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February 2, 2024

VIA EMAIL
Jason Evancic, PE, Permit Engineer
New Hampshire Department of Environmental Services
Solid Waste Management Bureau

Email: Jason.a.evancic@des.nh.gov

Subject: Town of Exeter 1.50 MW (AC) Solar Array
9 Cross Road, Exeter, New Hampshire
Application for Type I-B Permit
Response to Incomplete Application - Request for Additional Information Application # 2023-66180 dated December 15, 2023

Dear Jason,

On behalf of The Town of Exeter (Town), Sevee & Maher Engineers (SME) has prepared the following response to the New Hampshire Department of Environmental Services (NHDES) request for additional information for Application No. 2023-66180 for the proposed solar array project at the closed municipal landfill in Exeter, NH.

NHDES reviewed the above-cited application in accordance with ND Solid Waste Rules, Env-Sw 100 et seq and determined that the application is incomplete.

The comments and headings below correspond to the document forwarded to our office by email on December 15, 2023. The application and plan set materials have been revised in response to the review comments as indicated below:

1. Application Form

A. Correct the permittee name in Section II of the Application Form. The permittee name should be the Town of Exeter.

SME's Response: The permittee name in Section II of the Application Form has been updated to reflect the Town of Exeter. A copy of the updated application form is included in Attachment 1 for reference.

2. Facility Design Plans & Calculations

A. Env-Sw 1103.05(a) requires that the plans bear the facility permit number. The design plans submitted do not have the facility's permit number listed on the sheets. Update the design plans to include, at a minimum, the facility permit number on the cover sheet.

SME's Response: The cover sheet has been updated to include the facility permit number. A copy of the updated project plan set in included in Attachment 6 for reference.

B. Calculations regarding global stability were not complete. Pursuant to Env-Sw 315.05(c)(5) and Env-Sw 1103.05(h), and to assist NHDES in its review of the requirements in Env-Sw 800, please provide an analysis of global stability for the static and seismic conditions using the total loading of the solar array system. Ensure stability calculations incorporate snow loading.

SME's Response: The requested global Settlement and Stability calculations with snow loading are included on Attachment 2.

C. Design specifications for the electrical components were not provided. Provide design details (e.g., specifications, data sheets) sufficient for construction of electrical components in accordance with Env-Sw 315.05(c)(4)a. and Env-Sw 1103.05.

SME's Response: Design specifications for the electrical components that will be used for construction are included in Attachment 3.

D. Identify the maximum loading in pounds per square inch (psi) for all low ground pressure equipment that will be used during solar array construction on the landfill cap (off the access road) in accordance with Env-Sw 315.05(c)(5) and ensure the maximum load to be managed by the equipment is accounted for in the calculations.

SME's Response: Maximum loading for low ground pressure equipment will be 5 psi. This is supported in the Settlement and Stability calculations provided in Attachment 2.

3. Closure Plan

A. Proposed additions to the Closure Plan were provided as attachments to the application, titled "Operations and Maintenance Plan" and "Decommissioning Plan." The attachments include information that satisfies, in part, various content requirements of Env-Sw 1106.04, Closure Plan, Content and Format, but do not follow the format requirements. As required by Env-Sw 315.05(c)(4)c., provide amendments to the closure plan, which may be presented in the form of replacement pages. If the closure plan does not meet the content and format requirements in Env-Sw 1106.04, provide an updated plan that does as required by Env-Sw 315.05(c)(4)e. Ensure that the closure plan is written in plain language and provides sufficient detail to allow a third party to implement and complete all required facility closure tasks, including post-closure tasks. NHDES provides the following more detailed explanation:

a. **Section 1: This section was not provided.**

SME's Response: Facility identification for the Exeter Municipal Landfill is outlined below and provided in Attachment 4 in the form of a replacement page.

Facility name: Exeter Municipal Landfill
Mailing Address: 10 Front St, Exeter, NH
Location: 9 Cross Rd, Exeter, NH
Permit Number: DES-SW-SP-1992-001

b. **Section 2: As the facility is already closed, state such.**

SME's Response: The existing landfill was closed in 1994. This information is provided in Attachment 4 in the form of a replacement page.

c. **Section 3: The waste types collected at the facility were not identified.**

SME's Response: The Exeter Municipal Landfill received municipal solid waste. This information is provided in Attachment 4 in the form of a replacement page.

d. **Section 4: As the facility is already closed, state that no notifications are required.**

SME's Response: The facility is closed. No notifications are required for this project. This information is provided in Attachment 4 in the form of a replacement page.

e. **Section 5: As the facility is already closed, include or reference the closure as-built plans or drawings and specifications for the facility.**

SME's Response: "Landfill Closure Design and Specifications, Cross Road Landfill, Exeter, New Hampshire," prepared by GZA Geo Environmental Inc. dated March 30, 1994 is on file with NHDES under administrative order no. WMD 87-136. This information is provided in Attachment 4 in the form of a replacement page.

f. **Section 6: This section was not complete. This section is required to address the post-closure inspection, monitoring and maintenance requirements for the landfill, which are identified in Env-Sw 807.05.**

i. **Attachment 2, titled "Exeter Landfill Operations and Maintenance," contains operating and monitoring requirements for the solar array system; however, it does not include other post closure inspection, maintenance and monitoring requirements in sufficient detail for a third-party to conduct landfill post-closure care activities as required by Env-Sw 1106.04(a).**

SME's Response: The addition of the solar array will not change the ongoing landfill post-closure testing, inspection, maintenance or monitoring that is currently being performed at the facility. Reference NHDES permit number DES-SW-SP-1992-001 for applicable historical landfill post-closure reports. Attachment 4b includes an Inspection and Maintenance manual outlining the maintenance and monitoring for the third-party to conduct.

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ii. **Attachment 3, titled "Decommissioning Plan," includes a sequence for removal of end-of-life solar panels and other associated equipment. This plan appears to provide detailed closure activities relative to the solar array systems. NHDES suggests this be made an attachment to the closure plan.**

    SME's Response: The Decommissioning Plan is included as an attachment to the closure plan in Attachment 4a. This be is included as an attachment to the closure plan at the request of NHDES.

g. **Section 7: This section was not provided.**

   SME's Response: Copies of all records and reports will be maintained on-site during construction. Copies of these files will be transferred to NHDES at the completion of construction for Department records. This information is provided in Attachment 4 in the form of a replacement page.

h. **Section 8: This section was not provided.**

   SME's Response: Other permits required for this project include a NHDES Alteration of Terrain (AoT) permit. NHDES Permit Application Number 231107-221 is currently under review with NHDES. This information is provided in Attachment 4 in the form of a replacement page.

i. **Section 9: This section is required to contain a closure cost estimate prepared in accordance with Env-Sw 1403.02. See comments on financial assurance below.**

   SME's Response: A closure cost estimate prepared in accordance with Env-Sw 1403.02 for post-closure landfill care and maintenance and solar decommissioning is included in Attachment 4. The Town of Exeter intends to use the approved LOGO test for financial assurance to meet the requirements of Env-Sw 315 and Env-Sw 1400. A copy of the closure cost estimate is included in Attachment 5.

4. Financial Assurance

Env-Sw 315.05(c)(4)d. requires a complete financial assurance plan, prepared in accordance with Env-Sw 1400, be provided when changes to such are required. A complete financial assurance plan consists of both a closure cost estimate and a financial assurance mechanism. An updated financial assurance plan (i.e., cost estimate and mechanism) was not submitted with or identified in the application. Because the landfill is closed, only a cost estimate for post-closure care is required. Submit a post-closure care cost estimate prepared in accordance with Env-Sw 1403.02. A post-closure care cost estimate form may be found on the NHDES website. Ensure the updated cost estimate includes the cost for removal of the solar array installation and restoration of the site to its original condition. Note that the cost estimate is not allowed to include a credit for the salvage value of the solar array components pursuant to Env-Sw- 1403.02(f). Also, review the options for the financial assurance mechanism identified in 1403.01(b), and provide the financial assurance mechanism to be used for this landfill. NHDES notes that most municipalities use the local government (LOGO) financial test.

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SME's Response: A closure cost estimate is provided in Attachment 5.

If you have any questions or comments, please do not hesitate to contact me or Kate Tilas at ket@smemaine.com or 207.829.5016.

Sincerely,

SEVEE & MAHER ENGINEERS, INC.

Jeffrey T. Read, P.E.
Senior Civil Engineer

Attachments

Attachment 1	Application
Attachment 2	Settlement and Stability Response
Attachment 3	Electrical Components
Attachment 4	Closure Plan
Attachment 4a	Decommissioning Plan
Attachment 4b	Inspection and Maintenance Manual
Attachment 5	Closure Cost Estimate
Attachment 6	Plan Set

cc: Charlie Hanna, Revision Energy
Nate Niles, Revision Energy

ATTACHMENT 1

APPLICATION

INSTRUCTIONS
for obtaining a

Type I Modification To Solid Waste Management Facility Permit

pursuant to
RSA 149-M and New Hampshire Administrative Solid Waste Rule Env-Sw 315

Read these instructions before completing the attached form. For additional assistance contact the NH Department of Environmental Services (DES), Permitting & Design Review Section (P&DRS) at (603) 271-2925 or the below noted mailing address or TDD Access: Relay NH 1-800-735-2964.

Note: All references on this form beginning with "Env-Sw" are citations from the New Hampshire Solid Waste Rules. To obtain a copy of the Rules, contact the DES Public Information & Permitting Office at (603) 271-2975 or above noted TDD Access. The Rules are also available on the Internet at http:\\www.des.nh.gov/rules .

Complete the attached form to obtain either a "type I-A" or "type I-B" permit modification pursuant to Env-Sw 315.02(b) or (c), respectively. **Before completing the form, be certain the proposed facility modification falls within the definition of either a type I-A or type I-B modification.** [If unfamiliar with how to make this determination, refer to the worksheet on the reverse side of this instruction sheet and/or contact the P&DRS for assistance.]

All requested information must be provided as specified. Do **NOT** skip any question, unless instructed to do so. Do **NOT** mark any question "not applicable." If you need more room than provided on the form to answer a particular question and are using a paper copy of the form, attach additional pages as necessary; mark each page clearly to show both the applicant name and the question being answered; and indicate on the form that the additional pages are attached.

Submit **THREE** copies of the completed form, **EACH bearing ORIGINAL signatures**. Applications may be submitted to the department electronically. If an applicant chooses to submit an application electronically, a single paper copy of the application shall also be submitted to the department to the following address:

NH Department of Environmental Services (DES)
Waste Management Division (WMD)
Permitting & Design Review Section (P&DRS)
29 Hazen Drive, PO Box 95
Concord, NH 03302-0095

Include the required fee, as determined from the following table. Make checks or money orders payable to "TREASURER, State of New Hampshire":

Type I-A Modification, without a capacity increase	**$1500**
Type I-A Modification, with a capacity increase	**See Env-Sw 310.07(a)(2) for formula to calculate or contact the P&DRS for assistance, at (603) 271-2925**
Type I-B Modification	**$100**

Your application will be processed by DES in accordance with Env-Sw 304 and Env-Sw 305. If your application is correctly filed (i.e., you submit the right number of copies, each with original signatures, and the required fee), your application will be accepted for processing. Within 60 days of receipt, and earlier whenever possible, you will be notified whether the application is complete (i.e., whether the application provides all information required to support a full technical review and determine whether the proposed modification meets all requirements of the Rules). If incomplete, you will be given instructions for correcting the deficiencies. If complete, you will be notified in writing and the agency will undertake a technical review of the application to determine whether the proposal meets all requirements of the Rules. In addition, for certain type I-A modifications, the agency must also hold a public hearing within the host municipality during the technical review process. Following the close of the technical review process and the hearing, if held, DES will make a final decision to issue or deny the requested modification. You will be notified in writing, as will the host municipality and host solid waste management district.

WORKSHEET FOR DETERMINING MODIFICATION TYPE

STEP 1: In order to correctly use and complete the attached application form, you must first confirm that your proposed facility modification is a "type I" modification (as opposed to being either a "type II" through "type V" modification). If your response to each of the following questions is "FALSE," your proposed facility modification most likely falls within the scope of a "type I" modification:

☐ **True** ☒ **False** The proposed change is required by a condition of my permit which requires me to submit final plans for DES approval based on preliminary plans provided to DES on an earlier date. (Note: If this statement is "TRUE," your proposed modification is most likely a "type II" modification and you need to file your application by completing a "Type II Permit Modification Application Form.")

☐ **True** ☒ **False** The proposed change is one of the following **AND** I am able to certify compliance with each of the statements provided in Section X of this application form:

- A change in facility operating hours between the hours of 6 AM and 6 PM or within alternative limits specified in my permit, or for a private facility managing only on-site generated waste, within limits allowed by local ordinance.
- A change in a key above-ground site feature, for instance a facility structure or appurtenance, which will not alter the permitted function(s) of the facility, change the basis of the approved facility design or violate any applicable siting criteria specified in the Rules, and which is merely a change to improve facility operations within the limits specified in my permit.
- For a facility permitted to collect recyclable materials, a change in the type of select recyclable materials (paper, cardboard, glass, plastic, metal or textiles) to be collected which does not increase the facility's approved storage capacity or require a change in the approved financial assurance plan of record for the facility.
- For landfills, a change in the type of cover material to be used at the facility, pursuant to Env-Sw 806.03.
- A name change for the permittee or facility that does not constitute a change in ownership or operational control of the facility.
- A change in organizational structure, including a change in the individuals/entities holding 10% or more of the permittee's equity or debt and/or a change in officers, directors, partners or key employees, that does not constitute a change in ownership or operational control of the facility.

(Note: If you respond "TRUE" to the above statement, your proposed modification is most likely a "type III" modification and you need to file your application by completing a "Type III Permit Modification Application Form.")

☐ **True** ☒ **False** The proposed change is to transfer my permit or otherwise authorize a change in the ownership or operational control of the facility. (Note: If you respond "TRUE" to this statement, your proposed modification is most likely a "type IV" modification and you need to file your application by completing a "Type IV Permit Modification Application Form.")

☐ **True** ☒ **False** The proposed change is to authorize the destruction or relocation of facility records. (Note: If you respond "TRUE" to this statement, your proposed modification is most likely a "type V" modification and you need to file your application by completing a "Type V Permit Modification Application Form.")

STEP 2: If your response to each of the above is "FALSE," you may assume that the proposed modification is a type I modification. You must now determine whether the proposed change is a "type I-A" or "type I-B" modification, as defined by Env-Sw 315.02(b) or (c).

A "type I-A" modification is one that will change facility operations in a manner having the potential to adversely affect the state's ability to establish and maintain an integrated system of facilities which: (1) will assist in achieving the waste reduction/recycling goals in RSA 149-M:2; (2) is consistent with the hierarchy in RSA 149-M:3; and (3) will provide a substantial public benefit pursuant to RSA 149-M:11. Therefore, if any of the following statements are TRUE relative to the change you are proposing at your facility, the change falls within the definition of a "type I-A" modification.

☐ **True** ☒ **False** The proposed modification will increase the approved design capacity of the facility.

☐ **True** ☐ **False** The proposed modification will extend the expiration date of the permit.

☐ **True** ☒ **False** The proposed modification will reduce the operating life expectancy of a NH landfill without a comparable reduction in the permitted capacity of the landfill, as by directly or indirectly increasing the quantity of waste which will be received daily at a New Hampshire landfill.

☐ **True** ☒ **False** The proposed modification will expand the permitted service area of the subject facility.

☐ **True** ☒ **False** The proposed modification will change the subject facility service type from a "limited service" area facility (one which can accept waste from only certain sources specified in the permit) to an "unlimited service" area facility (one which can accept waste from any source).

☐ **True** ☒ **False** The proposed modification will change facility operations to include a waste management method less preferred in the RSA 149-M:3 hierarchy. The methods, in order of descending preference as specified in RSA 149-M:3 are: source reduction; recycling and reuse; composting; waste-to-energy technologies (including incineration); incineration without resource recovery; and landfilling.

If you answer "FALSE" to each of the above statements, your proposed modification is most likely a "type I-B" modification, i.e., a modification which is unlikely to have an adverse effect on the state's ability to establish and maintain an integrated system of facilities which (1) will assist in achieving the waste reduction/recycling goals in RSA 149-M:2; (2) is consistent with the hierarchy in RSA 149-M:3; and (3) provides a substantial public benefit pursuant to RSA 149-M:11.

