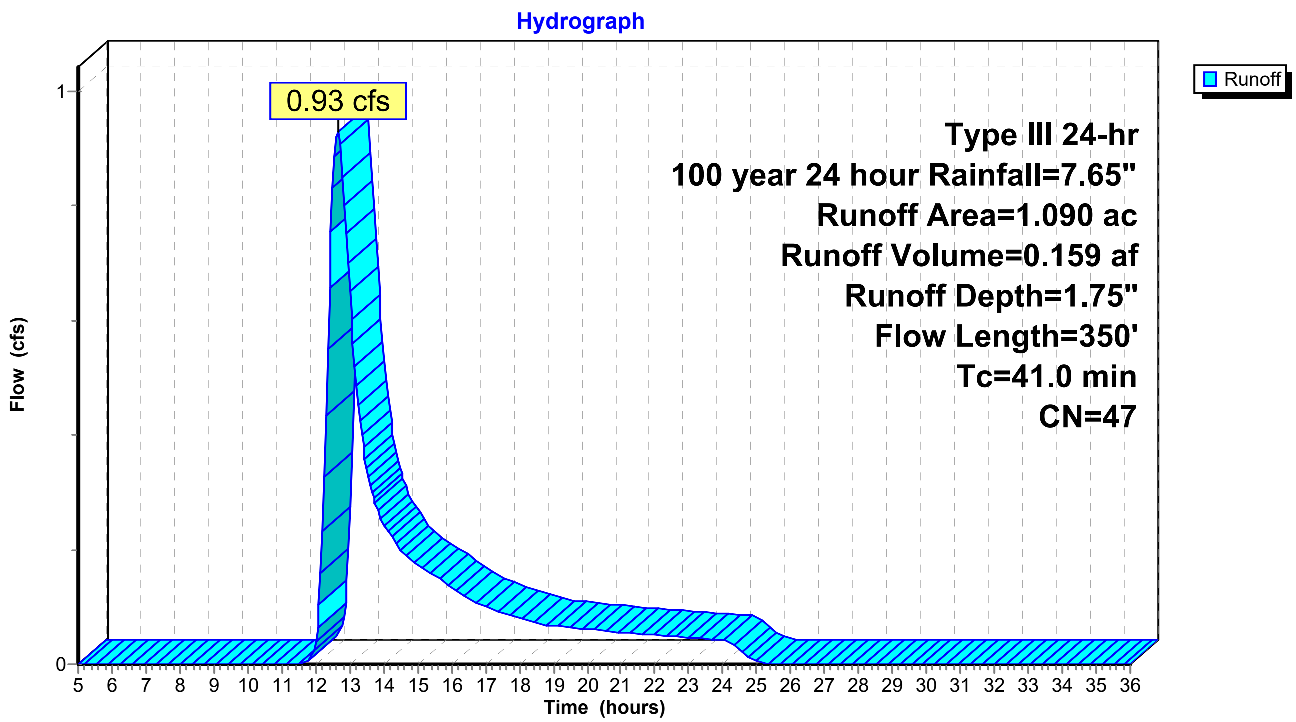
Runoff = 0.93 cfs @ 12.65 hrs, Volume= 0.159 af, Depth= 1.75"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 year 24 hour Rainfall=7.65"

	Area (ac)	CN	Description
	0.790	30	Meadow, non-grazed, HSG A
	0.070	78	Meadow, non-grazed, HSG D
*	0.230	98	New Impervious
	1.090	47	Weighted Average
	0.860		78.90% Pervious Area
	0.230		21.10% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
24.2	150	0.0310	0.10		**Sheet Flow, Meadow** n= 0.400 P2= 3.40"
16.3	155	0.0010	0.16		**Shallow Concentrated Flow, Meadow** Kv= 5.0 fps
0.5	45	0.0100	1.58	19.01	**Channel Flow,** Area= 12.0 sf Perim= 10.9' r= 1.10' n= 0.100 Earth, dense brush, high stage
41.0	350	Total			

Subcatchment P1D: Post Watershed 1D



Summary for Subcatchment P1E: Post Watershed 1E

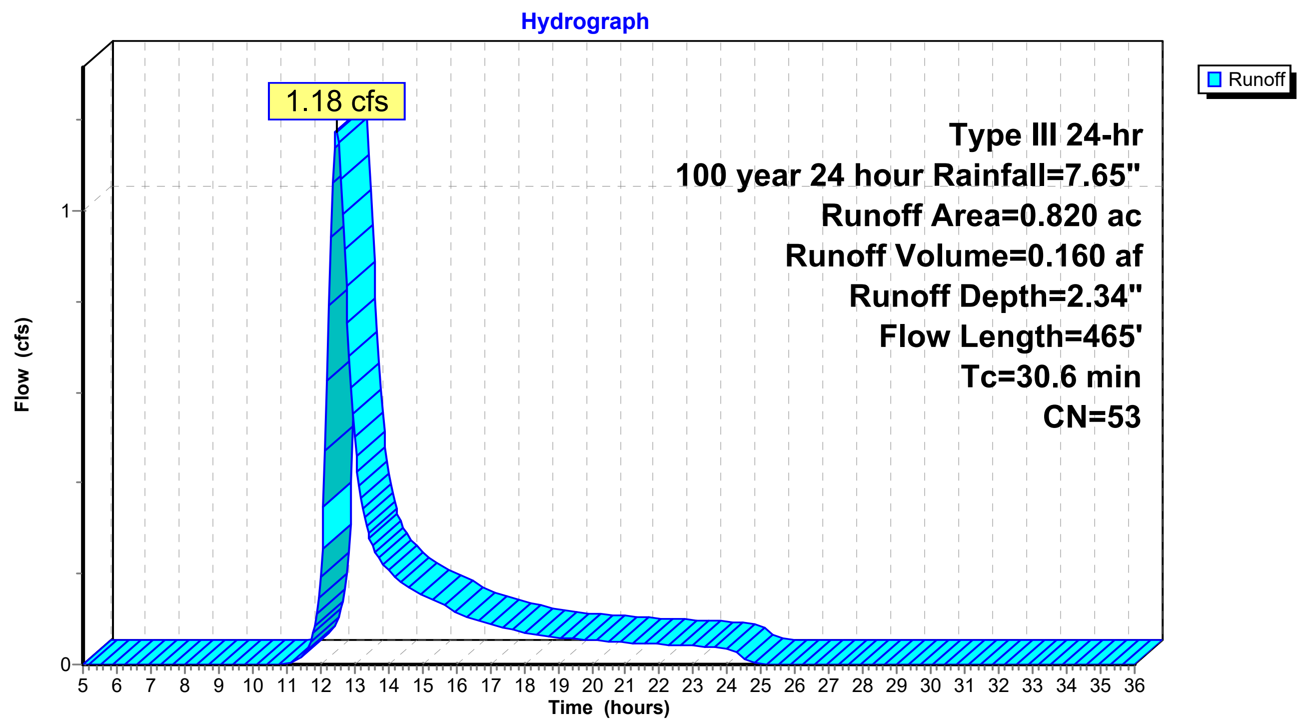
Runoff = 1.18 cfs @ 12.47 hrs, Volume= 0.160 af, Depth= 2.34"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 year 24 hour Rainfall=7.65"

	Area (ac)	CN	Description
	0.500	30	Meadow, non-grazed, HSG A
	0.150	78	Meadow, non-grazed, HSG D
*	0.170	98	New Impervious
	0.820	53	Weighted Average
	0.650		79.27% Pervious Area
	0.170		20.73% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
24.2	150	0.0310	0.10		**Sheet Flow, Meadow** n= 0.400 P2= 3.40"
4.7	45	0.0010	0.16		**Shallow Concentrated Flow, Meadow** Kv= 5.0 fps
1.7	270	0.0280	2.65	31.81	**Channel Flow,** Area= 12.0 sf Perim= 10.9' r= 1.10' n= 0.100 Earth, dense brush, high stage
30.6	465	Total			

Subcatchment P1E: Post Watershed 1E



Summary for Subcatchment P1F: Post Watershed 1F

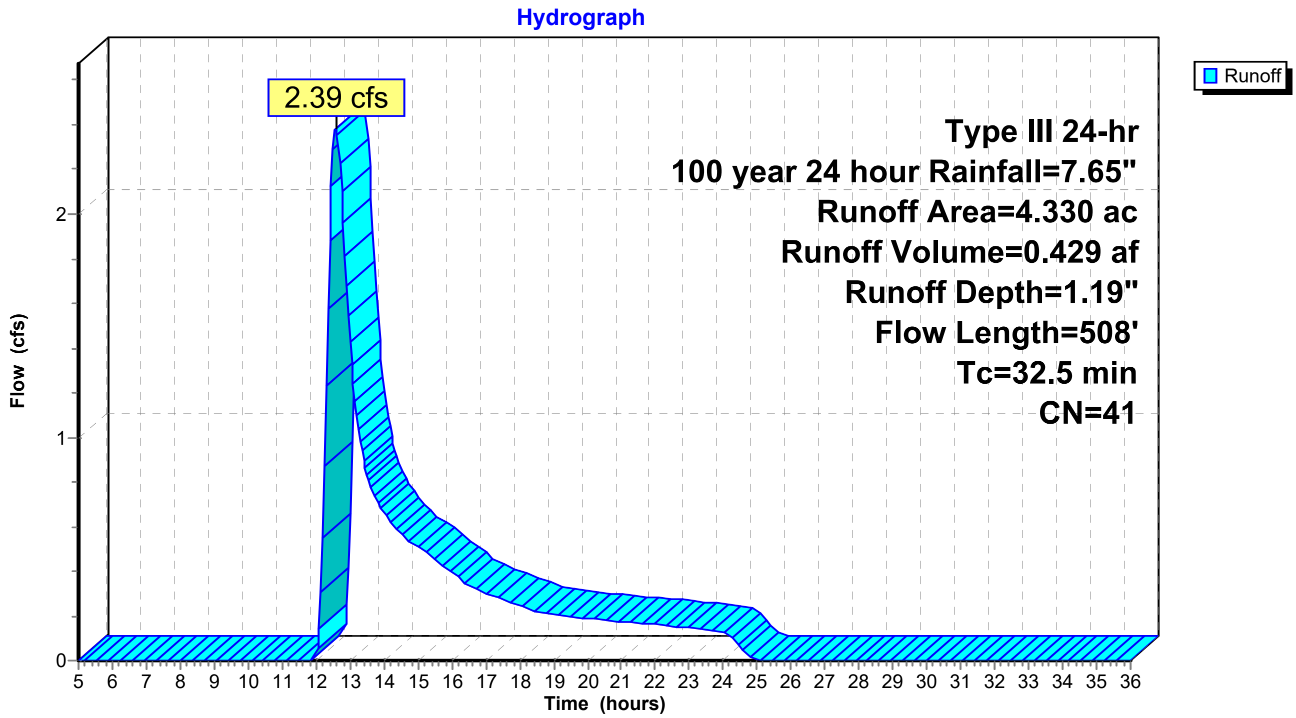
Runoff = 2.39 cfs @ 12.58 hrs, Volume= 0.429 af, Depth= 1.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 year 24 hour Rainfall=7.65"

	Area (ac)	CN	Description
	0.730	30	Woods, Good, HSG A
	0.260	77	Woods, Good, HSG D
	0.170	39	Pasture/grassland/range, Good, HSG A
	0.100	80	Pasture/grassland/range, Good, HSG D
	2.530	30	Meadow, non-grazed, HSG A
	0.490	78	Meadow, non-grazed, HSG D
*	0.050	98	New Impervious
	4.330	41	Weighted Average
	4.280		98.85% Pervious Area
	0.050		1.15% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.4	150	0.0420	0.12		**Sheet Flow, Meadow** n= 0.400 P2= 3.40"
1.8	108	0.0420	1.02		**Shallow Concentrated Flow, Meadow** Kv= 5.0 fps
9.3	250	0.0080	0.45		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
32.5	508	Total			

Subcatchment P1F: Post Watershed 1F



Summary for Subcatchment P2A: Post Watershed 2A

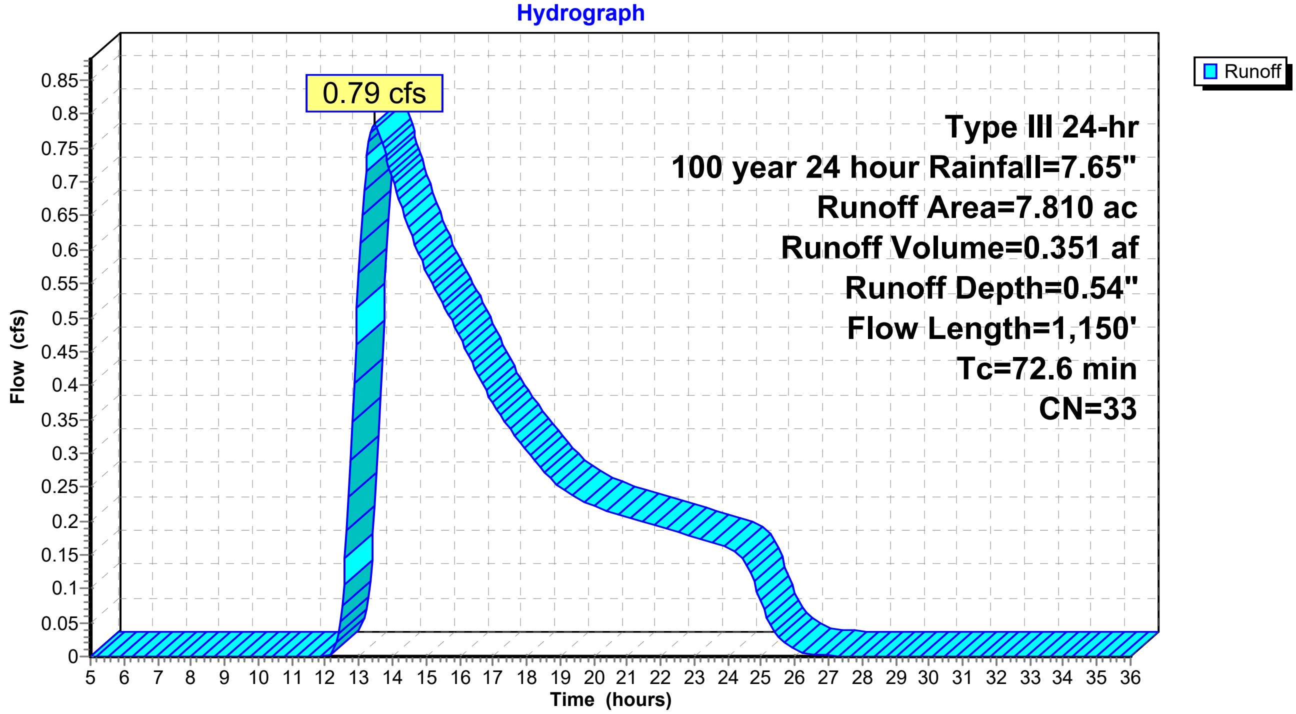
Runoff = 0.79 cfs @ 13.47 hrs, Volume= 0.351 af, Depth= 0.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 year 24 hour Rainfall=7.65"

Area (ac)	CN	Description
1.050	30	Woods, Good, HSG A
0.500	77	Woods, Good, HSG D
0.050	39	Pasture/grassland/range, Good, HSG A
0.010	80	Pasture/grassland/range, Good, HSG D
6.140	30	Meadow, non-grazed, HSG A
0.060	78	Meadow, non-grazed, HSG D
7.810	33	Weighted Average
7.810		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
43.9	150	0.0070	0.06		**Sheet Flow, Meadow** n= 0.400 P2= 3.40"
9.3	405	0.0210	0.72		**Shallow Concentrated Flow, Meadow** Kv= 5.0 fps
16.3	345	0.0050	0.35		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
3.1	250	0.0050	1.36	10.20	**Channel Flow,** Area= 7.5 sf Perim= 8.7' r= 0.86' n= 0.070 Sluggish weedy reaches w/pools
72.6	1,150	Total			

Subcatchment P2A: Post Watershed 2A



Summary for Subcatchment P2B: Post Watershed 2B

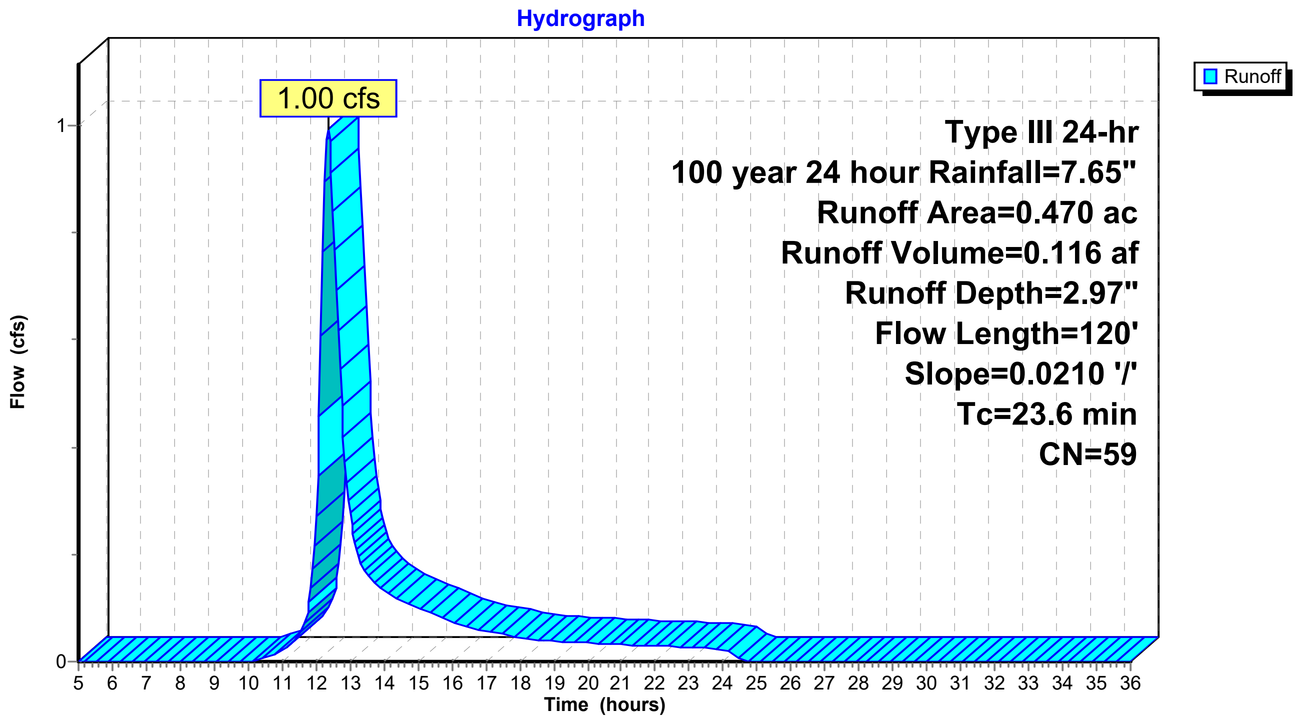
Runoff = 1.00 cfs @ 12.35 hrs, Volume= 0.116 af, Depth= 2.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 year 24 hour Rainfall=7.65"

	Area (ac)	CN	Description
	0.260	30	Meadow, non-grazed, HSG A
	0.010	30	Woods, Good, HSG A
*	0.200	98	New Impervious
	0.470	59	Weighted Average
	0.270		57.45% Pervious Area
	0.200		42.55% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.6	120	0.0210	0.08		**Sheet Flow, Meadow** n= 0.400 P2= 3.40"

Subcatchment P2B: Post Watershed 2B



Summary for Subcatchment P2C: Post Watershed 2C

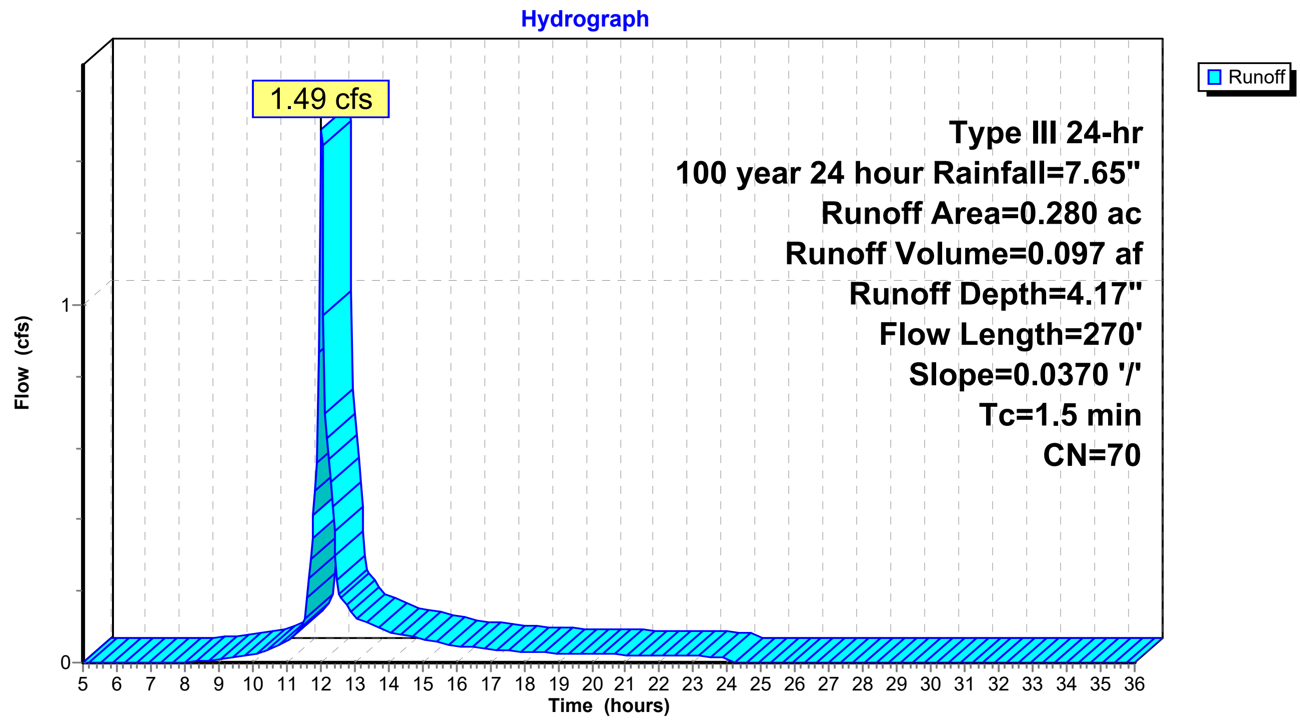
Runoff = 1.49 cfs @ 12.03 hrs, Volume= 0.097 af, Depth= 4.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 year 24 hour Rainfall=7.65"

	Area (ac)	CN	Description
	0.100	30	Meadow, non-grazed, HSG A
	0.020	78	Meadow, non-grazed, HSG D
	0.010	30	Woods, Good, HSG A
*	0.150	98	New Impervious
	0.280	70	Weighted Average
	0.130		46.43% Pervious Area
	0.150		53.57% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.5	270	0.0370	3.05	36.57	**Channel Flow,** Area= 12.0 sf Perim= 10.9' r= 1.10' n= 0.100 Earth, dense brush, high stage

Subcatchment P2C: Post Watershed 2C



Summary for Subcatchment P2D: Post Watershed 2D

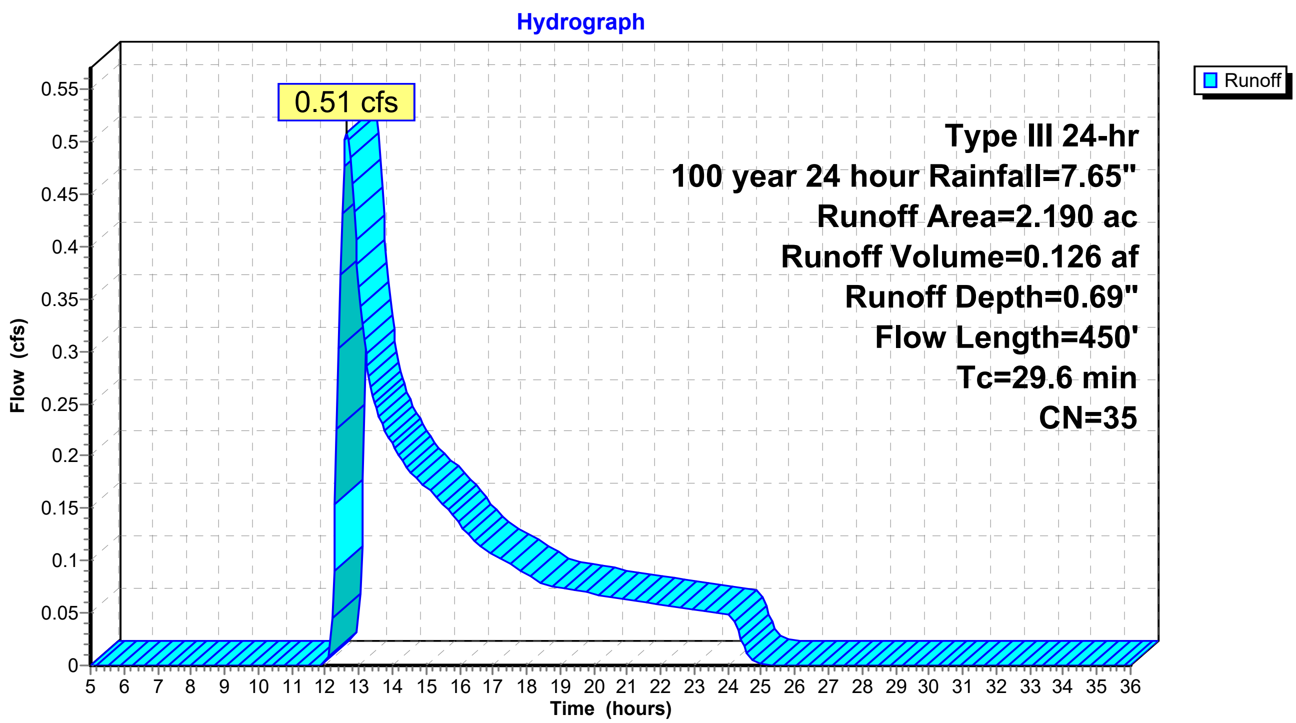
Runoff = 0.51 cfs @ 12.65 hrs, Volume= 0.126 af, Depth= 0.69"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 year 24 hour Rainfall=7.65"

	Area (ac)	CN	Description
	2.030	30	Meadow, non-grazed, HSG A
	0.010	78	Meadow, non-grazed, HSG D
*	0.150	98	New Impervious
	2.190	35	Weighted Average
	2.040		93.15% Pervious Area
	0.150		6.85% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
24.5	150	0.0300	0.10		**Sheet Flow, Meadow** n= 0.400 P2= 3.40"
5.1	300	0.0380	0.97		**Shallow Concentrated Flow, Meadow** Kv= 5.0 fps
29.6	450	Total			

Subcatchment P2D: Post Watershed 2D



Summary for Subcatchment P2E: Post Watershed 2E

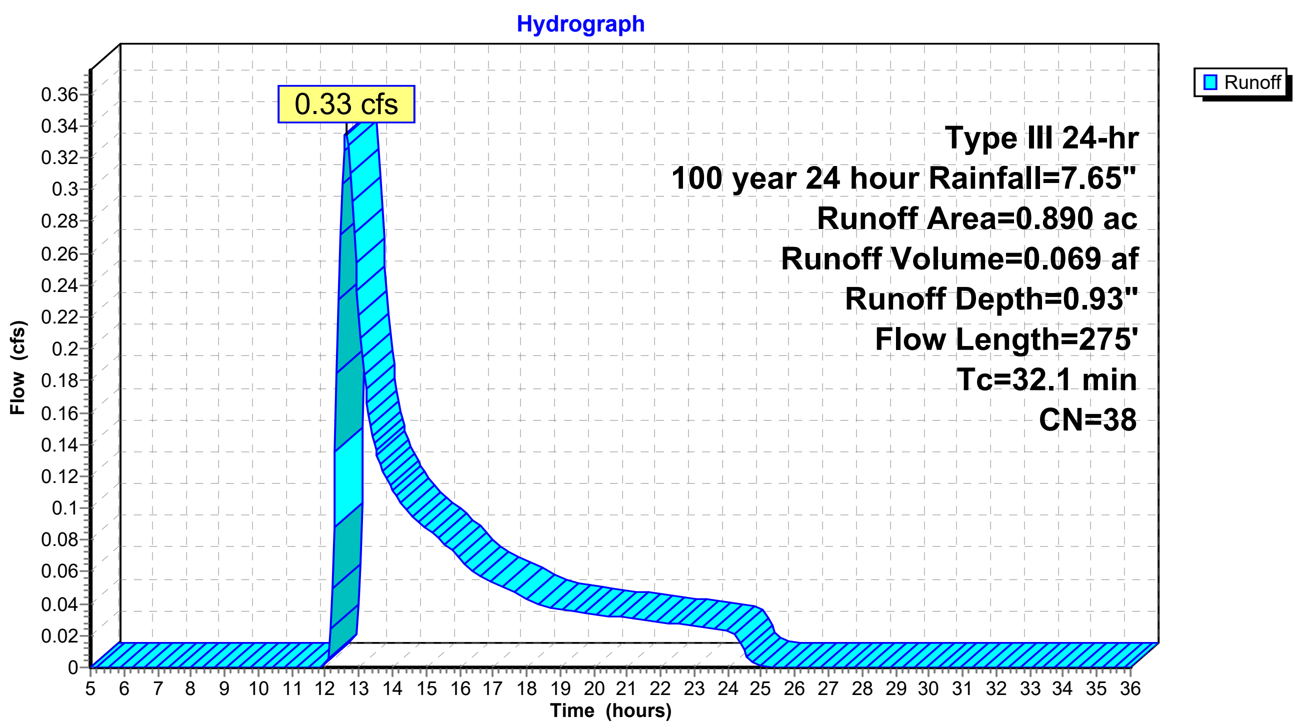
Runoff = 0.33 cfs @ 12.62 hrs, Volume= 0.069 af, Depth= 0.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 year 24 hour Rainfall=7.65"

	Area (ac)	CN	Description
	0.790	30	Meadow, non-grazed, HSG A
*	0.100	98	New Impervious
	0.890	38	Weighted Average
	0.790		88.76% Pervious Area
	0.100		11.24% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
30.1	150	0.0180	0.08		**Sheet Flow, Meadow** n= 0.400 P2= 3.40"
2.0	125	0.0450	1.06		**Shallow Concentrated Flow, Meadow** Kv= 5.0 fps
32.1	275	Total			

Subcatchment P2E: Post Watershed 2E



Summary for Subcatchment P3A: Post Watershed 3A

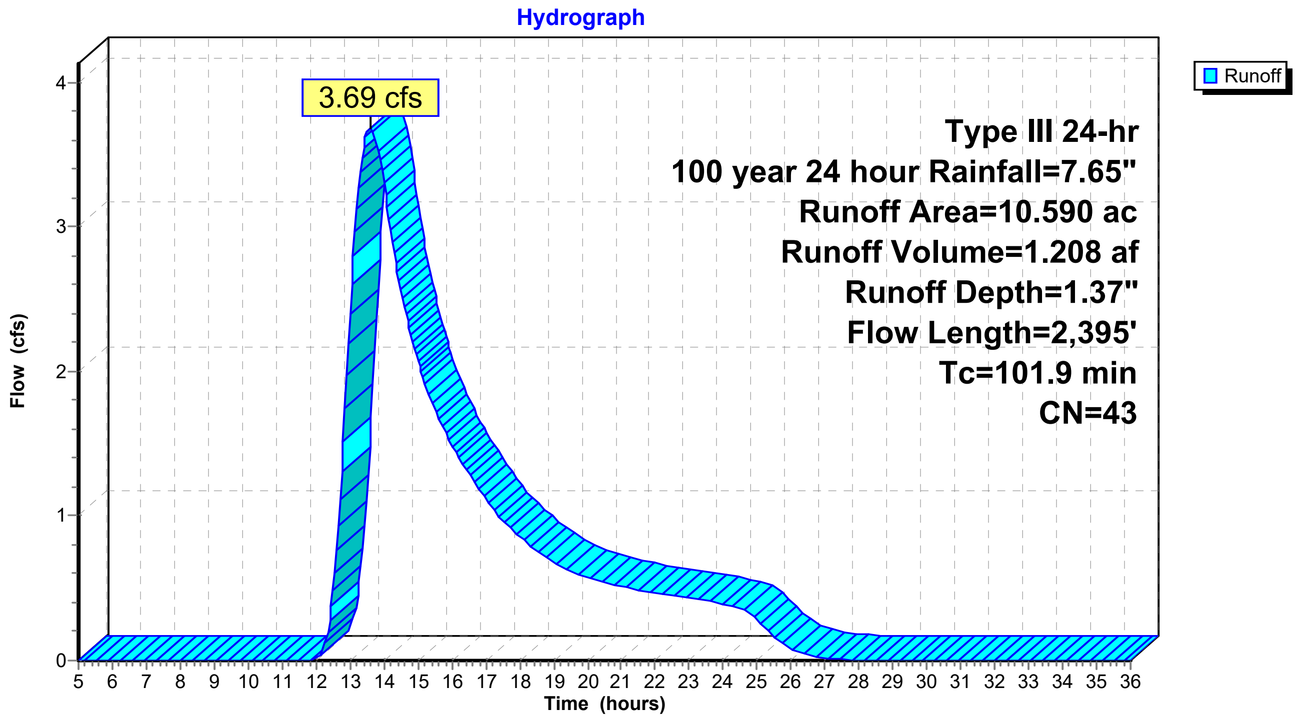
Runoff = 3.69 cfs @ 13.60 hrs, Volume= 1.208 af, Depth= 1.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 year 24 hour Rainfall=7.65"

	Area (ac)	CN	Description
	0.090	30	Woods, Good, HSG A
	0.860	77	Woods, Good, HSG D
	7.680	30	Meadow, non-grazed, HSG A
	1.880	78	Meadow, non-grazed, HSG D
*	0.080	98	New Impervious
	10.590	43	Weighted Average
	10.510		99.24% Pervious Area
	0.080		0.76% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.8	150	0.0400	0.11		**Sheet Flow, Meadow** n= 0.400 P2= 3.40"
3.3	170	0.0290	0.85		**Shallow Concentrated Flow, Meadow** Kv= 5.0 fps
2.4	105	0.0220	0.74		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
67.9	1,440	0.0050	0.35		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
6.5	530	0.0050	1.36	10.20	**Channel Flow,** Area= 7.5 sf Perim= 8.7' r= 0.86' n= 0.070
101.9	2,395	Total			

Subcatchment P3A: Post Watershed 3A



Summary for Subcatchment P3B: Post Watershed 3B

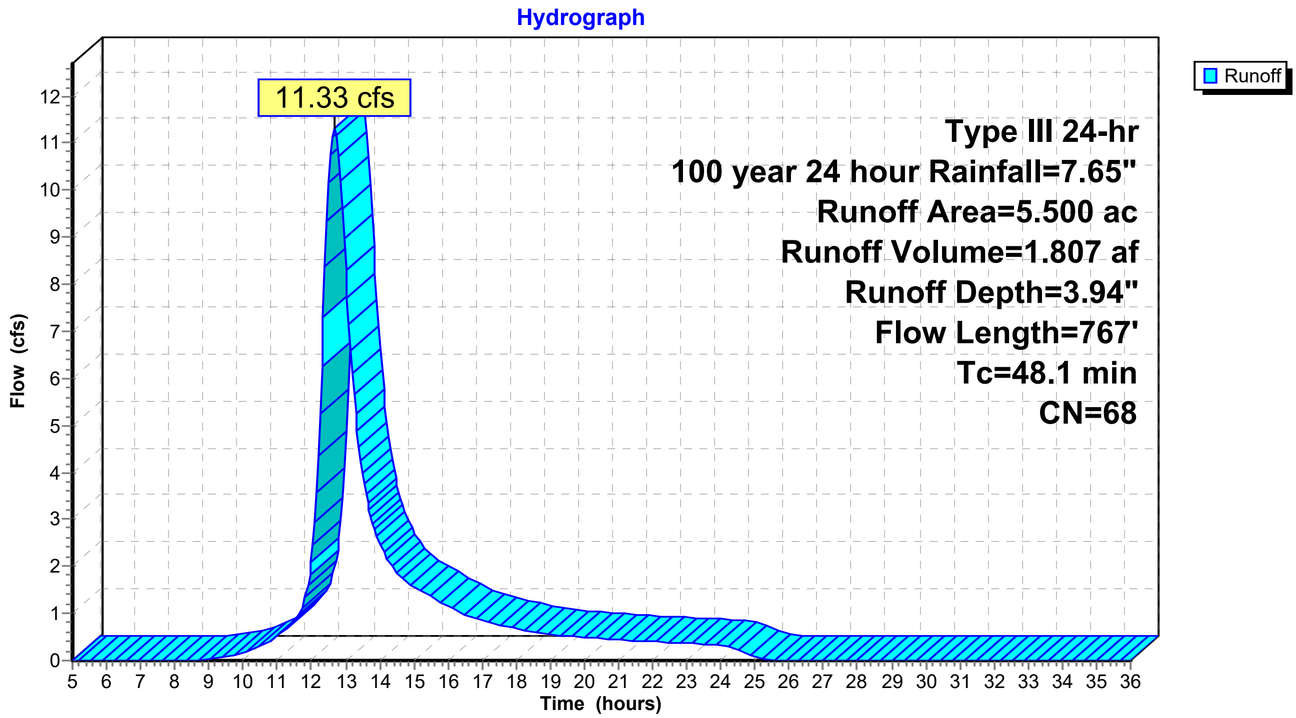
Runoff = 11.33 cfs @ 12.67 hrs, Volume= 1.807 af, Depth= 3.94"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Type III 24-hr 100 year 24 hour Rainfall=7.65"

	Area (ac)	CN	Description
	0.260	30	Woods, Good, HSG A
	0.720	77	Woods, Good, HSG D
	0.190	39	Pasture/grassland/range, Good, HSG A
	0.120	80	Pasture/grassland/range, Good, HSG D
	0.770	30	Meadow, non-grazed, HSG A
	3.370	78	Meadow, non-grazed, HSG D
*	0.070	98	New Impervious
	5.500	68	Weighted Average
	5.430		98.73% Pervious Area
	0.070		1.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
34.2	150	0.0130	0.07		**Sheet Flow, Meadow** n= 0.400 P2= 3.40"
3.4	152	0.0220	0.74		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
10.5	465	0.0220	0.74		**Shallow Concentrated Flow, Meadow** Kv= 5.0 fps
48.1	767	Total			

Subcatchment P3B: Post Watershed 3B



Summary for Pond 1P: Level Lip Spreader LS1

Inflow Area = 0.340 ac, 58.82% Impervious, Inflow Depth > 6.43" for 100 year 24 hour event
Inflow = 2.62 cfs @ 12.05 hrs, Volume= 0.182 af
Outflow = 2.39 cfs @ 12.07 hrs, Volume= 0.130 af, Atten= 9%, Lag= 1.7 min
Primary = 2.39 cfs @ 12.07 hrs, Volume= 0.130 af

Routing by Stor-Ind method, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 116.39' @ 12.07 hrs Surf.Area= 2,776 sf Storage= 2,645 cf

Plug-Flow detention time= 158.6 min calculated for 0.130 af (71% of inflow)
Center-of-Mass det. time= 68.6 min (845.5 - 776.9)

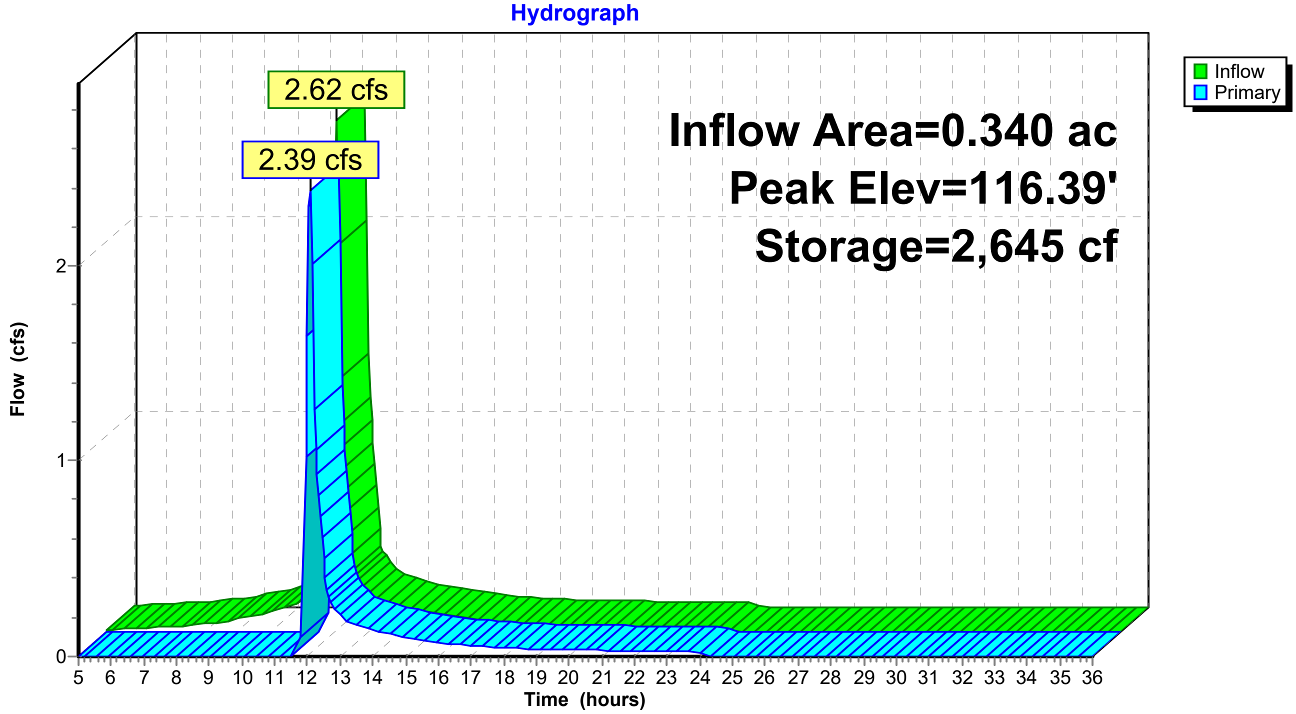
Volume	Invert	Avail.Storage	Storage Description
#1	114.50'	2,971 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
114.50	229	0	0
115.00	739	242	242
116.00	2,160	1,450	1,692
116.50	2,958	1,280	2,971

Device	Routing	Invert	Outlet Devices
#1	Primary	116.25'	**20.0' long x 4.0' 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) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Primary OutFlow Max=2.30 cfs @ 12.07 hrs HW=116.38' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Weir Controls 2.30 cfs @ 0.87 fps)

Pond 1P: Level Lip Spreader LS1



Summary for Pond 2P: Level Lip Spreader LS2

Inflow Area = 0.120 ac, 58.33% Impervious, Inflow Depth > 6.43" for 100 year 24 hour event
Inflow = 0.96 cfs @ 12.01 hrs, Volume= 0.064 af
Outflow = 0.06 cfs @ 13.42 hrs, Volume= 0.018 af, Atten= 94%, Lag= 84.7 min
Primary = 0.06 cfs @ 13.42 hrs, Volume= 0.018 af

Routing by Stor-Ind method, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 116.26' @ 13.42 hrs Surf.Area= 1,210 sf Storage= 2,047 cf

Plug-Flow detention time= 398.8 min calculated for 0.017 af (27% of inflow)
Center-of-Mass det. time= 236.7 min (1,011.7 - 775.0)

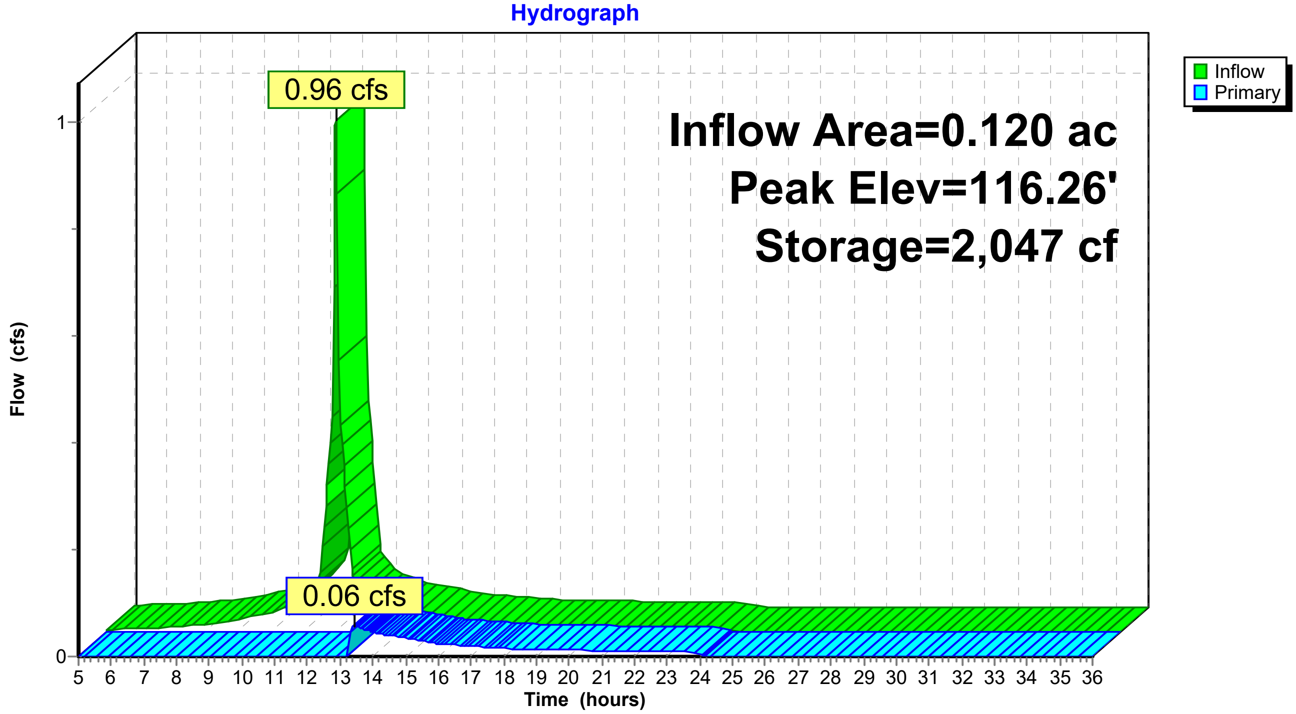
Volume	Invert	Avail.Storage	Storage Description
#1	112.00'	2,357 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
112.00	104	0	0
113.00	210	157	157
114.00	357	284	441
115.00	605	481	922
116.00	1,061	833	1,755
116.50	1,350	603	2,357

Device	Routing	Invert	Outlet Devices
#1	Primary	116.25'	**20.0' long x 4.0' 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) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Primary OutFlow Max=0.03 cfs @ 13.42 hrs HW=116.26' (Free Discharge)
1=Broad-Crested Rectangular Weir (Weir Controls 0.03 cfs @ 0.21 fps)

Pond 2P: Level Lip Spreader LS2



Summary for Pond 3P: Level Lip Spreader LS3

Inflow Area = 1.090 ac, 21.10% Impervious, Inflow Depth = 1.75" for 100 year 24 hour event
Inflow = 0.93 cfs @ 12.65 hrs, Volume= 0.159 af
Outflow = 0.07 cfs @ 18.67 hrs, Volume= 0.029 af, Atten= 92%, Lag= 361.3 min
Primary = 0.07 cfs @ 18.67 hrs, Volume= 0.029 af

Routing by Stor-Ind method, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 116.26' @ 18.67 hrs Surf.Area= 3,280 sf Storage= 5,673 cf

Plug-Flow detention time= 526.0 min calculated for 0.029 af (18% of inflow)
Center-of-Mass det. time= 357.4 min (1,273.1 - 915.8)

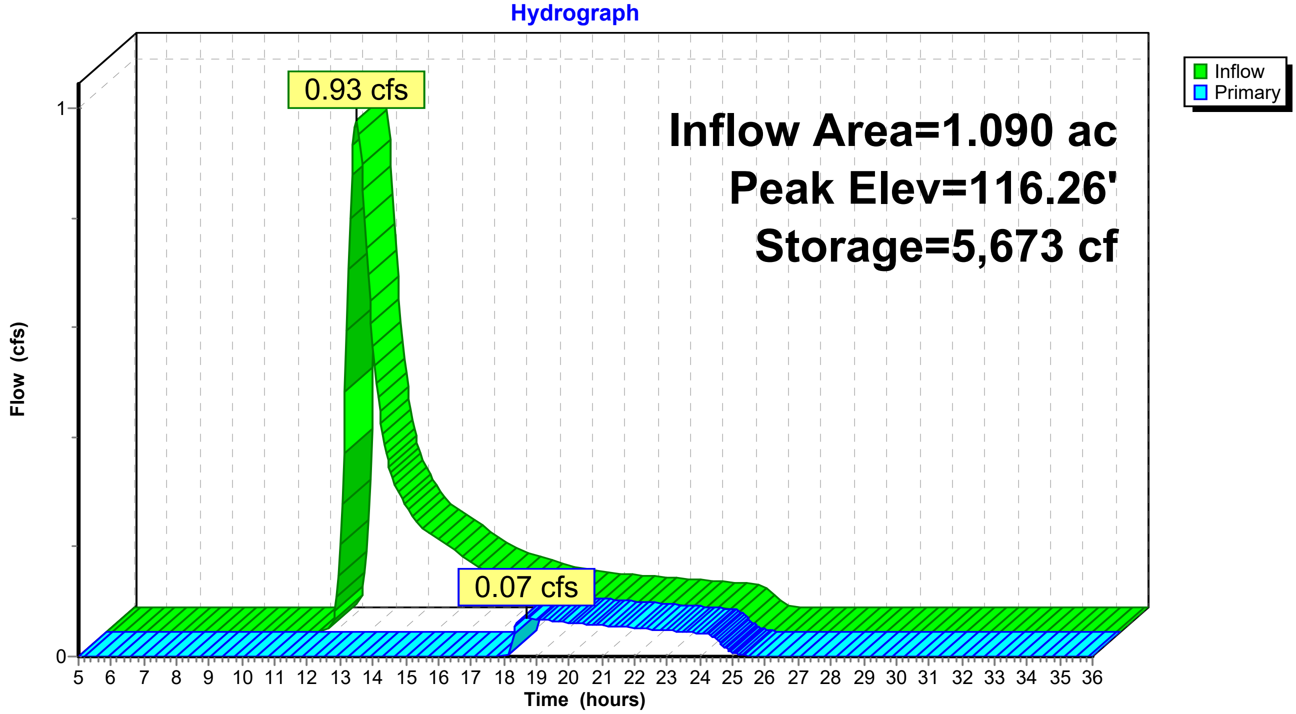
Volume	Invert	Avail.Storage	Storage Description
#1	112.00'	6,496 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
112.00	318	0	0
113.00	570	444	444
114.00	917	744	1,188
115.00	1,722	1,320	2,507
116.00	2,986	2,354	4,861
116.50	3,553	1,635	6,496

Device	Routing	Invert	Outlet Devices
#1	Primary	116.25'	**20.0' long x 4.0' 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) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Primary OutFlow Max=0.04 cfs @ 18.67 hrs HW=116.26' (Free Discharge)
1=Broad-Crested Rectangular Weir (Weir Controls 0.04 cfs @ 0.23 fps)

Pond 3P: Level Lip Spreader LS3



Summary for Pond 4P: Level Lip Spreader LS4

Inflow Area = 0.820 ac, 20.73% Impervious, Inflow Depth = 2.34" for 100 year 24 hour event
Inflow = 1.18 cfs @ 12.47 hrs, Volume= 0.160 af
Outflow = 0.95 cfs @ 12.77 hrs, Volume= 0.109 af, Atten= 19%, Lag= 18.0 min
Primary = 0.95 cfs @ 12.77 hrs, Volume= 0.109 af

Routing by Stor-Ind method, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 109.32' @ 12.77 hrs Surf.Area= 1,229 sf Storage= 2,314 cf

Plug-Flow detention time= 179.0 min calculated for 0.109 af (68% of inflow)
Center-of-Mass det. time= 70.9 min (959.3 - 888.4)

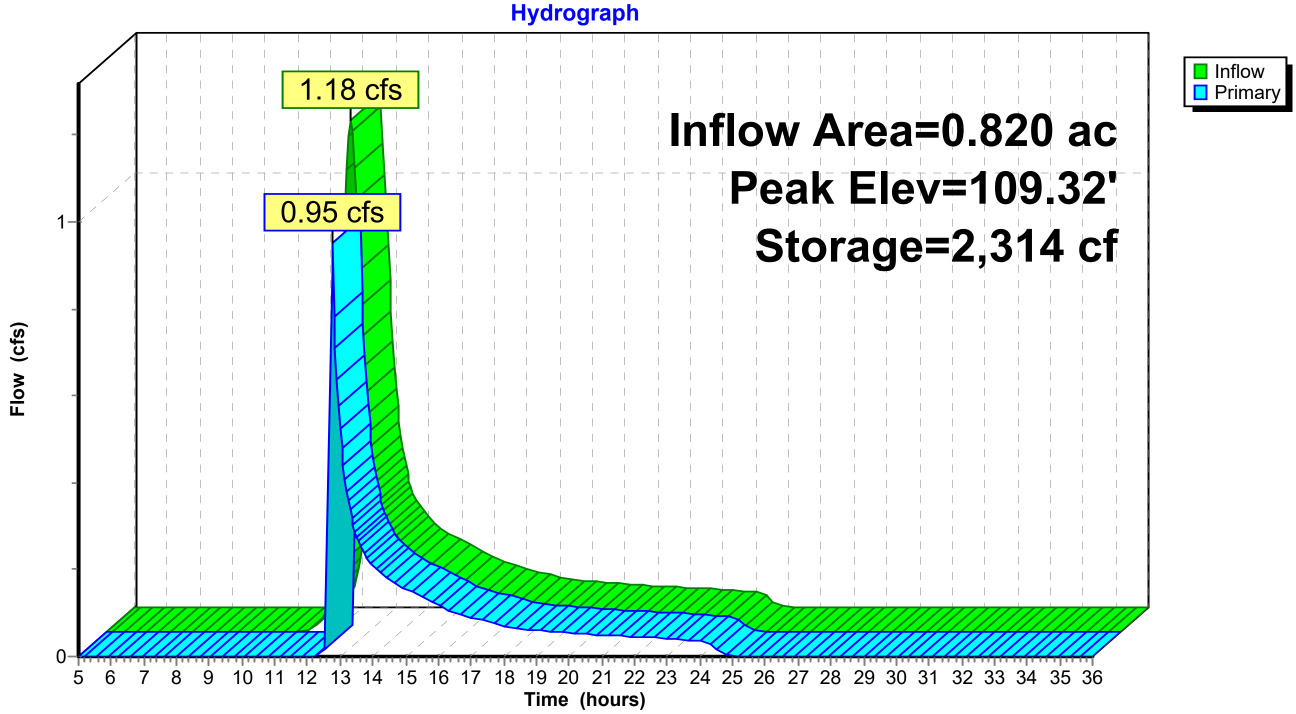
Volume	Invert	Avail.Storage	Storage Description
#1	106.00'	2,535 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
106.00	263	0	0
107.00	483	373	373
108.00	765	624	997
109.00	1,110	938	1,935
109.50	1,293	601	2,535

Device	Routing	Invert	Outlet Devices
#1	Primary	109.25'	**20.0' long x 4.0' 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) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Primary OutFlow Max=0.83 cfs @ 12.77 hrs HW=109.32' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Weir Controls 0.83 cfs @ 0.62 fps)

Pond 4P: Level Lip Spreader LS4



Summary for Pond 5P: Level Lip Spreader LS5

Inflow Area = 4.330 ac, 1.15% Impervious, Inflow Depth = 1.19" for 100 year 24 hour event
Inflow = 2.39 cfs @ 12.58 hrs, Volume= 0.429 af
Outflow = 1.94 cfs @ 12.87 hrs, Volume= 0.337 af, Atten= 19%, Lag= 17.3 min
Primary = 1.94 cfs @ 12.87 hrs, Volume= 0.337 af

Routing by Stor-Ind method, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 109.36' @ 12.87 hrs Surf.Area= 2,242 sf Storage= 4,247 cf

Plug-Flow detention time= 141.8 min calculated for 0.337 af (79% of inflow)
Center-of-Mass det. time= 52.7 min (984.6 - 931.9)

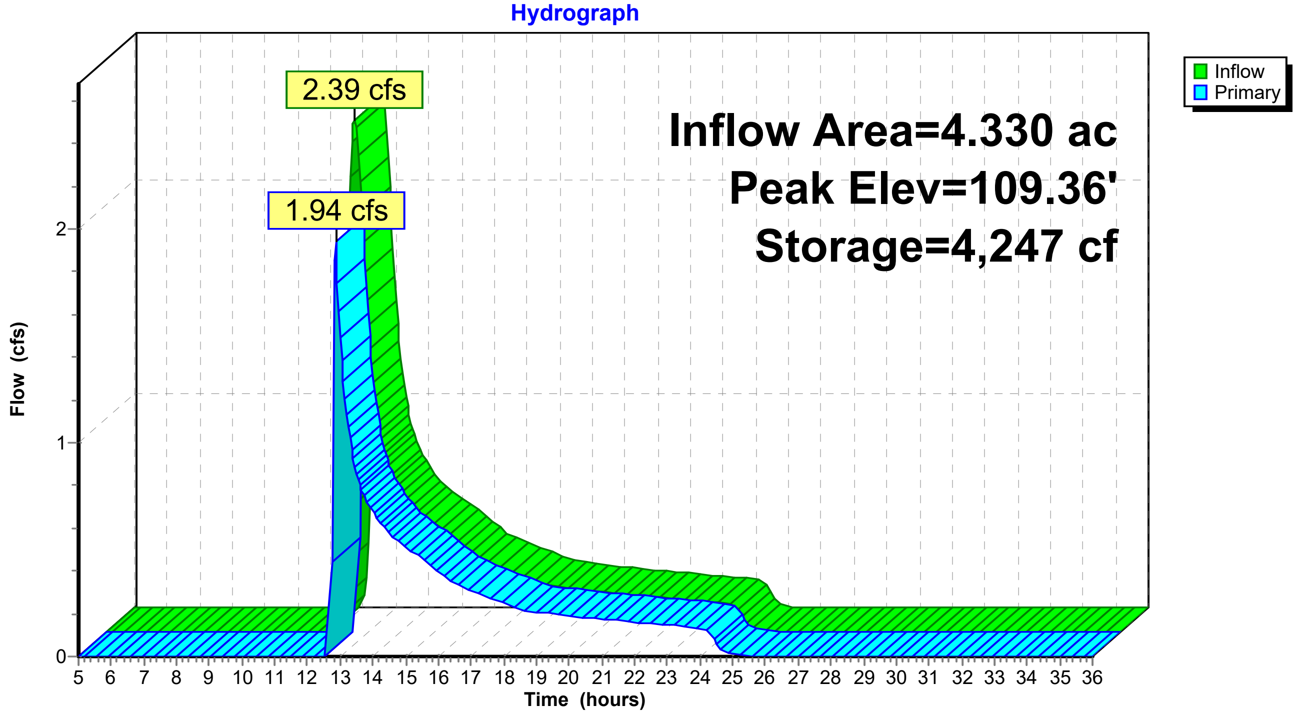
Volume	Invert	Avail.Storage	Storage Description
#1	106.00'	4,568 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
106.00	541	0	0
107.00	892	717	717
108.00	1,326	1,109	1,826
109.00	1,993	1,660	3,485
109.50	2,339	1,083	4,568

Device	Routing	Invert	Outlet Devices
#1	Primary	109.25'	**20.0' long x 18.0' 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

Primary OutFlow Max=1.80 cfs @ 12.87 hrs HW=109.35' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Weir Controls 1.80 cfs @ 0.86 fps)

Pond 5P: Level Lip Spreader LS5



Summary for Pond 6P: Level Lip Spreader LS6

Inflow Area = 0.470 ac, 42.55% Impervious, Inflow Depth = 2.97" for 100 year 24 hour event
Inflow = 1.00 cfs @ 12.35 hrs, Volume= 0.116 af
Outflow = 0.08 cfs @ 15.61 hrs, Volume= 0.113 af, Atten= 91%, Lag= 195.5 min
Discarded = 0.08 cfs @ 15.61 hrs, Volume= 0.113 af
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 104.12' @ 15.61 hrs Surf.Area= 1,422 sf Storage= 2,776 cf

Plug-Flow detention time= 433.8 min calculated for 0.113 af (97% of inflow)
Center-of-Mass det. time= 419.4 min (1,286.5 - 867.2)

Volume	Invert	Avail.Storage	Storage Description
#1	101.00'	3,342 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

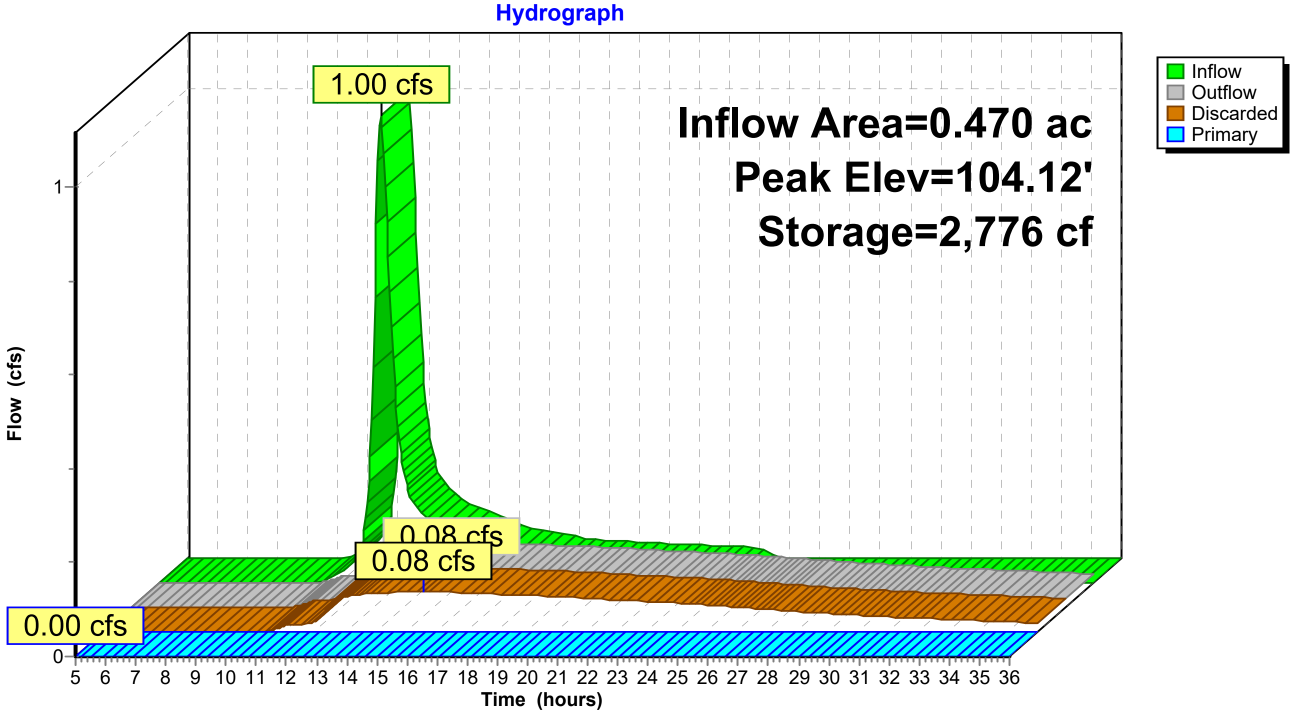
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
101.00	451	0	0
102.00	695	573	573
103.00	998	847	1,420
104.00	1,374	1,186	2,606
104.50	1,570	736	3,342

Device	Routing	Invert	Outlet Devices
#1	Primary	104.25'	**20.0' long x 4.0' 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) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32
#2	Discarded	101.00'	**1.420 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 99.00'

Discarded OutFlow Max=0.08 cfs @ 15.61 hrs HW=104.12' (Free Discharge)
└─**2=Exfiltration** (Controls 0.08 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=101.00' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 6P: Level Lip Spreader LS6



Summary for Pond 7P: Level Lip Spreader LS7

Inflow Area =	0.280 ac, 53.57% Impervious,	Inflow Depth = 4.17"	for 100 year 24 hour event	
Inflow =	1.49 cfs @	12.03 hrs, Volume=	0.097 af	
Outflow =	0.48 cfs @	12.36 hrs, Volume=	0.097 af,	Atten= 68%, Lag= 19.7 min
Discarded =	0.06 cfs @	12.36 hrs, Volume=	0.082 af	
Primary =	0.42 cfs @	12.36 hrs, Volume=	0.015 af	

Routing by Stor-Ind method, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 95.29' @ 12.36 hrs Surf.Area= 1,128 sf Storage= 1,795 cf

Plug-Flow detention time= 309.4 min calculated for 0.097 af (100% of inflow)
Center-of-Mass det. time= 309.8 min (1,132.4 - 822.6)

Volume	Invert	Avail.Storage	Storage Description
#1	93.00'	2,037 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