For Office Use Only:
WMD Log #:__________
Date Rec'd.:__________
No. of Copies:__________
Fee: $________/Check #________

Wast
Divis

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

APPLICATION FORM FOR

TYPE I MODIFICATION TO SOLID WASTE MANAGEMENT FACILITY PERMIT

pursuant to
RSA 149-M and New Hampshire Administrative Solid Waste Rule Env-Sw 315

SECTION I. FACILITY IDENTIFICATION

(1) Facility name: Exeter Municipal Landfill
(2) Functional classification: ☐ collection/storage/transfer ☐ processing/treatment ☒ landfill
(3) Mailing address:
(4) Permit number: DES-SW-SP-1992-001
(5) Location, by street address and municipality: 9 Cross Road Exeter, NH

SECTION II. PERMITTEE IDENTIFICATION

(1) Permittee/applicant name: Town of Exeter
(2) Mailing address: 10 Front Street Exeter, NH 0383
(3) Telephone number: 603-773-6102
(4) If different than above, identify the individual associated with and designated by the permittee/applicant to be the contact individual for matters concerning this application:
(a) Name: (b) Title:
(c) Mailing address:
(d) Telephone number: (e) E-Mail:

SECTION III. DESCRIPTION OF PROPOSED MODIFICATION

Describe the proposed modification by answering each of the following questions. Use additional paper as necessary.

(1) Provide a **BRIEF** description of the proposed modification. [Check box if response is provided on separate paper ☒]

(2) Identify whether the proposed modification is a "type I-A" or "type I-B" modification. (If uncertain, use the worksheet provided with the instructions for this form): ☐ Type I-A ☒ Type I-B
(3) Identify, either below or on separate paper, each written permit condition that will require amendment to effect the proposed modification and provide draft language for the same. [Check box if response is provided on separate paper ☐]
No permit conditions will require amendment, See Closure plans

(4) Identify, below, each "last approved plan of record" identified in the permit which will be affected by the proposed modification and will therefore require amendment/revision:

Check here if affected	TYPE OF PLAN	DES APPROVAL DATE	WMD LOG # (Find this number on your copy of the approval)
☐	Facility design plans/specifications		
☐	Facility operating plan		
☒	Facility closure plan		
☐	Facility financial assurance plan		
☐	Other plan (specify):		

(5)	Submit, on separate paper, the proposed amendments/revisions for each document identified pursuant to (4) above, based on the below listed instructions. (Note: The revisions may be presented in the form of replacement pages ready for substitution into the last approved plan of record, each page being clearly marked to show the date of revision. In the event there is no last approved plan of record for any of the following, you must prepare and submit a full plan, including the proposed modification(s), in accordance with the applicable cited Rules.)	
	☐	Facility design plans must be prepared in accordance with Env-Sw 1103.05.
	☒	Facility operating plans must be prepared in accordance with Env-Sw 1105.11.
	☐	Facility closure plans must be prepared in accordance with Env-Sw 1106.04.
	☐	Financial assurance plans must be prepared as specified in Env-Sw 1400 and must include all related draft financial assurance documents required to effect the proposed modification.
(6)	In order for DES to approve the proposed modification, the agency must be able to conclude from the information provided in this application that the proposed modification meets all applicable requirements of the Rules. Therefore, for any aspect of the proposed modification where it may not be self-evident that the proposed change meets all applicable requirements of the Rules, you should explicitly provide such information. Provide your response below and/or use separate paper as necessary. (Check box if response is attached on separate paper ☐)	
	The proposed modifications are not proposed to alter or impact the existing capping system	

SECTION IV. SCHEDULE

Provide a proposed schedule for implementing the modification. Use separate paper if necessary. (Check box if response is attached on separate paper ☐)

SECTION V. STATEMENT OF NEED

Provide a statement of need describing why the proposed change is necessary or desirable. Use separate paper if necessary. (Check box if response is attached on separate paper ☒)

SECTION VI. IMPACT EVALUATION

On separate paper, identify all impacts, both positive and adverse, which the proposed modification will have, including each of the below listed considerations.

(1) The effect the modification will have on facility function, capacity, life expectancy, service type and service area.

(2) The effect the modification will have on the environment, public health and safety.

(3) The effect the modification will have on the state's ability to achieve the goals and objectives specified in RSA 149-M:2, namely achieving a 40% minimum weight reduction in the solid waste stream on a per capita basis by the year 2000 and avoiding the disposal of recyclable materials in a lined landfill with a leachate collection system.

(4) The effect the modification will have on establishing and maintaining integrated waste management systems consistent with the hierarchy of waste management methods in RSA 149-M:3 [the methods, in descending order of preference as specified in RSA 149-M:3, are: source reduction; recycling and reusing; composting; waste-to-energy technologies (including incineration), incineration without resource recovery; and landfilling].

(5) Consistency with the state solid waste management plan and the applicable district plan, pursuant to RSA 149-M:12,I(b). If necessary, contact the P&DRS at (603) 271-2925 for plan information.

SECTION VII. PUBLIC BENEFIT DEMONSTRATION

Provide a "demonstration of public benefit" based on the below listed instructions. Check which one of the listed instructions applies to your particular application.

☐ **For a type I-A modification of a standard permit**, provide a "demonstration of public benefit" in accordance with RSA 149-M:11 and in conformance with the provisions of Env-Sw 1005.05. Prepare and submit the demonstration on separate paper.

☐ **For a type I-A modification of an emergency permit or a research and development permit, or a permit-by-notification**, there is a presumption of public benefit, provided that the proposed modification meets all requirements of the Rules. Therefore, you may skip this section and go to Section VIII.

☒ **For a type I-B modification**, there is a presumption of public benefit, provided that the proposed modification meets all requirements of the Rules. Therefore, you may skip this section and go to Section VIII.

SECTION VIII. OTHER PERMITS

Complete the following table to identify and provide the status of all other permits or approvals necessary to effect the proposed modification.

Type of Permit/Approval Required	Date the Application was/will be Submitted	Status/Comments
Alteration of Terrain	September 5, 2023	Pending

SECTION IX. LEGAL NOTICES

Submit proof of having provided certain legal notifications and filings, as follows:

(1) You must send by certified mail, or deliver in hand, a complete copy of this application to the host municipality, host solid waste management district and other affected entities, with a "notice of filing," as specified by Env-Sw 303.

(2) For a type I-A modification, you must send by certified mail, or deliver in hand, a "notice of filing" to each owner of property abutting the facility site, as specified by Env-Sw 303. If the applicant/permittee or the owner of the facility site owns any abutting parcel of land, the "notice of filing" must be sent to the owner(s) of the next parcel(s) not owned by the permittee/applicant or facility site owner.

(3) You must also provide a "notice of filing" to the New Hampshire Department of Justice/Office of the Attorney General (NH DoJ/AGO) if, pursuant to Section X(2) of this form, you are required to submit business and personal disclosure information.

(4) You must attach to this application "proof" that notification has been provided as required by (1) through (3) above. Therefore, attach a copy of the notice(s) of filing and the signature(s) of all required recipients, acknowledging receipt.

SECTION X. CERTIFICATION OF COMPLIANCE/COMPLIANCE REPORT

All applications for permit modification must be submitted with either certification of compliance or a compliance report, as follows:

(1) If you are ABLE to certify that each of the statements numbered (1) - (8) below are true, do so by your signature.

(2) If you are UNABLE to certify that each of the statements numbered (1) - (8) below are true, you must:

- ☐ Prepare and submit a separate Compliance Report as specified by Env-Sw 303.15; and
- ☐ If the proposed modification involves a change in organizational structure, or a change in individuals/entities holding 10% or more of the permittee's debt or equity, or a change in officers, directors, partners or key employees, none of which constitutes a change in operational control of the facility or a change in ownership per Env-Sw 315.02(f), also submit completed "business and personal disclosure forms" for each non-compliant individual and entity involved in the change. Obtain the required forms from the P&DRS at (603) 271-2925. Submit the completed forms, with the notice of filing referenced by Section IX(3) of this form and a copy of the Compliance Report, direct to the New Hampshire Department of Justice/Office of Attorney General, Environmental Protection Bureau, 33 Capitol Street, Concord, NH 03301-6397. [Note: Copies of the completed disclosure forms should NOT be attached to this application when it is submitted to DES or to the host municipality, host solid waste management district and other effected entities, pursuant to Section IX(1) above. Only the NH DoJ/AGO should receive copies of the disclosure forms].

COMPLIANCE STATEMENT

The applicant shall certify that each of the statements listed in (1)-(8) below are true for each of the following individuals and entities:

- ☒ **The applicant, and**
- ☒ **The facility owner, and**
- ☒ **The facility operator, and**
- ☐ **All individuals and entities holding 10% or more of the applicant's debt or equity, and**
- ☒ **All of the applicant's officers, directors, and partners, and**
- ☒ **All individuals and entities having managerial, supervisory or substantial decision making authority and responsibility for the management of the facility operations or the activity(s) for which approval is being sought.**

(1) No individual or entity listed above has been convicted of or plead guilty or no contest to a felony in any state or federal court during the 5 years before the date of the application.

(2) No individual or entity listed above has been convicted of or plead guilty or no contest to a misdemeanor for a violation of environmental statutes or rules in any state or federal court during the 5 years before the date of the application.

(3) No individual or entity listed above has owned or operated any hazardous or solid waste facility which has been the subject of an administrative or judicial enforcement action for a violation of environmental statutes or rules during the 5 years before the date of the application.

(4)	No individual or entity listed above has been the subject of any administrative or judicial enforcement action for a violation of environmental statutes and rules during the 5 years before the date of the application;
(5)	All hazardous and solid waste facilities owned or operated in New Hampshire by any individual or entity listed above are in compliance with either.
	(a) All applicable environmental statutes, rules, and DES permit requirements; or
	(b) A DES approved schedule for achieving compliance therewith.
(6)	All individuals and entities listed above are in compliance with all civil and criminal penalty provisions of any outstanding consent agreement, settlement, or court order to which DES is a party.
(7)	All individuals and entities listed above have paid, or are in compliance with the payment schedule for any administrative fine assessed by DES.
(8)	All individuals and entities listed above are in compliance with all terms and conditions under every administrative order, court order or settlement agreement relating to programs implemented by DES.

Signature of the permittee/applicant certifying the above statements are true:

Permittee/Applicant Name **(Print Clearly or Type)** Dave Sharples

Permittee/Applicant Signature [signature]

Date 2/1/2024

SECTION XI. PERMITTEE/APPLICANT SIGNATURE REQUIREMENTS

The permittee/applicant must sign the following statement prior to submitting this application. All copies of the application filed with DES must bear the permittee's/applicant's ORIGINAL signature. If the permittee/applicant is not an individual, an individual duly authorized by the permittee/applicant shall sign the application.

To the best of my knowledge and belief, the information and material submitted herewith is correct and complete. I understand that any approval granted by DES based on false and/or incomplete information shall be subject to revocation or suspension, and that administrative, civil or criminal penalties may also apply. I certify that this application is submitted on a complete and accurate form, as provided by DES, without alteration of the text.

Permittee/Applicant Name **(Print Clearly or Type)** Dave Sharples

Permittee/Applicant Signature [signature]

Date 2/1/2024

SECTION XII. PROPERTY OWNER SIGNATURE

If the permittee and property owner are not the same, the property owner must also sign this form as follows. All copies of the application filed with DES must bear the property owner's ORIGINAL signature. If the property owner is not an individual, an individual duly authorized by the property owner shall sign the application.

(1) I hereby affirm that the permittee/applicant has the legal right to occupy and use the property on which the subject facility is or will be located for the purposes specified in this application.

(2) I hereby affirm that I shall grant access to the property for closure and post-closure monitoring of the subject facility and site as required by RSA 149-M and the New Hampshire Solid Waste Rules (Env-Sw 100 - 300 and Env-Sw 400 - 2000), as amended.

Property Owner Name **(Print Clearly or Type)** ____________________

Property Owner Signature ____________________

Date ____________

ATTACHMENT 2

SETTLEMENT AND STABILITY RESPONSE

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January 23, 2024

VIA EMAIL
Charlie Hanna
ReVision Energy

Email: channa@revisionenergy.com

Subject: Response to NHDES letter dated December 15,2023
Regrading Geotechnical – Global Slope Stability
Landfill located at 9 Cross Road, Exeter, New Hampshire
NHDES Application No. 2023-66180, Permit No. DES-SW-SP-1992-001

Dear Charlie,

After review of Application No. 2023-66180 for the proposed 1.50 MW AC solar array to be located at 9 Cross Road in Exeter, New Hampshire, the New Hampshire Department of Environmental Services (NHDES) issued a letter to the Town of Exeter, which provided comments for completion of the aforementioned application. In particular, the NHDES letter included two comments (i.e., 2.B and 2.D) that related to the geotechnical aspects of the proposed solar array. Those comments and Sevee & Maher Engineers, Inc.'s (SME) responses to the comments are provided below. ReVision Energy (ReVision) is the developer of the proposed solar array.

NHDES Comment 2.B

Calculations regarding global stability were not complete. Pursuant to Env-Sw 315.05(c)(5) and Env-Sw 1103.05(h), and to assist NHDES in its review of the requirements in Env-Sw 800, please provide an analysis of global stability for the static and seismic conditions using the total loading of the solar array system. Ensure stability calculations incorporate snow loading.

SME Response to Comment 2.B

Two landfill cross-sections (A-A and B-B) were selected for evaluation of global (i.e., overall) slope stability with respect to installation of the proposed solar array. Figure 1 (figures are attached) shows the locations of the cross-sections relative to the landfill topography and horizontal limits of the waste deposit. Cross-section A-A is representative of a location where seven solar panels will be located on the gradually sloping top area of the landfill, whereas Cross-section B-B is representative of a steeper portion of the landfill top area where four solar panels will be positioned. Cross-sections A-A and B-B are considered to represent the combination of solar panels and ground slope variables the array will be comprised of. Figures 2 and 3 show the geometries of Cross-sections A-A and B-B and the solar panel locations. Slope stability was evaluated at two locations along each of the cross-sections. (1) Slope stability was evaluated for the portion of the cross-sections representing the southern sideslope of the landfill (where no solar panels will be placed, but where the landfill slope angles are the steepest), and (2) for the central portion (i.e., top area) of the landfill (where the solar panels will be placed on the gradually sloping ground surface).

The ground surface for the geometry of Cross-sections A-A and B-B follows the elevation contours shown on Figure 1. Since the landfill was capped with a 3.5-foot-thick soil cover in approximately 1996, the cover is included as the uppermost layer on the cross-sections. The waste deposit beneath the soil cover is principally municipal solid waste (MSW) of unknown thickness. The USDA – Natural Resources Conservation Service soil map for the landfill area shows the landfill to be located in a former sand and gravel borrow pit. The base of the landfill was approximated by projecting the ground surface topography on the southern side of the landfill to the lateral limit of the waste of the northern side of the landfill using a minimal slope angle (to simulate the floor of a borrow pit). Geotechnical properties (i.e., density and shear strength) for the cross-sections are summarized as the inset tables shown on Figures 2 and 3. Attachment 1 includes the basis for those property values. Note that the cover soil density (i.e., Gamma) on the inset tables includes a density increase representation of a 5-foot overlying snow depth. The mathematics supporting the density increase are included in Attachment 1.

To evaluate global slope stability of the landfill due to addition of the solar array, Cross-sections A-A and B-B were subjected to five separate loading conditions.

- Loading Condition #1. Represents the existing conditions at the landfill without any loads from the proposed solar panels. Note that the landfill cover soil density reflects inclusion of a 5-foot depth snow load over the full expanse of the landfill surface.
- Loading Condition #2. Represents the existing conditions at the landfill plus the vertical loads exhibited by the panels once in-place. Attachment 2 provides the solar panel loads as provided by the developer.
- Loading Condition #3. Represents the existing conditions at the landfill plus the worst-case load expected to be associated with constructing the panels (i.e., panel load plus equipment load). Attachment 2 provides the equipment loads used for this condition.
- Loading Condition #4. Represents the vertical loads exhibited by the panels once in-place plus the wind load the panels are designed to resist. Attachment 2 provides the wind loads as provided by the developer.
- Loading Condition #5. Represents the vertical loads exhibited by the panels once in-place plus a 0.2g seismic load. The 0.2g seismic coefficient is representative of the peak horizontal ground acceleration for the Exeter, New Hampshire area, as provided by the United States Geological Survey, that has a 90 percent probability of not being exceeded in 250 years (see Attachment 2). The selected ground acceleration is consistent with the guidance set forth in the RCRA Subtitle D regulations (40 CPR Part 258): Seismic Design Guidance for Municipal Solid Waste Landfill Facilities.

GSLOPE^{TM} slope stability software was used to perform the global slope stability calculations. GSLOPE is software program that calculates Factors of Safety (FoS) for various loading conditions applied to slopes such as those common to landfills using limit equilibrium methods. The following table summarizes the lowest FoS values calculated by GSLOPE for Cross-sections A-A and B-B relative to loading Conditions 1 through 5. Graphic results of the GSLOPE slope stability analyses are presented in Attachment 3.

SUMMARY OF LOWEST CALCULATED FACTORS OF SAFETY FOR GLOBAL SLOPE STABILITY
LANDFILL CROSS-SECTIONS A-A AND B-B
LANDFILL LOCATED AT 9 CROSS ROAD, EXETER, NEW HAMPSHIRE

		Slope Stability Loading Condition				
		#1	#2	#3	#4	#5
		Existing Conditions	Panel Load	Panel Load plus Construction Loads	Panel Load plus Wind Load	Panel Load plus 0.2g Seismic
		GSLOPE File Name				
Section A-A – Panel Area		A-A-PA-C.1	A-A-PA-C.2	A-A-PA-C.3	A-A-PA-C.4	A-A-PA-C.5
	Factor of Safety	19.75	15.80	8.80	15.11	3.62
Section A-A – Southern Sideslope		A-A-SS-C.1	A-A-SS-C.2	A-A-SS-C.3	A-A-SS-C.4	A-A-SS-C.5
	Factor of Safety	2.31	2.31	2.31	2.31	1.24
Section B-B – Panel Area		B-B-PA-C.1	B-B-PA-C.2	B-B-PA-C.3	B-B-PA-C.4	B-B-PA-C.5
	Factor of Safety	9.67	8.38	5.82	7.99	2.98
Section B-B – Southern Sideslope		B-B-SS-C.1	B-B-SS-C.2	B-B-SS-C.3	B-B-SS-C.4	B-B-SS-C.5
	Factor of Safety	2.79	2.79	2.79	2.79	1.58

SME Response on Slope Stability Findings

Typically, the geotechnical community considers static (i.e., no seismic) slope stability FoS values of 1.5 or greater to be acceptable for static loading conditions and FoS values of 1.0 or greater to be acceptable for seismic loading conditions. The FoS values calculated for the panel area portion of the cross-sections is to be expected due to the relatively flat ground surface in those area. The FoS values calculated for the sideslope areas show that the solar panels can be expected to have little to no effect on the stability of the landfill sideslopes. Moreover, the sideslope areas are at distance from the panel areas and owing to the limited thickness of the waste deposit, the loads imparted by the panels are reduced to near zero with respect to increasing the in situ stresses effecting the sideslopes. Evaluation of the FoS values calculated for Cross-sections A-A and B-B relative to loading Conditions #1, #2, #3, #4, and #5 show that the proposed solar panels can be expected to have negligible effect on the overall slope stability of the landfill.

NHDES Comment 2.D

Identify the maximum loading in pounds per square inch (psi) for all low ground pressure equipment that will be used during solar array construction on the landfill cap (off the access road) in accordance with Env-Sw 315.05(c)(5) and ensure the maximum load to be managed by the equipment is accounted for in the calculations.

SME Response to Comment 2.D

Based on correspondence with the solar array developer, track-mounded skid-steer front-end-loaders and wheel-mounted front-end-loaders equipped with forks (rather than a bucket) are expected to be used to construct the solar array. Data sheets representative of each loader type are included in Attachment 2. The equipment loads were included in the slope stability analyses performed for Cross-sections A-A and B-B (see Response to Comment 2.B) as related to loading Condition #3. As can be seen from the calculated FoS values, the construction loads have minimal effect on global slope stability.

If you have any questions, or if SME can be of further assistance, please do not hesitate to contact me.

Sincerely,

SEVEE & MAHER ENGINEERS, INC.

Matthew W. Muzzy, P.E.
Principal/Senior Geo-environmental Engineer

Attachments: Figures 1, 2, and 3
Attachment 1 – Calculations
Attachment 2 – Load Data
Attachment 3 – Graphical Results of GSLOPE Analyses

cc: Nate Niles, ReVision Energy

FIGURES

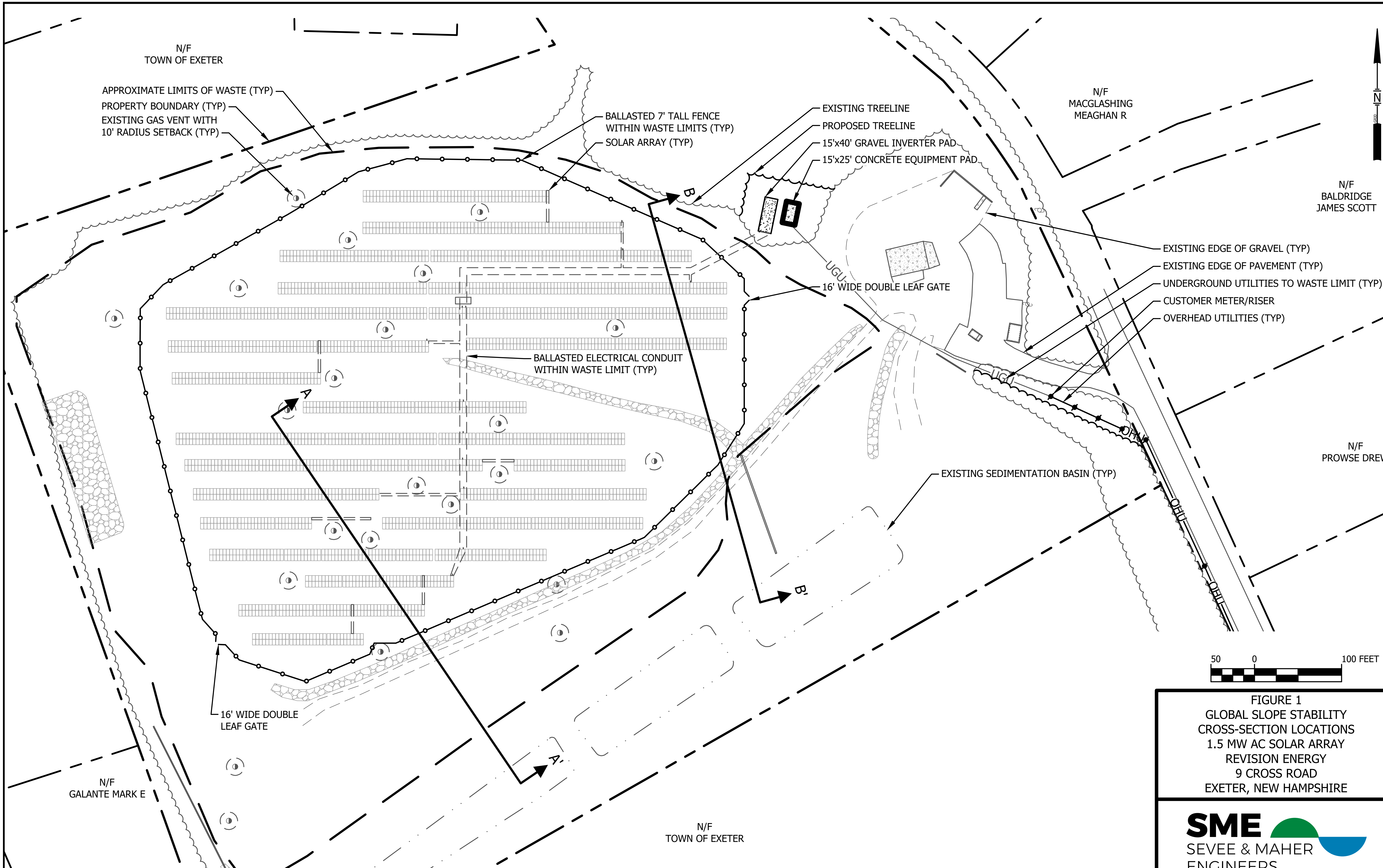

FIGURE 1
GLOBAL SLOPE STABILITY
CROSS-SECTION LOCATIONS
1.5 MW AC SOLAR ARRAY
REVISION ENERGY
9 CROSS ROAD
EXETER, NEW HAMPSHIRE

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DWG: BASE LMN: FIG1-XSEC CTB: SME-STD.CTB REV: 1/19/2024

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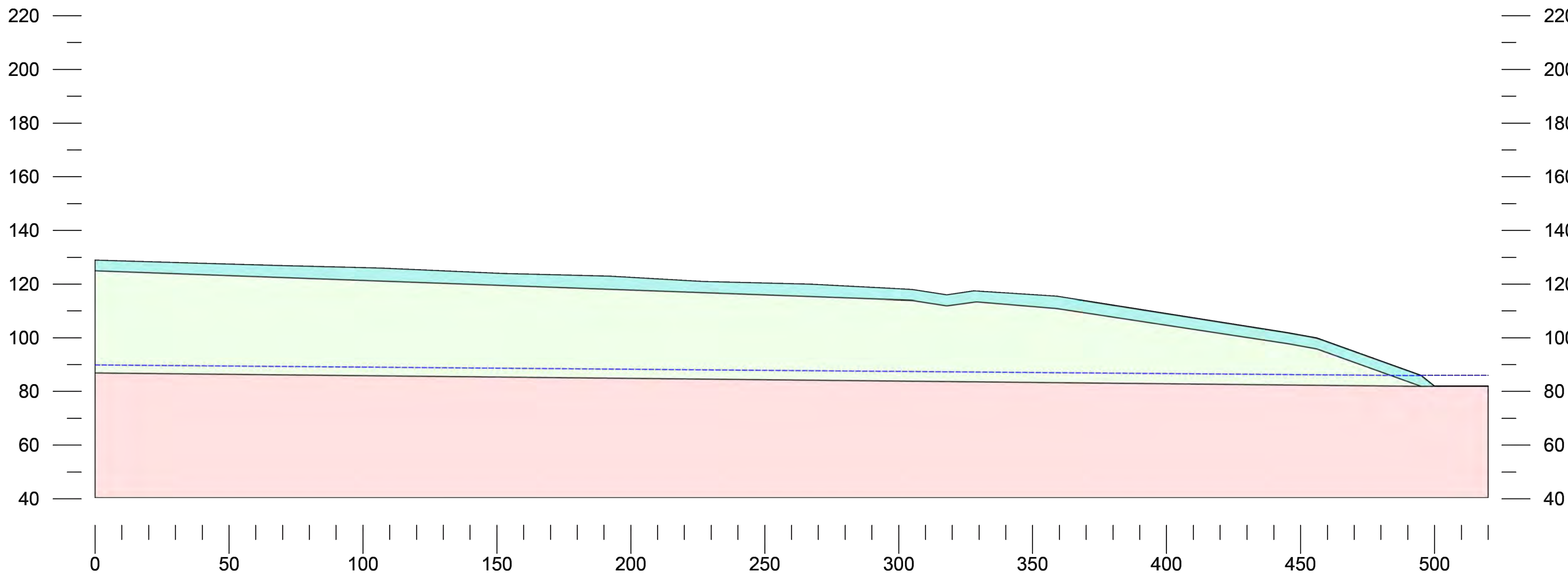

CROSS-SECTION A-A'

NTS

	Gamma pcf	C psf	Phi deg	Piezo Surf.
Cover Soil + Snow	129	0	33	1
Waste Deposit	75	104	36	1
Foundation	120	0	35	1

FIGURE 2
SLOPE STABILITY CROSS-SECTION A-A'
1.5 MW AC SOLAR ARRAY
REVISION ENERGY
9 CROSS ROAD
EXETER, NEW HAMPSHIRE

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DWG: BASE-FIGURES LMN: LMN CTB: SME-STD.CTB REV: 1/19/2024

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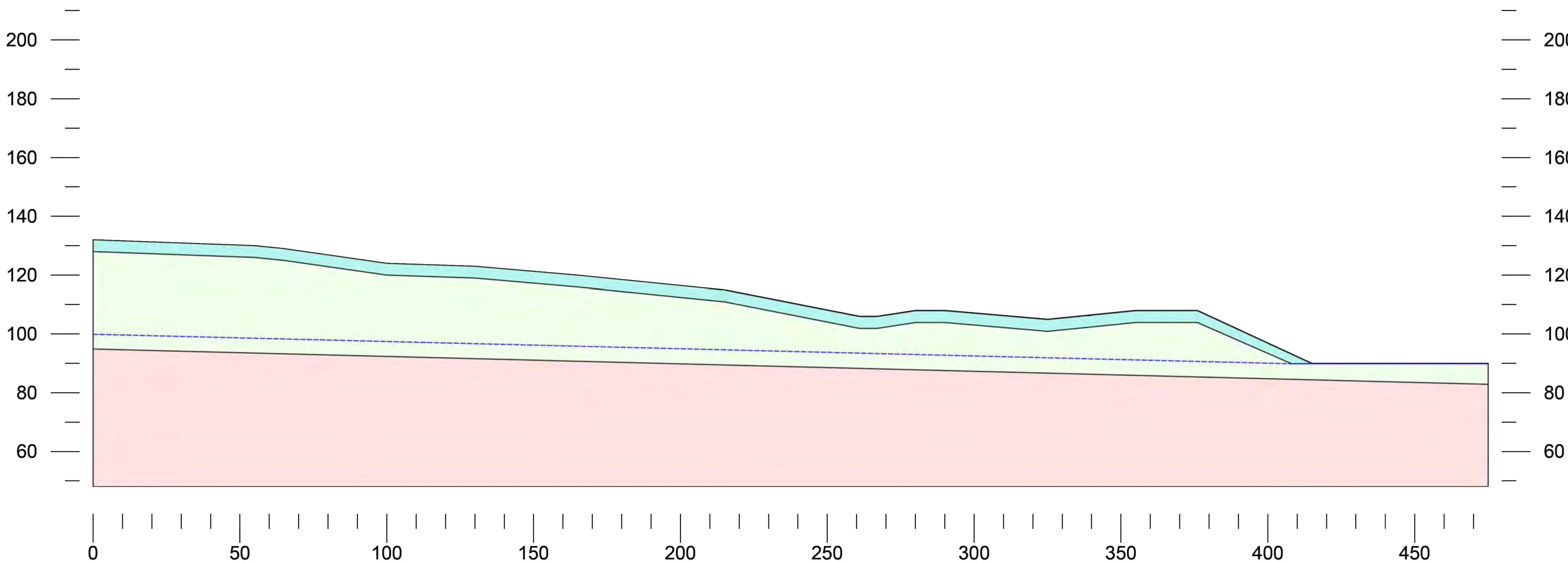

CROSS-SECTION B-B'

NTS

	Gamma pcf	C psf	Phi deg	Piezo Surf.
Cover Soil + Snow	129	0	33	1
Waste Deposit	75	104	36	1
Foundation	120	0	35	1