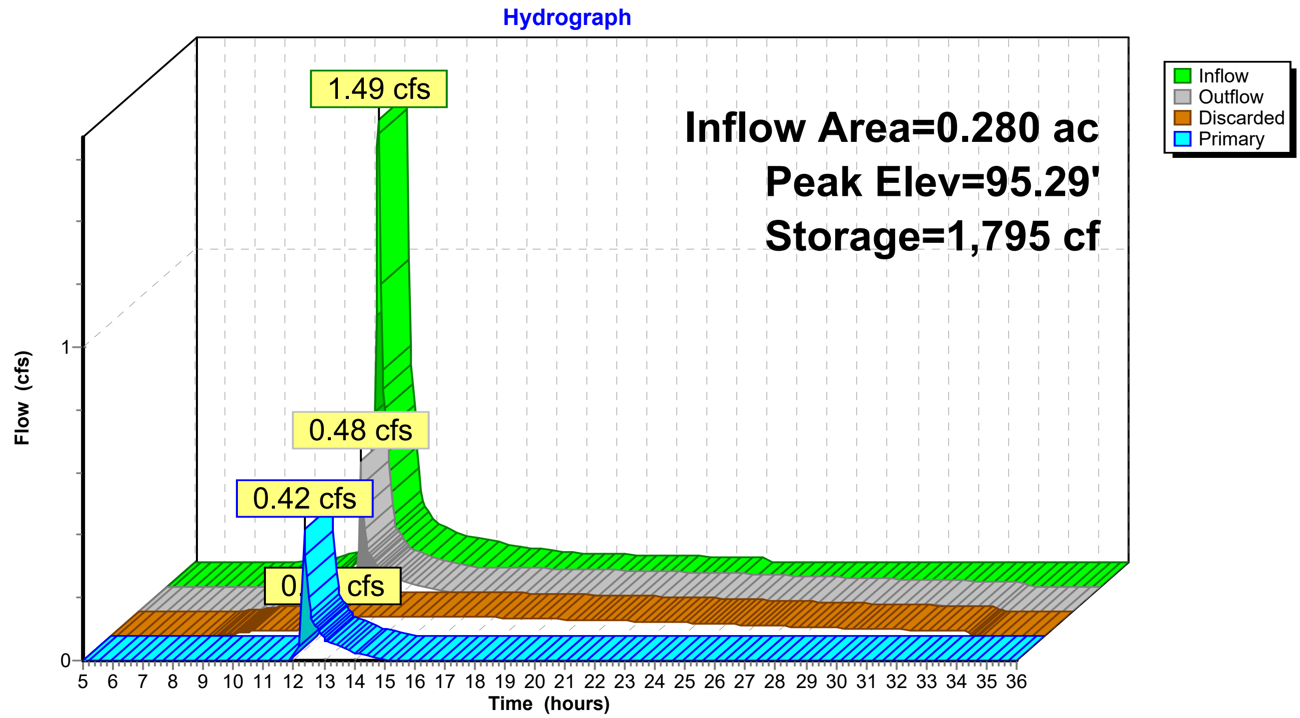
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
93.00	462	0	0
94.00	730	596	596
95.00	1,037	884	1,480
95.50	1,193	558	2,037

Device	Routing	Invert	Outlet Devices
#1	Primary	95.25'	**20.0' long x 4.0' 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) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32
#2	Discarded	93.00'	**1.420 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 91.00'

Discarded OutFlow Max=0.06 cfs @ 12.36 hrs HW=95.29' (Free Discharge)
└─**2=Exfiltration** (Controls 0.06 cfs)

Primary OutFlow Max=0.39 cfs @ 12.36 hrs HW=95.29' (Free Discharge)
└─**1=Broad-Crested Rectangular Weir** (Weir Controls 0.39 cfs @ 0.48 fps)

Pond 7P: Level Lip Spreader LS7



Summary for Pond 8P: Infiltration Basin 1

Inflow Area = 2.190 ac, 6.85% Impervious, Inflow Depth = 0.69" for 100 year 24 hour event
Inflow = 0.51 cfs @ 12.65 hrs, Volume= 0.126 af
Outflow = 0.10 cfs @ 17.34 hrs, Volume= 0.125 af, Atten= 80%, Lag= 281.3 min
Discarded = 0.10 cfs @ 17.34 hrs, Volume= 0.125 af
Primary = 0.00 cfs @ 17.34 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 94.26' @ 17.34 hrs Surf.Area= 2,174 sf Storage= 2,297 cf

Plug-Flow detention time= 322.8 min calculated for 0.125 af (99% of inflow)
Center-of-Mass det. time= 318.7 min (1,285.7 - 967.0)

Volume	Invert	Avail.Storage	Storage Description
#1	92.00'	2,853 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

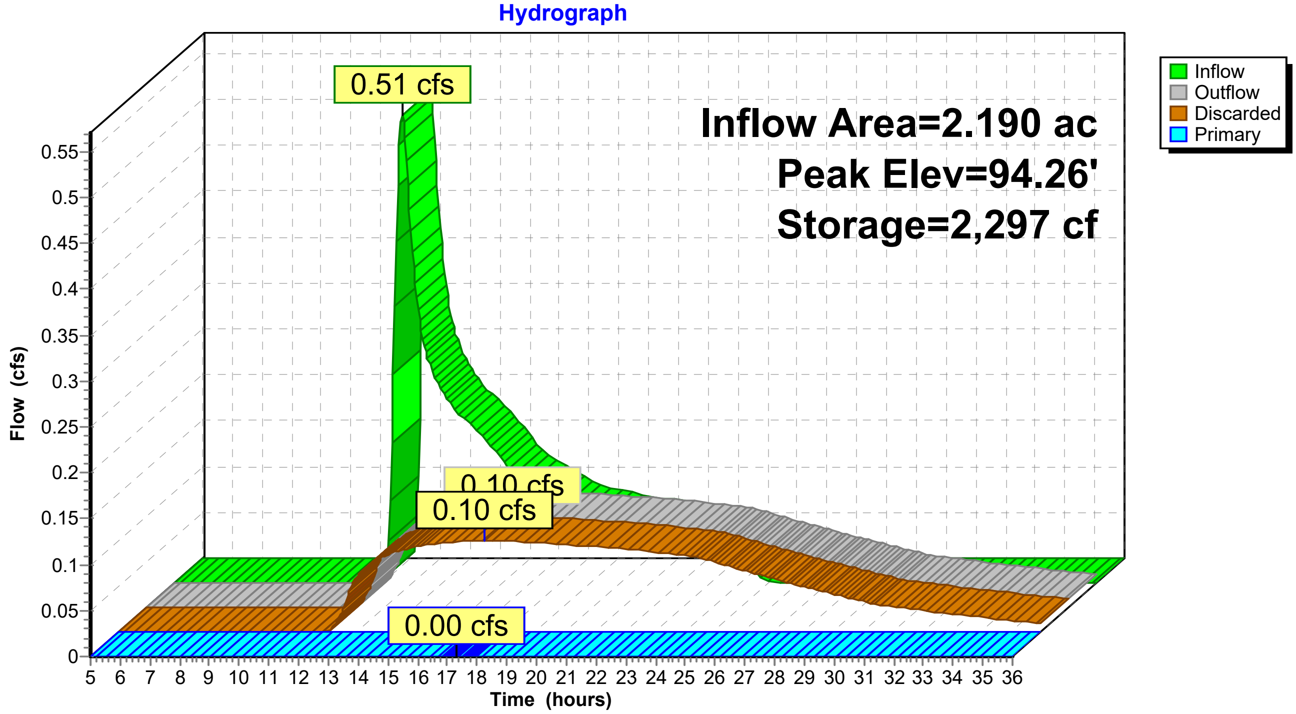
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
92.00	123	0	0
93.00	725	424	424
94.00	1,964	1,345	1,769
94.50	2,375	1,085	2,853

Device	Routing	Invert	Outlet Devices
#1	Discarded	92.00'	**1.420 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 90.00'
#2	Primary	94.25'	**15.0" Round Culvert** L= 40.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 94.25' / 93.50' S= 0.0187 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 1.23 sf

Discarded OutFlow Max=0.10 cfs @ 17.34 hrs HW=94.26' (Free Discharge)
1=Exfiltration (Controls 0.10 cfs)

Primary OutFlow Max=0.00 cfs @ 17.34 hrs HW=94.26' (Free Discharge)
2=Culvert (Inlet Controls 0.00 cfs @ 0.20 fps)

Pond 8P: Infiltration Basin 1



Summary for Pond 9P: Level Lip Spreader LS8

Inflow Area = 0.890 ac, 11.24% Impervious, Inflow Depth = 0.93" for 100 year 24 hour event
Inflow = 0.33 cfs @ 12.62 hrs, Volume= 0.069 af
Outflow = 0.06 cfs @ 16.62 hrs, Volume= 0.069 af, Atten= 83%, Lag= 239.9 min
Discarded = 0.06 cfs @ 16.62 hrs, Volume= 0.069 af
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 92.17' @ 16.62 hrs Surf.Area= 1,242 sf Storage= 1,291 cf

Plug-Flow detention time= 320.4 min calculated for 0.069 af (100% of inflow)
Center-of-Mass det. time= 319.1 min (1,267.0 - 947.9)

Volume	Invert	Avail.Storage	Storage Description
#1	90.00'	1,730 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

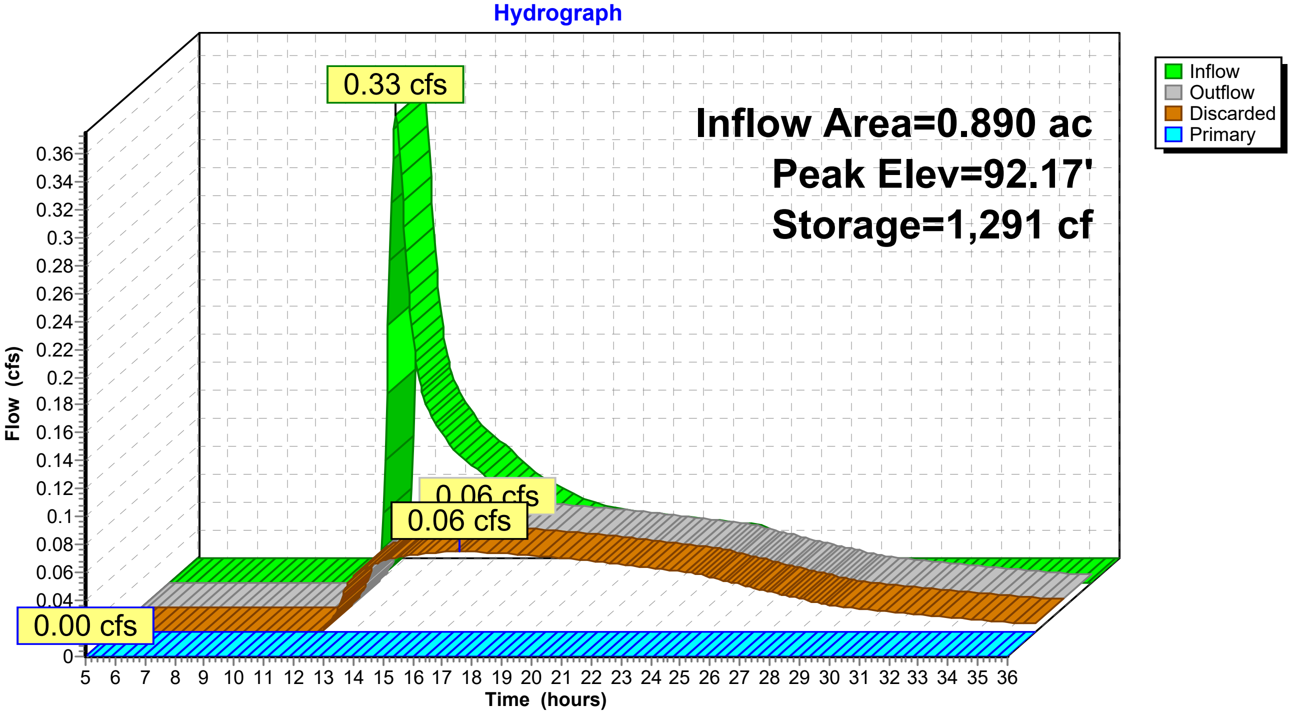
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
90.00	157	0	0
91.00	434	296	296
92.00	1,150	792	1,088
92.50	1,419	642	1,730

Device	Routing	Invert	Outlet Devices
#1	Discarded	90.00'	**1.420 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 88.00'
#2	Primary	92.25'	**20.0' long x 4.0' 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) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Discarded OutFlow Max=0.06 cfs @ 16.62 hrs HW=92.17' (Free Discharge)
└─**1=Exfiltration** (Controls 0.06 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=90.00' (Free Discharge)
└─**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 9P: Level Lip Spreader LS8



Summary for Pond 10P: Dry Basin 1

Inflow Area = 5.500 ac, 1.27% Impervious, Inflow Depth = 3.94" for 100 year 24 hour event
Inflow = 11.33 cfs @ 12.67 hrs, Volume= 1.807 af
Outflow = 4.75 cfs @ 13.37 hrs, Volume= 1.726 af, Atten= 58%, Lag= 42.3 min
Primary = 4.75 cfs @ 13.37 hrs, Volume= 1.726 af

Routing by Stor-Ind method, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs
Peak Elev= 94.64' @ 13.37 hrs Surf.Area= 13,804 sf Storage= 34,871 cf

Plug-Flow detention time= 311.5 min calculated for 1.726 af (96% of inflow)
Center-of-Mass det. time= 286.8 min (1,156.9 - 870.1)

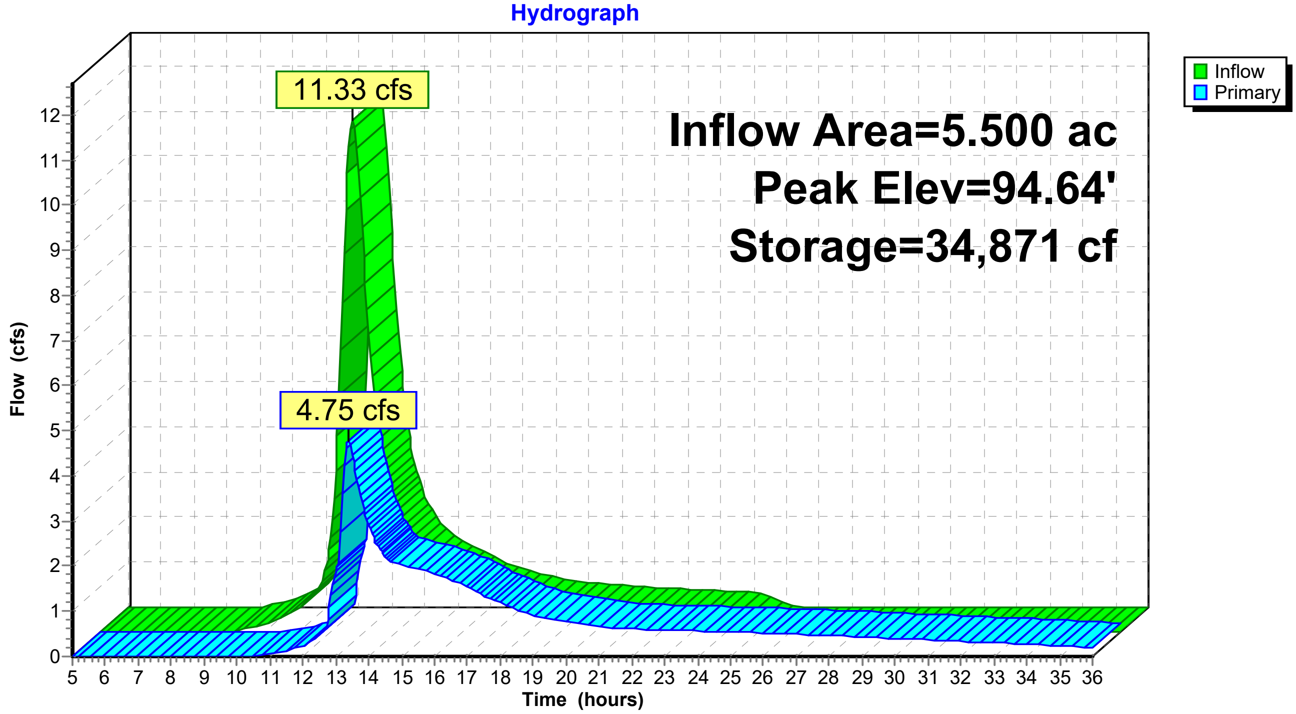
Volume	Invert	Avail.Storage	Storage Description
#1	91.50'	47,418 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
91.50	8,637	0	0
92.00	9,354	4,498	4,498
93.00	10,914	10,134	14,632
94.00	12,635	11,775	26,406
95.00	14,461	13,548	39,954
95.50	15,395	7,464	47,418

Device	Routing	Invert	Outlet Devices
#1	Primary	91.40'	**15.0" Round Culvert** L= 30.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 91.40' / 91.10' S= 0.0100 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 1.23 sf
#2	Device 1	91.50'	**4.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	93.50'	**8.0" Vert. Orifice/Grate** C= 0.600
#4	Primary	94.50'	**20.0' long x 4.0' 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) 2.38 2.54 2.69 2.68 2.67 2.67 2.65 2.66 2.66 2.68 2.72 2.73 2.76 2.79 2.88 3.07 3.32

Primary OutFlow Max=4.72 cfs @ 13.37 hrs HW=94.64' (Free Discharge)
1=Culvert (Passes 2.23 cfs of 7.54 cfs potential flow)
2=Orifice/Grate (Orifice Controls 0.72 cfs @ 8.30 fps)
3=Orifice/Grate (Orifice Controls 1.51 cfs @ 4.32 fps)
4=Broad-Crested Rectangular Weir (Weir Controls 2.48 cfs @ 0.89 fps)

Pond 10P: Dry Basin 1

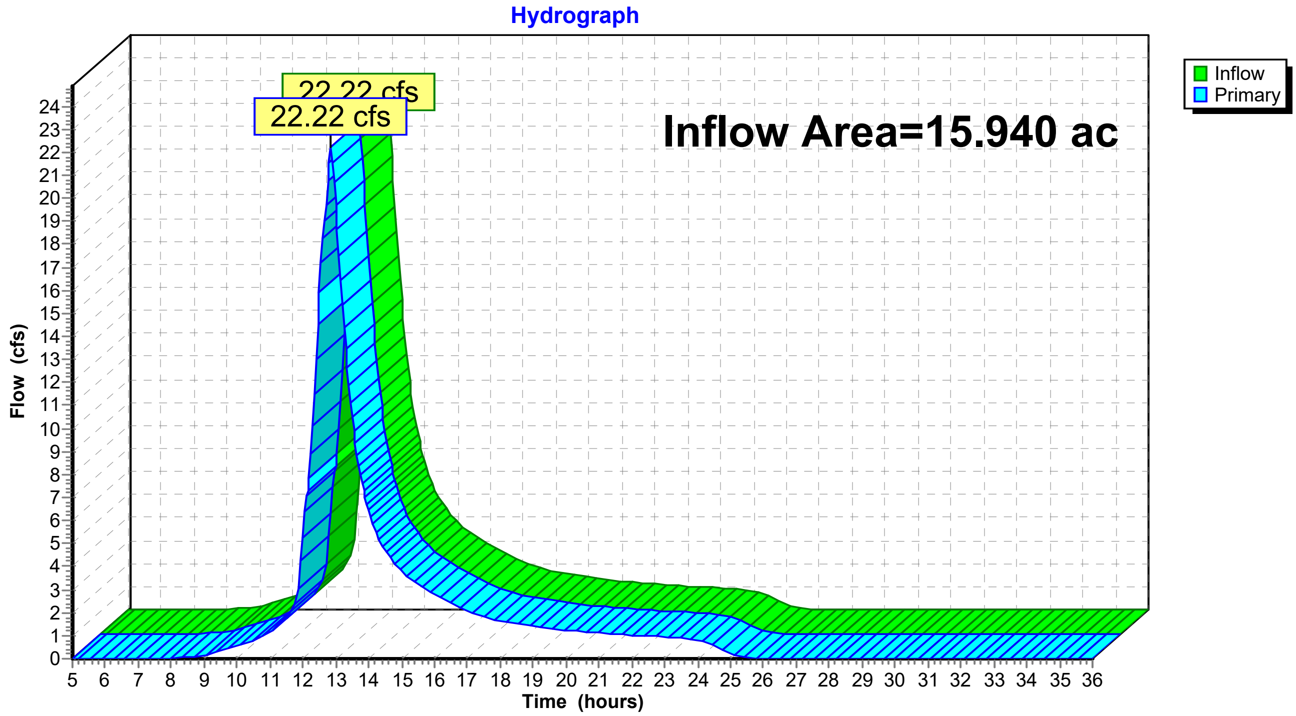


Summary for Link SN01: SN001

Inflow Area =	15.940 ac,	4.83% Impervious, Inflow Depth = 3.08"	for 100 year 24 hour event	
Inflow =	22.22 cfs @	12.85 hrs, Volume=	4.088 af	
Primary =	22.22 cfs @	12.85 hrs, Volume=	4.088 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs

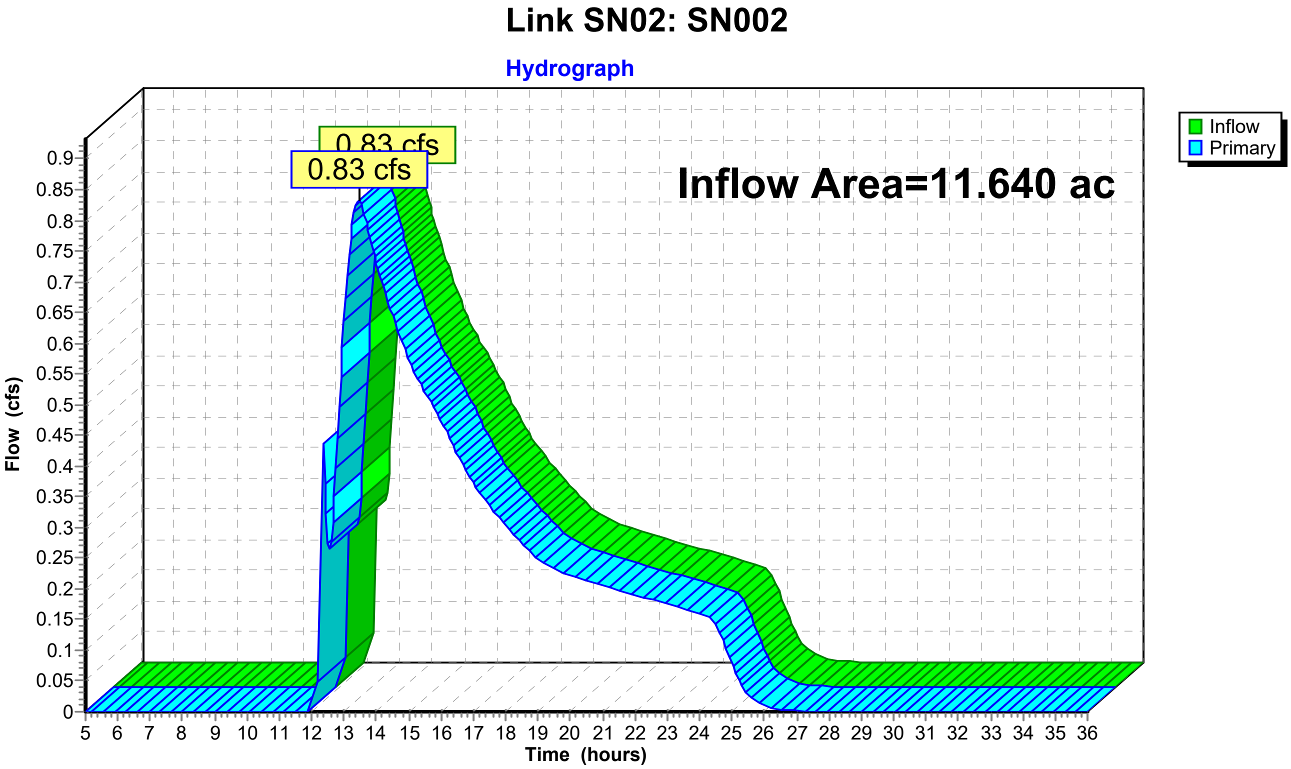
Link SN01: SN001



Summary for Link SN02: SN002

Inflow Area = 11.640 ac, 5.15% Impervious, Inflow Depth = 0.38" for 100 year 24 hour event
Inflow = 0.83 cfs @ 13.45 hrs, Volume= 0.366 af
Primary = 0.83 cfs @ 13.45 hrs, Volume= 0.366 af, Atten= 0%, Lag= 0.0 min

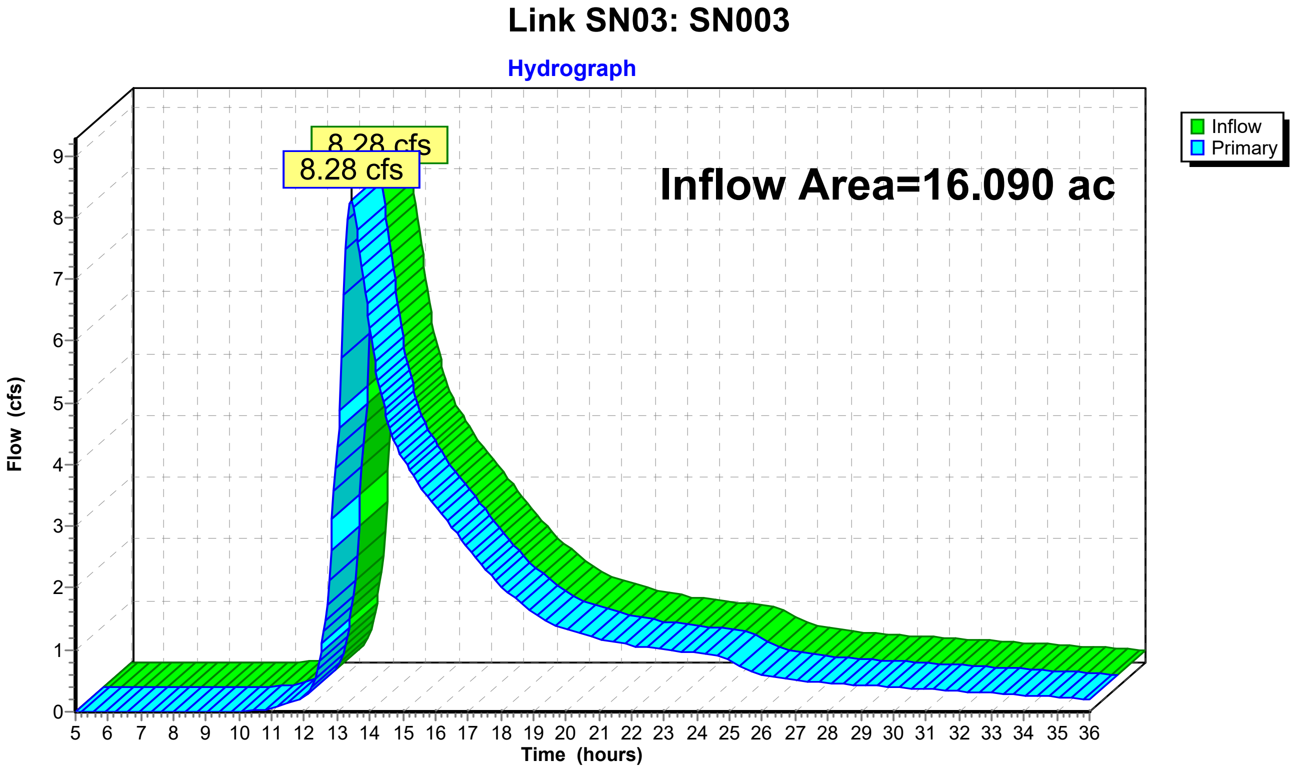
Primary outflow = Inflow, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs



Summary for Link SN03: SN003

Inflow Area =	16.090 ac,	0.93% Impervious,	Inflow Depth > 2.19"	for 100 year 24 hour event	
Inflow =	8.28 cfs @	13.41 hrs,	Volume=	2.934 af	
Primary =	8.28 cfs @	13.41 hrs,	Volume=	2.934 af,	Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-36.00 hrs, dt= 0.05 hrs



Appendix C

Draft Stormwater Pollution Prevention
Plan (SWPPP)

Stormwater Pollution Prevention Plan (SWPPP)

Costa Solar Project

Costa Drive
Freetown, Massachusetts 02717

SWPPP Prepared For:

Ironwood Renewables, LLC
c/o Hamilton Carrier
P.O. Box 51794
Lafayette, Louisiana 70505
(337) 344-7381
hcarrier@ironwoodenergy.com

SWPPP Prepared By:

Krebs and Lansing Consulting Engineers, Inc.
Greg Dixson, P.E. MA#55649
164 Main Street, Suite 201
Colchester, Vermont 05446
(802) 878-0375
greg.dixson@krebsandlansing.com

SWPPP Preparation Date:

DRAFT November 1, 2021

Estimated Project Dates:

Unknown at This Time

Contents

Section 1 – Contact Information and Responsible Parties

1.1 Operator(s) and Subcontractor(s)

Operator(s):

Overall Project Operator - Ironwood Renewables, LLC
P.O. Box 51794
Lafayette, Louisiana 70505
c/o Hamilton Carrier
(337) 344-7381
hcarrier@ironwoodenergy.com

Subcontractor(s):

Unknown at this time.

Emergency 24-hour Contact:

Ironwood Renewables, LLC
Hamilton Carrier
(337) 344-7381

1.2 Stormwater Team

Stormwater Team		
Name and/or position, and contact	Responsibilities	I Have Read the CGP and Understand the Applicable Requirements
Hamilton Carrier (337) 344-7381 hcarrier@ironwoodenergy.com	Principal Operator	☐ Yes Date: DRAFT
Unknown at this time.	Civil Site Contractor	☐ Yes Date: DRAFT
Unknown at this time	Construction Engineer	☐ Yes Date: DRAFT
Unknown at this time	Qualified Project Stormwater Inspector	☐ Yes Date: DRAFT

Section 2 – Site Evaluation, Assessment, and Planning

2.1 Project and Site Information

Project Name and Address:

Costa Solar Project
5 Costa Drive
Freetown, Massachusetts 02717
Bristol County

Project Latitude and Longitude:

Latitude: 41.75572° N
Longitude: -70.97576 ° W
Position Data Source: GPS
Horizontal Reference Datum: Massachusetts State Plane Grid North (NAD83)

Additional Project Information:

Are you requesting permit coverage as a "federal operator" as defined in CGP Appendix A of the 2017 CGP? **NO**

Is the project/site located on Indian country lands, or located on a property of religious or cultural significance to an Indian tribe? **NO**

If you are conducting earth-disturbing activities in response to a public emergency, document the cause of the public emergency *(e.g., natural disaster, extreme flooding conditions)*, information substantiating its occurrence *(e.g., state disaster declaration)*, and a description of the construction necessary to reestablish effective public services: **NOT APPLICABLE**

2.2 Discharge Information:

Does your project/site discharge stormwater into a Municipal Separate Storm Sewer System (MS4)? **No**

Are there any waters of the U.S. within 50 feet of your project's earth disturbances? **Yes, project has distrubances within 50 of wetlands around the project site. These wetlands are within the Fall Brook watershed.**

See Point of Discharge chart on the following page and refer to plan for location of specific discharge points.

Point of Discharge ID	Name of Receiving Water	Is Receiving water Impaired	Pollutants Causing Impairment	Has a TMLD been Completed	TMLD Name and ID	Pollutants for which there is a TMLD	Is the Receiving water Designated	Specify Designation
SN001	Unnamed Tributaries and Wetlands of the Fall Brook	NO	N/A	NO	N/A	N/A	NO	N/A
SN002	Unnamed Tributaries and Wetlands of the Fall Brook	NO	N/A	NO	N/A	N/A	NO	N/A
SN003	Unnamed Tributaries and Wetlands of the Fall Brook	NO	N/A	NO	N/A	N/A	NO	N/A

2.3 Nature of the Construction Activates:

General Description of the Project:

The proposed project is a 5.0 MW AC solar-generation facility located in Freetown, Massachusetts. The project will be located at the end of Costa Drive, off of Braely Road. The existing project area is currently an undeveloped wooded lot which is surrounded by residential homes and industrial buildings. The project is bisected by an existing railroad line operated by MTA. The project will be accessed by a private culdesac off of Costa Drive, see site plans for more detail on site location.

The development of the project site includes general construction work such as tree clearing, stumping and grubbing, minor grading to removed grade inconsistencies, installation of solar array, installation of fencing, installation of gravel access road, use of temporary staging areas, and other typical construction activities for installation of a fixed mount solar array. Specific tasks needed for the solar array construction include driving of support posts, erecting panel racking, installation of solar panels, construction of equipment pads, installation of project electrical equipment, trenching for underground conduit, and installation of power poles collection lines. In addition, the existing railroad crossing on the property will be improved to accommodate construction traffic.