FIGURE 3
SLOPE STABILITY CROSS-SECTION B-B'
1.5 MW AC SOLAR ARRAY
REVISION ENERGY
9 CROSS ROAD
EXETER, NEW HAMPSHIRE

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ATTACHMENT 1

CALCULATIONS

Exeter
MU339
JAN 2024

Geotech Parameters for Global Stability
Exeter Landfill

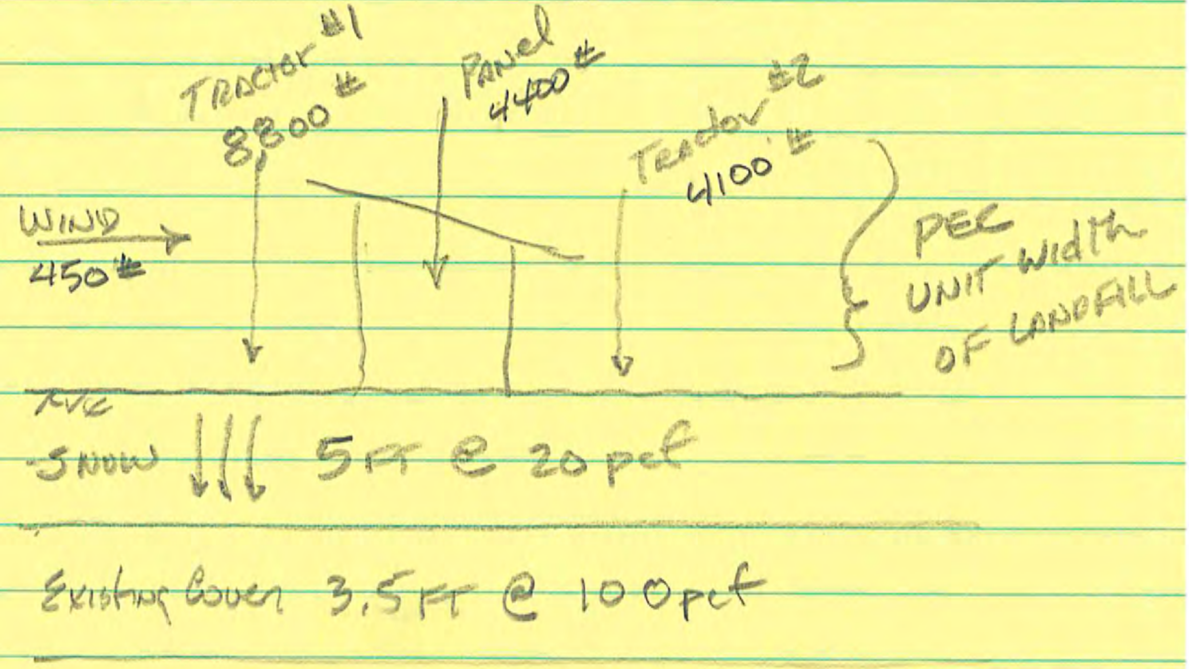
Cover
Thickness = 3.5'
γ = 100 + snow = 129 pcf (see snow calc)
ϕ = 33°
c = 0 psf

Waste Deposit → MSW
Thickness = varies 0 to 40' +/-
γ = 75 pcf
ϕ = 36°
c = 104 psf
} Bray et al, 2009

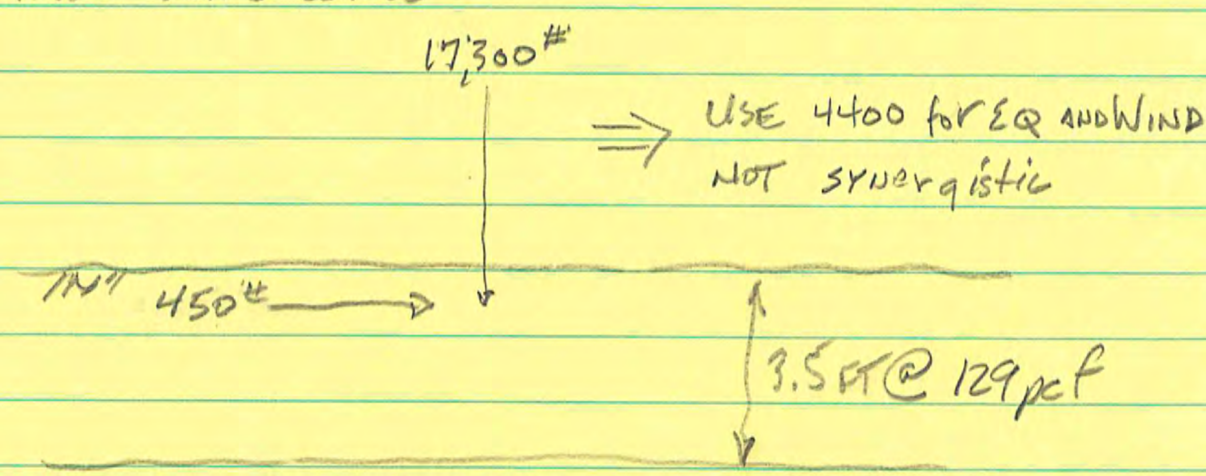
Foundation → Soil Map says old borrow pit
→ sands and gravels
Thickness – unknown – say 25 ± ft
ϕ = 35° in place sand & gravel
c = 0 psf

For slope stability cross-sections
assume base of Waste Deposit near
flat to account for previous Borrow Activity

LOADINGS FOR GLOBAL STABILITY CALC



Convert to POINT LOAD for each panel location → ASSUME TRACTORS, WIND, AND SNOW full time static LOADS



For global stabity for SIESMIC USE ONY PANEL LOAD AS other LOADS are TRANSIENT
USE 0.2g horiz

2/6

VERTICAL LOAD DUE to panel & foundation
USE MFG (i.e. APA) LOADS to estimate SINGLE point LOAD to LAND VIA POST(s) supporting panel

APA SAYS Post LOAD = 1461#
TO POSTS CAN IMPACT LOAD to slope stability cross section ∴ SO
EQUIV POST LOAD = 1461 × 2 = 2922#

Foundation basket = 84in × 24in × 22in (L × W × D)
Vol = 25.7 CF
γ rock FILL = 115
∴ Basket WT = 2955#
→ WHICH goes TO $2955 \times \frac{12}{24} = 1477\#$ / unit width

∴ static vert LOAD from panel
= 2922 + 1477
= 4399 POINT LOAD
SAY 4400#

Fork Tractor Load for global stability

Treat as point load

Tractor wt = 12100 #

Max lift = 5500 #

17,600 #

17,000 ÷ 4 = 4,400 #/wheel

Since stability eval is 2-dimensiona only two wheels on X-section at one time

Point load = 8,800 #

Skid Steer Loader for global stability

Treat as point load

ground pressure = 4.8psi

track length = 67.6in

track width = 17.7 in

Equiv Point Load from full track = 5743 #/track

Since slope stab is 2-dimension reduce track load to a unit width

$$5743\# \times \frac{12''}{17''} = 4054\#$$ Point load for one track

Say 4100 #

SNOW LOAD FOR GLOBAL STABILITY

γ_{SNOW} ~ 20 pcf
Worse case(?) depth = 5 FEET
Adds 100 psf to cover → σ_{SNOW}
rather than add specific Layer to
STABILITY ANALYSIS increse γ of
cover soil.

Cover soil is 3.5 FT Thick
Cover soil γ is 100 pcf
σ cover soil = 350 psF
ADD σ_{SNOW} = 100 psf
∴ Cover Load = 450 psf

Convert to equivalent density

$$450\,psf / 3.5\,ft = \gamma_{Eq} = 129\,pcf$$

Wind Load for Global Stability

APA says wind load is 61# per foot of panel width

posts typically support panel width = 88 inches ÷ 12 = 7.3 FT

∴ Wind load = 7.3 FT × 61#/FT = 447#

say 450#.

For simplicity apply full wind load all to one post

Shear Strength of Municipal Solid Waste

Article *in* Journal of Geotechnical and Geoenvironmental Engineering · June 2009

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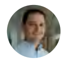

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Shear Strength of Municipal Solid Waste

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Abstract: A comprehensive large-scale laboratory testing program using direct shear (DS), triaxial (TX), and simple shear tests was performed on municipal solid waste (MSW) retrieved from a landfill in the San Francisco Bay area to develop insights about and a framework for interpretation of the shear strength of MSW. Stability analyses of MSW landfills require characterization of the shear strength of MSW. Although MSW is variable and a difficult material to test, its shear strength can be evaluated rationally to develop reasonable estimates. The effects of waste composition, fibrous particle orientation, confining stress, rate of loading, stress path, stress-strain compatibility, and unit weight on the shear strength of MSW were evaluated in the testing program described herein. The results of this testing program indicate that the DS test is appropriate to evaluate the shear strength of MSW along its weakest orientation (i.e., on a plane parallel to the preferred orientation of the larger fibrous particles within MSW). These laboratory results and the results of more than 100 large-scale laboratory tests from other studies indicate that the DS static shear strength of MSW is best characterized by a cohesion of 15 kPa and a friction angle of 36° at normal stress of 1 atm with the friction angle decreasing by 5° for every log cycle increase in normal stress. Other shearing modes that engage the fibrous materials within MSW (e.g., TX) produce higher friction angles. The dynamic shear strength of MSW can be estimated conservatively to be 20% greater than its static strength. These recommendations are based on tests of MSW with a moisture content below its field capacity; therefore, cyclic degradation due to pore pressure generation has not been considered in its development.

DOI: 10.1061/(ASCE)GT.1943-5606.0000063

CE Database subject headings: Dynamic properties; Municipal wastes; Solid wastes; Landfills; Shear strength; Stress strain relations; Laboratory tests.

Introduction

Static and seismic stability analyses of municipal solid waste (MSW) landfills require appropriate characterization of the shear strength of MSW. Landfill stability analyses can be no more reliable than the reliability of the engineer's estimate of the shear strength of the waste. Because modern municipal solid waste (MSW) landfills are built with multilayer liner systems that contain materials and interfaces with varied stress-strain responses, including some that may exhibit postpeak drops in shear strength, the stress-strain response of MSW may also need to be considered to provide mobilized shear strength values that are compatible with the level of deformation anticipated along potential failure surfaces.

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Note. This manuscript was submitted on May 28, 2008; approved on October 2, 2008; published online on May 15, 2009. Discussion period open until November 1, 2009; separate discussions must be submitted for individual papers. This paper is part of the ***Journal of Geotechnical and Geoenvironmental Engineering***, Vol. 135, No. 6, June 1, 2009. ©ASCE, ISSN 1090-0241/2009/6-709–722/$25.00.

There is considerable uncertainty associated with the MSW shear strength values currently employed in practice. Obstacles to evaluating the shear strength of MSW include its heterogeneity and the difficulty in recovering and testing representative waste samples due to the large size of some waste constituents. In this paper, relevant studies of MSW shear strength are briefly reviewed, and then the results from a comprehensive testing program on reconstituted specimens of waste sampled at a landfill in northern California are summarized. These data, which include large-scale direct shear (DS), triaxial (TX), and simple shear (SS) test results as well as large-scale testing data of waste from numerous landfills worldwide and back-analyses of failed landfill slopes in the field, are then interpreted to provide both recommendations for assessing the shear strength of MSW on a project-specific basis and a new generic shear strength characterization for MSW for use in design when project-specific data are not available.

Insights from Previous Studies

A comprehensive discussion of previous studies of the shear strength of MSW is presented in Zekkos (2005). These previous studies of MSW shear strength indicate:

- The Mohr-Coulomb strength criterion is typically used to characterize the shear strength of waste (e.g., Landva and Clark 1990). These characterizations indicate that MSW shear strength is primarily stress dependent (i.e., frictional), particularly at higher confining stresses, but that it also has significant strength at low confining stresses (i.e., cohesive strength). The shear strength at low confining stress appears to result primarily from the fibrous constituents of the waste.

- The equivalent (secant) friction angle of the MSW Mohr-Coulomb failure envelope appears to decrease as the normal stress increases (Pelkey et al. 2001).
- The shear strength used to characterize MSW may depend on the testing conditions (i.e., stress state, stress path, and strain path), specimen preparation, and the strength criterion used. Typical direct shear test results on both reconstituted specimens and on intact specimens tested in situ at low normal stress suggest a cohesion (c) of between 0 and 50 kPa and a friction angle (ϕ) of between 27 and 41°, with a majority of investigators suggesting $\phi \cong 33°$ (Landva and Clark 1990; Richardson and Reynolds 1991; Houston et al. 1995; Withiam et al. 1995; Kavazanjian et al. 1999; Mazzucato et al. 1999; Pelkey et al. 2001). MSW shear strength interpretation from triaxial tests is complicated by the need to use strain level-based definitions of shear strength due to the lack of a well defined peak strength and a continued increase in mobilized strength at large strains. MSW shear strength in triaxial compression has been defined in the literature as the mobilized shear stress at 5–25% axial strain. Friction angles as high as 45–53° have been reported at high strain levels (Jessberger and Kockel 1995; Grisolia et al. 1995). However, when strength is evaluated at lower strain levels typically considered appropriate for field characterization of shear strength (e.g., 5–10%), triaxial strength values tend to be lower than those from direct shear tests (Vilar and Carvalho 2002) or back-analysis of waste slopes (Kavazanjian et al. 1995; Eid et al. 2000).
- Simple shear tests on MSW are limited. In interpreting this test, an assumption of the orientation of the failure surface or of the value of the horizontal normal stress is required. Assuming the failure plane to be horizontal and interpreting the simple shear test as a direct shear test results in the lowest possible strength estimate, whereas assuming the normal stress on the vertical plane to be the K_o stress or that the normal stress on the vertical plane is the mean normal stress results in a significantly higher strength estimate. Using $K_o = 0.6$, Kavazanjian et al. (1999) estimated a lower bound shear strength envelope of $c = 16$ kPa and $\phi = 33°$ and an upper bound envelope of $c = 30$ kPa and $\phi = 59°$ from simple shear tests on reconstituted MSW. However, using the assumption of a horizontal failure plane, Kavazanjian et al. (1999) and Pelkey et al. (2001) found that the shear strength interpreted from large-scale simple shear tests was similar to the value interpreted from large-scale direct shear tests.
- Specimens with higher fiber content appear to be stronger than specimens with lower fiber content. Kavazanjian et al. (1999) observed that large direct shear specimens with lower fiber content were slightly weaker than specimens with more fiber content. Towhata et al. (2004) observed that triaxial specimens that included plastic inclusions sustained higher stresses at large strain than specimens without plastic inclusions.
- Testing to date has not indicated that the strength of MSW varies significantly due to reasonable variations in its unit weight (Kavazanjian et al. 1999; Vilar and Carvalho 2002).
- "Undisturbed" and reconstituted large-scale direct shear tests on MSW performed by Mazzucato et al. (1999) indicate similar shear strengths; however, only the "undisturbed" specimens exhibited a defined peak strength followed by a postpeak strength reduction.
- The shear strength estimated from stable and failed waste slopes is similar to that estimated from direct shear tests (Kavazanjian et al. 1995; Eid et al. 2000).

Some key observations that may be drawn from these studies on the shear strength of MSW are:

- There is great variability in the reported shear strengths in the literature. Cohesion values from 0 to 80 kPa and friction angles from 0–60° have been reported. In design, the static strength of MSW is often assumed to be that recommended by Kavazanjian et al. (1995) (i.e., $c = 24$ kPa and $\phi = 0°$ for normal stresses less than 37 kPa, and $c = 0$ kPa and $\phi = 33°$ for larger normal stresses) or by Eid et al. (2000) (i.e., a mean value of $c = 25$ kPa and $\phi = 35°$). The dynamic strength of MSW is typically assumed to be at least equal to and occasionally greater than its static strength. Augello et al. (1998) suggest that $\phi \cong 35-38°$ is a reasonable value for the strength of MSW subject to seismic loading.
- Specimen preparation and testing procedures are often not reported. Furthermore, there are significant differences among the specimen preparation and testing procedures that are reported.
- The stress-deformation response of MSW observed in different testing devices is remarkably different. In DS testing, the stress-displacement response is typically observed to be convex shaped (i.e., roughly hyperbolic), may approach an asymptotic value at large deformation, and sometimes includes a postpeak reduction in strength. In TX testing, MSW stress-strain response is often initially convex shaped, then almost linear, and finally becomes concave shaped (i.e. exhibits an increasing upward curvature) without any sign of reaching an asymptotic value, let alone a well-defined peak shear stress.
- The effects of waste degradation on MSW shear strength have not been addressed to any significant extent. Based on limited testing, it has been suggested that degradation will lower the strength of MSW. For example, triaxial test data presented by Turczynski (1988) indicate that the friction angle of MSW reduced from about 39° for fresh waste to 35°, to 32°, and finally to 26°, for 3 yr, 5 yr, and 15 yr old waste, respectively. The cohesion intercept interpreted from these tests also reduced systematically as the age of the waste increased. However, these trends are not observed in all the laboratory data. The problem is compounded by the fact that there has been no quantification of the level of degradation within waste. Although age is an important parameter, other factors, such as the waste composition, climate, moisture content, and landfill operational procedures are likely to contribute significantly to the rate of waste degradation.