Size of Construction Site:

Size of Property: ±50.8 Acres

Total Area Expected to Be Disturbed by Construction Activates: ±30.5 Acres

Maximum Area Expected to be disturbed at any one time: 5.0 Acres

Type of Construction Site:

Project will be a Commercial Solar Facility.

Will there be demolition of any structure built or renovated before January 1, 1980? **NO**

If yes, do any of the structures being demolished have at least 10,000 square feet of floor space? **N/A**

Was the pre-development land use used for agriculture (see CGP Appendix A for definition of "agricultural land")? **NO**

Pollutant Generating Activates:

All portions of the project's construction listed above could generate pollutants. Pollutants which could be generated from construction of this project are sediment, fertilizers (if used), concrete (if used), and fluids used in construction equipment.

Sediment: Clearing, stumping, grubbing, minor grading, and construction traffic create the possibility of sediment pollutant. The project will propose many construction stormwater best management practices to minimize the possibility of sediment pollutants leaving the site.

Fertilizers: The project does not expect the need to use fertilizers. However, not all characteristics of the existing soil properties are known at this time. Fertilizers would only be used during/after construction to facilitate the growth of the proposed grass cover post construction.

Concrete: The project may have poured equipment pads on site. These pads will be poured by concrete trucks. All truck washing, excess concrete, etc. will be the responsibility of the concrete company and will not take place on site.

Fluids used in Construction Equipment: The project will be constructed using general construction vehicles. Small spills and breakdowns of these vehicles are unavoidable. Contractor will abide by all local, state, and federal standards/practices for working with these vehicles and reporting any spills. Fluids include gasoline, motor oil, antifreeze, hydraulic fluid, etc.

Construction Support Activities:

This project proposes nearly all activities take place on the project property and within the project's limits of disturbance. The project only intends to import stone needed to construct the gravel access drives and any gravel/sand needed for installation of the electronic equipment. Contractor will work with a local quarry for these items, quarry is not known at this time. Contractor will also use local dumps and recycling centers for all refuse created by the project's construction.

2.4 Project Sequence and Phasing of Construction Activities:

Phase 1: Clearing. Dates: TBD

Contractor will clear the entire site of vegetation; larger tree stems may be removed from the property for sale or other use. Smaller trees, branches, and brush will be chipped and used for site stabilization and perimeter controls, as needed. Portion of this work will also include an area of selective clearing or vegetation management. In these zones all work will be performed by foot. Only large trees which will shade the array will be removed and trees will be dropped into the site and processed outside of the management zone. This is to minimize the disturbance within that area.

Phase 2: Stumping, grubbing, minor grading, and temporary stabilization. Dates: TBD

Contractor will remove all stumps within the project area with the exception of the vegetation management zone. The management zone stumps will be left in place to avoid additional disturbance. The area which was stumped will then be grubbed and minor grading may take place to remove any grade inconsistencies. The project area is mildly sloped (between 0-8% slopes) and very little grading is anticipated. The project will temporarily seed and mulch as the contractor moves through the site to maintain the 5.0-acre disturbance threshold. Temporary seeding mix and mulching specifications are outlined in the project plans and details.

Phase 3: Installation of access road, construction staging, and stabilized construction entrance. Dates: TBD

Contractor will install the access road on the site based on the details. The Contractor shall use the access road as the main egress throughout construction to minimize the construction sprawl to the extents practical. Create the main construction staging area to store equipment being delivered to the site, identify additional locations for panel staging within the array. Create and maintain a stabilized construction entrance at the entrance from Braely Road, see detail.

Phase 4: Erect solar support system, install solar panels, trench for underground power, and install additional project equipment. Dates: TBD

Contractor will erect the solar support system. This involves driving support posts into the ground and putting together the support racks which will be mounted on the posts. Once the support system has been erected, solar panels will be mounted to the racking. All trenches for underground power will be excavated and the conduits installed. Equipment and maintenance pads/vaults will be installed along underground power runs. Two transformers with secondary oil containment will also be installed along access drive.

Phase 5: Permanent stabilization, final electrical work, fence erection, and project cleanup. Dates: TBD

After installation of the panels, vehicle traffic around the project site will be greatly reduced. This will reduce the disturbance from construction traffic and allow the Contractor to permanently seed and mulch areas of the site. Final electrical work and connections will be happening but that work can be done by foot or use of small vehicle. The project perimeter fence will be installed towards the end of the project. Contractor will remove staging area and perform the final cleanup of the site.

2.5 Authorized Non-Stormwater Discharges:

The following are the only authorized non-stormwater discharges for this project. It is unknown if these discharges will be needed but are authorized if so.

- Landscape Irrigation – For grass growth and plantings as needed
- Water used to control dust
- Construction dewatering water

2.6 Site Maps:

See appendix A.

Section 3 – Documentation of Compliance with Other Federal Requirements

3.1 Endangered Species Protection

This project will fall under Criterion Eligibility A.

Criterion A: No ESA-listed species and/or designated critical habitat present in action area. Using the process outlined in Appendix D of this permit, you certify that ESA-listed species and designated critical habitat(s) under the jurisdiction of the USFWS or NMFS are not likely to occur in your site's "action area" as defined in Appendix A of this permit.

Basis Statement Content/Supporting Documentation:

Pending.

3.2 Historic Preservation

Do you plan on installing any ground disturbing stormwater controls at your site? **YES** Please list ground disturbing stormwater controls below.

- Dug in perimeter silt fence
- Upslope diversion swales/berms (as needed)
- Water bars
- Swales
- Stone Dispersion Pads
- Stormwater Basins

If yes, have prior surveys or evaluations been conducted on the site already determined that historic properties do not exist or that prior disturbances at the site have precluded the existence of historic properties? ***Pending.***

If no, have you determined that your installation of subsurface earth-disturbing stormwater controls will have no effect on historic properties? ***Pending.***

If no, did the State Historic Preservation Officer (SHPO), Tribal Historic Preservation Office (THPO), or other tribal representative (whichever applies) respond to you within 15 calendar days to indicate whether the subsurface earth disturbances caused by the installation of stormwater controls affect historic properties? ***Pending.***

If yes, describe the nature of their response.

3.3 Safe Drinking Water Act Underground Injection Control Requirements

The project has two stormwater basins to control larger storms on site. The existing soils on site are primarily hydrologic group D which have poor infiltrate rates. There are some hydrologic group A soils on site which have dequate hydrologic conductivity for infiltration. The basins will reacharge the groundwater aquifers. The water will be treated by running through shallowly sloped grasslined swales with stone check dams and will have a sediment forebay before entering the dry basin.

Project also proposes secondary oil containment around the project transformers which are filled with Envirotemp FR3 Fluid. Per manufacturer's specification FR3 is a bio based natural ester dielectric coolant formulated from seed oils and does not contain petroleum, halogen, silicon or corrosive sulfur. This secondary oil containment will ensure that the fuid does not leave the containment area in the event leak or failure.

Section 4 – Erosion and Sediment Control

4.1 Natural Buffers or Equivalent Sediment Controls

Are there any waters of the U.S. within 50 feet of your project's earth disturbances? **Yes**

The project is applying for notice of intent to disturb soils within 50' of some wetlands on the project site. The project will also disturb a wetland and stream when construction a stream crossing for access to the site.

4.2 Perimeter Controls

The project proposes a variety of perimeter controls for the project. The entirety of the project will be surrounded by temporary silt fences. The only areas where water will be permitted to leave the project site is at the outlet of the stormwater basins; these locations have been identified on the project plans. At these specified locations, the contractor will install either a crushed stone dispersion pad with fiber roll or a collection of fiber rolls to treat the water as it leaves the construction site. Provide a small sediment trap on the project side of this outlet structure and maintain trap's depth throughout construction. Silt fence is not needed in locations where the limits of construction are a higher gradient than construction and water does not leave the site. Contractor will review all these areas throughout construction. If large amounts of upslope run-on are occurring, installation of upslope diversion/berm may be installed to limit that run-on water.

Contractor will also install construction limit barrier fence around the project site to mark the limits of construction. This will limit construction traffic from accidentally leaving the project site or increasing the project footprint. It is also helpful in areas where silt fence is not needed, explained above. Details for all perimeter control installation and maintenance are provided in project plans. Perimeter controls will be installed while clearing is being performed and shall be fully installed prior to any stump removal or grubbing.

4.3 Sediment Track-Out

For sediment track-out the project will install and maintain a stabilized construction entrance at the entrance to the project on Horseneck Road. Location, details and maintenance are provided in project plans. If sediment has been tracked out from the site onto the paved road or other paved areas outside of your site, remove the deposited sediment by the end of the same business day in which the track-out occurs or by the end of the next business day if track-out occurs on a non-business day. Remove the track-out by sweeping, shoveling, or vacuuming these surfaces, or by using other similarly effective means of sediment removal. You are prohibited from hosing or sweeping tracked-out sediment into any stormwater conveyance, storm drain inlet, or water of the U.S.A stabilized construction entrance will be installed before tree clearing is performed and maintained throughout construction.

4.4 Stockpiled Sediment or Soil

There is grading proposed for this project, and we expect there will be a need for soil stockpiles on site. We also expect there will be stockpiles created when excavating trenches for the underground power, as well as stockpiles of sand/stone for underground power installation and electrical equipment installation. However, we expect these to be excavated, conduit/equipment installed and backfilled within a short timeframe. Regardless of the amount of time, all stockpiles will be surrounded by a horseshoe of silt fence, so the stockpile can be accessed but sediment does not leave the horseshoe. If there is a reason for a soil stockpile to sit unused for 14 days or more, it will be temporarily seeded and mulched. If a sand stockpile is left unused for 14 days or more, it should be covered by a tarp or plastic.

4.5 Minimize Dust

When and if dust is noticed leaving the site, it will be apparent on the vegetation which surrounds the site or visually observed in the air. If dust becomes an issue on the site, it will be mitigated using water trucks.

4.6 Minimize Steep Slope Disturbances

Steep slopes, as defined by the CGP Appendix A, are slopes which exceed 15%. There are areas within the limits of disturbance which exceed 15%. Those areas are limited to the side slopes of the stormwater basins, swales, and level lip spreaders. All the slopes on the site within the array area will be between 0%-10%. Contractor will use erosion control matting in these areas to help establish grass as soon as possible during construction.

4.7 Topsoil

Topsoil will be preserved on this site by leaving it in place. The construction of this solar array will require minor grading. The array will be constructed on the existing grade and the topsoil will be left in its existing conditions where possible. In the areas where substantial grading has been proposed, the topsoil will be stripped and stored to the side, then replaced once the earthwork has been completed. For installation of project equipment and the access road, the topsoil will be removed and immediately used on any areas which need topsoil. There is no need or plan to import or export topsoil for construction of this project.

4.8 Soil Compaction

Contractor shall limit construction traffic to as few locations as practical to minimize the chance for soil compaction. The project will also use low impact tracked vehicles as much as possible to also limit compaction. Compaction of soils is expected and unavoidable in some locations and the proposed cover for the project is grass. After the erection of the panel supports and the installation of the panels, the contractor shall limit the use of larger vehicles around the array to the extent practical. Areas of compaction shall be identified and mechanically harrowed/plowed to restore to pre-construction conditions.

4.9 Storm Drain Inlets

There are no storm drain inlets proposed for the project and there are no existing storm drain inlets in the proposed limits of disturbance.

4.10 Stormwater Conveyance Channels

The project will have roadside shallowly sloped grasslined swales which will convay runoff to the stormwater dry basins. These are shown on the site plans and details. Further temporary stormwater conveyances may be a useful tool during construction for upslope diversion to avoid sediment for entering clean upslope run-on. We have included details for upslope diversion, fabric roll check dams, and stone dispersion pads. These may be implemented for use in stormwater management throughout the project if needed. Please see plans, details and maintenance requirements in the plan set.

4.11 Sediment Basins

The project is calling for small sediment basins at all locations where water leaves the project site. Sediment basins are a useful tool for treating stormwater before it leaves the project site. We have included details for temporary sediment trap. These may be further implemented for use in stormwater management throughout the project if needed. There location will be on the project side of all the stone dispersion pads show on the project project plans.

4.12 Chemical Treatment

Soil Types within the project limits of disturbance:

- Ridgebury Fine Sandy Loam (71A) – 0 to 3 Percent Slopes, extremely stony (hydrologic soil group D)
- Wareham Loamy Sand (32A) – 0 to 3 Percent Slopes, (hydrologic soil group D)
- Sudbury Fine Sandy Loam (260B) – 3 to 8 Percent Slopes (hydrologic soil group B)
- Glouchester-Hinckley Complex (446B) – 3 to 8 Percent Slopes, very stony (hydrologic soil group A)
- Scarboro Mucky Fine Sandy Loam (39A) – 0 to 3 Percent Slopes (hydrologic soil group D)
- Woodbridge Fine Sandy Loam (311B) – 0 to 8 Percent Slopes, very stony (hydrologic soil group D)
- Windsor Loamy Sand (255B) – 3 to 8 Percent Slopes (hydrologic soil group A)
- Freetown Muck, Ponded (53A) – 0 to 1 Percent Slopes (hydrologic soil group D)

Treatment Chemicals

- Fertilizers to promote grass growth, if needed. The soils on site are not expected to need fertilizers but can be acidic and stunt grass growth.
- Dosages are not known at this time but would be similar to use on residential lawns.
- Specific fertilizers have not been designed at this time and therefore there are no specific Safety Data Sheets (SDS).
- Fertilizers will be kept in a dry location which would not be susceptible to water run-on. Fertilizers will be covered in a tarp or plastic when not in use.
- Contractor will abide by all local, state, and federal requirements for the specific fertilizer used, if needed.

Chemicals for Stormwater Control

- This project does not propose the use of chemicals for stormwater control.

4.13 Dewatering Practices

Effluent from dewatering operations shall be filtered or passed through an approved sediment trapping device, or both, and discharged in a manner that does not violate water quality standards or contribute to erosion. The depth of excavation for this project to install underground power and electrical equipment is expected to encounter groundwater based on soil charateristics and a evidence of higher watertable. The Contractor will provide dewatering details and those details shall be reviewed and approved by the Engineer and qualified project stormwater inspector.

4.14 Other Stormwater Controls

All stormwater controls are detailed on the project plans. Details include notes on installation, maintenance, and compliance.

4.15 Site Stabilization

Total amount of land disturbance occurring at any one time? Project shall limit the total disturbance on site to **5.0 acres** or less concurrently throughout construction. This project is not located in an arid, semi-arid, or drought-stricken area.

Project proposed permanent stabilization is vegetation, and the solar array will be covered in grass post construction. Permanent seeding and mulching are detailed in project plans. These measures should be installed after installation of the array and maintained until site has achieved more than 70% coverage. Maintenance includes re-seeding until vegetation coverage has been exceeded.

During construction the project will protect existing vegetation on site and limit construction traffic to reduce construction sprawl. The project will use a variety of temporary stabilization practices. All stabilization practices are detailed in the project plans. The practices include temporary seeding, mulching (with a variety of media), and erosion control blanket, if needed. All areas of earth disturbance associated with this project must be temporarily stabilized within 14 days of initial disturbance. After this initial 14-day period, all earth disturbance areas associated must be stabilized on a daily basis, with the following exceptions:

i. stabilization is not required if work is to continue within the area within the next 24 hours and there is no precipitation forecast for the next 24 hours.

ii. stabilization is not required if the work is occurring in a self-contained excavation (i.e., no outlet for stormwater) with a depth of 2 feet or greater (e.g., underground line installation).

Section 5 – Pollution Prevention Standards

5.1 Potential Sources of Pollution

Identify and describe all pollutant generating activates on site.

Sediment: Clearing, stumping, grubbing, minor grading, and construction traffic create the possibility of sediment pollutant. The project will propose many construction stormwater best management practices to minimize the possibility of sediment pollutants leaving the site.

Fertilizers: The project does not expect the need to use fertilizers. However, not all characteristics of the existing soil properties are known at this time. Fertilizers would only be used during/after construction to facilitate the growth of the proposed grass cover post construction. Fertilizers will be stored in a dry location and covered in tarp or plastic. The location will likely be a staging area by the site entrance, if needed.

Concrete: The project may have poured equipment pads on site. These pads will be poured by concrete trucks. All truck washing, excess concrete, etc. will be the responsibility of the concrete company and will not take place on site.

Construction and Domestic Waste: Project will generate trash and recycling. Contractor will hire a local company which will provide both trash and recycling services for the project. Project dumpsters will likely be kept in the staging area by the entrance to the site. It is the Contractor and Service Provider's responsibility to make sure all waste is disposed of property.

Wastewater: Project will provide temporary portalets for the workers on site during construction. Contractor will hire a local company to support this service. All associated cleaning and disposal of waste will happen offsite and is the responsibility of that Service Provider.

Transformer Oil: The project transformers will be filled with Envirotemp FR3 Fluid. Per manufacturer's specification FR3 is a bio based natural ester dielectric coolant formulated from seed oils and does not contain petroleum, halogen, silicon or corrosive sulfur. The project proposes a secondary oil containment around the location of the transformers on site. See SPCC plan for additional details.

Fluids used in Construction Equipment: The project will be constructed using general construction vehicles. Small spills and breakdowns of these vehicles are unavoidable. Contractor will abide by all local, state, and federal standards/practices for working with these vehicles and reporting any spills. Fluids include gasoline, motor oil, antifreeze, hydraulic fluid, etc.

5.2 Spill Prevention and Response

The General Permit provides that the discharge of hazardous substances or oil from a facility must be eliminated or minimized. To prevent accidental spills, no vehicle servicing activities will be allowed onsite and will be the responsibility of the Contractor to take place at their place of business. Accidental or unintentional releases or discharges of oil/oil products or of hazardous/toxic substances resulting from spills, leaks, ruptures, etc. must be reported immediately to the project operator. Spills or discharges to land, stormwater or non-stormwater conveyances must also be reported to the state or federal agencies by the site supervisor. Information regarding the location of the spill, the nature of the spilled material and the amount spilled should be reported to the agency. Where a permitted stormwater discharge contains hazardous substances or oil in an amount equal to or in excess of a reporting quantity established under 40 CFR 100, 40 CFR 117, or 40 CFR 302, during a 24-hour period, the General Permit requires the following actions:

- The permittee must notify the National Response Center (NRC) (800-424-8802) in accordance with the requirements of 40 CFR 110, 40 CFR 117, and 40 CFR 302, as soon as the permittee has knowledge of the discharge.

- The permittee must modify the stormwater pollution prevention plan for the facility within 14 calendar days of knowledge of the release to provide (1) a description of the release, (2) the date of the release, and (3) the circumstances leading to the release. In addition, the permittee must modify the plan, as appropriate, to identify measures to prevent the recurrence of such releases and to respond to such releases.

- Within 14 calendar days of the knowledge of the release, the permittee must submit to EPA (1) a written description of the release (including the type and estimated amount of material released), (2) the date that such release occurred, (3) the circumstances leading to the release, and (4) any steps to be taken to modify this plan.

Equipment and absorbent material will be kept on-site to respond to spills of 25 gallons or less. For emergency responses or additional assistance, call 911.

Minimal paints, solvents, primer or other materials will be stored on the construction site. Generally, equipment and materials will be stored at the Contractor's off site warehouse and delivered to the site as needed. No major equipment or vehicle repair/maintenance activities will be conducted on the construction site.

For spills of oil and hazardous substances or other substances and releases or threatened releases of hazardous waste, cleanup and restoration activities will be considered complete when approved by owner representative or notified state/federal agency.

If it is safe to do so, locate the source of the spill. Stop and contain the spill. Recover as much of the spilled material as possible and use as originally intended. Pick up the remainder with absorbent material. Recovered material that cannot be applied to its original purpose and spent absorbent material must be disposed of properly. Determination of whether spilled material and spent absorbent materials are considered to be hazardous waste must be made so as to determine their most appropriate disposal method.

5.3 Fueling and Maintenance of Equipment of Vehicles

No major equipment or vehicle repair/maintenance activities will be conducted on the construction site. Equipment will need to be refueled on site. Fuel should be kept in an appropriate location and in a permitted container. Contractor will have spill kits ready and accessible whenever refueling. Contractor shall abide by all other EPA restrictions when refueling on site.

5.4 Washing of Equipment and Vehicles

Washing of equipment and vehicles is not permitted on the construction site.

5.5 Storage, Handling and Disposal of Building Products, Materials, and Waste

See 5.1 for explanation and description for all project examples of fertilizers, fuels, oil, hydraulic fluids, construction and domestic waste, sanitary waste.

5.6 Washing of Applicators and Containers used for Paint, Concrete of Other Materials

Washing of any applicators and containers is not permitted on the construction site.

5.7 Fertilizers

See 5.1 for explanation and description for all project examples of fertilizers.

5.8 Other Pollution Prevention Practices

See all information above.

Section 6 – Inspection, Maintenance, and Corrective Action

6.1 Inspection Personnel and Procedures

Personnel Responsible for Inspections:

Qualified Project Stormwater Inspector

Not Known at this time.

Inspection Schedule

- During construction and while there is active earth disturbance, the Inspector will visit and report on the site every **7 Days**.
- Once the project is permanently stabilized, the Inspector will visit and report on the site twice in the first month (no more than 14 days apart); then once per month after the first month. This will continue until the site has reached more than 70% coverage.
- During frozen or snow covered conditions prior to final stabilization and without active earth disturbance, the Inspector will visit and report on the site once per month.
- During frozen or snow covered conditions prior to final stabilization and with active earth disturbance, the Inspector will visit and report on the site daily.

Inspection Report Form

- See typical report in Appendix D.

6.2 Corrective Action

Personnel Responsible for Corrective Actions:

Construction Engineer

Not Known at this time.

Qualified Project Stormwater Inspector

Not Known at this time.

Corrective Action Form

- See typical report in Appendix E.

6.3 Delegation of Authority

Duly Authorized Representative(s):

Principal Operator:

Ironwood Renewables, LLC
P.O. Box 51794
Lafayette, Louisiana 70505
c/o Hamilton Carrier
(337) 344-7381
hcarrier@ironwoodenergy.com

Civil Site Contractor:

Not Known at this time

Section 7 – Training

7.1 Inspection Personnel and Procedures

Personnel responsible for training and training documentation is the Civil Site Contractor. Contractor shall train everyone on the Stormwater Team and document the training and date the training was complete.

Civil Site Contractor:

Not Known at this time

Typical training with respects to CGP:

- General stormwater and best management practices (BMPs) awareness training for all staff and subcontractors.
- Identifying project limits, boundaries, regulations, and rules for the project with all staff and subcontractors.
- Spill Prevention, compliance and response training for all staff and subcontractors.
- Site cleanliness, housekeeping, and environmental awareness training for all staff and subcontractors
- Detailed training on CGP, specific stormwater responsibilities, project plans, inspections, and reporting for the Qualified Project Stormwater Inspector

Section 8 – Certification and Notification

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I have no personal knowledge that the information submitted is other than true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name: Ironwood c/o Hamilton Carrier Title: Principal Operator

Signature: DRAFT Date: ____________

Appendix A – Site Maps

See Site Plans.

Appendix B – Copy of 2017 CGP

Pending.

Appendix C – NOI and EPA Authorization Email

Pending.

Appendix D – Inspection Form

General Information (see reverse for instructions)					
Name of Project		**NPDES ID No.**		**Inspection Date**	
Weather conditions during inspection		**Inspection start time**		**Inspection end time**	
Inspector Name, Title & Contact Information					
Present Phase of Construction					
Inspection Location (if multiple inspections are required, specify location where this inspection is being conducted)					

Inspection Frequency *(Note: you may be subject to different inspection frequencies in different areas of the site. Check all that apply)*

Standard Frequency:
- ☐ Every 7 days
- ☐ Every 14 days and within 24 hours of a 0.25" rain or the occurrence of runoff from snowmelt sufficient to cause a discharge

Increased Frequency:
- ☐ Every 7 days and within 24 hours of a 0.25" rain (for areas of sites discharging to sediment or nutrient-impaired waters or to waters designated as Tier 2, Tier 2.5, or Tier 3)

Reduced Frequency:
- ☐ Twice during first month, no more than 14 calendar days apart; then once per month after first month; (for stabilized areas)
- ☐ Twice during first month, no more than 14 calendar days apart; then once more within 24 hours of a 0.25" rain (for stabilized areas on "linear construction sites")
- ☐ Once per month and within 24 hours of a 0.25" rain (for arid, semi-arid, or drought-stricken areas during seasonally dry periods or during drought)
- ☐ Once per month (for frozen conditions where earth-disturbing activities are being conducted)

Was this inspection triggered by a 0.25" storm event? ☐ Yes ☐ No

If yes, how did you determined whether a 0.25" storm event has occurred?

☐ Rain gauge on site ☐ Weather station representative of site. Specify weather station source:

Total rainfall amount that triggered the inspection (in inches)**:**

Was this inspection triggered by the occurrence of runoff from snowmelt sufficient to cause a discharge? ☐ Yes ☐ No

Unsafe Conditions for Inspection

Did you determine that any portion of your site was unsafe for inspection per CGP Part 4.5? ☐ Yes ☐ No

If "yes", complete the following:

- Describe the conditions that prevented you from conducting the inspection in this location:

- Location(s) where conditions were found:

Condition and Effectiveness of Erosion and Sediment (E&S) Controls (CGP Part 2.2) (see reverse for instructions)				
Type/Location of E&S Control **[Add an additional sheet if necessary]**	**Maintenance Needed?***	**Corrective Action Required?***	**Date on Which Maintenance or Corrective Action First Identified?**	**Notes**
1.	☐Yes ☐No	☐Yes ☐No		
2.	☐Yes ☐No	☐Yes ☐No		
3.	☐Yes ☐No	☐Yes ☐No		
4.	☐Yes ☐No	☐Yes ☐No		
5.	☐Yes ☐No	☐Yes ☐No		
6.	☐Yes ☐No	☐Yes ☐No		
7.	☐Yes ☐No	☐Yes ☐No		
8.	☐Yes ☐No	☐Yes ☐No		
9.	☐Yes ☐No	☐Yes ☐No		
10.	☐Yes ☐No	☐Yes ☐No		

*** Note:** The permit differentiates between conditions requiring routine maintenance, and those requiring corrective action. The permit requires maintenance in order to keep controls in effective operating condition. Corrective actions are triggered only for specific conditions, which include: 1) A stormwater control needs repair or replacement (beyond routine maintenance) if it is not operating as intended; 2) A stormwater control necessary to comply with the permit was never installed or was installed incorrectly; 3) You become aware that the stormwater controls you have installed and are maintaining are not effective enough for the discharge to meet applicable water quality standards or applicable requirements in Part 3.1; 4) One of the prohibited discharges in Part 1.3 is occurring or has occurred; or 5) EPA requires corrective actions as a result of a permit violation found during an inspection carried out under Part 4.8. If a condition on your site requires a corrective action, you must also fill out a corrective action form found at https://www.epa.gov/npdes/stormwater-discharges-construction-activities#resources. See Part 5 of the permit for more information.

If maintenance or corrective action is required, briefly note the reason. If maintenance or corrective action have been completed, make a note of the date it was completed and what was done. *If corrective action is required, note that you will need to complete a separate corrective action report describing the condition and your work to fix the problem.*

Condition and Effectiveness of Pollution Prevention (P2) Practices (CGP Part 2.3) (see reverse for instructions)				
Type/Location of P2 Practices [Add an additional sheet if necessary]	**Maintenance Needed?***	**Corrective Action Required?***	**Date on Which Maintenance or Corrective Action First Identified?**	**Notes**
1.	☐Yes ☐No	☐Yes ☐No		
2.	☐Yes ☐No	☐Yes ☐No		
3.	☐Yes ☐No	☐Yes ☐No		
4.	☐Yes ☐No	☐Yes ☐No		
5.	☐Yes ☐No	☐Yes ☐No		
6.	☐Yes ☐No	☐Yes ☐No		
7.	☐Yes ☐No	☐Yes ☐No		
8.	☐Yes ☐No	☐Yes ☐No		
9.	☐Yes ☐No	☐Yes ☐No		
10.	☐Yes ☐No	☐Yes ☐No		

*** Note:** The permit differentiates between conditions requiring routine maintenance, and those requiring corrective action. The permit requires maintenance in order to keep controls in effective operating condition. Corrective actions are triggered only for specific conditions, which include: 1) A stormwater control needs repair or replacement (beyond routine maintenance) if it is not operating as intended; 2) A stormwater control necessary to comply with the permit was never installed or was installed incorrectly; 3) You become aware that the stormwater controls you have installed and are maintaining are not effective enough for the discharge to meet applicable water quality standards or applicable requirements in Part 3.1; 4) One of the prohibited discharges in Part 1.3 is occurring or has occurred; or 5) EPA requires corrective actions as a result of a permit violation found during an inspection carried out under Part 4.8. If a condition on your site requires a corrective action, you must also fill out a corrective action form found at https://www.epa.gov/npdes/stormwater-discharges-construction-activities#resources. See Part 5 of the permit for more information.

Stabilization of Exposed Soil (CGP Part 2.2.14) (see reverse for instructions)			
Stabilization Area **[Add an additional sheet if necessary]**	**Stabilization Method**	**Have You Initiated Stabilization?**	**Notes**
1.		☐ YES ☐ NO If yes, provide date:	
2.		☐ YES ☐ NO If yes, provide date:	
3.		☐ YES ☐ NO If yes, provide date:	
4.		☐ YES ☐ NO If yes, provide date:	
5.		☐ YES ☐ NO If yes, provide date:	

Description of Discharges (CGP Part 4.6.6) (see reverse for instructions)	
Was a stormwater discharge or other discharge occurring from any part of your site at the time of the inspection? ☐ Yes ☐ No **If "yes", provide the following information for each point of discharge:**	
Discharge Location **[Add an additional sheet if necessary]**	**Observations**
1.	Describe the discharge: At points of discharge and the channels and banks of waters of the U.S. in the immediate vicinity, are there any visible signs of erosion and/or sediment accumulation that can be attributed to your discharge? ☐ Yes ☐ No If yes, describe what you see, specify the location(s) where these conditions were found, and indicate whether modification, maintenance, or corrective action is needed to resolve the issue:
2.	Describe the discharge: At points of discharge and the channels and banks of waters of the U.S. in the immediate vicinity, are there any visible signs of erosion and/or sediment accumulation that can be attributed to your discharge? ☐ Yes ☐ No If yes, describe what you see, specify the location(s) where these conditions were found, and indicate whether modification, maintenance, or corrective action is needed to resolve the issue:

Contractor or Subcontractor Signature and Certification (see reverse for instructions)
"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I have no personal knowledge that the information submitted is other than true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations." **Signature of Contractor or Subcontractor:** ______________________________ **Date:** **Printed Name and Affiliation:** ______________________________

Operator Signature and Certification (see reverse for instructions)
"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I have no personal knowledge that the information submitted is other than true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations." **Signature of Operator or "Duly Authorized Representative":** ______________________________ **Date:** **Printed Name and Affiliation:** ______________________________

Appendix E – Corrective Action Log

Project Name:SWPPP COSTA SOLAR PROJECT
SWPPP Contact:

Inspection Date	Inspector Name(s)	Description of BMP Deficiency	Corrective Action Needed (including planned date/responsible person)	Date Action Taken/Responsible person

Appendix F – SWPPP Amendment Log

Project Name: **SWPPP COSTA SOLAR PROJECT**
SWPPP Contact:

Amendment No.	Description of the Amendment	Date of Amendment	Amendment Prepared by [Name(s) and Title]

Appendix G – Subcontractor Certifications/Agreements

SUBCONTRACTOR CERTIFICATION
STORMWATER POLLUTION PREVENTION PLAN

Project Number: ____

Project Title: Costa Solar Project ______________________________________

Operator(s): Ironwood Renewables, LLC ____________________________

As a subcontractor, you are required to comply with the Stormwater Pollution Prevention Plan (SWPPP) for any work that you perform on-site. Any person or group who violates any condition of the SWPPP may be subject to substantial penalties or loss of contract. You are encouraged to advise each of your employees working on this project of the requirements of the SWPPP. A copy of the SWPPP is available for your review at the office trailer.

Each subcontractor engaged in activities at the construction site that could impact stormwater must be identified and sign the following certification statement:

I certify under the penalty of law that I have read and understand the terms and conditions of the SWPPP for the above designated project and agree to follow the BMPs and practices described in the SWPPP.

This certification is hereby signed in reference to the above named project:

Company: ____

Address: ____

Telephone Number: ______________________

Type of construction service to be provided: ______________________________

____

____

Signature: ______________________

Title: ______________________

Date: ______________________

Appendix H –Grading and Stabilization Activities Log

Project Name: SWPPP COSTA SOLAR PROJECT
SWPPP Contact:

Date Grading Activity Initiated	Description of Grading Activity	Date Grading Activity Ceased (Indicate Temporary or Permanent)	Date When Stabilization Measures are Initiated	Description of Stabilization Measure and Location

Appendix I –SWPPP Training Log

Stormwater Pollution Prevention Training Log

Project Name: Costa Solar Project

Project Location: **Freetown, Massachusetts**

Instructor's Name(s):

Instructor's Title(s):

Course Location: ________________________________ Date: __________________

Course Length (hours): ____________________________

Stormwater Training Topic: *(check as appropriate)*

- ❑ **Erosion Control BMPs**
- ❑ **Emergency Procedures**
- ❑ **Sediment Control BMPs**
- ❑ **Good Housekeeping BMPs**
- ❑ **Non-Stormwater BMPs**

Specific Training Objective:____

____

Attendee Roster: *(attach additional pages as necessary)*

No.	Name of Attendee	Company
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

Appendix J –Delegation of Authority Form

Delegation of Authority

I, ________________________ (name), hereby designate the person or specifically described position below to be a duly authorized representative for the purpose of overseeing compliance with environmental requirements, including the Construction General Permit, at the ______________________________________ construction site. The designee is authorized to sign any reports, stormwater pollution prevention plans and all other documents required by the permit.

____ (name of person or position)
____ (company)
____ (address)
____ (city, state, zip)
____ (phone)

By signing this authorization, I confirm that I meet the requirements to make such a designation as set forth in ______________________________________ (Reference State Permit), and that the designee above meets the definition of a "duly authorized representative" as set forth in ______________________________________ (Reference State Permit).

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name: ____

Company: ____

Title: ____

Signature: ____

Date: ____

Appendix K –Endangers Species Documentation

Pending.

Appendix L – Historical Preservation Documentation

Pending.

Appendix D

Draft Spill Prevention, Control and Countermeasures Plan (SPCC)

Spill Prevention, Control, and Countermeasures Plan

Costa Solar Project

Freetown, Massachusetts

Submitted on behalf of:

IRONWOOD RENEWABLES

&

BRI
BIODIVERSITY RESEARCH INSTITUTE

Prepared by:

KREBS & LANSING CONSULTING ENGINEERS

Krebs & Lansing Consulting Engineers, INC.
164 Main Street
Colchester, Vermont 05446
(802) 878-0375

DRAFT November 1st, 2021

Table of Contents

List of Appendices

Section 1.0 – Introduction

The proposed project is a 5.0 MW AC solar-generation facility located in Freetown, Massachusetts. The project will be located at the end of the cul-de-sac on Costa Drive. Refer to the site plans and project details more information about the project. This facility will have a total of four filled transformers filled with Envirotemp FR3 Fluid. Per manufacturer's specification FR3 is a bio based natural ester dielectric coolant formulated from seed oils and does not contain petroleum, halogen, silicon or corrosive sulfur. Transformer size has not been determined at this time, but is assumed to be four 2,000 kVA or less transformers which will contain approximately 500 gallons of the fluid. The transformers total amount of fluid makes the site a "Tier I qualified facility". The plan provides secondary transformer oil containment for all transformers.

Section 2.0 – Purpose

This plan will prescribe the minimum requirements to be met in order to create a self-certifying Spill Prevention, Control, and Countermeasures (SPCC) Plan. A copy of this plan shall be kept on site at the project substation, and will be kept available for review by Project Owner or their representative.

Section 3.0 – Regulatory Authority

The U.S. Environmental Protection Agency has issued the Spill Prevention, Control, and Countermeasures Rule (SPCC), last revised November 10, 2010 and codified under 40 C.F.R. Part 112. This plan will describe the manner in which this facility will comply with the requirements prescribed under 40 C.F.R. § 112.7 and the attached EPA document entitled "U.S. Environmental Protection Agency Tier I Qualified Facility SPCC Plan Template".

Section 4.0 – Responsible Parties

The Owner of the facility, their heirs and assigns, is ultimately responsible for the correct formulation and implementation of the SPCC. The firm contracted to complete the Operations and Maintenance (O&M) for the facility will assume this responsibility for the Owner. Only firms qualified to complete the environmental work, qualified to perform the limited work within the transformer, and properly insured will be contracted to this work. The firm contracted to complete the operations and maintenance work will be responsible for any and all reporting required by the current EPA SPCC Rule, any and all updates of that rule, any and all State of Massachusetts land use and environmental permit reporting requirements. The plan must be periodically reviewed, at least once every five years. The plan must also be updated if any changes are made to the facility. Prior to operations, the O&M firm shall be responsible for providing a quantity of spill control materials such as sorbents, tools and any other necessary materials to be kept on site in the vicinity of the project transformers in a secure central location to deal with small spills from maintenance vehicles and project equipment. All project transformers have a secondary oil containment area designed to sufficiently capture and contain all the oil present within each transformer. At a minimum, the following materials will be available on site:

• A 32-gallon barrel marked “Spill Kit”

• Sorbents capable of absorbing up to 21 gallons of oil

• Large “industrial” garbage bags and a small shovel

In addition, the O&M representative shall carry their own small spill kit to deal with spills from maintenance vehicles.

Space provided below for future determination of responsible parties.

Plan Preparer/ Project Design Engineer:	Gregory T. Dixson Massachusetts PE #55649 Krebs and Lansing Consulting Engineers, Inc. 164 Main Street, Suite 201 Colchester, Vermont 05446 (802) 878-0375
Project Owner:	Cost Solar, LLC. PO Box 51794, Lafayette, Louisiana, 70505 (337)-344-7381
O&M Firm:	________________________________ ________________________________ ________________________________ ________________________________ ________________________________

Section 5.0 – Inspection Procedure

The Operations and Maintenance (O&M) Firm will complete the following inspections of the site:

- Daily

  Inspection of Oil Gauge Alarm if tripped.

- Monthly

  Visual inspection of the site to look for evidence of leaking oil or spills, obvious faulty operation of the transformer, and obvious physical damage or deterioration of the transformer. Faulty transformer operation would be indicated by excessive noise or transformer surface temperature. If any oil discharges are noted, or the potential for an oil discharge is noted, measures shall be deployed to contain the oil in place before initiating cleanup. The intent of this requirement is to ensure that transformer oil does not reach sensitive environmental features. All materials necessary for the containment and clean-up of a spill shall be inventoried to determine a sufficient quantity is on-site and checked for expiration each month.

- Bi-Annually

  Same as monthly inspection plus a more detailed examination of the transformer. The exterior of the transformer will be carefully inspected for signs of corrosion, deterioration, or physical damage. This inspection will include opening the transformer cabinet. The interior of the cabinet area will be examined for corrosion. The oil level sight glass inside the transformer will be examined and the oil level recorded. The oil level will be compared to earlier measurements. Sampling port and pressure relief valve will be examined for damage or any signs of oil leakage/discharge. No inspection of the permeable reactive barrier membrane is required for systems with a permeable reactive barrier window in the containment membrane. If the system has been fitted with any Petro Plug type permeable reactive barrier control a detailed examination of the Petro-Pipe reactive plug outlet shall be completed. Plug should be functioning properly. Debris shall be cleaned from around the filter cage. Plug should be replaced if not functioning properly, i.e. water is dammed in secondary containment basin or plug is physically damaged. The O&M Firm will also review the Tier I Spill Prevention, Control, and Countermeasures Plan and the associated Oil Spill Contingency Plan documents and determine if any updates are needed. Any updates will be completed prior to the next monthly inspection.

Section 6.0 – Reporting Requirements

The Operations and Maintenance Firm (O&M Firm) will report any deficiencies to the Owner. If repairs are needed, the Operations and Maintenance Firm (O&M Firm) will return to the site after the repairs and complete the "Bi-Annual" inspection procedure. If the transformer oil is discharged for any reason this event will be reported to the EPA. This reporting will be in strict conformance with the requirements defined in the attached U.S. Environmental Protection Agency Tier I Qualified Facility SPCC Plan Template. Additionally, the Massachusetts DEP has stringent oil spill reporting requirements. All spills must be reported to MassDEP immediately upon discovery. To report an oil spill, call the MassDEP’s 24-hour emergency spill hotline at 1-888-304-1133

Appendix A

Location Map

IRONWOOD RENEWABLES

IRONWOOD ENERGY

bri BIODIVERSITY RESEARCH INSTITUTE

LOCATION MAP

COSTA SOLAR

Costa Drive
Freetown, Massachusetts

KREBS & LANSING CONSULTING ENGINEERS

164 Main Street, Suite 201
Colchester, Vermont 05446

P: (802) 878-0375
www.krebsandlansing.com

0' 2,500' 5,000' 10,000'

0" 1/2" 1" 2"

GRAPHIC SCALE 1" = 5,000'

Drawn by: GTD
Date: November 1, 2021
Project #: 21223
Scale: 1" = 5,000'

Appendix B

Transformer Secondary Oil Containment Details
(See Details on Site Plans – Page C-3.04)

Appendix C

Transformer Secondary Oil Containment
Capacity Calculations

Containment Volume Calculation:

(Also shown on Site Plan Details C-3.04)

Required Capacity:
125% of the 500 gallons of transformer oil = 625 gal. = 84 c.f.
(Note: fluid volume shown for 2,000 kVA transformer)

Required Minimum Freeboard:
24-hour duration, 25-year storm per NOAA Precipitation Frequency Server = 6.02" (0.50')
Containment Area & Pad = 17' x 17' = 289 s.f.
Volume of Freeboard Required = 289 s.f. x 0.50 ft. = 145 c.f.

Total Capacity Required = 84 c.f. + 145 c.f. = **229 c.f.**

Capacity Provided in Secondary Oil Containment System:
Area of Containment = (17'x17') - (13'x7') = 198 s.f.
Volume of Containment = 198 s.f. x 3.0' of depth = 594 c.f.
When filled with stone with 45% void ratio = 594 c.f. * 0.45 = 267 c.f.
Total Capacity Provided = **267 c.f.** > 212 c.f. required

Appendix D

U.S. EPA Tier I Qualified Facility
SPCC Plan Template

U.S. ENVIRONMENTAL PROTECTION AGENCY
TIER I QUALIFIED FACILITY SPCC PLAN TEMPLATE

Instructions to Complete this Template

This template is intended to help the owner or operator of a Tier I qualified facility develop a self-certified Spill Prevention, Control, and Countermeasure (SPCC) Plan. To use this template, your facility must meet all of the applicability criteria of a Tier I qualified facility listed under §112.3(g)(1) of the SPCC rule. This template provides every SPCC rule requirement necessary for a Tier I qualified facility, which you must address and implement.

You may use this template to comply with the SPCC regulation or use it as a model and modify it as necessary to meet your facility-specific needs. If you modify the template, your Plan must include a section cross-referencing the location of each applicable requirement of the SPCC rule and you must ensure that your Plan is an equivalent Plan that meets all applicable rule requirements of 40 CFR 112.6(a)(3).

You may complete this template either electronically or by hand on a printed copy. This document is a reformatted version of the template found in Appendix G of 40 CFR part 112.[a] No substantive changes have been made. Please note that a "Not Applicable" ("N/A") column has been added to both Table G-10 (General Rule Requirements for Onshore Facilities) and Table G-11 (General Rule Requirements for Onshore Oil Production Facilities). The "N/A" column should help you complete your self-certification when a required rule element does not apply to your facility. Use of the "N/A" column is optional and is not required by rule.

All Tier I qualified facility self-certifiers must complete Sections I, II, and III. Additionally, the owner or operator of an:

- Onshore facility (excluding production) must complete Section A.
- Onshore oil production facility (excluding drilling and workover facilities) must complete Section B.
- Onshore oil drilling and workover facility must complete Section C.

Complete and include with your Plan the appropriate attachments. You should consider printing copies of the attachments for use in implementing the SPCC Plan (e.g. Attachment 3.1 - Inspection Log & Schedule; Attachment 4 - Discharge Notification Form).

To complete the template, check the box next to the requirement to indicate that it has been adequately addressed. Either write "N/A" in the column or check the box under the "N/A" column to indicate those requirements that are not applicable to the facility. Where a section requires a description or listing, write in the spaces provided (or attach additional descriptions if more space is needed).

Below is a key for the colors used in the section headers:

Sections I, II, and III:	Required for all Tier I qualified facilities
Section A:	Onshore facilities (excluding production)
Section B:	Onshore oil production facilities (excluding drilling and workover facilities)
Section C:	Onshore oil drilling and workover facilities
Attachments:	1 - Five Year Review and Technical Amendment Logs 2 - Oil Spill Contingency Plan and Checklist 3 - Inspections, Dike Drainage and Personnel Training Logs 4 - Discharge Notification Form

After you have completed all appropriate sections, certify and date your Plan, and then implement it by the compliance date. If your facility was in operation before August 16, 2002, and you do not already have a Plan, then implement this template immediately. Conduct inspections and tests in accordance with the written procedures that you have developed for your facility. You must keep with the SPCC Plan a record of these inspections and tests, signed by the appropriate supervisor or inspector, for a period of three years.

Do not forget to periodically review your Plan (at least once every five years) or to update it when you make changes to your facility. You must prepare amendments within six months of the facility change, and implement them as soon as possible, but not later than six months following preparation of any amendment.

---

[a] Please note that the use of this template is not mandatory for a Tier I qualified facility. You may also meet the SPCC Plan requirement by preparing a satisfactory Tier II qualified facility Plan, preparing a satisfactory Plan that is certified by a Professional Engineer, or by developing an equivalent Plan for a Tier I qualified facility. Further information on the requirements of these methods can be found in 40 CFR part 112.6(a)(1). If you use any of these alternative methods you must include a cross reference in your Plan that shows how the equivalent Plan meets all applicable 40 CFR part 112 requirements.

In the event that your facility releases oil to navigable waters or adjoining shorelines, immediately call the National Response Center (NRC) at 1-800-424-8802. The NRC is the federal government's centralized reporting center, which is staffed 24 hours

Tier I Qualified Facility SPCC Plan

per day by U.S. Coast Guard personnel.

This template constitutes the SPCC Plan for the facility, when completed and signed by the owner or operator of a facility that meets the applicability criteria in §112.3(g)(1). This template addresses the requirements of 40 CFR part 112. Maintain a complete copy of the Plan at the facility if the facility is normally attended at least four hours per day, or for a facility attended fewer than four hours per day, at the nearest field office. When making operational changes at a facility that are necessary to comply with the rule requirements, the owner/operator should follow state and local requirements (such as for permitting, design and construction) and obtain professional assistance, as appropriate.

Facility Description

Facility Name: Costa Solar

Facility Address: Costa Drive

City: Freetown State: Massachusetts ZIP: 02717

County: Bristol County Tel. Number: ( ) -

Owner or Operator Name: Costa Solar, LLC

Owner or Operator Address:

City: State: ZIP:

County: Tel. Number: ( ) -

I. Self-Certification Statement (§112.6(a)(1))

The owner or operator of a facility certifies that each of the following is true in order to utilize this template to comply with the SPCC requirements:

I DRAFT certify that the following is accurate:

1. I am familiar with the applicable requirements of 40 CFR part 112;
2. I have visited and examined the facility;
3. This Plan was prepared in accordance with accepted and sound industry practices and standards;
4. Procedures for required inspections and testing have been established in accordance with industry inspection and testing standards or recommended practices;
5. I will fully implement the Plan;
6. This facility meets the following qualification criteria (under §112.3(g)(1)):
   a. The aggregate aboveground oil storage capacity of the facility is 10,000 U.S. gallons or less; and
   b. The facility has had no single discharge as described in §112.1(b) exceeding 1,000 U.S. gallons and no two discharges as described in §112.1(b) each exceeding 42 U.S. gallons within any twelve month period in the three years prior to the SPCC Plan self-certification date, or since becoming subject to 40 CFR part 112 if the facility has been in operation for less than three years (not including oil discharges as described in §112.1(b) that are the result of natural disasters, acts of war, or terrorism); and
   c. There is no individual oil storage container at the facility with an aboveground capacity greater than 5,000 U.S. gallons.
7. This Plan does not deviate from any requirement of 40 CFR part 112 as allowed by §112.7(a)(2) (environmental equivalence) and §112.7(d) (impracticability of secondary containment) or include any measures pursuant to §112.9(c)(6) for produced water containers and any associated piping;
8. This Plan and individual(s) responsible for implementing this Plan have the full approval of management and I have committed the necessary resources to fully implement this Plan.

I also understand my other obligations relating to the storage of oil at this facility, including, among others:

1. To report any oil discharge to navigable waters or adjoining shorelines to the appropriate authorities. Notification information is included in this Plan.
2. To review and amend this Plan whenever there is a material change at the facility that affects the potential for an oil discharge, and at least once every five years. Reviews and amendments are recorded in an attached log [See Five Year Review Log and Technical Amendment Log in Attachments 1.1 and 1.2.]
3. Optional use of a contingency plan. A contingency plan:
   a. May be used in lieu of secondary containment for qualified oil-filled operational equipment, in accordance with the requirements under §112.7(k), and;
   b. Must be prepared for flowlines and/or intra-facility gathering lines which do not have secondary containment at an oil production facility, and;
   c. Must include an established and documented inspection or monitoring program; must follow the provisions of 40 CFR part 109; and must include a written commitment of manpower, equipment and materials to expeditiously remove any quantity of oil discharged that may be harmful. If applicable, a copy of the contingency plan and any additional documentation will be attached to this Plan as Attachment 2.

I certify that I have satisfied the requirement to prepare and implement a Plan under §112.3 and all of the requirements under §112.6(a). I certify that the information contained in this Plan is true.

Signature ______DRAFT______ Title: ____________

Name ____________ Date: ___/___/ 2021

II. Record of Plan Review and Amendments

Five Year Review (§112.5(b)):

Complete a review and evaluation of this SPCC Plan at least once every five years. As a result of the review, amend this Plan within six months to include more effective prevention and control measures for the facility, if applicable. Implement any SPCC Plan amendment as soon as possible, but no later than six months following Plan amendment. Document completion of the review and evaluation, and complete the Five Year Review Log in Attachment 1.1. If the facility no longer meets Tier I qualified facility eligibility, the owner or operator must revise the Plan to meet Tier II qualified facility requirements, or complete a full PE certified Plan.

Table G-1 Technical Amendments (§§112.5(a), (c) and 112.6(a)(2))	
This SPCC Plan will be amended when there is a change in the facility design, construction, operation, or maintenance that materially affects the potential for a discharge to navigable waters or adjoining shorelines. Examples include adding or removing containers, reconstruction, replacement, or installation of piping systems, changes to secondary containment systems, changes in product stored at this facility, or revisions to standard operating procedures.	☒
Any technical amendments to this Plan will be re-certified in accordance with Section I of this Plan template. *[§112.6(a)(2)]* **[See Technical Amendment Log in Attachment 1.2]**	☒

III. Plan Requirements

1. Oil Storage Containers (§112.7(a)(3)(i)):

Table G-2 Oil Storage Containers and Capacities	
This table includes a complete list of all oil storage containers (aboveground containers[a] and completely buried tanks[b]) with capacity of 55 U.S. gallons or more, unless otherwise exempt from the rule. For mobile/portable containers, an estimated number of containers, types of oil, and anticipated capacities are provided.	☒

Oil Storage Container *(indicate whether aboveground (A) or completely buried (B))*	**Type of Oil**	**Shell Capacity (gallons)**
Transformer A	Envirotemp FR3 Fluid	500
Transformer B	Envirotemp FR3 Fluid	500
Transformer C	Envirotemp FR3 Fluid	500
Transformer D	Envirotemp FR3 Fluid	500

Total Aboveground Storage Capacity [c] 2,000 gallons
Total Completely Buried Storage Capacity 0 gallons
Facility Total Oil Storage Capacity 2,000 gallons

[a] Aboveground storage containers that must be included when calculating total facility oil storage capacity include: tanks and mobile or portable containers; oil-filled operational equipment (e.g. transformers); other oil-filled equipment**,** such as flow-through process equipment. Exempt containers that are not included in the capacity calculation include: any container with a storage capacity of less than 55 gallons of oil; containers used exclusively for wastewater treatment; permanently closed containers; motive power containers; hot-mix asphalt containers; heating oil containers used solely at a single-family residence; and pesticide application equipment or related mix containers.

[b] Although the criteria to determine eligibility for qualified facilities focuses on the aboveground oil storage containers at the facility, the completely buried tanks at a qualified facility are still subject to the rule requirements and must be addressed in the template; however, they are not counted toward the qualified facility applicability threshold.

[c] Counts toward qualified facility applicability threshold.

2. Secondary Containment and Oil Spill Control (§§112.6(a)(3)(i) and (ii), 112.7(c) and 112.9(c)(2)):

Table G-3 Secondary Containment and Oil Spill Control	
Appropriate secondary containment and/or diversionary structures or equipment[a] is provided for all oil handling containers, equipment, and transfer areas to prevent a discharge to navigable waters or adjoining shorelines. The entire secondary containment system, including walls and floor, is capable of containing oil and is constructed so that any discharge from a primary containment system, such as a tank or pipe, will not escape the containment system before cleanup occurs.	☒

[a] Use one of the following methods of secondary containment or its equivalent: (1) Dikes, berms, or retaining walls sufficiently impervious to contain oil; (2) Curbing; (3) Culverting, gutters, or other drainage systems; (4) Weirs, booms, or other barriers; (5) Spill diversion ponds; (6) Retention ponds; or (7) Sorbent materials.

Table G-4 below identifies the tanks and containers at the facility with the potential for an oil discharge; the mode of failure; the flow direction and potential quantity of the discharge; and the secondary containment method and containment capacity that is provided.

Table G-4 Containers with Potential for an Oil Discharge					
Area	Type of failure (discharge scenario)	Potential discharge volume (gallons)	Direction of flow for uncontained discharge	Secondary containment method[a]	Secondary containment capacity (gallons)
Bulk Storage Containers and Mobile/Portable Containers[b]					
Oil-filled Operational Equipment (e.g., hydraulic equipment, transformers)[c]					
Transformer	Breach of Transformer wall from accident or corrosion, discharge from pressure reliefe valve due to overpressure condition	500 gal. per transformer		Rectangular Remote Impoundment Structure	1,998 per transformer
Piping, Valves, etc.					
Fittings on Transformers	Relief Valve			Rectangular Remote Impoundment Structure	1,998 per transformer
	Level Gauge			Rectangular Remote Impoundment Structure	1,998 per transformer
Product Transfer Areas (location where oil is loaded to or from a container, pipe or other piece of equipment.)					
Other Oil-Handling Areas or Oil-Filled Equipment (e.g. flow-through process vessels at an oil production facility)					

[a] Use one of the following methods of secondary containment or its equivalent: (1) Dikes, berms, or retaining walls sufficiently impervious to contain oil; (2) Curbing; (3) Culverting, gutters, or other drainage systems; (4) Weirs, booms, or other barriers; (5) Spill diversion ponds; (6) Retention ponds; or (7) Sorbent materials.
[b] For storage tanks and bulk storage containers, the secondary containment capacity must be at least the capacity of the largest container plus additional capacity to contain rainfall or other precipitation.
[c] For oil-filled operational equipment: Document in the table above if alternative measures to secondary containment (as described in §112.7(k)) are implemented at the facility.

3. Inspections, Testing, Recordkeeping and Personnel Training (§§112.7(e) and (f), 112.8(c)(6) and (d)(4), 112.9(c)(3), 112.12(c)(6) and (d)(4)):

Table G-5 Inspections, Testing, Recordkeeping and Personnel Training	
An inspection and/or testing program is implemented for all aboveground bulk storage containers and piping at this facility. *[§§112.8(c)(6) and (d)(4), 112.9(c)(3), 112.12(c)(6) and (d)(4)]*	☒
The following is a description of the inspection and/or testing program (e.g. reference to industry standard utilized, scope, frequency, method of inspection or test, and person conducting the inspection) for all aboveground bulk storage containers and piping at this facility: 1) Assign qualified employees of the firm hired to complete the Operations and Maintenance of the facility (the O&M Firm) to perform periodic inspections of the transformer and surrounding area. 2) The O&M Firm will review the SPCC Plan for completeness, accurate and up to date reporting information and updates required. O&M Firm shall complete all updates to the SPCC Plan. 3) The firm shall complete the inspections, associated logs and record keeping as detailed below: Daily - Inspection of oil gauge alarm if tripped. Monthly - Visual inspection of the site to look for leaking oil, obvious faulty operation of the transformer, and obvious physical damage to the transformer. Faulty transformer operation would be indicated by excessive noise or transformer surface temperature. Bi-Annually - Same as monthly inspection plus a more detailed examination of the transformer. The exterior of the transformer will be carefully inspected for signs of corrosion, deterioration, or physical damage. This inspection will include opening the transformer cabinet. The interior of the cabinet area will be examined for corrosion. The oil level sight glass inside the transformer will be examined and the oil level recorded. The oil level will be compared to earlier measurements. Sampling port and pressure relief valve will be examined for damage or any signs of oil leakage/discharge. The O&M Firm will also examine review the Tier I Spill Prevention, Control, and Countermeasures Plan and the associated Oil Spill Contingency Plan documents and determine if any updates are needed. Any updates will be completed prior to the next monthly inspection.	
Inspections, tests, and records are conducted in accordance with written procedures developed for the facility. Records of inspections and tests kept under usual and customary business practices will suffice for purposes of this paragraph. *[§112.7(e)]*	☒
A record of the inspections and tests are kept at the facility or with the SPCC Plan for a period of three years. *[§112.7(e)]* **[See Inspection Log and Schedule in Attachment 3.1]**	☒
Inspections and tests are signed by the appropriate supervisor or inspector. *[§112.7(e)]*	☒
Personnel, training, and discharge prevention procedures [§112.7(f)]	
Oil-handling personnel are trained in the operation and maintenance of equipment to prevent discharges; discharge procedure protocols; applicable pollution control laws, rules, and regulations; general facility operations; and, the contents of the facility SPCC Plan. *[§112.7(f)]*	☒
A person who reports to facility management is designated and accountable for discharge prevention. *[§112.7(f)]* Name/Title: (Add name of responsible party once O&M firm has been selected)	☒
Discharge prevention briefings are conducted for oil-handling personnel annually to assure adequate understanding of the SPCC Plan for that facility. Such briefings highlight and describe past reportable discharges or failures, malfunctioning components, and any recently developed precautionary measures. *[§112.7(f)]* **[See Oil-handling Personnel Training and Briefing Log in Attachment 3.4]**	☒

4. Security (excluding oil production facilities) §112.7(g):

Table G-6 Implementation and Description of Security Measures	
Security measures are implemented at this facility to prevent unauthorized access to oil handling, processing, and storage area.	☒
The following is a description of how you secure and control access to the oil handling, processing and storage areas; secure master flow and drain valves; prevent unauthorized access to starter controls on oil pumps; secure out-of-service and loading/unloading connections of oil pipelines; address the appropriateness of security lighting to both prevent acts of vandalism and assist in the discovery of oil discharges: 1) The facility will have restricted gated access and perimeter fencing. Only authorized personnel from Costa Solar, LLC and the O&M Firm will have access to the site. 2) The transformer cabinet will be locked.	

5. Emergency Procedures and Notifications (§112.7(a)(3)(iv) and 112.7(a)(5)):

Table G-7 Description of Emergency Procedures and Notifications
The following is a description of the immediate actions to be taken by facility personnel in the event of a discharge to navigable waters or adjoining shorelines *[§112.7(a)(3)(iv) and 112.7(a)(5)]*: 1) Contact Eversource and have the transformer disconnected. 2) Contact MassDEP within immediately upon discovery of the spill. 3) Contact Cleanup Contractor and complete actions necessary to contain and clean up spill. 4) Concurrently contact the Owner, National Response Center, Environmental Assistance Hotline, Fire Department, Police. 5) Review the spill and any possible effects on the surrounding area. Determine if any actions are needed and complete those actions.

6. Contact List (§112.7(a)(3)(vi)):

Table G-8 Contact List	
Contact Organization / Person	**Telephone Number**
National Response Center (NRC)	1-800-424-8802
Cleanup Contractor(s) ACV Enviro Norfolk, MA	508-872-5000
Key Facility Personnel	
Designated Person Accountable for Discharge Prevention:	Office:
	Emergency:
Eversource	Office: 800-286-2000
	Emergency: 888-783-6617
Massachusetts Department of Environmental Protection	Office: 508-946-2700
	Emergency: 888-304-1133
	Office:
	Emergency:
Other State, Federal, and Local Agencies Bristol County Sheriff's Office	508-995-1311
Local Fire Department Freetown, MA Fire Department	508-763-4828
Local Police Department Freetown, MA Police Department	508-763-4017
Hospital Saint Anne's Hospital, Fall River, MA	508-674-5600
Other Contact References (e.g., downstream water intakes or neighboring facilities)	

7. NRC Notification Procedure (§112.7(a)(4) and (a)(5)):

Table G-9 NRC Notification Procedure	
In the event of a discharge of oil to navigable waters or adjoining shorelines, the following information identified in Attachment 4 will be provided to the National Response Center immediately following identification of a discharge to navigable waters or adjoining shorelines **[See Discharge Notification Form in Attachment 4]**: *[§112.7(a)(4)]*	☒
• The exact address or location and phone number of the facility; • Date and time of the discharge; • Type of material discharged; • Estimate of the total quantity discharged; • Estimate of the quantity discharged to navigable waters; • Source of the discharge;	• Description of all affected media; • Cause of the discharge; • Any damages or injuries caused by the discharge; • Actions being used to stop, remove, and mitigate the effects of the discharge; • Whether an evacuation may be needed; and • Names of individuals and/or organizations who have also been contacted.

8. SPCC Spill Reporting Requirements (Report within 60 days) (§112.4):

Submit information to the EPA Regional Administrator (RA) and the appropriate agency or agencies in charge of oil pollution control activities in the State in which the facility is located within 60 days from one of the following discharge events:

A single discharge of more than 1,000 U.S. gallons of oil to navigable waters or adjoining shorelines or
Two discharges to navigable waters or adjoining shorelines each more than 42 U.S. gallons of oil occurring within any twelve month period

<u>You must submit the following information to the RA:</u>

(1) Name of the facility;
(2) Your name;
(3) Location of the facility;
(4) Maximum storage or handling capacity of the facility and normal daily throughput;
(5) Corrective action and countermeasures you have taken, including a description of equipment repairs and replacements;
(6) An adequate description of the facility, including maps, flow diagrams, and topographical maps, as necessary;
(7) The cause of the reportable discharge, including a failure analysis of the system or subsystem in which the failure occurred; and
(8) Additional preventive measures you have taken or contemplated to minimize the possibility of recurrence
(9) Such other information as the Regional Administrator may reasonably require pertinent to the Plan or discharge

* * * * *

NOTE: Complete one of the following sections (A, B or C)

as appropriate for the facility type.