Based upon these observations, there are still many uncertainties associated with the shear strength of MSW. Key issues associated with the shear strength of MSW include:

- The influence of specimen preparation procedures on the shear strength measured in laboratory tests;
- The influence of stress state on stress-strain behavior and shear strength (e.g., the discrepancy in the stress-strain-strength response of MSW between the DS and TX testing);
- The influence of dynamic loading;
- The influence of degradation; and
- The relationship of the shear strength measured in laboratory tests to field values of MSW shear strength.

A comprehensive multi-institution testing program was developed to address some of these issues and to develop revised recommendations for the shear strength of MSW for use in landfill stability analyses.

Laboratory Testing Program

General

Waste samples collected at the Tri-Cities landfill were reconstituted and subjected to monotonic loading in three different large-scale testing devices: (1) a 300 mm by 300 mm DS box ($H = 180$ mm) at the University of Patras (UP) in Greece; (2) a 300 mm diam TX device ($H = 600 - 630$ mm) at the University of California at Berkeley (UCB); and (3) a 400 mm by 300 mm SS device ($H = 150$ mm) at Arizona State University (ASU). A total of 23 DS, 27 TX, and 3 SS large-scale monotonic loading tests were performed. Additional testing was performed in a 71 mm diam conventional TX device at UCB. The goal of this testing program was to evaluate factors influencing shear strength of MSW, including stress and strain path, waste composition, waste fiber orientation, unit weight, and loading rate.

Laboratory Test Devices

The large DS test equipment used in this study is a Wykeham Farrance model WF25505 device at UP that is described in Zekkos (2005). It can apply a shear force of up to 100 kN after applying a vertical load up to 100 kN. The bottom half of the split shear box can be displaced horizontally at a controlled rate between 0.00001 and 5 mm/min, and the shear resistance of the upper half of the DS box is measured with a proving ring. LVDTs measure horizontal and vertical movement during the test.

The large-scale TX tests were conducted in a floor-based device at UCB that was originally developed by Seed et al. (1984) and can test specimens at high confining stresses and to large strains (Zekkos 2005). End platens were lubricated for some of the tests to evaluate potential boundary effects during testing, which were found to be negligible. Strength testing commenced generally 1 h after the application of the final confining stress. TX specimens were initially isotropically loaded under a vacuum of 75 kPa for at least 24 h to minimize variations due to time under confinement effects. Strain-controlled loading was used in the TX tests.

The large scale SS device at ASU was originally developed for solid waste testing at the Operating Industries, Inc. (OII) landfill (Matasovic and Kavazanjian 1998; Kavazanjian et al. 1999). To enforce the simple shear zero lateral strain boundary condition, 12 mm thick teflon-coated stacked steel plates, each with a 400 mm by 300 mm rectangular opening, were employed. Test specimens were typically on the order of 150 mm high after reconstitution. Vertical normal stresses of up to 1,500 kPa can be applied through a top cap that is fixed against translation, and horizontal shear stresses of up to 750 kPa can be applied to the base of the specimen. Vertical deformations were measured using LVDTs at two points on the top cap to check for tilting. Lateral deformations were measured using LVDTs at the bottom and mid-height of the stacked rings to check for shear strain uniformity. Either stress-controlled or strain-controlled shear loading and either constant normal stress or constant specimen height (constant volume) testing can be performed. Shear strain rates can be varied from 0.0005%/min to 0.1%/min.

Waste Materials Tested

Two large diam (760 mm) borings were augered to depths of 10 and 32 m using a bucket auger at the Tri-Cities landfill in Fremont, California. Relatively new and 15^{+} year old waste materials were retrieved and stored separately in sealed drums. Excessive grinding of the waste particles was not observed, so the collected waste materials were considered to be unprocessed. The in situ unit weight of waste, measured using a gravel replacement procedure originally developed for the field investigation at the OII landfill (Matasovic and Kavazanjian, 1998) and described in Zekkos et al. (2006), ranged from 10 kN/m^3 near the surface to 16 kN/m^3 at depth. The recovered waste samples were divided into general classes, and strength testing was performed on samples of Class A "deep old waste" and on Class C "shallow fresh waste." According to landfill records, Class A waste was placed in the late 1980s, and Class C waste was placed after 1999. The general composition of the three waste samples tested in this study is described in Table 1.

Table 1. Characteristics of Tested MSW Sample Groups

	A3	C6	C3
Borehole	BH-2	BH-1	BH-2
Depth, m	25.6–26.2	7.6–9.6	3.5–4.5
% by weight $<$20 mm material	59	72	64
% by weight of paper	12	11	11
% by weight of wood	11	3	9
% by weight of soft plastics	2	3	3
% by weight of gravel	10	6	5
% by weight of others	6	5	8
% moisture content[a]	12	13	23
% organic[a]	13–23	11–13	17–27
Age (years)	15	$<$1	2

[a]Information for the smaller than 20 mm material.

Waste material was visually characterized and then screened to partition it into material larger and smaller than 20 mm. The waste material smaller than 20 mm was referred to as "soil-like" material and was composed primarily of daily soil cover, other soil materials disposed of in the landfill, degraded waste, and fine waste inclusions. The material larger than 20 mm generally consisted of "waste products," mostly paper, wood, and soft plastics. Some gravel particles were also larger than 20 mm. Other constituents such as metals, stiff plastics, textiles, and glass, comprised volumetrically a significantly lower percentage of the larger than 20 mm material. This larger than 20 mm material was broadly characterized as fibrous waste. At the Tri-Cities landfill, about 50–75% of the total waste sample by weight was smaller than 20 mm. The moisture content and organic content of the waste material smaller and larger than 20 mm were measured. Moisture content of the smaller than 20 mm material is defined as the ratio of the weight loss to the weight that remained after heating at a temperature of 55°C until the specimen has dried to a constant mass. Organic content of the smaller than 20 mm material is defined as the ratio of the weight loss to the initial specimen weight after heating from a temperature of 105°C to a temperature of 440°C. Additional details on the field investigation, waste characterization, and MSW test sample groups are presented in Zekkos (2005).

Strength testing was performed on waste test specimens that were prepared with varying fractions of soil-like (less than 20 mm) and fibrous (larger than 20 mm) waste materials to investigate the effects of waste composition on shear strength. Specimens were prepared with 100%, 62–76%, and 8–25% of the material smaller than 20 mm by weight. Specimens were reconstituted in layers using a 100 N weight that was dropped repeatedly from a constant height to achieve a target unit weight or a

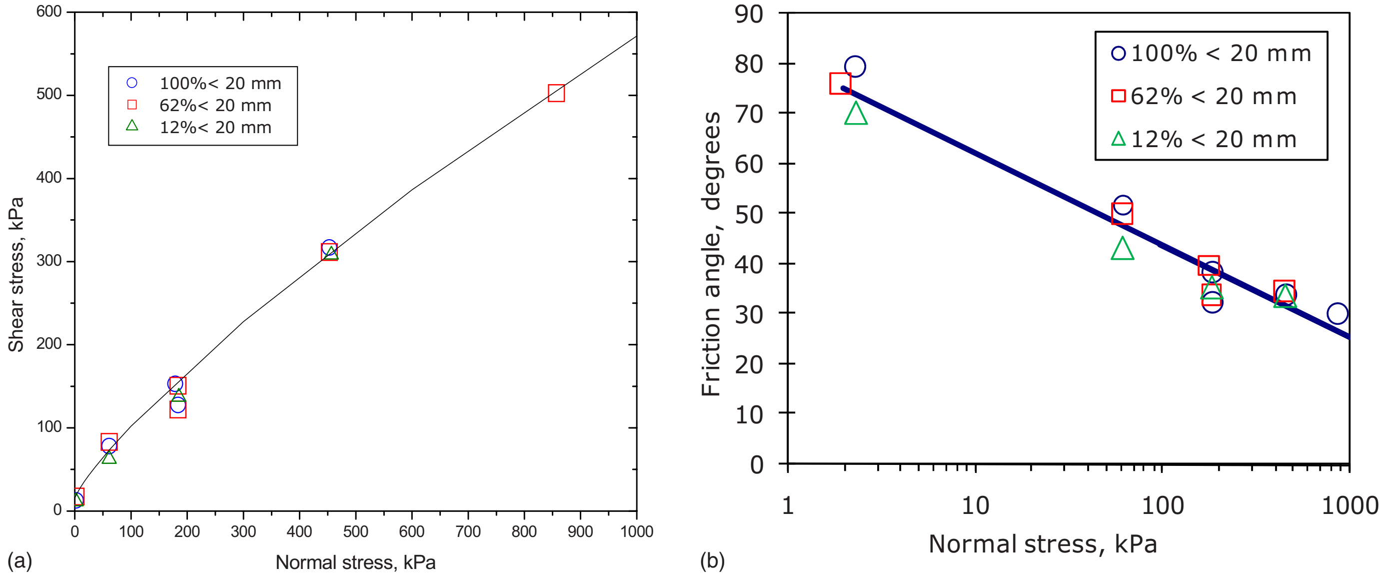


Fig. 1. Direct shear strength of Tri-Cities landfill MSW: (a) curved strength envelope for samples with varying waste composition; (b) decrease in secant friction angle with increasing normal stress assuming $c=5$ kPa

target compaction energy at the in situ water content of the material (Zekkos 2005). Unit weights of the compacted specimens ranged from 7 to 16 kN/m^3, and compaction water contents were between 8 and 25%. Loose lift thicknesses were on the order of 25 to 80 mm and the top of each lift was scarified before placing the next lift. During compaction, it was observed that the long axis of the larger, fibrous particles generally became oriented in the horizontal plane mimicking the waste structure typically observed in the field (Matasovic and Kavazanjian 1998).

For the tests conducted in the devices with a maximum dimension of 300 mm (i.e., DS and TX tests), bulky waste products (e.g., wood, glass, and gravel) were screened to a maximum particle size of about 40 mm, whereas the paper and plastic constituents that are more flexible were screened to a maximum allowable particle size of about 80 mm. For the larger 400 mm maximum dimension SS device, the maximum allowed sizes of bulky waste products and pliable, elongated waste products were 50 and 100 mm, respectively. It is generally accepted that soil particles no larger than one-sixth of the diameter of the test specimen can be included without biasing the results (e.g., ASTM test procedure D4767). Hence, this criterion was used for the bulky waste products. However, the maximum dimension of pliable, elongated waste products such as plastic and paper were allowed to exceed this criterion, because these particles had high aspect ratios, folded easily, and were flexible. The fibrous particles used in this testing program were considered to be of sufficient dimension to represent the effect of the fibrous material on in situ waste mass behavior, because once particles become significantly larger than those in the waste matrix, especially if it is fibrous, their actual size should not be critical (Gray and Ohashi 1983).

Direct Shear Test Results

Waste Composition Effects and Confining Stress Effects

Direct shear tests were performed on MSW specimens from the A3 sample group that included 100, 62, and 12% smaller than 20 mm constituents over a large range of normal stresses. The initial series of DS tests that were performed on waste specimens prepared with the long axis of the fibrous particles generally oriented horizontally resulted in generally similar shear strengths for waste that contained 100, 62, and 12% material that is smaller than 20 mm. As shown in Fig. 1(a), the fibrous (larger than 20 mm) material did not appear to contribute significantly to the waste shearing resistance in this initial test series. The secant friction angle was found to decrease with increasing confining stress [Fig. 1(b)].

Fibrous Particle Orientation Effects

In the next DS test series, specimens were prepared with identical waste compositions and compaction procedures as the first test series but were prepared in a specially designed mold that allowed each test specimen to be rotated up to 90° before placing it in the DS device. This special mold allowed the preferred orientation of the long axis of the fibrous material to be oriented perpendicular to the horizontal shear surface imposed by the direct shear box.

Representative results from two test specimens with identical compositions (62% smaller than 20 mm material) that were tested at approximately the same unit weight at low confining stress but with different orientations of the fibrous material with respect to the shear plane are presented in Fig. 2. In the tests shown in Fig. 2, the long axes of the fibers are oriented horizontally (i.e., parallel to the shear surface) in specimen UP-10, whereas the long axes of the fibers are oriented perpendicular to the horizontal shear surface in specimen UP-15. The stress-displacement responses of the two specimens shown in Fig. 2 differ significantly. Specimen UP-15 (long particle axes generally perpendicular to the shear plane) exhibits initially a softer response followed by an upward curvature of the stress-displacement curve. Specimen UP-10 (long particle axes generally parallel to the shear plane) exhibits a hyperbolic-shaped stress-displacement response. At a horizontal displacement of 55 mm, the mobilized shear stress of specimen UP-15 is twice that of specimen UP-10, which has hori-

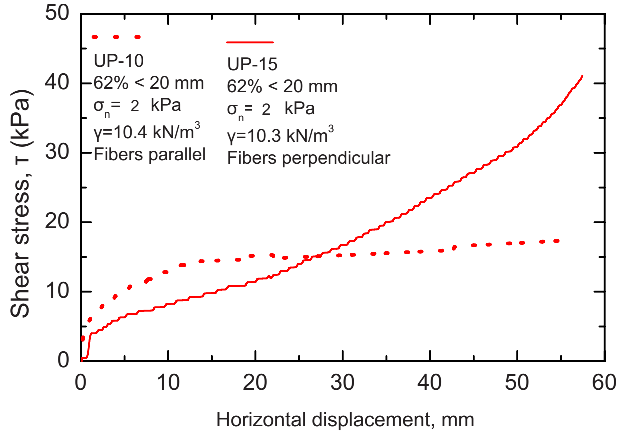


Fig. 2. Comparison of the responses of MSW in direct shear testing for specimens where fibers are oriented parallel or perpendicular to the horizontal shear surface

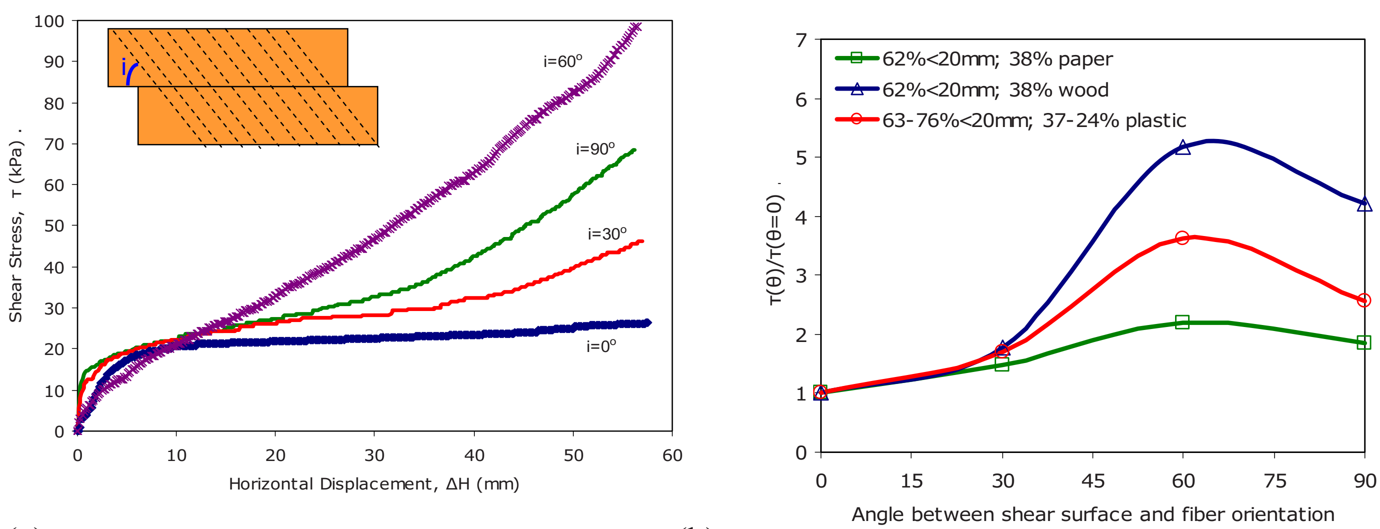
zontally oriented fibers. As the applied normal stress increases, the difference in the observed responses decreases.