A. Onshore Facilities (excluding production) (§§112.8(b) through (d), 112.12(b) through (d)):

The owner or operator must meet the general rule requirements as well as requirements under this section. Note that not all provisions may be applicable to all owners/operators. For example, a facility may not maintain completely buried metallic storage tanks installed after January 10, 1974, and thus would not have to abide by requirements in §§112.8(c)(4) and 112.12(c)(4), listed below. **In cases where a provision is not applicable, write "N/A".**

Table G-10 General Rule Requirements for Onshore Facilities		N/A
Drainage from diked storage areas is restrained by valves to prevent a discharge into the drainage system or facility effluent treatment system, except where facility systems are designed to control such discharge. Diked areas may be emptied by pumps or ejectors that must be manually activated after inspecting the condition of the accumulation to ensure no oil will be discharged. *[§§112.8(b)(1) and 112.12(b)(1)]*	☐	☒
Valves of manual, open-and-closed design are used for the drainage of diked areas. *[§§112.8(b)(2) and 112.12(b)(2)]*	☐	☒
The containers at the facility are compatible with materials stored and conditions of storage such as pressure and temperature. *[§§112.8(c)(1) and 112.12(c)(1)]*	☐	☒
Secondary containment for the bulk storage containers (including mobile/portable oil storage containers) holds the capacity of the largest container plus additional capacity to contain precipitation. Mobile or portable oil storage containers are positioned to prevent a discharge as described in §112.1(b). *[§112.6(a)(3)(ii)]*	☒	☐
If uncontaminated rainwater from diked areas drains into a storm drain or open watercourse the following procedures will be implemented at the facility: *[§§112.8(c)(3) and 112.12(c)(3)]* • Bypass valve is normally sealed closed • Retained rainwater is inspected to ensure that its presence will not cause a discharge to navigable waters or adjoining shorelines • Bypass valve is opened and resealed under responsible supervision • Adequate records of drainage are kept **[See Dike Drainage Log in Attachment 3.3]**	 ☐ ☐ ☐ ☐	 ☒ ☒ ☒ ☒
For completely buried metallic tanks installed on or after January 10, 1974 at this facility *[§§112.8(c)(4) and 112.12(c)(4)]*: • Tanks have corrosion protection with coatings or cathodic protection compatible with local soil conditions. • Regular leak testing is conducted.	 ☐ ☐	 ☒ ☒
For partially buried or bunkered metallic tanks *[§112.8(c)(5) and §112.12(c)(5)]*: • Tanks have corrosion protection with coatings or cathodic protection compatible with local soil conditions.	 ☐	 ☒
Each aboveground bulk container is tested or inspected for integrity on a regular schedule and whenever material repairs are made. Scope and frequency of the inspections and inspector qualifications are in accordance with industry standards. Container supports and foundations are regularly inspected. **[See Inspection Log and Schedule and Bulk Storage Container Inspection Schedule in Attachments 3.1 and 3.2]** *[§112.8(c)(6) and §112.12(c)(6)(i)]*	☒	☐
Outsides of bulk storage containers are frequently inspected for signs of deterioration, discharges, or accumulation of oil inside diked areas. **[See Inspection Log and Schedule in Attachment 3.1]** *[§§112.8(c)(6) and 112.12(c)(6)]*	☒	☐
For bulk storage containers that are subject to 21 CFR part 110 which are shop-fabricated, constructed of austenitic stainless steel, elevated and have no external insulation, formal visual inspection is conducted on a regular schedule. Appropriate qualifications for personnel performing tests and inspections are documented. **[See Inspection Log and Schedule and Bulk Storage Container Inspection Schedule in Attachments 3.1 and 3.2]** *[§112.12(c)(6)(ii)]*	☒	☐

Table G-10 General Rule Requirements for Onshore Facilities		N/A
Each container is provided with a system or documented procedure to prevent overfills for the container. Describe: 1) The transformer has an oil level gauge inside the cabinet. The oil level shall be monitored when filling. 2) Drip pans shall be used under fittings if refilling of the transformer oil is required. 3) A spill kit will be used to contain any small spills.	☒	☐
Liquid level sensing devices are regularly tested to ensure proper operation **[See Inspection Log and Schedule in Attachment 3.1]**. *[§112.6(a)(3)(iii)]*	☒	☐
Visible discharges which result in a loss of oil from the container, including but not limited to seams, gaskets, piping, pumps, valves, rivets, and bolts are promptly corrected and oil in diked areas is promptly removed. *[§§112.8(c)(10) and 112.12(c)(10)]*	☒	☐
Aboveground valves, piping, and appurtenances such as flange joints, expansion joints, valve glands and bodies, catch pans, pipeline supports, locking of valves, and metal surfaces are inspected regularly. **[See Inspection Log and Schedule in Attachment 3.1]** *[§§112.8(d)(4) and 112.12(d)(4)]*	☒	☐
Integrity and leak testing are conducted on buried piping at the time of installation, modification, construction, relocation, or replacement. **[See Inspection Log and Schedule in Attachment 3.1]** *[§§112.8(d)(4) and 112.12(d)(4)]*	☐	☒

B. Onshore Oil Production Facilities (excluding drilling and workover facilities) (§112.9(b), (c), and (d)):

The owner or operator must meet the general rule requirements as well as the requirements under this section. Note that not all provisions may be applicable to all owners/operators. **In cases where a provision is not applicable, write "N/A".**

Table G-11 General Rule Requirements for Onshore Oil Production Facilities		N/A
At tank batteries, separation and treating areas, drainage is closed and sealed except when draining uncontaminated rainwater. Accumulated oil on the rainwater is returned to storage or disposed of in accordance with legally approved methods. *[§112.9(b)(1)]*	☐	☐
Prior to drainage, diked areas are inspected and *[§112.9(b)(1)]*:		
• Retained rainwater is inspected to ensure that its presence will not cause a discharge to navigable waters	☐	☐
• Bypass valve is opened and resealed under responsible supervision	☐	☐
• Adequate records of drainage are kept **[See Dike Drainage Log in Attachment 3.3]**	☐	☐
Field drainage systems and oil traps, sumps, or skimmers are inspected at regularly scheduled intervals for oil, and accumulations of oil are promptly removed **[See Inspection Log and Schedule in Attachment 3.1]** *[§112.9(b)(2)]*	☐	☐
The containers used at this facility are compatible with materials stored and conditions of storage. *[§112.9(c)(1)]*	☐	☐
All tank battery, separation, and treating facility installations (except for flow-through process vessels) are constructed with a capacity to hold the largest single container plus additional capacity to contain rainfall. Drainage from undiked areas is safely confined in a catchment basin or holding pond. *[§112.9(c)(2)]*	☐	☐
Except for flow-through process vessels, containers that are on or above the surface of the ground, including foundations and supports, are visually inspected for deterioration and maintenance needs on a regular schedule. **[See Inspection Log and Schedule in Attachment 3.1]** *[§112.9(c)(3)]*	☐	☐
New and old tank batteries at this facility are engineered/updated in accordance with good engineering practices to prevent discharges including at least one of the following: i. adequate container capacity to prevent overfill if regular pumping/gauging is delayed; ii. overflow equalizing lines between containers so that a full container can overflow to an adjacent container; iii. vacuum protection to prevent container collapse; or iv. high level sensors to generate and transmit an alarm to the computer where the facility is subject to a computer production control system. *[§112.9(c)(4)]*	☐	☐
Flow-through process vessels and associated components are:		
• Are constructed with a capacity to hold the largest single container plus additional capacity to contain rainfall. Drainage from undiked areas is safely confined in a catchment basin or holding pond; *[§112.9(c)(2)]* and	☐	☐
• That are on or above the surface of the ground, including foundations and supports, are visually inspected for deterioration and maintenance needs on a regular schedule. **[See Inspection Log and Schedule in Attachment 3.1]** *[§112.9(c)(3)]*	☐	☐
Or		
• Visually inspected and/or tested periodically and on a regular schedule for leaks, corrosion, or other conditions that could lead to a discharge to navigable waters; and	☐	☐
• Corrective action or repairs are applied to flow-through process vessels and any associated components as indicated by regularly scheduled visual inspections, tests, or evidence of an oil discharge; and	☐	☐
• Any accumulations of oil discharges associated with flow-through process vessels are promptly removed; and	☐	☐
• Flow-through process vessels are provided with a secondary means of containment for the entire capacity of the largest single container and sufficient freeboard to contain precipitation within six months of a discharge from flow-through process vessels of more than 1,000 U.S. gallons of oil in a single discharge as described in §112.1(b), or a discharge more than 42 U.S. gallons of oil in each of two discharges as described in §112.1(b) within any twelve month period. *[§112.9(c)(5)]* *(Leave blank until such time that this provision is applicable.)*	☐	☐

Table G-11 General Rule Requirements for Onshore Oil Production Facilities		N/A
All aboveground valves and piping associated with transfer operations are inspected periodically and upon a regular schedule. The general condition of flange joints, valve glands and bodies, drip pans, pipe supports, pumping well polish rod stuffing boxes, bleeder and gauge valves, and other such items are included in the inspection. **[See Inspection Log and Schedule in Attachment 3.1]** *[§112.9(d)(1)]*	☐	☐
An oil spill contingency plan and written commitment of resources are provided for flowlines and intra-facility gathering lines **[See Oil Spill Contingency Plan and Checklist in Attachment 2 and Inspection Log and Schedule in Attachment 3.1]** *[§112.9(d)(3)]*	☐	☐
or		
Appropriate secondary containment and/or diversionary structures or equipment is provided for flowlines and intra-facility gathering lines to prevent a discharge to navigable waters or adjoining shorelines. The entire secondary containment system, including walls and floor, is capable of containing oil and is constructed so that any discharge from the pipe, will not escape the containment system before cleanup occurs.	☐	☐
A flowline/intra-facility gathering line maintenance program to prevent discharges from each flowline has been established at this facility. The maintenance program addresses each of the following:	☐	☐
• Flowlines and intra-facility gathering lines and associated valves and equipment are compatible with the type of production fluids, their potential corrosivity, volume, and pressure, and other conditions expected in the operational environment;	☐	☐
• Flowlines, intra-facility gathering lines and associated appurtenances are visually inspected and/or tested on a periodic and regular schedule for leaks, oil discharges, corrosion, or other conditions that could lead to a discharge as described in §112.1(b). The frequency and type of testing allows for the implementation of a contingency plan as described under part 109 of this chapter.	☐	☐
• Corrective action and repairs to any flowlines and intra-facility gathering lines and associated appurtenances as indicated by regularly scheduled visual inspections, tests, or evidence of a discharge.	☐	☐
• Accumulations of oil discharges associated with flowlines, intra-facility gathering lines, and associated appurtenances are promptly removed. *[§112.9(d)(4)]*	☐	☐
The following is a description of the flowline/intra-facility gathering line maintenance program implemented at this facility:		

C. Onshore Oil Drilling and Workover Facilities (§112.10(b), (c) and (d)):

The owner or operator must meet the general rule requirements as well as the requirements under this section.

Table G-12 General Rule Requirements for Onshore Oil Drilling and Workover Facilities	
Mobile drilling or worker equipment is positioned or located to prevent discharge as described in §112.1(b). *[§112.10(b)]*	☐
Catchment basins or diversion structures are provided to intercept and contain discharges of fuel, crude oil, or oily drilling fluids. *[§112.10(c)]*	☐
A blowout prevention (BOP) assembly and well control system was installed before drilling below any casing string or during workover operations. *[§112.10(d)]*	☐
The BOP assembly and well control system is capable of controlling any well-head pressure that may be encountered while the BOP assembly and well control system are on the well. *[§112.10(d)]*	☐

ATTACHMENT 1 – Five Year Review and Technical Amendment Logs

ATTACHMENT 1.1 – Five Year Review Log

I have completed a review and evaluation of the SPCC Plan for this facility, and will/will not amend this Plan as a result.

Table G-13 Review and Evaluation of SPCC Plan for Facility			
Review Date	Plan Amendment		Name and signature of person authorized to review this Plan
	Will Amend	Will Not Amend	
	☐	☐	
	☐	☐	
	☐	☐	
	☐	☐	
	☐	☐	
	☐	☐	
	☐	☐	
	☐	☐	
	☐	☐	
	☐	☐	
	☐	☐	
	☐	☐	
	☐	☐	

ATTACHMENT 1.2 – Technical Amendment Log

Any technical amendments to this Plan will be re-certified in accordance with Section I of this Plan template.

Table G-15 Description and Certification of Technical Amendments

Review Date	Description of Technical Amendment	Name and signature of person certifying this technical amendment

ATTACHMENT 2 – Oil Spill Contingency Plan and Checklist

An oil spill contingency plan and written commitment of resources is required for:

- Flowlines and intra-facility gathering lines at oil production facilities and
- Qualified oil-filled operational equipment which has no secondary containment.

An oil spill contingency plan meeting the provisions of 40 CFR part 109, as described below, and a written commitment of manpower, equipment and materials required to expeditiously control and remove any quantity of oil discharged that may be harmful is attached to this Plan.	☒

Complete the checklist below to verify that the necessary operations outlined in 40 CFR part 109 - Criteria for State, Local and Regional Oil Removal Contingency Plans - have been included.

Table G-15 Checklist of Development and Implementation Criteria for State, Local and Regional Oil Removal Contingency Plans (§109.5)[a]	
(a) Definition of the authorities, responsibilities and duties of all persons, organizations or agencies which are to be involved in planning or directing oil removal operations.	☒
(b) Establishment of notification procedures for the purpose of early detection and timely notification of an oil discharge including:	
(1) The identification of critical water use areas to facilitate the reporting of and response to oil discharges.	☒
(2) A current list of names, telephone numbers and addresses of the responsible persons (with alternates) and organizations to be notified when an oil discharge is discovered.	☒
(3) Provisions for access to a reliable communications system for timely notification of an oil discharge, and the capability of interconnection with the communications systems established under related oil removal contingency plans, particularly State and National plans (e.g., NCP).	☒
(4) An established, prearranged procedure for requesting assistance during a major disaster or when the situation exceeds the response capability of the State, local or regional authority.	☒
(c) Provisions to assure that full resource capability is known and can be committed during an oil discharge situation including:	
(1) The identification and inventory of applicable equipment, materials and supplies which are available locally and regionally.	☒
(2) An estimate of the equipment, materials and supplies which would be required to remove the maximum oil discharge to be anticipated.	☒
(3) Development of agreements and arrangements in advance of an oil discharge for the acquisition of equipment, materials and supplies to be used in responding to such a discharge.	☒
(d) Provisions for well defined and specific actions to be taken after discovery and notification of an oil discharge including:	
(1) Specification of an oil discharge response operating team consisting of trained, prepared and available operating personnel.	☒
(2) Predesignation of a properly qualified oil discharge response coordinator who is charged with the responsibility and delegated commensurate authority for directing and coordinating response operations and who knows how to request assistance from Federal authorities operating under existing national and regional contingency plans.	☒
(3) A preplanned location for an oil discharge response operations center and a reliable communications system for directing the coordinated overall response operations.	☒
(4) Provisions for varying degrees of response effort depending on the severity of the oil discharge.	☒
(5) Specification of the order of priority in which the various water uses are to be protected where more than one water use may be adversely affected as a result of an oil discharge and where response operations may not be adequate to protect all uses.	☒
(6) Specific and well defined procedures to facilitate recovery of damages and enforcement measures as provided for by State and local statutes and ordinances.	☒

[a] The contingency plan must be consistent with all applicable state and local plans, Area Contingency Plans, and the National Contingency Plan (NCP)

ATTACHMENT 3 – Inspections, Dike Drainage and Personnel Training Logs

ATTACHMENT 3.1 – Inspection Log and Schedule

Table G-16 Inspection Log and Schedule

This log is intended to document compliance with §§112.6(a)(3)(iii), 112.8(c)(6), 112.8(d)(4), 112.9(b)(2), 112.9(c)(3), 112.9(d)(1), 112.9(d)(4), 112.12.(c)(6), and 112.12(d)(4), as applicable.

Date of Inspection	Container / Piping / Equipment	Describe Scope (or cite Industry Standard)	Observations	Name/ Signature of Inspector	Records maintained separately [a]
		Monthly visual inspection of transformer and surrounding site as prescribed in G-5			☐
		Monthly visual inspection of transformer and surrounding site as prescribed in G-5			☐
		Monthly visual inspection of transformer and surrounding site as prescribed in G-5			☐
		Monthly visual inspection of transformer and surrounding site as prescribed in G-5			☐
		Monthly visual inspection of transformer and surrounding site as prescribed in G-5			☐

[a] Indicate in the table above if records of facility inspections are maintained separately at this facility.

ATTACHMENT 3.2 – Bulk Storage Container Inspection Schedule – onshore facilities (excluding production):

To comply with integrity inspection requirement for bulk storage containers, inspect/test each shop-built aboveground bulk storage container on a regular schedule in accordance with a recognized container inspection standard based on the minimum requirements in the following table.

Table G-17 Bulk Storage Container Inspection Schedule	
Container Size and Design Specification	**Inspection requirement**
Portable containers (including drums, totes, and intermodal bulk containers (IBC))	Visually inspect monthly for signs of deterioration, discharges or accumulation of oil inside diked areas
55 to 1,100 gallons with sized secondary containment	Visually inspect monthly for signs of deterioration, discharges or accumulation of oil inside diked areas plus any annual inspection elements per industry inspection standards
1,101 to 5,000 gallons with sized secondary containment and a means of leak detection[a]	
1,101 to 5,000 gallons with sized secondary containment and no method of leak detection[a]	Visually inspect monthly for signs of deterioration, discharges or accumulation of oil inside diked areas, plus any annual inspection elements and other specific integrity tests that may be required per industry inspection standards

[a] Examples of leak detection include, but are not limited to, double-walled tanks and elevated containers where a leak can be visually identified.

ATTACHMENT 3.3 – Dike Drainage Log

Table G-18 Dike Drainage Log

Date	Bypass valve sealed closed	Rainwater inspected to be sure no oil (or sheen) is visible	Open bypass valve and reseal it following drainage	Drainage activity supervised	Observations	Signature of Inspector
	☐	☐	☐	☐		
	☐	☐	☐	☐		
	☐	☐	☐	☐		
	☐	☐	☐	☐		
	☐	☐	☐	☐		
	☐	☐	☐	☐		
	☐	☐	☐	☐		
	☐	☐	☐	☐		

ATTACHMENT 3.4 – Oil-handling Personnel Training and Briefing Log

Table G-19 Oil-Handling Personnel Training and Briefing Log		
Date	**Description / Scope**	**Attendees**
	To be completed by O&M firm at commissioning of facility	

ATTACHMENT 4 – Discharge Notification Form

In the event of a discharge of oil to navigable waters or adjoining shorelines, the following information will be provided to the National Response Center **[also see the notification information provided in Section 7 of the Plan]**:

Table G-20 Information provided to the National Response Center in the Event of a Discharge			
Discharge/Discovery Date		Time	
Facility Name	Costa Solar		
Facility Location (Address/Lat-Long/Section Township Range)	Costa Drive, Freetown, MA 02717 Bristol County N41° 45' 20.6" W70° 58' 32.7"		
Name of reporting individual		Telephone #	
Type of material discharged		Estimated total quantity discharged	Gallons/Barrels
Source of the discharge		Media affected	☐ Soil ☐ Water (specify) ☐ Other (specify)
Actions taken			
Damage or injuries	☐ No ☐ Yes (specify)	Evacuation needed?	☐ No ☐ Yes (specify)
Organizations and individuals contacted	☐ National Response Center 800-424-8802 Time ☐ Cleanup contractor (Specify) Time ☐ Facility personnel (Specify) Time ☐ State Agency (Specify) Time ☐ Other (Specify) Time		

Appendix E

Oil Spill Contingency Plan

OIL SPILL CONTINGENCY PLAN

Instructions: Complete the following information to (1) generate an Oil Spill Contingency Plan that meets the provisions of 40 CFR part 109 and (2) provide a written commitment of manpower, equipment and materials required to expediously control and remove any quantity of oil discharged that may be harmful. The contingency plan must be consistent with all applicable state and local plans, Area Contingency Plans, and the National Contingency Plan (NCP). Attach all of the information in this Appendix to your SPCC Plan.

DISCLAIMER: Completion of this Oil Spill Contingency Plan Template does not guarantee compliance. Each owner/operator is responsible for ensuring that his or her facility meets the requirements of 40 CFR 109 and 40 CFR 112 (74 FR 58811) and its proposed revisions.

List the authorities, responsibilities, and duties of all persons, organizations or agencies which are to be involved in planning or directing oil removal operations. Operations and Maintenance Firm (to be identified prior to site commissioning) Duties will include all inspections, reporting, SPCC Plan updates, contact with appropriate State and Federal regulatory agencies, contact and direction of Cleanup Contractor needed. ACV Enviro (Cleanup Contractor) Duties will include all removal and cleanup of spilled oil.

Establish notification procedures for the purpose of early detection and timely notification of an oil discharge including:

Identify critical water use areas. Unnamed tributaries and wetlands of Fall Brook	
Provide a current list of names, telephone numbers and addresses of the responsible persons and organizations to be notified when an oil discharge is discovered	See *Emergency Contact Information* and *Table 10: Discharge Notification Form* in the SPCC Plan
[X] Access to a reliable communication system is provided for timely notification of an oil discharge. This system is capable of interconnection with the communications systems established under related oil removal contingency plans, particularly State and National Plans (e.g., NCP).	See *Emergency Contact Information* in the SPCC Plan
What is the procedure for requesting assistance during a major disaster or when the situation exceeds the response capability of the State, local, or regional authority? All parties listed in Table 10 of the SPCC Plan shall be notified. All parties will be notified and the National Response Center shall be contacted in the unlikely event of a spill situation which exceeds the response capability of State, Local, or Regional Authorities.	

The following provisions have been made to assure that all available resources have been identified and can be committed during an oil discharge situation including:

Identify and list applicable equipment, materials and supplies which are available locally and regionally	See *Emergency Cleanup Contractors/Individuals* information in the SPCC Plan

Estimate the type and amount of equipment, materials, and supplies which could be required to remove the maximum potential oil discharge to be anticipated	
	Equipment To be completed by O&M Firm with assistance of Cleanup Contractor (ACV Enviro) prior to commissioning of facility.
	Materials To be completed by O&M Firm with assistance of Cleanup Contractor (ACV Enviro) prior to commissioning of facility.
	Supplies To be completed by O&M Firm with assistance of Cleanup Contractor (ACV Enviro) prior to commissioning of facility.

List entities for which agreements and arrangements in advance of an oil discharge have been developed:

To be completed by O&M Firm with assistance of Cleanup Contractor (ACV Enviro) prior to commissioning of facility.

The following information describes the provisions made for well defined and specific actions to be taken after an oil discharge has been discovered and reported.

List name and phone numbers of your designated oil discharge response team. This team must consist of trained, prepared, and available operating personnel.

To be completed by O&M Firm with the assistance of Cleanup Contractor (ACV Enviro) prior to commissioning of facility.

Name the designated oil discharge response coordinator.

☒ This coordinator has the responsibility and delegated commensurate authority to direct and coordinate response operations.

☒ This coordinator knows how to request assistance from Federal authorities operating under existing national and regional contingency plans.

Location of oil discharge response operations center and reliable communications system: To be completed by the O&M Firm prior to commissioning of the facility.
Describe the response efforts and procedures that will be used for oil discharges of different severities: To be completed by the O&M Firm prior to commissioning of the facility.
List the order in which the critical water use areas need to be protected: Unnamed tributaries and wetlands of Fall Brook
Provide the well defined and detailed procedures that are in place to facilitate the recovery of damages and enforcement measures as provided for by State and local statues and ordinances: Contact all parties as described in Item 5 of the SPCC Plan after cleanup and verify all damages are corrected or paid. Also verify that all enforcement measures resulting from the incident are completed.

WRITTEN COMMITMENT OF RESOURCES (§112.7(d)(2)):

Instructions: In the space and table below describe the manpower, equipment, and materials committed to quickly controlling and removing any quantity of discharged oil that may be harmful. List any arrangements made with individuals or contractors to share personnel, and/or equipment[1], supplies[2], and services[3] during an emergency cleanup of an oil discharge. Attach any written agreements to this plan.

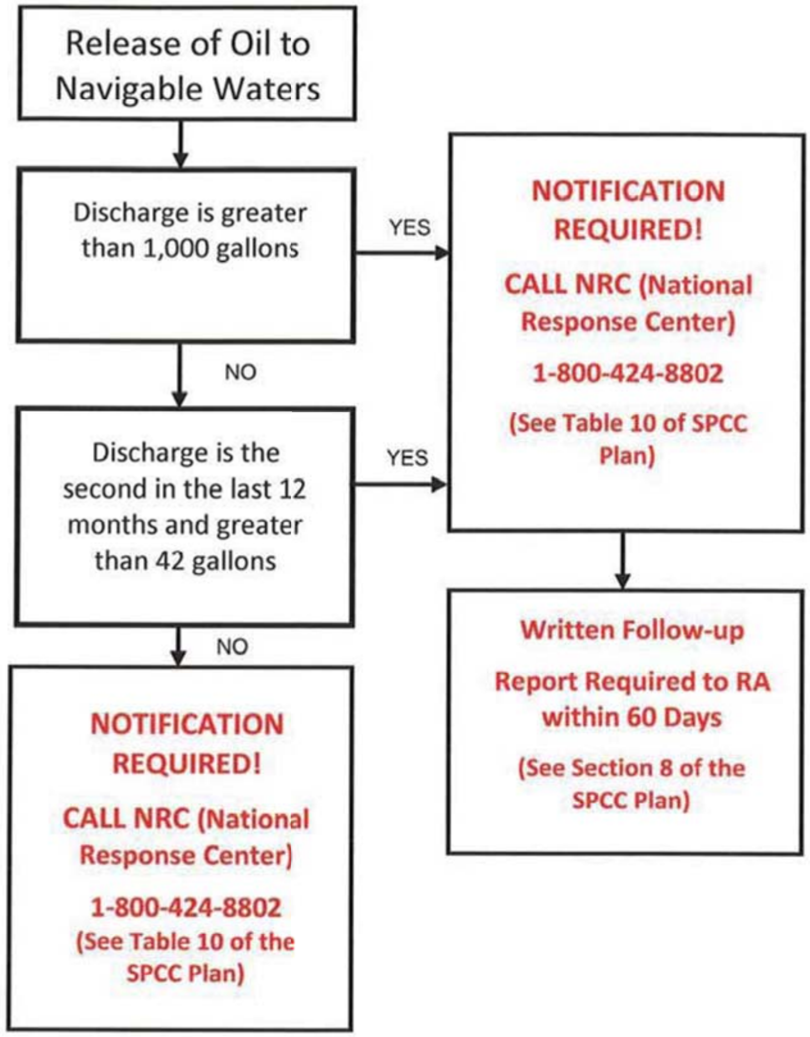
To be completed by the O&M Firm with the assistance of the Cleanup Firm (ACV Envrio) prior to site commissioning.

Table 13: Emergency Cleanup Contractors

Name/Company	Signed Agreement?	Phone	Location/Address	Equipment[a], Supplies[b], Services[c] Provided
Costa Solar, LLC	Yes ☐ No ☐	See Table 10 of SPCC Plan		
ACV Enviro	Yes ☐ No ☐	See Table 10 of SPCC Plan		
(O&M Firm, name to be added)	Yes ☐ No ☐	See Table 10 of SPCC Plan		
	Yes ☐ No ☐			
	Yes ☐ No ☐			

[1] *Example equipment*: vacuum slurry tank, irrigation pumps, bulldozer/track loader, backhoe
[2] *Example supplies*: oil absorbent materials (pads, pillows, socks, booms)
[3] *Example services*: emergency response cleanup

Discharge Reporting and Notification Requirements



Appendix F

Transformer Specifications

Three-phase pad-mounted compartmental type transformer

General

At Eaton, we are constantly striving to introduce new innovations to the transformer industry, bringing you the highest quality, most reliable transformers. Eaton's Cooper Power series Transformer Products are ISO 9001 compliant, emphasizing process improvement in all phases of design, manufacture, and testing. In order to drive this innovation, we have invested both time and money in the Thomas A. Edison Technical Center, our premier research facility in Franksville, Wisconsin. Such revolutionary products as distribution-class UltraSIL™ Polymer-Housed Evolution™ surge arresters and Envirotemp™ FR3™ fluid have been developed at our Franksville lab.

With transformer sizes ranging from 45 kVA to 12 MVA and high voltages ranging from 2400 V to 46 kV, Eaton has you covered. From fabrication of the tanks and cabinets to winding of the cores and coils, to production of arresters, switches, tap changers, expulsion fuses, current limit fuses, bushings (live and dead) and molded rubber goods, Eaton does it all. Eaton's Cooper Power series transformers are available with electrical grade mineral oil or Envirotemp™ FR3™ fluid, a less-flammable and bio-degradable fluid. Electrical codes recognize the advantages of using Envirotemp™ FR3™ fluid both indoors and outdoors for fire sensitive applications. The bio-based fluid meets Occupational Safety and Health Administration (OSHA) and Section 450.23 NEC Requirements.

EATON
Powering Business Worldwide

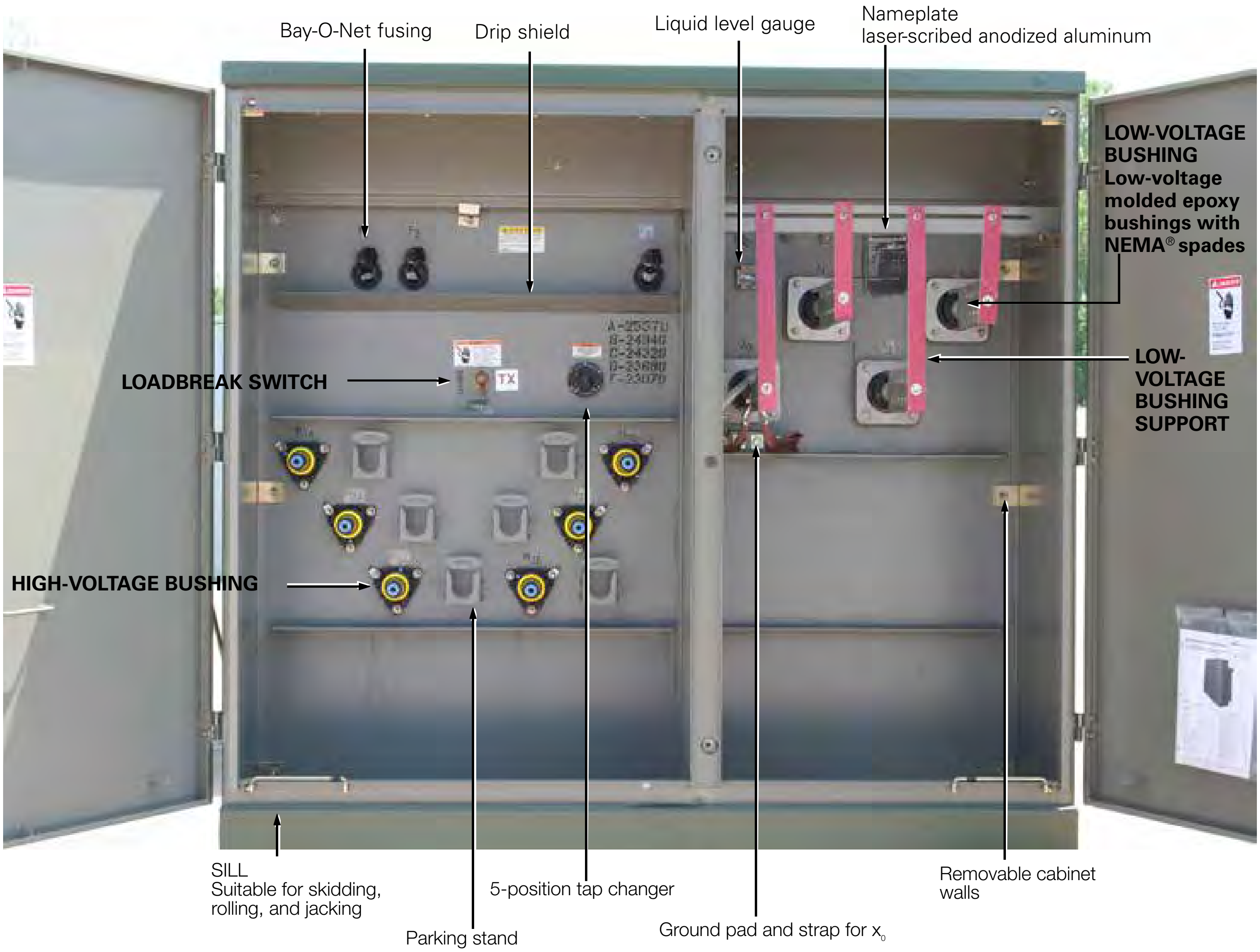


Figure 1. Three-phase pad-mounted compartmental type transformer.

Table 1. Product Scope

Type	Three Phase, 50 or 60 Hz, 65 °C Rise (55 °C, 55/65 °C), 65/75 °C, 75 °C
Fluid Type	Mineral oil or Envirotemp™ FR3™ fluid
Coil Configuration	2-winding or 4-winding or 3-winding (Low-High-Low), 3-winding (Low-Low-High)
Size	45 – 10,000 kVA
Primary Voltage	2,400 – 46,000 V
Secondary Voltage	208Y/120 V to 14,400 V
Specialty Designs	Inverter/Rectifier Bridge
	K-Factor (up to K-19)
	Vacuum Fault Interrupter (VFI)
	UL® Listed & Labeled and Classified
	Factory Mutual (FM) Approved®
	Solar/Wind Designs
	Differential Protection
	Seismic Applications (including OSHPD)
	Hardened Data Center

Table 2. Three-Phase Ratings

Three-Phase 50 or 60 Hz
kVA Available[1] 45, 75, 112.5, 150, 225, 300, 500, 750, 1000, 1500, 2000, 2500, 3000, 3750, 5000, 7500, 10000

[1]Transformers are available in the standard ratings and configurations shown or can be customized to meet specific needs.