To explore the influence of fiber orientation further, additional DS tests were performed on waste specimens from Greece. Specimens were prepared with similar percentages of plastic, paper, or wood fibrous reinforcement with these fibrous reinforcement elements intentionally oriented at a specified angle to the shear plane. Angles of 0, 30, 60 and 90 deg to the horizontal were employed in the testing program (Athanasopoulos et al. 2008). The results for the tests with plastic reinforcement performed with a normal stress of 50 kPa are shown in Fig. 3(a). They indicate that the fibrously reinforced specimen response is highly anisotropic, depending greatly on fiber orientation. The highest mobilized shear stress is observed at a fiber orientation angle of 60°. Lower values of mobilized shear stress are observed for fiber orientation angles of 90, 30, and 0°. The peak shear stress in DS is approximately three to four times greater when the plastic fibers in the specimen were oriented at 60° as opposed to when they are oriented at 0°. Furthermore, the specimen with a fiber orientation angle of 0° (i.e., when the reinforcing layers are parallel to the horizontal failure surface) is the only specimen that does not exhibit an upward curvature in its stress-displacement response.

The stiffness of the fibrous reinforcement elements was also found to be an important factor in the DS response of the compacted waste specimens. As shown in Fig. 3(b), MSW specimens containing wooden reinforcement had a significantly higher mobilized shear stress at a fiber orientation angle of 60° than that observed for specimens containing plastic or paper fibers. Fig. 3(b) shows that the wood fibers, which are significantly stiffer than plastic or paper fibers, result in a stiffer stress-displacement response compared to paper or plastic fibers. In testing of reinforced sand specimens, Shewbridge and Sitar (1989) observed a similar trend of increasing strength with increasing reinforcement stiffness. For all specimens tested in the DS testing program, regardless of reinforcement stiffness, the largest contribution of the fibers to mobilized shear stress was observed for specimens with a fiber orientation angle of approximately 60 deg to the shear plane. This observation is also similar to the trend observed in reinforced soils (Gray and Ohashi 1983; Jewell and Wroth 1987; Michalowski and Cermak 2002).

Unit Weight Effects

Several DS test specimens were prepared at significantly different unit weights and then loaded to a normal stress of 150 kPa before testing. As a result of the application of the normal stress, unit weight values converged before shearing. For example, A3 waste material (with 62% material smaller than 20 mm) that was compacted initially to a unit weight of 8.5 kN/m^3 increased to 10.2 kN/m^3, but when compacted initially to 11.4 kN/m^3 it increased to only 12.2 kN/m^3 under the 150 kPa normal load. Despite the convergence in unit weight, the mobilized shear strength differed noticeably for these two tests, as shown in Fig. 4. Several similar pairs of tests were conducted to investigate the effects of variation in unit weight on mobilized strength in the DS test program. In these tests, the mobilized strength of the waste differed by up to 25% for unit weight differences of 5 to 20% (with higher



(a) (b)

Fig. 3. (a) Stress-displacement response for MSW specimens with plastic reinforcement oriented at different angles at a normal stress of 50 kPa; (b) effects of fiber orientation angle and materials for all specimens at a normal stress of 50 kPa

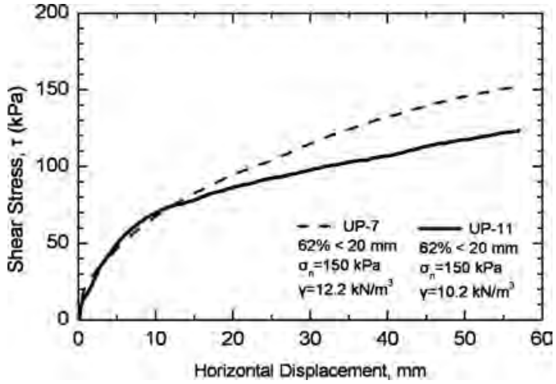


Fig. 4. Effect of unit weight on the DS strength of specimens with 62% material smaller than 20 mm by weight at a normal stress of 150 kPa

unit weight resulting in higher strength). Hence, unit weight was found to be a potentially important factor in estimating the shear strength of waste.

Rate of Loading Effects

Staged loading DS tests were performed to evaluate loading rate effects on the shear strength of MSW. The displacement rate was varied between 0.1 mm/min and 5 mm/min during the same test to eliminate scatter due to specimen variability. Representative results are shown in Fig. 5 for a specimen with 62% smaller than 20 mm material and fibers oriented parallel to the horizontal shear surface. The stress-displacement rate response illustrated in Fig. 5 suggests that as the loading rate increases, the mobilized shear stress in the waste increases. Similar results were observed for a test specimen with 12% smaller than 20 mm material with horizontally oriented waste fibers. Another test specimen with 12% smaller than 20 mm material that had vertically oriented fibers (i.e., fibers oriented perpendicular and across the shearing surface) yielded even more pronounced loading rate effects. The

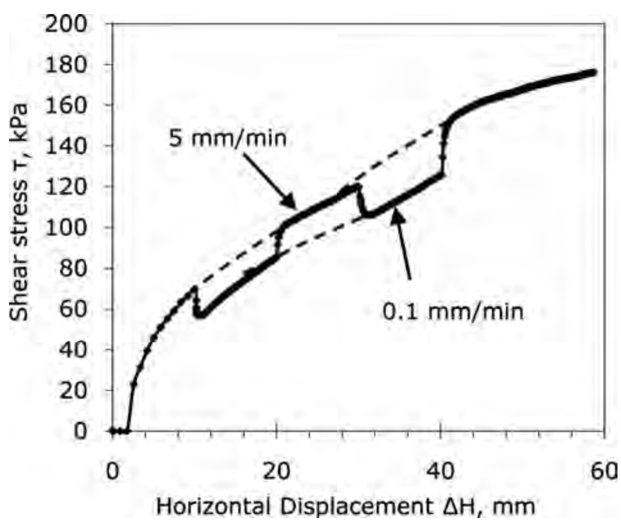


Fig. 5. Response of MSW with 62% less than 20 mm material in direct shear testing loaded at two displacement rates

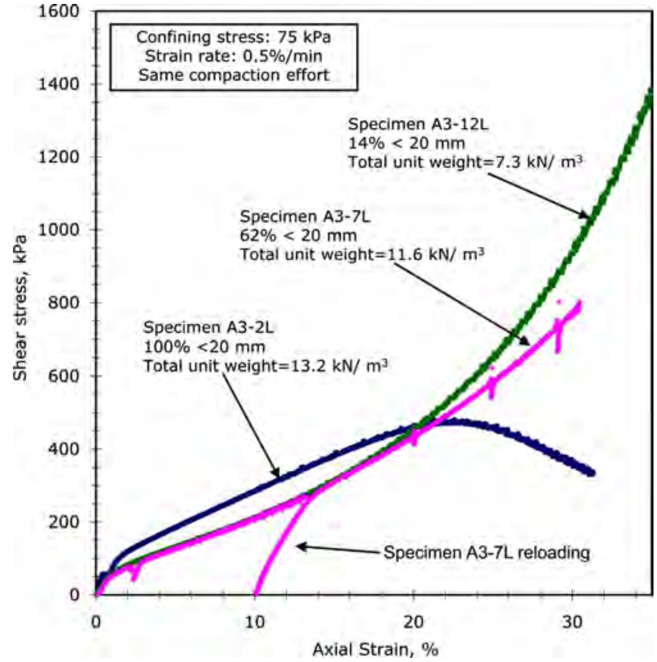


Fig. 6. Responses of MSW in monotonic triaxial compression testing for specimens with varying waste compositions

mobilized shear strength increased by 10–15% for a log-cycle increase in the displacement rate during the series of DS tests with vertically oriented fibers.

Triaxial Test Results

Waste Composition Effects

Triaxial compression (TXC) test specimens were prepared in the same manner as the direct shear test specimens (i.e., with different percentages of fibrous waste particles to evaluate the effects of waste composition on waste stress strain and strength response). Representative results are shown in Fig. 6 for three specimens that were prepared with the same compaction effort, subjected to an isotropic confining stress of 75 kPa, and sheared at an axial strain rate of 0.5%/min. Although the same compaction effort was applied to each specimen, their unit weights differed due to their different compositions. Specimen A3-2L included 100% smaller than 20 mm material and had a unit weight of 13.2 kN/m^3 prior to shearing. Specimen A3-7L included 62% smaller than 20 mm material and had a unit weight of 11.6 kN/m^3 prior to shearing. Specimen A3-12L, included 14% smaller than 20 mm material and had a unit weight of 7.3 kN/m^3 prior to shearing.

Specimen A3-2L, which contained 100% particles smaller than 20 mm, reaches a peak shear stress at an axial strain of about 22% and then exhibits a postpeak reduction in shear resistance. When fibrous (i.e., larger than 20 mm) material is included in the specimen (e.g., specimen A3-7L with 62% smaller than 20 mm), the specimen exhibits initially a softer response than the specimen with no fibrous material but exhibits an increasing upward curvature at strains greater than 5% without reaching a peak shear stress. Specimen A3-12L, which includes 14% smaller than 20 mm material by weight, has an even more pronounced upward curvature in its stress-strain response at strains greater than 15% compared to the specimen with 62% smaller than 20 mm material. The upward curvature of the stress-strain curve in isotropically consolidated triaxial testing has also been reported by several previous researchers (e.g., Jessberger and Kockel 1993; Grisolia et al. 1995).

Stress-Strain Compatibility

With one exception, only the TXC specimens that included 100% smaller than 20 mm particles exhibited a peak shear stress in this study. The one exception was specimen C6-8L, which included 62% smaller than 20 mm material. Specimen C6-8L was compacted with higher energy input and had a unit weight upon compaction greater than that of other specimens with the same composition. Specimen C6-8L exhibited the upward curvature response characteristic of the other specimens prepared with larger than 20 mm particles but reached a peak shear stress at an axial strain of about 40% and then exhibited a postpeak reduction in mobilized stress. Hence, it may be that all of the test specimens, even those that exhibit the unusual upward curvature in their stress-strain response, would have eventually reached a peak strength followed by a postpeak drop in strength if the tests were run out to large enough strains. The level of strain required to reach peak strength, however, is apparently very large for specimens with fibrous particles, at least for the range of confining pressures and unit weights investigated in this study.

Because of the continued increase in the mobilized shear stress at strains generally considered to be in the range of engineering interest (e.g., axial strains of less than 20% in triaxial tests), shear strength envelopes based upon the mobilized shear stress at a specified level of strain are often employed to characterize MSW shear strength from TXC tests (e.g., Manassero et al. 1997). Most commonly 5 or 10% axial strain from an isotropic stress condition has been used to develop MSW strength parameters from TXC test results (although axial strains of 15 and 20% have also been used). As the initial condition for waste in the field is commonly the anisotropic at-rest (K_o) condition, use of the isotropic stress state as the starting point from which the limiting strain is measured is only representative of field conditions if the coefficient of lateral earth pressure at rest, K_o, for MSW is close to one. However, field and laboratory test data indicate that K_o for MSW in the field is more likely in the range of 0.3 to 0.6 (Landva et al. 2000; Towhata et al. 2004; Dixon and Jones 2005; Zekkos 2005; Kavazanjian 2006). In an isotropically consolidated TXC test, a significant amount of strain generally occurs before the specimen is loaded to the K_o stress state. The amount of strain that occurs will depend on several factors including the value of K_o, compaction effort, waste composition, unit weight, and loading rate. The value of K_o is likely to be the most important of these factors. To determine the appropriate strain-dependent mobilized shear strength corresponding to field conditions with a strain-based failure criterion, the axial strain that occurs upon loading to the K_o stress state should be subtracted from the total axial strain measured in an isotropic TXC test to find the incremental strain associated with the mobilized shear strength.

To examine the effect of K_o on the mobilized strength of MSW, mobilized shear strength envelopes were developed from the TXC data produced in this study for assumed K_o values of 0.3, 0.6, and 1.0 for incremental strain levels of 5 and 10%. For each case, a secant friction angle was calculated for the waste assuming no cohesion. Results for $K_o=0.3$, 0.6, and 1.0 plus 5% axial strain and for $K_o=0.3$ and 10% axial strain are shown in Fig. 7 [additional results are presented in Zekkos et al. (2007b)]. As these results show, as the assumed value of K_o decreases, the mobilized shear strength increases for a specified incremental axial strain. Furthermore, as expected, the mobilized shear strength increases as the incremental axial strain increases. Additionally, the scatter in the data reduces significantly as the value of K_o decreases and as the incremental axial strain increases. For the "$K_o=0.3+5\%$ strain" failure criterion, the secant friction angle of Tri-Cities MSW in TXC is approximately 42°. For "$K_o=0.6+5\%$ strain," the secant friction angle of reconstituted Tri-Cities MSW in TXC is about 35°. The mobilized stress at these levels of "failure" strain is attained at the early stages of the upward curvature of the shear stress versus strain plot, indicating that the waste still has additional strength. At the maximum axial strain in the TXC tests, which was generally between 27 and 33%, the friction angle was typically on the order of 65°.

Stress Path

To examine the effects of stress path on mobilized shear strength, a series of TX unloading tests were performed on reconstituted specimens of MSW from the Tri-Cities landfill. The tests included both isotropically consolidated tests in which the MSW specimen was isotropically consolidated and then the vertical stress was reduced until failure (i.e., triaxial extension, TXE) and anisotropically consolidated tests in which the MSW specimen was consolidated under an anisotropic state of stress ($K_o=0.2$ or 0.38) and then the horizontal stress was gradually reduced until failure [i.e., triaxial lateral extension (TXLE)]. If failure did not occur in the TXLE tests when the horizontal stress equaled zero, the specimen was subjected to additional axial loading. The secant friction angles measured in the TX unloading tests were on the same order as those measured in the TX compression tests at very large strains (i.e., 50–60°). However, MSW exhibited a less ductile response in triaxial unloading.

The TXE tests were performed on MSW specimens reconstituted with 62% of their material smaller than 20 mm. A peak stress condition was reached in the isotropically consolidated TXE tests at about 2% axial strain, whereas peak stress conditions were reached at axial strains of 20% or larger in the isotropically consolidated TXC tests. Additionally, the upward curvature that was observed in the TXC tests did not occur in the TXE tests. Instead, the stress-strain curve in TXE tests was hyperbolic in shape, with some tests exhibiting a slight reduction in mobilized shear stress beyond the peak stress (Fig. 8).