Table 3. Impedance Voltage

	Low-voltage rating		
Rating (kVA)	**≤ 600 V**	**2400 Δ through 4800 Δ**	**6900 Δ through 13800GY/7970 or 13800 Δ**
45-75	2.70-5.75	2.70-5.75	2.70-5.75
112.5-300	3.10-5.75	3.10-5.75	3.10-5.75
500	4.35-5.75	4.35-5.75	4.35-5.75
750-2500	5.75	5.75	5.75
3750	5.75	5.75	6.00
5000		6.00	6.50

Note: The standard tolerance is ± 7.5%

Table 4. Audible Sound Levels

Self-Cooled, Two Winding kVA Rating	NEMA® TR-1 Average Decibels (dB)
45-500	56
501-700	57
701-1000	58
1001-1500	60
1501-2000	61
2001-2500	62
2501-3000	63
3001-4000	64
4001-5000	65
5001-6000	66
6001-7500	67
7501-10000	68

Table 5. Insulation Test Levels

KV Class	Induced Test 180 or 400 Hz 7200 Cycle	kV BIL Distribution	Applied Test 60 Hz (kV)
1.2	Twice Rated Voltage	30	10
2.5		45	15
5		60	19
8.7		75	26
15		95	34
25		125	40
34.5		150	50

Table 6. Temperature Rise Ratings 0-3300 Feet (0-1000 meters)

	Standard	Optional
Unit Rating (Temperature Rise Winding)	65 °C	55 °C, 55/65 °C, 75 °C
Ambient Temperature Max	40 °C	50 °C
Ambient Temperature 24 Hour Average	30 °C	40 °C
Temperature Rise Hotspot	80 °C	65 °C

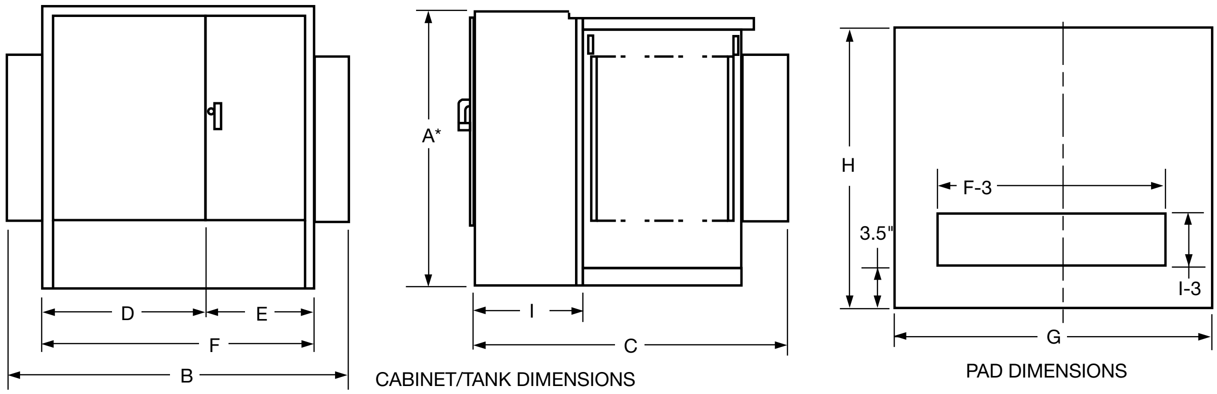


Figure 2. Transformer and pad dimensions.

* Add 9" for Bay-O-Net fusing.

Table 7. Fluid-filled—aluminum windings 55/65 °C Rise[1]

65° Rise	DEAD-FRONT—LOOP OR RADIAL FEED—BAY-O-NET FUSING OIL FILLED—ALUMINUM WINDINGS									
	OUTLINE DIMENSIONS (in.)									
kVA Rating	A*	B	C	D	E	F	G	H	I	Gallons of Fluid	Approx. Total Weight (lbs.)
45	50	68	39	42	26	68	72	43	20	110	2,100
75	50	68	39	42	26	68	72	43	20	115	2,250
112.5	50	68	49	42	26	68	72	53	20	120	2,350
150	50	68	49	42	26	68	72	53	20	125	2,700
225	50	72	51	42	30	72	76	55	20	140	3,150
300	50	72	51	42	30	72	76	55	20	160	3,650
500	50	89	53	42	30	72	93	57	20	190	4,650
750	64	89	57	42	30	72	93	61	20	270	6,500
1000	64	89	59	42	30	72	93	63	20	350	8,200
1500	73	89	86	42	30	72	93	90	24	410	10,300
2000	73	72	87	42	30	72	76	91	24	490	12,500
2500	73	72	99	42	30	72	76	103	24	530	14,500
3000	73	84	99	46	37	84	88	103	24	620	16,700
3750	84	85	108	47	38	85	88	112	24	660	19,300
5000	84	96	108	48	48	96	100	112	24	930	25,000
7500	94	102	122	54	48	102	100	126	24	1,580	41,900

1 Weights, gallons of fluid, and dimensions are for reference only and not for construction. Please contact Eaton for exact dimensions.

* Add 9" for Bay-O-Net fusing.

Table 8. Fluid-Filled—Copper Windings 55/65 °C Rise[1]

65° Rise	DEAD-FRONT—LOOP OR RADIAL FEED—BAY-O-NET FUSING OIL FILLED—COPPER WINDINGS										
	OUTLINE DIMENSIONS (in.)										
kVA Rating	A*	B	C	D	E	F	G	H	I	Gallons of Fluid	Approx. Total Weight (lbs.)
45	50	64	39	34	30	64	69	43	20	110	2,100
75	50	64	39	34	30	64	69	43	20	115	2,350
112.5	50	64	49	34	30	64	69	53	20	115	2,500
150	50	64	49	34	30	64	69	53	20	120	2,700
225	50	64	51	34	30	64	73	55	20	140	3,250
300	50	64	51	34	30	64	75	55	20	160	3,800
500	50	81	53	34	30	64	85	57	20	200	4,800
750	64	89	57	42	30	72	93	61	20	255	6,500
1000	64	89	59	42	30	72	93	63	20	300	7,800
1500	73	89	86	42	30	72	93	90	24	410	10,300
2000	73	72	87	42	30	72	76	91	24	420	11,600
2500	73	72	99	42	30	72	76	103	24	500	14,000
3000	73	84	99	46	37	84	88	103	24	720	18,700
3750	84	85	108	47	38	85	88	112	24	800	20,500
5000	84	96	108	48	48	96	100	112	24	850	25,000
7500	94	102	122	54	48	102	100	126	24	1,620	46,900

1 Weights, gallons of fluid, and dimensions are for reference only and not for construction. Please contact Eaton for exact dimensions.

* Add 9" for Bay-O-Net fusing.

Standard features

Connections and neutral configurations

- Delta - Wye: Low voltage neutral shall be a fully insulated X0 bushing with removable ground strap.
- Grounded Wye-Wye: High voltage neutral shall be internally tied to the low voltage neutral and brought out as the H0X0 bushing in the secondary compartment with a removable ground strap.
- Delta-Delta: Transformer shall be provided without a neutral bushing.
- Wye-Wye: High voltage neutral shall be brought out as the H0 bushing in the primary compartment and the low voltage neutral shall be brought as the X0- bushing in the secondary compartment.
- Wye-Delta: High voltage neutral shall be brought out as the H0 bushing in the primary compartment. No ground strap shall be provided (line to line rated fusing is required).

High and low voltage bushings

- 200 A bushing wells (15, 25, and 35 kV)
- 200 A, 35 kV Large Interface
- 600 A (15, 25, and 35 kV) Integral bushings (dead-front)
- Electrical-grade wet-process porcelain bushings (live-front)

Tank/cabinet features

- Bolted cover for tank access (45-2500 kVA)
- Welded cover with hand hole (>2500 kVA)
- Three-point latching door for security
- Removable sill for easy installation
- Lifting lugs (4)
- Stainless steel cabinet hinges and mounting studs
- Steel divider between HV and LV compartment
- 20” Deep cabinet (45-1000 kVA)
- 24” Deep cabinet (1500-7500 kVA)
- 30” Deep cabinet (34.5/19.92 kV)
- Pentahead captive bolt
- Stainless steel 1-hole ground pads (45-500 kVA)
- Stainless steel 2-hole ground pads (750-10,000 kVA)
- Parking Stands (dead-front)

Valves/plugs

- One-inch upper filling plug
- One-inch drain plug (45-500 kVA)
- One-inch combination drain valve with sampling device in low voltage compartment (750-10,000 kVA)
- Automatic pressure relief valve

Nameplate

- Laser-scribed anodized aluminum nameplate

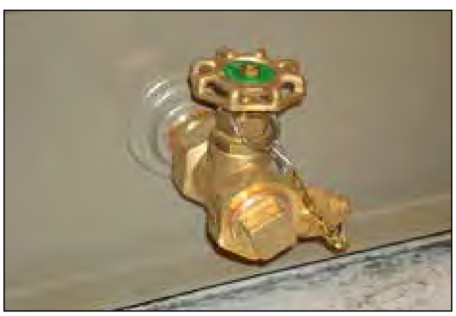


Figure 3. Drain valve with sampler.

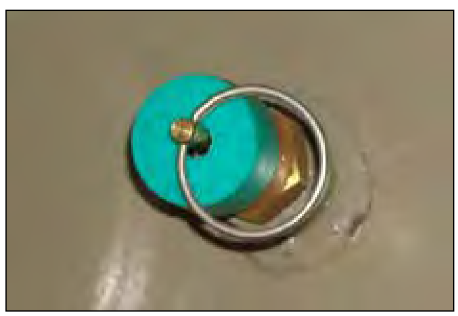


Figure 4. Automatic Pressure relief valve.

Figure 5. Liquid level gauge.

Figure 6. External Gauges.

Figure 7. External visible break with gauges.

Optional features

High and low voltage bushings

- 200 A (15, 25 kV) bushing inserts
- 200 A (15, 25 kV) feed thru inserts
- 200 A (15, 25 kV) (HTN) bushing wells with removable studs
- High-voltage 600 A (15, 25, 35 kV) deadbreak one-piece bushings
- Low voltage 6-, 8-holes spade
- Low voltage 12-, 16-, 20-holes spade (750-2500 kVA)
- Low voltage bushing supports

Tank/cabinet features

- Stainless steel tank base and cabinet
- Stainless steel tank base, cabinet sides and sill
- 100% stainless steel unit
- Service entrance (2 inch) in sill or cabinet side
- Touch-up paint (domestic)
- Copper ground bus bar
- Kirk-Key provisions
- Nitrogen blanket
- Bus duct cutout

Special designs

- Factory Mutual (FM)
- UL® Classified
- Triplex
- High altitude
- K-Factors
- Step-up
- Critical application
- Modulation transformers
- Seismic applications (including OSHPD)

Switches

- One, two, or three On/Off loadbreak switches
- 4-position loadbreak V-blade switch or T-blade switch
- Delta-wye switch
- 3-position V-Blade selector switch
- 100 A, 150 A, 300 A tap changers
- Dual voltage switch
- Visible break with VFI interrupter interlock
- External visible break (15, 25, and 35 kV, up to 3 MVA)
- External visible break with gauges (15, 25, and 35 kV, up to 3 MVA)

Gauges and devices

- Liquid level gauge (optional contacts)
- Pressure vacuum gauge (optional contacts and bleeder)
- Dial-type thermometer (optional alarm contacts)
- Cover mounted pressure relief device (optional alarm contacts)
- Ground connectors
- Hexhead captive bolt
- Molded case circuit breaker mounting provisions
- External gauges in padlockable box

Overcurrent protection

- Bay-O-Net fusing (Current sensing, dual sensing, dual element, high amperage overload)
- Bay-O-Net expulsion fuse in series with a partial range under-oil ELSP current limiting fuse (below 23 kV)
- Cartridge fusing in series with a partial range under-oil ELSP current limiting fuse (above 23 kV)
- MagneX™ interrupter with ELSP current-limiting fuse
- Vacuum Fault Interrupter (VFI)
- Visible break window
- Fuse/switch interlock

Valves/plugs

- Drain/sampling valve in high-voltage compartment
- Globe type upper fill valve

Overvoltage protection

- Distribution-, intermediate-, or station-class surge arresters
- Elbow arresters (for dead-front connections)

Metering/fan/control

- Full metering package
- Current Transformers (CTs)
- Metering Socket
- NEMA® 4 control box (optional stainless steel)
- NEMA® 7 control box (explosion proof)
- Fan Packages

Testing

- Customer test witness
- Customer final inspection
- Zero Sequence Impedance Test
- Heat Run Test
- ANSI® Impulse Test
- Audible Sound Level Test
- RIV (Corona) Test
- Dissolved Gas Analysis (DGA) Test
- 8- or 24-Hour Leak Test

Coatings (paint)

- ANSI® Bell Green
- ANSI® #61 Light Gray
- ANSI® #70 Sky Gray
- Special paint available per request

Nameplate

- Stainless steel nameplate

Decals and labels

- High voltage warning signs
- Mr. Ouch
- Bi-lingual warning
- DOE compliant
- Customer stock code
- Customer stenciling
- Shock and arc flash warning decal
- Non-PCB decal

Construction

Core

The three-legged, step-lap mitered core construction is manufactured using a high-quality cutting machine. For maximum efficiency, cores are precisely stacked, virtually eliminating gaps in the corner joints.

Five-legged wound core or shell-type triplex designs are used for wye-wye connected transformers, and other special transformer designs.

Cores are manufactured with precision cut, burr-free, grain-oriented silicon steel. Many grades of core steel are available for optimizing core loss efficiency.

Coils

Pad-mounted transformers feature a rectangular coil configuration with wire-wound, high-voltage primaries and sheet-wound secondaries. The design minimizes axial stress developed by short circuits and provides for magnetic balancing of tap connections.

Coils are wound using the highest quality winding machines providing exacting tension control and conductor placement for superior short-circuit strength and maximum efficiency.

Extra mechanical strength is provided by diamond pattern, epoxy-coated paper insulation, used throughout the coil, with additional epoxy at heavy stress points. The diamond pattern distribution of the epoxy and carefully arranged ducts, provide a network of passages through which cooling fluid can freely circulate.

Coil assemblies are heat-cured under calculated hydraulic pressure to ensure performance against short-circuit forces.

Core and coil assemblies

Pad-mounted transformer core and coil assemblies are braced with heavy steel ends to prevent the rectangular coil from distorting under short-circuit conditions. Plates are clamped in place using presses, and welded or bolted to form a solid core and coil assembly. Core and coil assemblies exceed ANSI® and IEEE® requirements for short-circuit performance. Due to the rigidity of the design, impedance shift after short-circuit is comparable to that of circular wound assemblies.

Tanks

Transformer tanks are designed for high strength and ease of handling, installation, and maintenance. Tanks are welded using precision-cut, hot rolled, pickled and oiled steel. They are sealed to protect the insulating fluid and other internal components.

Transformer tanks are pressure-tested to withstand 7 psig without permanent distortion and 15 psig without rupture.

Tank finish

An advanced multi-stage finishing process exceeds IEEE Std C57.12.28™-2014 standards. The eight-stage pre-treatment process assures coating adhesion and retards corrosion. It converts tank surfaces to a nonmetallic, water insoluble iron phosphate coating.

The paint method consists of two distinct layers of paint. The first is an epoxy primer (E-coat) layer which provides a barrier against moisture, salt and corrosives. The two-component urethane final coat seals and adds ultraviolet protection.

Vacuum processing

Transformers are dried and filled with filtered insulating fluid under vacuum, while secondary windings are energized. Coils are heated to drive out moisture, ensuring maximum penetration of fluid into the coil insulation system.

Insulating fluid

Eaton's Cooper Power series transformers are available with electrical-grade mineral insulating oil or Envirotemp™ FR3™ fluid. The highly refined fluids are tested and degassed to assure a chemically inert product with minimal acid ions. Special additives minimize oxygen absorption and inhibit oxidation. To ensure high dielectric strength, the fluid is re-tested for dryness and dielectric strength, refiltered, heated, dried, and stored under vacuum before being added to the completed transformer.

Eaton's Cooper Power series transformers filled with Envirotemp™ FR3™ fluid enjoy unique fire safety, environmental, electrical, and chemical advantages, including insulation life extending properties.

A bio-based, sustainable, natural ester dielectric coolant, Envirotemp™ FR3™ fluid quickly and thoroughly biodegrades in the environment and is non-toxic per acute aquatic and oral toxicity tests.

Building for Environmental and Economic Sustainability (BEES) total life cycle assessment software, utilized by the US Dept. of Commerce, reports its overall environmental performance impact score at 1/4th that reported for mineral oil. Envirotemp™ FR3™ fluid has also earned the EPA Environmental Technology Verification of transformer materials.

With a fire point of 360 °C, Envirotemp™ FR3™ fluid is FM Approved® and Underwriters Laboratories (UL®) Classified "Less-Flammable" per NEC® Article 450-23, fitting the definition of a Listed Product per NEC®.

Figure 8. VFI transformer with visible break.

Pad-mounted VFI transformer

Eaton's Cooper Power series VFI transformer combines a conventional distribution transformer with the proven Vacuum Fault Interrupter (VFI). This combination provides both voltage transformation and transformer over current protection in one space saving and money saving package. The pad-mounted VFI transformer protects the transformer and provides proper coordination with upstream protective devices. When a transformer fault or overload condition occurs, the VFI breaker trips and isolates the transformer.

The three-phase VFI breaker has independent single-phase initiation, but is three-phase mechanically gang-tripped. A trip signal on any phase will open all three phases. This feature eliminates single-phasing of three phase loads. It also enables the VFI breaker to be used as a three-phase load break switch.

Due to the resettable characteristics of the VFI breaker, restoring three-phase service is faster and easier.

The sealed visible break window and switch is an option that can be installed to provide visible break contact. This feature provides enhanced safety and allows an operator to see if the loadbreak switch contacts are in an open or closed position before performing maintenance.

Envirotran™ FM Approved special protection transformer

Eaton's Cooper Power series Envirotran™ transformer is FM Approved and suitable for indoor locations. Factory Mutual Research Corporation's (FMRC) approval of the Envirotran transformer line makes it easy to comply with and verify compliance with Section 450.23, 2008 NEC, Less-Flammable Liquid-Filled Transformer Requirements for both indoor and outdoor locations.

Envirotran FM Approved transformers offer the user the benefit of a transformer that can be easily specified to comply with NEC, and makes FM Safety Data Sheet compliance simpler, while also providing maximum safety and flexibility for both indoor and outdoor installations.

Because the "FM Approved" logo is readily visible on the transformer and its nameplate, NEC compliance is now easily verifiable by the inspector.

Envirotran FM Approved transformers are manufactured under strict compliance with FMRC Standard 3990 and are filled with FM Approved Envirotemp™ FR3™ fluid, a fire-resistant dielectric coolant.

FM APPROVED

Special application transformers

Data Center transformer

With focus rapidly shifting from simply maximizing uptime and supporting demand to improving energy utilization, the data center industry is continually looking for methods to increase its energy efficiency and reliability. Utilizing cutting edge technology, Eaton's Cooper Power series Hardened Data Center (HDC) transformers are the solution. Designed with special attention given to surge protection, HDC liquid-filled transformers provide superior performance under the harshest electrical environments. Contrary to traditional dry-type units, HDC transformers provide unsurpassed reliability, overloadability, operational life, efficiency, thermal loading and installed footprint. These units have reliably served more than 100 MW of critical data center capacity for a total of more than 6,000,000 hours without any reported downtime caused by a thermal or short-circuit coil failure.

The top priority in data center operations is uninterrupted service. Envirotran HDC transformers from Eaton, having substantially higher levels of insulation, are less susceptible to voltage surges. Eaton has experienced zero failures due to switching transients. The ANSI® and IEEE® standard impulse withstand ratings are higher for liquid-filled transformers, making them less susceptible to insulation failure. The Envirotran HDC transformer provides ultimate protection by increasing the BIL rating one level higher than standard liquid-filled transformer ratings. The cooling system of liquid-filled transformers provides better protection from severe overloads—overloads that can lead to significant loss of life or failure.

Data center design typically includes multiple layers of redundancy, ensuring maximum uptime for the critical IT load. When best in class transformer manufacturing lead times are typically weeks, not days, an unexpected transformer failure will adversely affect the facility's reliability and profitability. Therefore, the ability to determine the electrical and mechanical health of a transformer can reduce the probability of costly, unplanned downtime. Routine diagnostic tests, including key fluid properties and dissolved gas analysis (DGA), can help determine the health of a liquid-filled transformer. Although sampling is not required for safe operation, it will provide the user with valuable information, leading to scheduled repair or replacement, and minimizing the duration and expense of an outage. With a dry-type transformer, there is no reliable way to measure the health or likelihood of an impending failure.

Solar transformer

As a result of the increasing number of states that are adopting aggressive Renewable & Alternative Energy Portfolio Standards, the solar energy market is growing—nearly doubling year over year. Eaton, a key innovator and supplier in this expanding market, is proud to offer its Cooper Power series Envirotran transformers specifically designed for Solar Photovoltaic medium-voltage applications. Eaton is working with top solar photovoltaic developers, integrators and inverter manufacturers to evolve the industry and change the way we distribute power.

In accordance with this progressive stance, every Envirotran Solar transformer is filled with non-toxic, biodegradable Envirotemp™ FR3™ dielectric fluid, made from renewable seed oils. On top of its biodegradability, Envirotemp™ FR3™ fluid substantially extends the life of the transformer insulation, saving valuable resources. What better way to distribute green power than to use a green transformer. In fact, delaying conversion to Envirotran transformers places the burden of today's environmental issues onto tomorrow's generations. Eaton can help you create a customized transformer, based on site specific characteristics including: temperature profile, site altitude, solar profile and required system life. Some of the benefits gained from this custom rating include:

- Reduction in core losses
- Improved payback on investment
- Reduction in footprint
- Improved fire safety
- Reduced environmental impact

For the solar photovoltaic industry, Eaton is offering standard step up transformers and dual secondary designs, including 4-winding, 3-winding (Low-High-Low) and 3-winding (Low-Low-High) designs.

Wind transformer

Eaton is offering custom designs for renewable energy power generation. Eaton manufactures its Cooper Power series Generator Step-Up (GSU) transformers for installation at the base of every wind turbine. Additionally, grounding transformers are available for wind power generation.

DOE efficiency

The United States Department of Energy (DOE) has mandated efficiency values for most liquid type, medium voltage transformers. As a result, all applicable Eaton's Cooper Power series transformers 2500 kVA and below conform to efficiency levels as specified in the DOE ruling "10 CFR Part 431 Energy Conservation Program".

Underwriters Laboratories® (UL®) Listed and Labeled/ Classified

The Envirotran transformer from Eaton can be specified as UL® Listed & Labeled, and/or UL® Classified. Underwriters Laboratories (UL®) listing is a verification of the design and construction of the transformer to the ANSI® and IEEE® standards. UL® listing generally is the most efficient, cost-effective solution for complying with relevant state and local electrical codes. UL® Combination Classification/Listing is another way in which to comply with Section 450.23, 2008 NEC® requirements. This combines the UL® listed transformer with a UL® Classified Less-Flammable Liquid and complies with the use restrictions found within the liquid Classification.

C UL US LISTED

K-Factor transformer

With a drastic increase in the use of ferromagnetic devices, arcing devices, and electric power converters, higher frequency loads have increased significantly. This harmonic loading has the potential to generate higher heat levels within a transformer's windings and leads by as much as 300%. Harmonic loading has the potential to induce premature failure in standard-design distribution transformers.

In addition to standard UL® "K-Factor" ratings, transformers can be designed to customer-provided specifications detailing precise loading scenarios. Onsite measurements of magnitude and frequency, alongside harmonic analysis of the connected load can be performed by Eaton engineers or a third party consultant. These field measurements are used to determine exact customer needs and outline the transformer specifications.

Eaton will design harmonic-resistant transformers that will be subjected to the unique harmonic loads. These units are designed to maintain normal temperature rise under harmonic, full-load conditions. Standard UL® "K-Factor" designs can result in unnecessary costs when the "next-highest" K-Factor must be selected for a calculated design factor. To save the customer these unnecessary costs, Eaton can design the transformer to the specific harmonic spectrum used in the application. Eaton's Cooper Power series K-factor transformers are filled with mineral oil or Envirotemp™ FR3™ fluid and enjoy the added benefits of dielectric cooling such as higher efficiencies than dry-type transformers.

Modulation transformer

Bundled with an Outboard Modulation Unit (OMU) and a Control and Receiving Unit (CRU), a Modulation Transformer Unit (MTU) is designed to remotely achieve two way communication.

The use of an MTU reduces travel time and expense versus traditional meter reading performed by high voltage electricians. Additionally, with MTU it is possible to manage and evaluate energy consumption data, providing reduced metering costs and fewer tenant complaints.

An MTU utilizes existing utility infrastructure, therefore eliminating the need to engineer and construct a dedicated communication network.

Figure 9. Modular transformer.

Inverter/rectifier bridge

Eaton complements its range of applications for transformers by offering dual winding designs. These designs are intended for connection to 12-pulse rectifier bridges.

Product attributes

To set us apart from other transformer manufactures, Eaton includes the following guarantees with every three-phase pad-mounted transformer.

Engineered to order (ETO)

Providing the customer with a well developed, cost-effective solution is the number one priority at Eaton. Using customer specifications, Eaton will work with the customer from the beginning to the end to develop a solution to fit their needs. Whether it is application specific, site specific, or a uniquely specified unit, Eaton will provide transformers with the best in class value and performance, saving the customer time and money.

Made in the U.S.A.

Eaton's three-phase pad-mounted transformers are produced right here in the United States of America. Our manufacturing facilities are positioned strategically for rapid shipment of products. Furthermore, should the need arise, Eaton has a broad network of authorized service repair shops throughout the United States.

Superior paint performance

Protecting transformers from nature's elements worldwide, Eaton's E-coat system provides unrivaled transformer paint life, and exceeds IEEE Std C57.12.28™-2014 and IEEE Std C57.12.29™-2005 standards. In addition to the outside of the unit, each transformer receives a gray E-coat covering in the interior of the tank and cabinet, providing superior rust resistance and greater visibility during service.

If the wide range of standard paint selections does not suit the customer's needs, Eaton will customize the paint color to meet their requirements.

Rectangular coil design

Eaton utilizes a rectangular coil design. This winding technique results in a smaller overall unit footprint as well as reducing the transformer weight. The smaller unit size does not hinder the transformer performance in the least. Units have proven short circuit withstand capabilities up to 10 MVA.

Testing

Eaton performs routing testing on each transformer manufactured including the following tests:

- Insulation Power Factor: This test verifies that vacuum processing has thoroughly dried the insulation system to required limits.
- Ratio, Polarity, and Phase Relation: Assures correct winding ratios and tap voltages; checks insulation of HV and LV circuits. Checks entire insulation system to verify all live-to-ground clearances.
- Resistance: This test verifies the integrity of internal high-voltage and low-voltage connections; provides data for loss upgrade calculations.
- Routine Impulse Tests: The most severe test, simulating a lightning surge. Applies one reduced wave and one full wave to verify the BIL rating.
- Applied Potential: Applied to both high-voltage and low-voltage windings, this test stresses the entire insulation system to verify all live-to-ground clearances.
- Induced Potential: 3.46 times normal plus 1000 volts for reduced neutral designs.
- Loss Test: These design verification tests are conducted to assure that guaranteed loss values are met and that test values are

within design tolerances. Tests include no-load loss and excitation current along with impedance voltage and load loss.

- Leak Test: Pressurizing the tank to 7 psig assures a complete seal, with no weld or gasket leaks, to eliminate the possibility of moisture infiltration or fluid oxidation.

Design performance tests

The design performance tests include the following:

- Temperature Rise: Our automated heat run facility ensures that any design changes meet ANSI® and IEEE® temperature rise criteria.
- Audible Sound Level: Ensures compliance with NEMA® requirements.
- Lightning Impulse: To assure superior dielectric performance, this test consists of one reduced wave, two chopped waves and one full wave in sequence, precisely simulating the harshest conditions.

Thomas A Edison Research and Test Facility

We are constantly striving to introduce new innovations to the transformer industry, bringing you the highest quality transformer for the lowest cost. Eaton's Cooper Power series Transformer Products are ISO 9001 compliant, emphasizing process improvement in all phases of design, manufacture, and testing. We have invested millions of dollars in the Thomas A. Edison Technical Center, our premier research facility in Franksville, Wisconsin affirming our dedication to introducing new innovations and technologies to the transformer industry. This research facility is fully available for use by our customers to utilize our advanced electrical and chemical testing labs.

Eaton
1000 Eaton Boulevard
Cleveland, OH 44122
United States
Eaton.com

Eaton's Cooper Power Systems Division
2300 Badger Drive
Waukesha, WI 53188
United States
Eaton.com/cooperpowerseries

Printed in USA
Publication No. CA202003EN

For Eaton's Cooper Power series three-phase transformer product information call 1-877-277-4636 or visit: www.eaton.com/cooperpowerseries.

Powering Business Worldwide

Appendix G

Material Safety Data Sheet for
Transformer Oil

MATERIAL SAFETY DATA SHEET

1. Product and Company Identification

Material name	**ENVIROTEMP FR3 FLUID**
Version #	01
Issue date	06-13-2012
Revision date	-
Supersedes date	-
CAS #	Mixture
MSDS Number	12.55.1
Product use	Dielectric Coolant
Manufacturer/Supplier	Industrial Oils & Lubricants 9320 Excelsior Blvd. Hopkins, Minnesota 55343 US IOLCustomerService@cargill.com
General Information:	1-800-842-3631
Emergency	Emergency Telephone: 1-800-424-9300

2. Hazards Identification

Physical state	Liquid.
Appearance	Green Liquid.
Emergency overview	CAUTION! Prolonged or repeated skin contact may cause drying, cracking, or irritation.
OSHA regulatory status	This product is not hazardous according to OSHA 29CFR 1910.1200.
Potential health effects	
Routes of exposure	Skin contact.
Eyes	Direct contact with eyes may cause temporary irritation.
Skin	Prolonged or repeated contact may cause itching, redness, and rash in some individuals.
Inhalation	Under normal conditions of intended use, this material is not expected to be an inhalation hazard.
Ingestion	No harmful effects expected in amounts likely to be ingested by accident.

3. Composition / Information on Ingredients

Components	CAS #	Percent
Vegetable Oil	8001-22-7	> 98.5

Composition comments All concentrations are in percent by weight unless ingredient is a gas. Gas concentrations are in percent by volume.

4. First Aid Measures

First aid procedures	
Eye contact	Any material that contacts the eye should be washed out immediately with water. If easy to do, remove contact lenses. Get medical attention promptly if symptoms occur after washing.
Skin contact	Wash skin with soap and water. Get medical attention promptly if symptoms occur after washing.
Inhalation	If symptomatic, move to fresh air. Get medical attention if symptoms persist.
Ingestion	First aid is normally not required. However, if greater than 1/2 liter (pint) ingested, seek medical attention.

5. Fire Fighting Measures

Flammable properties No unusual fire or explosion hazards noted.

Extinguishing media	
Suitable extinguishing media	Water. Water fog. Foam. Dry chemical powder. Carbon dioxide (CO_2).
Fire fighting equipment/instructions	Self-contained breathing apparatus and full protective clothing must be worn in case of fire.
Hazardous combustion products	Carbon oxides.

6. Accidental Release Measures

Personal precautions	Wear appropriate personal protective equipment (See Section 8).
Environmental precautions	Environmental manager must be informed of all major releases.
Methods for cleaning up	Absorb spill with vermiculite or other inert material, then place in a container for chemical waste. Large Spills: Flush area with water. Prevent runoff from entering drains, sewers, or streams. Dike for later disposal.

7. Handling and Storage

Handling	Observe good industrial hygiene practices.
Storage	Keep container closed.

8. Exposure Controls / Personal Protection

Occupational exposure limits	No exposure limits noted for ingredient(s).
Engineering controls	Ensure adequate ventilation, especially in confined areas.
Personal protective equipment	
Eye / face protection	Wear safety glasses with side shields (or goggles).
Skin protection	Wear chemical-resistant gloves, footwear and protective clothing appropriate for risk of exposure. Contact glove manufacturer for specific information.
Respiratory protection	If engineering controls do not maintain airborne concentrations below recommended exposure limits (where applicable) or to an acceptable level (in countries where exposure limits have not been established), an approved respirator must be worn. Respirator type: Air-purifying respirator with an appropriate, government approved (where applicable), air-purifying filter, cartridge or canister.
General hygiene considerations	Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants.

9. Physical & Chemical Properties

Appearance	Green Liquid.
Physical state	Liquid.
Form	Liquid.
Color	Green.
Odor	Mild.
Odor threshold	Not available.
pH	Neutral
Vapor pressure	< 0.01 mm Hg @ 20 °C
Vapor density	Not available.
Boiling point	> 680 °F (> 360 °C)
Melting point/Freezing point	Not Available
Solubility (water)	Insoluble
Specific gravity	0.92
Flash point	590 - 608 °F (310 - 320 °C) Closed Cup
Flammability limits in air, upper, % by volume	Not Available.
Flammability limits in air, lower, % by volume	Not Available.
Auto-ignition temperature	753.8 - 759.2 °F (401 - 404 °C)

VOC	< 0.001 g/l
Viscosity	33 - 35 mm^2/s @ 40 °C
Other data	
Decomposition temperature	Not Available.

10. Chemical Stability & Reactivity Information

Chemical stability	Material is stable under normal conditions.
Conditions to avoid	Excessive heat.
Incompatible materials	Strong oxidizing agents.
Hazardous decomposition products	No hazardous decomposition products are known.
Possibility of hazardous reactions	Hazardous polymerization does not occur.

11. Toxicological Information

Sensitization	No sensitizing effects known.
Acute effects	Prolonged or repeated skin contact may cause drying, cracking, or irritation.
Local effects	High mist concentrations may cause irritation of respiratory tract.
Carcinogenicity	This product is not considered to be a carcinogen by IARC, ACGIH, NTP, or OSHA.
Symptoms and target organs	Prolonged or repeated skin contact may cause drying, cracking, or irritation.