In two tests in the anisotropically consolidated TXLE test series, the specimen did not fail when the horizontal stress was reduced to zero. In these two tests, as the horizontal confining stress was reduced to zero, the MSW specimen deformed axially a few percent strain. The specimen then continued to deform axially at a slowing rate for a few minutes. After the axial strain ceased, the vertical load was increased while maintaining a zero confining stress. One TXLE test specimen with 62% smaller than 20 mm material ($\sigma_{1c}=1{,}340$ kPa and $K_o=0.38$) eventually reached a peak stress condition at a maximum shear stress of about 1,000 kPa, and the other TXLE test specimen with 12% smaller than 20 mm material ($\sigma_{1c}=710$ kPa and $K_o=0.2$) never reached peak stress up to the maximum shear stress of 1,800 kPa applied in the test. A third TXLE test specimen with 62% smaller than 20 mm material ($\sigma_{1c}=2{,}430$ kPa and $K_o=0.2$) reached a

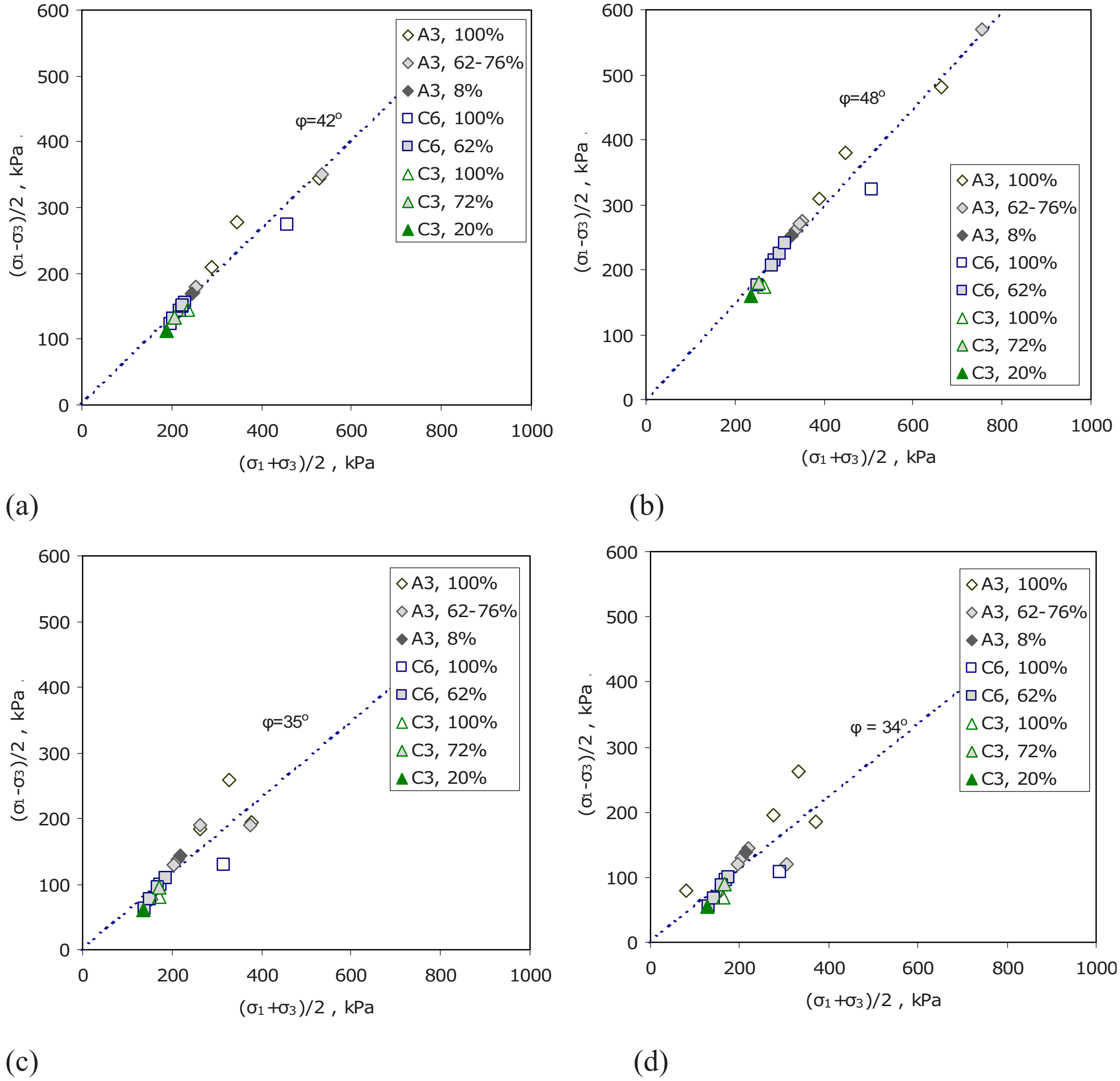


Fig. 7. Mobilized TX stress-based friction angles: (a) $K_o=0.3$ and 5% axial strain ($R^2=0.95$); (b) $K_o=0.3$ and 10% axial strain ($R^2=0.96$); (c) $K_o=0.6$ and 5% axial strain ($R^2=0.75$); and (d) $K_o=1$ and 5% axial strain ($R^2=0.66$); the sample group and percent of material smaller than 20 mm is provided in the legends

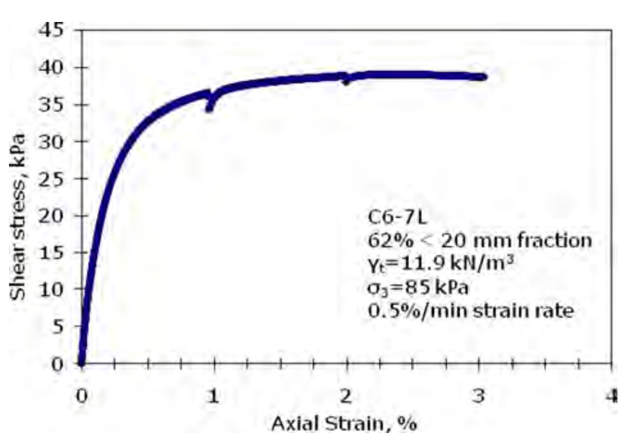


Fig. 8. Stress-strain response in TX extension

peak stress condition at an axial strain of 7% when the horizontal stress was reduced to 78 kPa. The peak friction angle for this third test was 67°. The stress-strain curves for all three tests had a generally hyperbolic shape during the unloading phase of the testing. However, when the two specimens that did not fail in the initial phase were reloaded in TXC, they exhibited a slight to noticeable upward curvature in their stress-strain response.

Confining Stress Effects

The effects of confining stress on the response of MSW in TXC was investigated in testing on specimens from the A3 and C6 groups with varying waste compositions (Zekkos 2005). Similar to the trend observed in the DS testing, the secant friction angle for TX test specimens prepared with the same composition and compaction effort reduced as the confining stress increased. TXC test data provided in Zekkos (2005) indicate that the secant friction angle decreased by approximately 4–6° as the confining stress increased from approximately 100 to 200 kPa (assuming

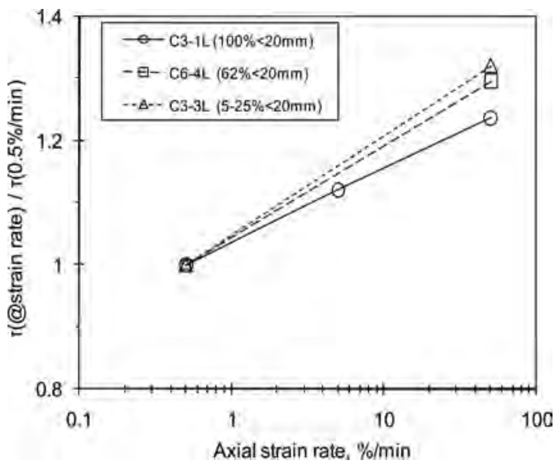


Fig. 9. Strain rate effects for TX specimens with varying waste compositions; Specimen C3-1L has 100%, Specimen C6-4L has 62%, and Specimen C3-3L has 20% <20 mm material

$c=0$). Hence, the change of the friction angle over one log-cycle change of normal stress, $\Delta\phi$, is on the order of 5–8°.

Unit Weight Effects

The initial (as compacted) MSW unit weight and the associated compaction effort also affect the stress-strain response of MSW in the TXC tests. As described in Zekkos (2005), specimens with lower initial unit weight have a softer initial response and lower mobilized shear strengths at a specified strain level. For example, two specimens with the same composition of 62% smaller than 20 mm material and with total unit weights prior to shearing of 12.3 and 10.9 kN/m^3, respectively, were tested. The denser specimen had secant friction angles of 39 and 47 deg at 5 and 10% axial strain (measured from the isotropic stress state), respectively, whereas the looser specimen had a friction angle that was lower by 8 deg at each strain level. The difference in the interpreted friction angle is smaller if measured from an anisotropic initial stress state, but still the effect of the unit weight on the shear resistance of the waste can be significant.

Rate of Loading Effects

Variable strain-rate monotonic loading tests were performed on TXC test specimens of varying waste composition and unit weight from the three waste groups. Stress-strain plots and detailed results from these tests are presented in Zekkos et al. (2007a). Specimens were sheared in stages at strain rates of 0.5, 5, and 50%/min. In the same manner, as illustrated in Fig. 5 for staged loading direct shear testing, the complete stress-strain response for each specimen at each strain rate was then estimated from these staged loading rate tests. Using these interpolated stress-strain curves, Fig. 9 shows the ratio of the mobilized shear stress at any strain rate divided by the mobilized shear stress at a reference strain rate of 0.5%/min for the TXC staged loading tests performed on the Tri-Cities MSW. For all specimens, the mobilized shear stress increases with increasing strain rate. As observed in the DS testing, the mobilized shear strength of MSW was significantly affected by the loading rate in TXC testing with strength increasing as loading rate increases by approximately 10–15% per log cycle of strain rate. This trend is similar to the observed behavior of clayey soils. Strain rate effects appear to be more pronounced for specimens with higher amounts of larger than 20 mm material (i.e., more fibrous waste material).

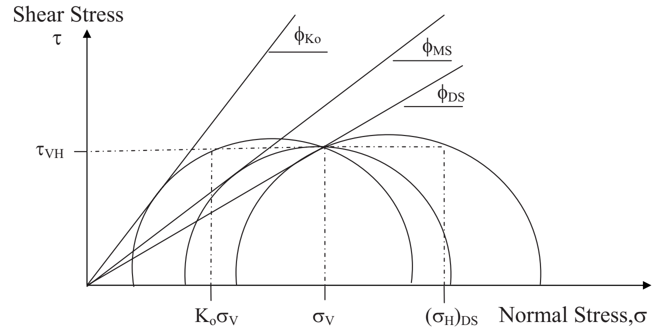


Fig. 10. Alternative methods for interpretation of shear strength from simple shear tests

Simple Shear Testing

Interpretation of Shear Strength

Interpretation of shear strength from SS tests is complicated by uncertainties regarding the stress state within the specimen as it approaches failure. In SS testing, after the specimen is consolidated to a K_o stress state under a vertical normal stress σ_v a shear stress τ_{vh} is applied to the horizontal plane of the specimen. Ideally, a corresponding complementary shear stress is induced on the vertical plane. If the applied shear stress does not induce any change in the horizontal normal stresses within the specimen, the resulting stress state represents a concentric expansion of the Mohr circle about the initial K_o Mohr circle. This interpretation, termed herein the K_o interpretation method, can lead to relatively high values of friction angle, termed ϕ_{K_o} herein, for MSW. For instance, interpretation of simple shear tests on reconstituted waste from the OII landfill using this method lead to friction angles as great as 59 deg (Kavazanjian et al. 1999; Kavazanjian 2001). Fig. 10 illustrates the K_o interpretation of the direct shear test for a K_o value on the order of 0.5. It should be noted that ϕ_{K_o}, the friction angle from the K_o interpretation method, applies to failure planes that cut across the preferred orientation of the long particles (typically at an angle between 45 and 60 deg). Furthermore, the K_o interpretation method does not preclude failure along a horizontal plane in a specimen with anisotropic shear strength. In this case, the shear strength on the horizontal plane is represented by the DS shear strength and the shear strength calculated using other points on the K_o. Mohr's circle represents minimum shear strengths for failure planes with the corresponding orientation.

An alternative means of interpreting shear strength from simple shear test results is to assume that the stresses on the horizontal plane (i.e., σ_v and τ_{vh}) represent the stresses on the failure plane (Harris et al. 2006). This method of interpretation is termed herein the direct shear interpretation method, because this assumption is similar to that used for DS tests. The direct shear interpretation method requires a reversal of the direction of the principal planes in the specimen, with the horizontal normal stress, designated $(\sigma_H)_{DS}$ in Fig. 10, increasing to a value significantly greater than the applied vertical normal stress. Further-

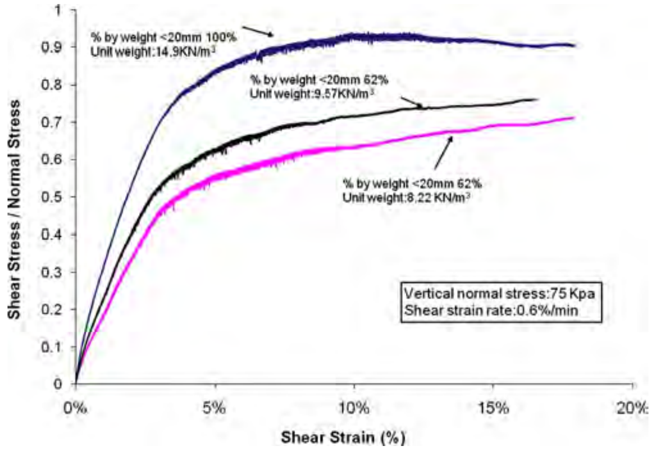


Fig. 11. Results of simple shear tests on reconstituted Tri-Cities landfill MSW

more, the friction angle interpreted in this manner, designated ϕ_{DS} in Fig. 10, represents the lowest possible value of shear strength from the simple shear test.

Numerical analyses performed by Prevost and Hoeg (1976) using a nested yield surface plasticity model to simulate the response of clay in SS tests suggest that the assumption of a constant horizontal normal stress during shear made by the K_o interpretation method may not be valid. These analyses indicated that the horizontal normal stress may increase during shear in SS testing, with the final value depending on the soil's plastic modulus. These analyses also indicated that, in the limit, the horizontal normal stress may approach, but should not exceed, the vertical normal stress applied to the specimen. In this limiting condition, the applied stresses on the vertical plane in the SS test, σ_v and τ_{vh}, represent the peak point on the Mohr circle. Even under this limiting condition, referred to herein as the mean stress (MS) interpretation, the interpreted friction angle, designated as ϕ_{MS} in Fig. 10, will be greater than the ϕ_{DS}, the value developed employing the direct shear interpretation method. The MS interpretation of the simple shear test is used in this study.

Initial Stress State and Waste Composition

The initial stress state in the SS test is by definition the K_o (zero lateral strain during consolidation) stress state. So, no assumption regarding the value of K_o and no correction to the measured strain for field consolidation conditions are required in interpreting SS test results. Three monotonic loading SS tests were conducted on reconstituted specimens of MSW from the Tri-Cities landfill—one using 100% smaller than 20 mm material compacted to a unit weight of 14.9 kN/m^3, the second using 64% less than 20 mm compacted to 9.6 kN/m^3 using the same compaction energy used to compact the first specimen, and a third test using 64% less than 20 mm but compacted with less energy to a unit weight of 8.2 kN/m^3. All three tests were sheared under a vertical normal stress of 75 kPa at a shear strain rate of approximately 0.6% per min. The results of these tests are shown in Fig. 11. Using the DS interpretation method, the secant friction angle at a shear strain of 10% varied from 32° for the low unit weight specimen with 64% less than 20 mm to 42° for the specimen with 100% less than 20 mm. Using the preferred MS interpretation, the secant friction at a shear strain of 10% angle varied from 38° for the low unit weight specimen with 64% less than 20 mm to 65° for the specimen with 100% less than 20 mm. The K_o interpretation yields even higher strengths. In the two tests with 64% minus 20 mm, as in SS tests on reconstituted MSW from the OII superfund site by Kavazanjian et al. (1999), the stress-strain response was generally hyperbolic with no discernible peak and a mobilized shear stress equal to roughly 90% of the interpreted asymptotic value was achieved at a shear strain of less than 10%. In the test on the specimen with 100% minus 20 mm, the mobilized strength does reach a peak at a shear strain of approximately 10% with a very slight decline thereafter.

Interpretation of Laboratory Test Results

The large-scale laboratory testing on reconstituted specimens of MSW from the Tri-Cities landfill provides significant insight into the stress-strain-strength response of MSW, including the influence of waste composition, stress state, and confining pressure. The DS tests on specimens in which the preferred orientation of the fibrous waste was oriented at different angles to the shear plane clearly illustrate the anisotropic nature of MSW with a preferred particle orientation (as observed in the field) as well as the role of fibrous reinforcement in the upward curvature of the stress-strain curve and the continued increase in mobilized shear stress at very large strains previously observed in isotropically consolidated TXC testing on waste. The shear resistance of MSW measured in typical DS testing is representative of the shear resistance along a shear plane oriented such that the contribution of the fibrous waste materials is minimal (i.e., shearing is parallel to the preferred fiber orientation). When shearing is constrained to cut across long, fibrous waste particles, the shear resistance of MSW increases significantly and a strain hardening response is observed (i.e., there is an upward curvature of the stress-displacement response). These observations suggest that the upward curvature is attributable to the progressive contribution of the fibrous materials to the shear resistance of the MSW when the shear plane cuts across the long axis of the fibrous particles.