12. Ecological Information

Ecotoxicity	Not expected to be harmful to aquatic organisms.
Persistence and degradability	No data available.
Bioaccumulation / Accumulation	No data available.
Mobility in environmental media	No data available.

13. Disposal Considerations

Disposal instructions	Dispose of contents/container in accordance with local/regional/national/international regulations.
Waste from residues / unused products	Dispose of in accordance with local regulations.
Contaminated packaging	Since emptied containers may retain product residue, follow label warnings even after container is emptied.

14. Transport Information

DOT

Not regulated as a hazardous material by DOT.

IATA

Not regulated as dangerous goods.

IMDG

Not regulated as dangerous goods.

TDG

Not regulated as dangerous goods.

15. Regulatory Information

US federal regulations

This product is not hazardous according to OSHA 29CFR 1910.1200.
All components are on the U.S. EPA TSCA Inventory List.

TSCA Section 12(b) Export Notification (40 CFR 707, Subpt. D)

Not regulated.

CERCLA (Superfund) reportable quantity (lbs) (40 CFR 302.4)

None

Superfund Amendments and Reauthorization Act of 1986 (SARA)

Hazard categories	Immediate Hazard - No Delayed Hazard - No Fire Hazard - No Pressure Hazard - No Reactivity Hazard - No
Section 302 extremely hazardous substance (40 CFR 355, Appendix A)	No
Section 311/312 (40 CFR 370)	No

Drug Enforcement Administration (DEA) (21 CFR 1308.11-15) Not controlled

WHMIS status Non-controlled

Inventory status

Country(s) or region	Inventory name	On inventory (yes/no)*
Canada	Domestic Substances List (DSL)	Yes
Canada	Non-Domestic Substances List (NDSL)	No
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	Yes

*A "Yes" indicates this product complies with the inventory requirements administered by the governing country(s)

State regulations This product does not contain a chemical known to the State of California to cause cancer, birth defects or other reproductive harm.

US - California Proposition 65 - Carcinogens & Reproductive Toxicity (CRT): Listed substance

Not listed.

US. Massachusetts RTK - Substance List

Vegetable Oil (CAS 8001-22-7) Listed.

US. New Jersey Worker and Community Right-to-Know Act

Not regulated.

US. Pennsylvania RTK - Hazardous Substances

Vegetable Oil (CAS 8001-22-7) Listed.

16. Other Information

Further information HMIS® is a registered trade and service mark of the NPCA.

HMIS® ratings
Health: 1
Flammability: 1
Physical hazard: 0

NFPA ratings
Health: 1
Flammability: 1
Instability: 0

Disclaimer To the best of our knowledge, the information contained herein is accurate. However, neither the above named supplier nor any of its subsidiaries assumes any liability whatsoever for completeness of the information contained herein. Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

Appendix E

Draft Operations and Maintenance
Plan (O&M)

Operation and Maintenance Plan

Costa Solar Project
Freetown, Massachusetts

Submitted on behalf of:

IRONWOOD RENEWABLES

&

BIODIVERSITY RESEARCH INSTITUTE

Prepared by:

KREBS & LANSING CONSULTING ENGINEERS

Krebs & Lansing Consulting Engineers, INC.
164 Main Street
Colchester, Vermont 05446
(802) 878-0375

DRAFT November 1st, 2021

OPERATIONS AND MAINTENANCE

Project Address: Costa Drive, Freetown, Massachusetts 02717

1.0 Project Operators and Contact Information

Project Operator(s):

Overall Project Operator – Costa Solar, LLC
P.O. Box 51794
Lafayette, Louisiana 70505
c/o Hamilton Carrier
(337) 344-7381
hcarrier@ironwoodenergy.com

Site O&M Contractor(s):

Unknown at this time.

Electrical Contractor(s):

Unknown at this time.

Landscaping Contractor(s):

Unknown at this time.

Emergency 24-hour Contact:

Costa Solar, LLC
Hamilton Carrier
(337) 344-7381

**Note: Contractor information is not known at this time. The project will provide an updated version of this O&M report to the Town of Freetown prior to the end of construction.*

2.0 Operations

The Project will be inspected by qualified electrical engineers before it is energized and upon commissioning. Due to the passive nature of solar, operations activities at the site will be minimal. The Project and associated electrical equipment will be operated with remote monitoring supervisory control and data acquisition equipment, and the equipment will undergo routine maintenance as needed. Physical personal operations will be limited to maintenance which is outlined below.

3.0 Maintenance

Electrical Maintenance

The project is an electrical generating plant and will therefore require maintenance. The site will be monitored and controlled remotely. Electrical problems, alterations, and fixes which will occur, will not be on a regimented schedule, these will be on a need based time interval. To provide an average, the site may be visited 2-4 times a month for electrical maintenance. Some items and proceedures to be reviewed, replaced, and repaired during electrical work are outlined below. These will not happen every time an inspector visits the site.

Solar Array

- Modules are free of damage to the frame, cracked front glass, cracked backsheet, signs of delamination, signs of water ingress or damage termination box.
- Modules are properly secured w/ mounting system and all hardware is properly tighten and secure.
- Thermal inspection of the modules are free of anomalies.
- Modules are free of any vegetation contacting the backsheet or vegetation growing up through the array.
- Module soiling level.
- Thermal inspection of DC connectors are free of anomalies.
- DC wiring is properly routed and secured, add zip ties as needed.
- Conduits are free of damage, properly supported and weather heads are in place and are properly sealing the conduit from water ingress.
- Using a meter, confirm continuity between the module (sample) and the racking then confirmed continuity between racking and grounding wire. Grounding connections are firmly attached, properly secured, free of corrosion, or other damage.
- Array racking is free of paint damage, corrosion, or any other physical damage.
- Racking fasteners are properly torqued, free of corrosion, or other damage.

Central Inverters (if used)

- Safety and warning placards are installed and legible in accordance with site as-built drawings.
- The Inverter housing is clean, free of paint damage, corrosion, or any other physical damage.
- HMI screen is in good condition, properly functioning and legible.
- Filters have been removed, inspected, cleaned or replaced, are free of dirt, debris or damage, and properly installed.
- Cooling fans operate correctly without an abnormal noises or oscillation and are free of any damage.
- Thermal inspection of all internal components and terminations show no thermal anomalies.
- Control wires and control wire termination blocks are properly seated, secured, and free of damage.
- All master boards, driver boards and communication boards, have connectors that are properly seated, locked into position, and free of damage.
- All fuses tested and confirmed in good electrical condition.
- All breakers are in the closed position and free of damage.
- Main AC breaker was manually tripped open and power confirmed absent. Main AC breaker was closed, power was confirmed and closing spring was recharged.
- Capacitors show no signs of heat, fluid leaks, deformities or any other damage.
- Review AC and DC voltage readings (phasing and grounding).
- Recorded input and output voltages match values on HMI display.
- Busbars are properly torqued and free of corrosion, signs of heat or any other damage.
- All AC cables are properly torqued, show no signs of insulation degradation, stress, heat, or any other damage.
- All DC cables are properly torqued, show no signs of insulation degradation, stress, heat, or any other damage.
- Panel and door gaskets are free of damage, seated properly and correctly seal the cabinet when closed.
- Door latches, locks and hinges, move freely, operate correctly are free of damage.

String Inverters (if used)

- External inverter housing is clean, free of paint damage, corrosion, or any other physical damage.
- Internal inverter housing shows no signs of water ingression. All gaskets, grommets and pernertations are sealed and free of damage.
- Fan cover has been removed, the fan, filter, fan cover have been cleaned and are free of dirt, debris or damage.

- Hand covers / cooling fin covers have been removed, cooling fins have been cleaned and are free of dirt, debris or damage.
- DC Disconnect has been operated multiple times, showing no signs of malfunction and using a meter, DC power has been confirmed absent with the DC Disconnect in the open position.
- All string terminations are confirmed properly seated or torqued, and free of signs of heat or damage.
- Thermal inspection of the inverter and DC string connections are free of anomalies.
- All fuses have been checked and confirmed with a meter to be in good working condition and show no signs of damage.
- Review AC and DC voltage readings (phasing and grounding).
- All AC cables are properly torqued, show no signs of insulation degradation, stress, heat, or any other damage.
- All DC cables are properly torqued, show no signs of insulation degradation, stress, heat, or any other damage.
- Surge arrester is not in the trip position and shows no signs of failure or damage.

Combiner Boxes

- The Combiner Box is free of paint damage, corrosion, water ingress or any other physical damage.
- All safety and warning placards are in place and legible.
- DC wiring shows no signs of insulation degradation, stress, heat, or any other damage.
- All fuses for each string, tested for continuity and confirmed in good electrical condition.
- All fuse holders are free of signs of heat, cracks, or any other damage and fuses properly seated.
- Thermal inspection of combiner box is free of anomalies.
- Lightning arrestors show no signs of heat, damage or indications of failure.
- Panel and door gaskets are free of damage, seated properly and correctly seal the combiner box when closed.
- Combiner Box is free of debris, rodent nest, insect infestation, or any other unwanted materials.

Communication Cabinet(s)

- Communication Cabinet is free of paint damage, corrosion, water ingress, or any other physical damage
- All equipment is securely mounted and free of any signs of damage.
- All equipment shows LED lit or flashing indicating that it is powered.

- All communication cables are properly plug in, secure, and free of any signs of damage, add zip ties as needed.
- Communication Cabinet is free of debris, rodent nest, insect infestation, or any other unwanted materials.

Switchgear(s)

- Switchgear/ Recloser is free of paint damage, corrosion, or any other physical damage.
- Switchgear / Recloser pad is free of cracks, erosion, or any other type of damage.
- Switchgear / Recloser is in the closed position and all indicators properly displaying.
- Switchgear / Recloser terminations and cables shows no signs of physical, electrical, heat, or any other types of damage.
- Thermal inspection of switchgear is free of anomalies.
- Internal gas pressure gauge indicates OK to operate.
- Switchgear cabinet is free of debris, rodent nest, insect infestation, or any other unwanted materials.
- All safety and warning placards are in place and legible (verify in As-built).

Transformer(s)

- The Transformer is free of paint damage, corrosion, or any other physical damage.
- Transformer pad/vault cover cleaned and free of cracks, erosion, or any other type of damage.
- Transformer oil temperature gauge reading.
- All cables show no signs of insulation degradation, stress, heat, or any other damage.
- Thermal inspection of Transformer is free of thermal anomalies.
- Transformer is free of debris, rodent nest, insect infestation, or any other unwanted materials.
- All safety and warning placards are in place and legible.
- Review and inspect condition of secondary oil containment.

Weather Station(s)

- Weather Station cabinet is free of paint damage, corrosion, or any other physical damage.
- Anemometer cleaned, securely mounted, freely rotates, and is free of damage.
- Windvane cleaned, securely mounted, freely rotates, and is free of damage.
- Pyranometer cleaned, securely mounted, at the same angle as the array, and is free of damage.
- Pyranometer is within the calibration date.
- List Pyranometer calibration date.

- Pyranometer cleaned, securely mounted, unshaded, and free of damage.
- Other sensors (temp, barometric pressure, rainfall etc.) are cleaned, securely mounted, and free of damage.
- Weather Station cabling is cleanly routed and secured in place, add zip ties as needed.
- Weather Station cabinet is free of debris, rodent nest, insect infestation, or any other unwanted materials.

AC Panel Cabinet

- AC Panel Cabinet is free of paint damage, corrosion, or any other physical damage.
- All breakers are properly labeled or has a panel schedule.
- All breakers are in the closed position.
- All internal breakers are in good condition and free of signs of damage.
- Thermal inspection of AC Panel Cabinet is free of anomalies.
- AC Panel Cabinet is free of debris, rodent nest, insect infestation, or any other unwanted materials.

Landscaping and Snow Removal

The project area will be maintained as a meadow, allowing the grasses and small shrubs to grow to a height which would not exceed the bottom edge of the solar panels. We expect in a typical growing season the site will only be mowed 2-3 times per year.

Selective clearing will continue to happen throughout the life of the project. The project will maintain the same cleared area outlined in the project plans throughout the life of the project. We expect these areas will need brush hogging once a year or every other year outside the fence. Vegetation which has fallen within the project limits will also be removed as needed.

Landscaper would be responsible for evaluating/reviewing the site for any evidence of animal or insect habitation. Remove any nests, hieves, dens, etc. which hinder production or are a safety concern to the project. Dispose of any unwated or removed materials offsite in an appropriate disposal location.

During the winter months, access roads will be plowed as necessary for snow removal to assure year-round access to the facility. The snow removal will be limited to the access road on site. Expected this would be needed after every substantial snow storm, would need to exceed 6-8 inch storm. The project is not proposing to plow the array field or removed snow from the panels. This process will occur naturally.

Civil Site

Once the project is built there will be little need for changes to the site. Some expected maintenance issues which may arise over the course of the project's life time would be the following.

- Maintaining fence making sure fence is in good condition and free of any damage, fix as necessary.
- Review site grounds. Fix any ruts, holes, erosion or depressions which are not part of the site design.
- Review the site for any vandalism, clean up or repair any vandalism noticed.
- Adding additional gravel/compaction to roadway surfaces
- Maintaining project gates and access
- Maintaining grass lined swales – removal of built up sand/silt, seed/mulch any bare spots within swale, fix any rutting/scouring within swales
- Maintaining Storm basins – removal of built up sand/silt in forebay or basin, seed/mulch any bare spots, fix any rutting/scouring, add stone around broad-crested weirs if scouring is witnessed,

Project would likely be reviewed once a year or once every two years. Any repair or maintence work would be on an as needed basis. Actual visits to the site would be so minimal over the course of the project lifetime, they would difficult to quantify.

Unforeseen Issues

Technology in solar development is growing and changing at a rapid rate. There is a chance that newer technology could provide an opportunity for the site to run better or more efficiently. Any large scale changes or alterations to the project which would require a substantial construction effort would require a redesign of the array. In this event, the project would work with the Town to permit that effort.

Heavy damage to the site from natural or other event could require a substantial contruction effort. In this event the project would work with the Town to permit that effort.

Appendix F

Massachusetts Department of Environmental Protection
Checklist for Stormwater Report

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands Program

Checklist for Stormwater Report

A. Introduction

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.

A Stormwater Report must be submitted with the Notice of Intent permit application to document compliance with the Stormwater Management Standards. The following checklist is NOT a substitute for the Stormwater Report (which should provide more substantive and detailed information) but is offered here as a tool to help the applicant organize their Stormwater Management documentation for their Report and for the reviewer to assess this information in a consistent format. As noted in the Checklist, the Stormwater Report must contain the engineering computations and supporting information set forth in Volume 3 of the Massachusetts Stormwater Handbook. The Stormwater Report must be prepared and certified by a Registered Professional Engineer (RPE) licensed in the Commonwealth.

The Stormwater Report must include:

- The Stormwater Checklist completed and stamped by a Registered Professional Engineer (see page 2) that certifies that the Stormwater Report contains all required submittals.[1] This Checklist is to be used as the cover for the completed Stormwater Report.
- Applicant/Project Name
- Project Address
- Name of Firm and Registered Professional Engineer that prepared the Report
- Long-Term Pollution Prevention Plan required by Standards 4-6
- Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan required by Standard 8[2]
- Operation and Maintenance Plan required by Standard 9

In addition to all plans and supporting information, the Stormwater Report must include a brief narrative describing stormwater management practices, including environmentally sensitive site design and LID techniques, along with a diagram depicting runoff through the proposed BMP treatment train. Plans are required to show existing and proposed conditions, identify all wetland resource areas, NRCS soil types, critical areas, Land Uses with Higher Potential Pollutant Loads (LUHPPL), and any areas on the site where infiltration rate is greater than 2.4 inches per hour. The Plans shall identify the drainage areas for both existing and proposed conditions at a scale that enables verification of supporting calculations.

As noted in the Checklist, the Stormwater Management Report shall document compliance with each of the Stormwater Management Standards as provided in the Massachusetts Stormwater Handbook. The soils evaluation and calculations shall be done using the methodologies set forth in Volume 3 of the Massachusetts Stormwater Handbook.

To ensure that the Stormwater Report is complete, applicants are required to fill in the Stormwater Report Checklist by checking the box to indicate that the specified information has been included in the Stormwater Report. If any of the information specified in the checklist has not been submitted, the applicant must provide an explanation. The completed Stormwater Report Checklist and Certification must be submitted with the Stormwater Report.

[1] The Stormwater Report may also include the Illicit Discharge Compliance Statement required by Standard 10. If not included in the Stormwater Report, the Illicit Discharge Compliance Statement must be submitted prior to the discharge of stormwater runoff to the post-construction best management practices.

[2] For some complex projects, it may not be possible to include the Construction Period Erosion and Sedimentation Control Plan in the Stormwater Report. In that event, the issuing authority has the discretion to issue an Order of Conditions that approves the project and includes a condition requiring the proponent to submit the Construction Period Erosion and Sedimentation Control Plan before commencing any land disturbance activity on the site.

B. Stormwater Checklist and Certification

The following checklist is intended to serve as a guide for applicants as to the elements that ordinarily need to be addressed in a complete Stormwater Report. The checklist is also intended to provide conservation commissions and other reviewing authorities with a summary of the components necessary for a comprehensive Stormwater Report that addresses the ten Stormwater Standards.

Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the item is not applicable (N.A.) and provide the reasons for that determination.

A complete checklist must include the Certification set forth below signed by the Registered Professional Engineer who prepared the Stormwater Report.

Registered Professional Engineer's Certification

I have reviewed the Stormwater Report, including the soil evaluation, computations, Long-term Pollution Prevention Plan, the Construction Period Erosion and Sedimentation Control Plan (if included), the Long-term Post-Construction Operation and Maintenance Plan, the Illicit Discharge Compliance Statement (if included) and the plans showing the stormwater management system, and have determined that they have been prepared in accordance with the requirements of the Stormwater Management Standards as further elaborated by the Massachusetts Stormwater Handbook. I have also determined that the information presented in the Stormwater Checklist is accurate and that the information presented in the Stormwater Report accurately reflects conditions at the site as of the date of this permit application.

Registered Professional Engineer Block and Signature

COMMONWEALTH OF MASSACHUSETTS
GREGORY T. DIXSON
CIVIL ENGINEER
No. 55649
REGISTERED PROFESSIONAL ENGINEER

November 4, 2021

Signature and Date

Checklist

Project Type: Is the application for new development, redevelopment, or a mix of new and redevelopment?

☒ New development

☐ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist (continued)

LID Measures: Stormwater Standards require LID measures to be considered. Document what environmentally sensitive design and LID Techniques were considered during the planning and design of the project:

- ☐ No disturbance to any Wetland Resource Areas
- ☐ Site Design Practices (e.g. clustered development, reduced frontage setbacks)
- ☐ Reduced Impervious Area (Redevelopment Only)
- ☐ Minimizing disturbance to existing trees and shrubs
- ☐ LID Site Design Credit Requested:
  - ☐ Credit 1
  - ☐ Credit 2
  - ☐ Credit 3
- ☐ Use of “country drainage” versus curb and gutter conveyance and pipe
- ☐ Bioretention Cells (includes Rain Gardens)
- ☐ Constructed Stormwater Wetlands (includes Gravel Wetlands designs)
- ☐ Treebox Filter
- ☐ Water Quality Swale
- ☒ Grass Channel
- ☐ Green Roof
- ☐ Other (describe): ____________________

Standard 1: No New Untreated Discharges

- ☒ No new untreated discharges
- ☒ Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth
- ☒ Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.

Checklist (continued)

Standard 2: Peak Rate Attenuation

☐ Standard 2 waiver requested because the project is located in land subject to coastal storm flowage and stormwater discharge is to a wetland subject to coastal flooding.

☒ Evaluation provided to determine whether off-site flooding increases during the 100-year 24-hour storm.

☒ Calculations provided to show that post-development peak discharge rates do not exceed pre-development rates for the 2-year and 10-year 24-hour storms. If evaluation shows that off-site flooding increases during the 100-year 24-hour storm, calculations are also provided to show that post-development peak discharge rates do not exceed pre-development rates for the 100-year 24-hour storm.

Standard 3: Recharge

☐ Soil Analysis provided.

☐ Required Recharge Volume calculation provided.

☐ Required Recharge volume reduced through use of the LID site Design Credits.

☐ Sizing the infiltration, BMPs is based on the following method: Check the method used.

☐ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

☐ Runoff from all impervious areas at the site discharging to the infiltration BMP.

☐ Runoff from all impervious areas at the site is *not* discharging to the infiltration BMP and calculations are provided showing that the drainage area contributing runoff to the infiltration BMPs is sufficient to generate the required recharge volume.

☐ Recharge BMPs have been sized to infiltrate the Required Recharge Volume.

☐ Recharge BMPs have been sized to infiltrate the Required Recharge Volume *only* to the maximum extent practicable for the following reason:

☐ Site is comprised solely of C and D soils and/or bedrock at the land surface

☐ M.G.L. c. 21E sites pursuant to 310 CMR 40.0000

☐ Solid Waste Landfill pursuant to 310 CMR 19.000

☐ Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.

☐ Calculations showing that the infiltration BMPs will drain in 72 hours are provided.

☐ Property includes a M.G.L. c. 21E site or a solid waste landfill and a mounding analysis is included.

[1] 80% TSS removal is required prior to discharge to infiltration BMP if Dynamic Field method is used.

Checklist (continued)

Standard 3: Recharge (continued)

☐ The infiltration BMP is used to attenuate peak flows during storms greater than or equal to the 10-year 24-hour storm and separation to seasonal high groundwater is less than 4 feet and a mounding analysis is provided.

☐ Documentation is provided showing that infiltration BMPs do not adversely impact nearby wetland resource areas.

Standard 4: Water Quality

The Long-Term Pollution Prevention Plan typically includes the following:

- Good housekeeping practices;
- Provisions for storing materials and waste products inside or under cover;
- Vehicle washing controls;
- Requirements for routine inspections and maintenance of stormwater BMPs;
- Spill prevention and response plans;
- Provisions for maintenance of lawns, gardens, and other landscaped areas;
- Requirements for storage and use of fertilizers, herbicides, and pesticides;
- Pet waste management provisions;
- Provisions for operation and management of septic systems;
- Provisions for solid waste management;
- Snow disposal and plowing plans relative to Wetland Resource Areas;
- Winter Road Salt and/or Sand Use and Storage restrictions;
- Street sweeping schedules;
- Provisions for prevention of illicit discharges to the stormwater management system;
- Documentation that Stormwater BMPs are designed to provide for shutdown and containment in the event of a spill or discharges to or near critical areas or from LUHPPL;
- Training for staff or personnel involved with implementing Long-Term Pollution Prevention Plan;
- List of Emergency contacts for implementing Long-Term Pollution Prevention Plan.

☒ A Long-Term Pollution Prevention Plan is attached to Stormwater Report and is included as an attachment to the Wetlands Notice of Intent.

☐ Treatment BMPs subject to the 44% TSS removal pretreatment requirement and the one inch rule for calculating the water quality volume are included, and discharge:

- ☐ is within the Zone II or Interim Wellhead Protection Area
- ☐ is near or to other critical areas
- ☐ is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)
- ☐ involves runoff from land uses with higher potential pollutant loads.

☐ The Required Water Quality Volume is reduced through use of the LID site Design Credits.

☐ Calculations documenting that the treatment train meets the 80% TSS removal requirement and, if applicable, the 44% TSS removal pretreatment requirement, are provided.

Checklist (continued)

Standard 4: Water Quality (continued)

☐ The BMP is sized (and calculations provided) based on:

- ☐ The ½" or 1" Water Quality Volume or
- ☐ The equivalent flow rate associated with the Water Quality Volume and documentation is provided showing that the BMP treats the required water quality volume.

☐ The applicant proposes to use proprietary BMPs, and documentation supporting use of proprietary BMP and proposed TSS removal rate is provided. This documentation may be in the form of the propriety BMP checklist found in Volume 2, Chapter 4 of the Massachusetts Stormwater Handbook and submitting copies of the TARP Report, STEP Report, and/or other third party studies verifying performance of the proprietary BMPs.

☐ A TMDL exists that indicates a need to reduce pollutants other than TSS and documentation showing that the BMPs selected are consistent with the TMDL is provided.

Standard 5: Land Uses With Higher Potential Pollutant Loads (LUHPPLs)

☐ The NPDES Multi-Sector General Permit covers the land use and the Stormwater Pollution Prevention Plan (SWPPP) has been included with the Stormwater Report.

☐ The NPDES Multi-Sector General Permit covers the land use and the SWPPP will be submitted ***prior to*** the discharge of stormwater to the post-construction stormwater BMPs.

☐ The NPDES Multi-Sector General Permit does ***not*** cover the land use.

☐ LUHPPLs are located at the site and industry specific source control and pollution prevention measures have been proposed to reduce or eliminate the exposure of LUHPPLs to rain, snow, snow melt and runoff, and been included in the long term Pollution Prevention Plan.

☐ All exposure has been eliminated.

☐ All exposure has ***not*** been eliminated and all BMPs selected are on MassDEP LUHPPL list.

☐ The LUHPPL has the potential to generate runoff with moderate to higher concentrations of oil and grease (e.g. all parking lots with >1000 vehicle trips per day) and the treatment train includes an oil grit separator, a filtering bioretention area, a sand filter or equivalent.

Standard 6: Critical Areas

☐ The discharge is near or to a critical area and the treatment train includes only BMPs that MassDEP has approved for stormwater discharges to or near that particular class of critical area.

☐ Critical areas and BMPs are identified in the Stormwater Report.

Checklist (continued)

Standard 7: Redevelopments and Other Projects Subject to the Standards only to the maximum extent practicable

☐ The project is subject to the Stormwater Management Standards only to the maximum Extent Practicable as a:

- ☐ Limited Project
- ☐ Small Residential Projects: 5-9 single family houses or 5-9 units in a multi-family development provided there is no discharge that may potentially affect a critical area.
- ☐ Small Residential Projects: 2-4 single family houses or 2-4 units in a multi-family development with a discharge to a critical area
- ☐ Marina and/or boatyard provided the hull painting, service and maintenance areas are protected from exposure to rain, snow, snow melt and runoff
- ☐ Bike Path and/or Foot Path
- ☐ Redevelopment Project
- ☐ Redevelopment portion of mix of new and redevelopment.

☐ Certain standards are not fully met (Standard No. 1, 8, 9, and 10 must always be fully met) and an explanation of why these standards are not met is contained in the Stormwater Report.

☐ The project involves redevelopment and a description of all measures that have been taken to improve existing conditions is provided in the Stormwater Report. The redevelopment checklist found in Volume 2 Chapter 3 of the Massachusetts Stormwater Handbook may be used to document that the proposed stormwater management system (a) complies with Standards 2, 3 and the pretreatment and structural BMP requirements of Standards 4-6 to the maximum extent practicable and (b) improves existing conditions.

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control

A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan must include the following information:

- Narrative;
- Construction Period Operation and Maintenance Plan;
- Names of Persons or Entity Responsible for Plan Compliance;
- Construction Period Pollution Prevention Measures;
- Erosion and Sedimentation Control Plan Drawings;
- Detail drawings and specifications for erosion control BMPs, including sizing calculations;
- Vegetation Planning;
- Site Development Plan;
- Construction Sequencing Plan;
- Sequencing of Erosion and Sedimentation Controls;
- Operation and Maintenance of Erosion and Sedimentation Controls;
- Inspection Schedule;
- Maintenance Schedule;
- Inspection and Maintenance Log Form.

☒ A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan containing the information set forth above has been included in the Stormwater Report.

Checklist for Stormwater Report

Checklist (continued)

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control (continued)

☐ The project is highly complex and information is included in the Stormwater Report that explains why it is not possible to submit the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan with the application. A Construction Period Pollution Prevention and Erosion and Sedimentation Control has ***not*** been included in the Stormwater Report but will be submitted ***before*** land disturbance begins.

☐ The project is ***not*** covered by a NPDES Construction General Permit.

☐ The project is covered by a NPDES Construction General Permit and a copy of the SWPPP is in the Stormwater Report.

☒ The project is covered by a NPDES Construction General Permit but no SWPPP been submitted. The SWPPP will be submitted BEFORE land disturbance begins.

Standard 9: Operation and Maintenance Plan

☒ The Post Construction Operation and Maintenance Plan is included in the Stormwater Report and includes the following information:

- ☒ Name of the stormwater management system owners;
- ☒ Party responsible for operation and maintenance;
- ☐ Schedule for implementation of routine and non-routine maintenance tasks;
- ☐ Plan showing the location of all stormwater BMPs maintenance access areas;
- ☐ Description and delineation of public safety features;
- ☐ Estimated operation and maintenance budget; and
- ☐ Operation and Maintenance Log Form.

☐ The responsible party is ***not*** the owner of the parcel where the BMP is located and the Stormwater Report includes the following submissions:

- ☐ A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;
- ☐ A plan and easement deed that allows site access for the legal entity to operate and maintain BMP functions.

Standard 10: Prohibition of Illicit Discharges

☒ The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;

☐ An Illicit Discharge Compliance Statement is attached;

☒ NO Illicit Discharge Compliance Statement is attached but will be submitted ***prior to*** the discharge of any stormwater to post-construction BMPs.

Attachment 11

Decommissioning Plan and Financial Assurance

Decommissioning Plan & Financial Assurance

Decommissioning Overview

Costa Solar (Project) will be decommissioned within 150 days of the end of its operational life, or the expiration or termination of the land lease agreement. Costa Solar, LLC, or its successor, will be responsible for decommissioning activities, including removing the solar facility, disposing of waste, restoring the Project site, and periodically updating the Decommissioning Plan and form of surety. Decommissioning will be fully funded prior to construction. The Site Plan Review Authority will be notified by certified mail of the proposed date of discontinued operations and plans for removal. Waste will be transported by licensed transporters and recycled or disposed of in accordance with local, state, and federal regulations. General decommissioning activities include:

- Physical removal of all Project components, including solar panels, racking structures, foundations, electrical equipment, interconnection equipment, utility poles, fencing, and access roads, to the extent that they are not otherwise in productive use or permitted to remain in place.
- Disposal of all solid waste from the site and from decommissioning activities, in accordance with applicable local, state, and federal waste disposal regulations.
- Restoration of the site, including grading, stabilization, seeding, and revegetation, as necessary to minimize erosion and runoff.

Decommissioning Process

Decommissioning tasks are listed in Table 1. A final, detailed decommissioning plan will be prepared by a qualified engineer prior to commencing decommissioning activities.

Table 1: Decommissioning Tasks

Task	Task Description
1	Remove rack wiring
2	Remove solar panels
3	Dismantle racks
4	Remove electrical equipment
5	Break up and remove concrete pads
6	Remove racks
7	Remove racking foundations and power poles
8	Remove fence
9	Grading
10	Seed disturbed area
11	Truck items to recycling center

Equipment Removal and Site Restoration

Solar panels and electrical equipment such as transformers, inverters, and switchgear will be detached and transported to an appropriate facility for recycling or reuse. Wiring, racking, equipment pads, and other aboveground components will be removed using tools and small machinery. Belowground components such as racking posts and power poles will be removed to a depth of at least two feet, with remaining material abandoned in place. The battery bank will be removed and recycled by the original equipment manufacturer. All removed components will be transported by state-licensed transporters to an appropriate recycling or disposal facility.

Minimal ground disturbance is anticipated from decommissioning activities, and the site will be restored to a natural state that minimizes erosion and runoff and is suitable for other uses. Restoration will include grading, mulching, seeding, and revegetating. Disturbed areas will be re-seeded with the same wildlife/conservation seed mix used across the site during Project construction.

Decommissioning Cost Estimate

A task-by-task cost estimate for Project decommissioning is provided in Table 2, based on estimates from the New York State Energy Research and Development Authority (NYSERDA).[1]

Table 2: Decommissioning Cost Estimate by Task

Task	Task Description	Estimated Cost
1	Remove rack wiring	$ 7,044
2	Remove solar panels	$ 7,044
3	Dismantle racks	$ 35,506
4	Remove electrical equipment	$ 5,319
5	Break up and remove concrete pads	$ 4,313
6	Remove racks	$ 22,425
7	Remove racking foundations and power poles	$ 58,506
8	Remove fence	$ 14,231
9	Grading	$ 11,500
10	Seed disturbed area	$ 719
11	Truck items to recycling center	$ 6,469
	Total Cost	$ 173,075

[1] New York State Energy Research and Development Authority. (2021). *New York Solar Guidebook for Local Governments*.

Financial Assurance

Costa Solar, LLC c/o Ironwood Renewables will fully fund the decommissioning of the Project at an estimated cost of $173,075. As required by the Town of Freetown, the Project will provide financial assurance documents demonstrating fully funded decommissioning costs prior to construction. Financial assurance will be demonstrated through a performance bond, surety bond, irrevocable letter of credit, or other form acceptable to the Town of Freetown. After 15 years, and every five years thereafter, Costa Solar, LLC, or its successor, will update the cost of Project decommissioning and the form of surety with the Site Plan Review Authority.