TXC testing on material with and without fibrous waste (i.e., with and without material larger than 20 mm in dimension) supports this concept. Consistent with the findings from the DS tests, TXC tests exhibit upward curvature in the stress-strain response only for specimens that contained larger than 20 mm material (i.e., fibrous waste). In these specimens, the shearing surfaces cut across fibers to engage their reinforcing effect. As the failure surface in TXC testing is oriented at an angle of about $45° + \phi/2$ to the horizontal fibers, the failure surface in a typical TXC test on MSW would be oriented at an angle of 60–65 deg from the horizontal for typical values of friction angle. Previous studies in reinforced soils (Gray and Ohashi 1983) suggest that when the failure surface is oriented about 60 deg to the fiber orientation, the reinforced material exhibits its highest shear strength.

Triaxial specimens of MSW generally compress significantly during loading and large axial strains (e.g., greater than 10–20%) are sometimes required to mobilize friction angles of 30° or more in isotropically consolidated TXC. Therefore, several investigators have proposed relatively low values of mobilized friction angles (e.g., as low as 20°) for MSW to compensate for "strain incompatibility" and the potential for development of excessive deformations in the waste prior to failure. Friction angles back-calculated from field performance (Kavazanjian et al. 1995; Eid et al. 2000), friction angles measured in DS tests on specimens in which the shear plane was aligned with the fibrous particles, and friction angles interpreted from K_o consolidated (by definition) simple shear tests (regardless of the method of interpretation) are significantly higher than 20°. If the field K_o consolidation condition is taken into account, the strain-dependent mobilized shear strength in MSW in TXC tests becomes more consistent with back-calculated field and DS laboratory friction angles. The mobilized strength of MSW TXC at a limiting strain of 5% beyond an in situ stress state of $K_o=0.3$ provides a secant friction angle on the order of 38–42° for confining stresses up to 200 kPa. These values are consistent with values interpreted from SS tests, which are also K_o consolidated.

For the initial DS test series, in which shearing was in the same direction as the preferred orientation of the fibrous materials within the waste, a nonlinear shear strength envelope can be defined that is independent of the amount of fibrous material in the MSW. As shown in Fig. 1(b), the secant friction angle reduces with increasing confining stress, similar to what is observed for many soils (Duncan and Wright 2005). The DS strength of the Tri-Cities landfill waste materials from this initial test series may be defined by

$$\tau = c + \sigma_n \cdot \tan(\phi_\sigma) \tag{1}$$

where τ = shear strength of Tri-Cities MSW in direct shear; σ_n = total normal stress; c = cohesion intercept; and ϕ_σ = normal stress dependent friction angle given by

$$\phi_\sigma = \phi_o - \Delta\phi \cdot \log\left(\frac{\sigma_n}{p_a}\right) \tag{2}$$

where ϕ_o = friction angle measured at a normal stress of 1 atm; $\Delta\phi$ = change of the friction angle over 1 log-cycle change of normal stress; and p_a = atmospheric pressure (i.e., 101.3 kPa). Setting $c=15$ kPa, the best fit envelope from the initial series of DS tests gives $\phi_o=41°$ and $\Delta\phi=12°$. These values are consistent with the results of the TXC tests interpreted on the basis of a limiting strain of 5% beyond an in situ stress state of $K_o=0.3$.

TX unloading tests indicate substantial unconfined compressive strength for consolidated MSW. These tests suggest that waste material that has been under relatively high confining stress has relatively high strength in unconfined conditions, especially if it has been unloaded significantly before shearing. The fibrous nature of larger waste particles, particle interlocking, and stress history effects on the "soil-like" finer waste fraction likely contribute to the relatively high strength of waste that has been unloaded. These test results help explain field observations of unsupported high vertical cuts in consolidated MSW being stable for periods of months to years (Kavazanjian et al. 1995; Eid et al. 2000).

The laboratory-derived strength values for MSW resulting from this work are generally consistent with strength values developed through back-analysis of MSW slopes (Kavazanjian et al. 1995; Eid et al. 2000). This suggests that the tests conducted for this project were not compromised by particle size restrictions. On this basis, it appears that the inclusion of 80–100 mm particles of fibrous material may be sufficient to capture the reinforcing effect of fibrous waste on the smaller than 20 mm matrix material in the waste mass. However, additional testing using even larger devices and particle sizes may be required to confirm this hypothesis.

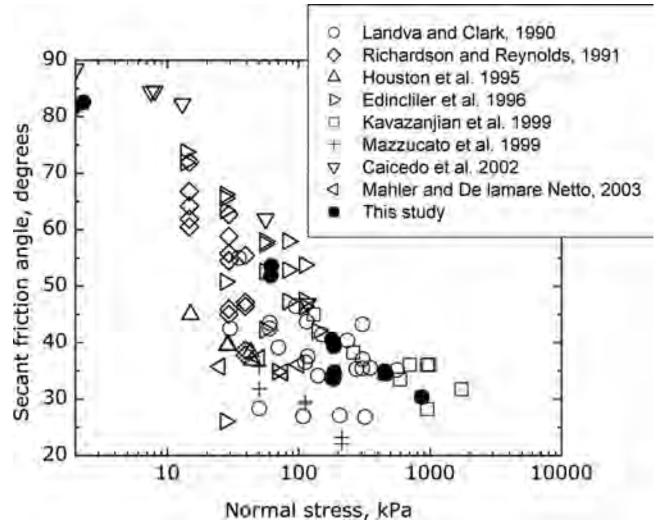


Fig. 12. Relationship of the secant value of friction angle with confining stress for direct shear tests on MSW

Recommendations for Use in Practice

General

Similar to soils, there is no unique set of Mohr-Coulomb strength parameters for MSW. The shear strength of MSW depends on composition, unit weight, confining stress, stress history, stress path, and loading rate, among other factors. As one would expect, there is significant variability in the available strength data in the literature on MSW. However, the results of this comprehensive testing program of MSW in DS, TX, and SS devices, at various waste compositions, confining stresses, loading rates, etc. does provide a framework for integrating the available data to develop general guidance for estimating the shear strength of MSW.

Static Shear Strength of MSW

The expected stress path or shearing mode is a critical factor in evaluating the shear strength of MSW. In most cases, for shear deformation through the waste mass in an unlined landfill, DS tests provide a reasonable, conservative approximation of the shearing mode. Therefore, the large database available from DS testing of MSW provides a reasonable basis for developing Mohr-Coulomb strength parameters for MSW. A total of 103 large-scale DS tests (i.e., DS tests at least 30×30 cm in size and as large as 122×122 cm) were collected from eight other studies and combined with the large-scale DS tests conducted on Tri-Cities MSW. The waste material included in this data set is from landfills in Canada, Maine, Arizona, Wisconsin, California, Italy, Colombia, and Brazil. Fig. 12 shows secant friction angles versus normal stress for this comprehensive large scale DS data set. Although some scatter is observed (which is to be expected, particularly when variations in composition, unit weight, and waste origin are considered), these results clearly show that the DS strength envelope for MSW is nonlinear and stress dependent, with the secant friction angle decreasing as confining stress increases.

Data from the large-scale MSW DS data set described above are plotted in Fig. 13. A reasonable mean estimate of the static shear strength of MSW for use in preliminary stability evaluations can be developed from these data. Using the c, ϕ_o, $\Delta\phi$ relationship described in Eqs. (1) and (2), the DS static shear strength of

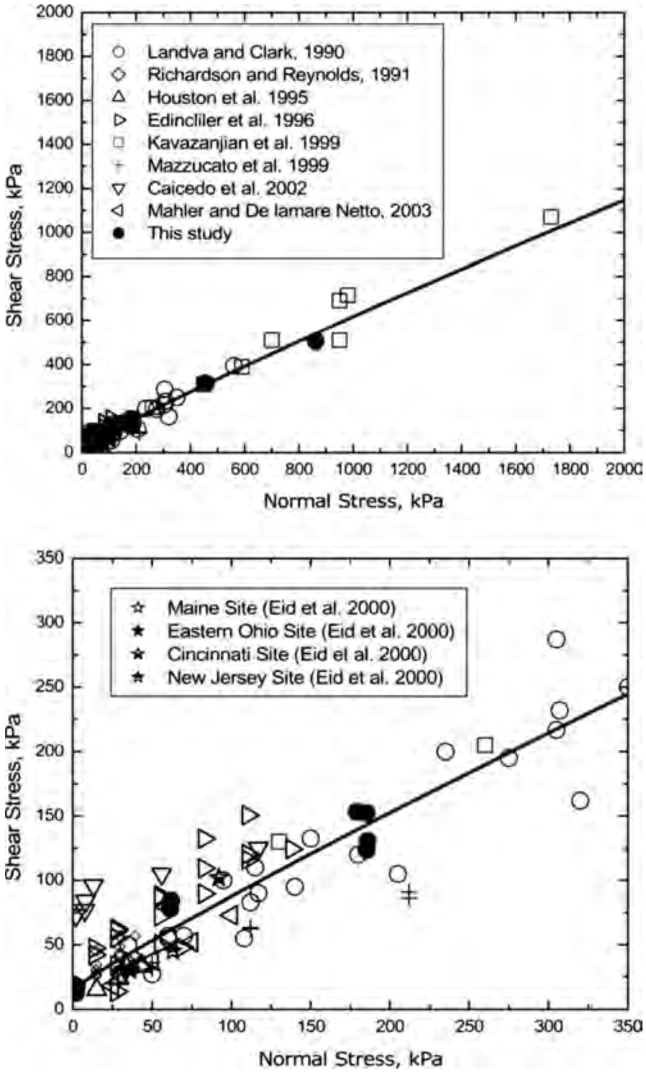


Fig. 13. Recommended static shear strength of MSW based primarily on direct shear tests and field observations of static slope stability

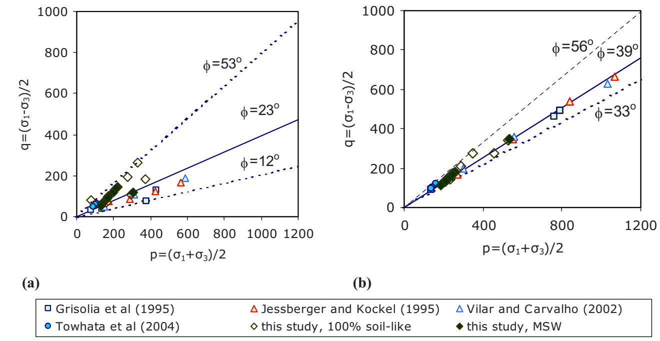


Fig. 14. Mobilized shear strength in large-scale triaxial compression tests using two different criteria: (a) isotropic consolidation plus 5% axial strain (best fit $\phi=23°$, $R^2=0.27$); (b) anisotropic consolidation to $K_o=0.3$ plus 5% axial strain (best fit $\phi=39°$, $R^2=0.99$)

MSW is best characterized by $c=15$ kPa, $\phi_o=36°$, and $\Delta\phi=5°$. This envelope represents an estimate of shear strength along the plane of the preferred orientation of long particles within the waste, which is generally the horizontal plane. Planes with other orientations, i.e., planes that cut across the preferred axis of the long particles, are likely to have higher strengths. This recommended shear strength envelope is reasonably consistent with those recommended previously by Kavazanjian et al. (1995), Manassero et al. (1997), and Eid et al. (2000) but is based on significantly more large-scale in situ and laboratory data, as well as laboratory data at higher confining stresses. Fig. 13 also includes points representing the four case histories of failed waste slopes back-calculated by Eid et al. (2000) from landfill sites in Maine, Cincinnati, eastern Ohio, and New Jersey. These back-calculated field data points lie within the scatter of the laboratory data.

Assessment of Additional Factors That Affect the Static Shear Strength of MSW

There are many cases when the failure plane cuts across the elongated fibrous particles in the waste mass. For instance, the backscarp of a potential slide mass that cuts up through a waste landfill also cuts across and engages fibrous particles in the waste mass. In these cases, the DS, TX, and SS test results indicate that the shear strength of MSW can be significantly higher than that defined by DS testing on waste where its fibrous particles are oriented parallel to the shear plane. For these cases, higher strength values may be justified. Data from this testing program were combined with data from four other MSW testing programs that employed TXC tests to define a TXC strength envelope defined on the basis of mobilized shear stress at an axial strain of 5% beyond the $K_o=0.3$ stress state. As shown in Fig. 14, the $K_o=0.3$ plus 5% criterion reduces the scatter in test results considerably compared to a criterion based upon strain measured from the isotropic consolidation stress state. The $K_o=0.3$ plus 5% criterion results in a friction angle on the order of 34–44°, with a mean value of 39°. This is a reasonable characterization of the TXC strength of MSW for confining stresses up to 400 kPa.

TXE and TXLE tests performed as part of this study indicate that the peak strength of waste with fibrous inclusions can be on the order of 50–65°, which is similar to the peak strength eventually reached in TXC tests. As opposed to TXC tests, peak strength is reached in TXE tests at relatively low levels of strain (i.e., 1–4%). Thus, a relatively high friction angle of 50° could be employed to characterize the waste strength in this region of the sliding surface. However, some TXE tests exhibited a reduction in strength past the peak, so consideration of postpeak strain softening would be required if such a large shear strength value was used in a stability analysis.

Waste composition is typically an important factor in estimating MSW properties (Zekkos et al. 2006; Zekkos et al. 2008). This factor likely contributes to most of the scatter in the strength data reported in the literature, so it should be considered. However, the shear strength of MSW materials tested in this study and by others for waste with constituents that are larger than 20 mm did not appear to vary significantly due to waste content when consistently interpreted. Waste composition does greatly influence the shape of the stress-strain response observed in TX testing with specimens with larger amounts of waste products, such as paper, plastic, and wood, having a greater tendency to exhibit upward curvature. However, when interpreted on the basis of a K_o plus 5% axial strain failure criteria, differences due to waste composition are minimized.

Unit weight was also shown to be an important factor in this study. Variations in unit weight of 5–20% could produce similar variations in the measured shear strength of similarly prepared MSW of similar composition. Strength increased as unit weight increased. Although this trend could be identified in a carefully performed laboratory study that isolated this factor, it is difficult to identify this trend in the data available in the literature, as specimens in the testing programs were prepared differently and have different compositions. Hence, unit weight variations also likely contribute to the scatter observed in the test data. If the MSW's unit weight in a particular project is known to deviate significantly from typical values, one could increase or decrease the shear strength parameters slightly from the values recommended previously. However, an adjustment of more than $\pm 10\%$ in the shear strength to account for significant variations in the MSW's unit weight is difficult to justify at this time.

Similarly, water content is potentially an important factor, but for water contents at or below field capacity, which is the predominant condition for the MSW landfills in the United States, a significant systematic trend in the strength of waste as a function of water content was not observed. Thus, for water contents in the range of 10–25%, which is at or below the field capacity of most MSW materials, water content was not found to be a key factor. However, in bioreactor landfills where waste may be saturated or nearly saturated, significant excess pore pressures could be produced during shear due to the highly compressible nature of MSW. This in turn could lead to a significant drop in effective stress and a loss in strength. Potential strength loss due to excess pore pressure generation in saturated waste has not been investigated fully and its implications should be carefully considered when warranted.

The effects of waste degradation on its shear strength have not been addressed adequately. It has often been speculated that significant degradation of MSW lowers its strength (Turczynski 1988). The level of degradation within waste is hard to quantify. Although age is an important factor, waste composition, climate, water content, and landfill construction and maintenance procedures are also likely to be important. However, it seems likely that degradation will move the waste mass composition towards that of a material with 100% smaller than 20 mm in dimension. Thus, the DS shear strength envelope for specimens with a shear plane oriented in the same direction as the long particle axis (i.e., for specimens where fibrous reinforcement does not affect the strength) would appear to be appropriate for this case. Additional work is warranted in this area, and caution should be exercised when evaluating the long-term strength of MSW for landfills that are anticipated to undergo significant waste degradation.

Dynamic Shear Strength of MSW

The testing conducted herein, and observations of the field performance of landfills in earthquakes (Augello et al. 1998) suggest that the dynamic shear strength of MSW is greater than its static strength. Testing performed as part of this study found that the mobilized shear stress increased about 30% for a 100-fold strain rate increase (e.g., from 0.5% / min to 50% / min in the TX tests). From numerical analyses, the strain rate of strong earthquake ground motions is estimated to be approximately 30% / min, which is 60 times higher than the strain rate of 0.5% / min used to develop the static shear strength envelopes reported herein. Based on these considerations and the results of the tests reported herein, the dynamic shear strength of MSW is estimated to be about 25% greater than its static shear strength (i.e., a loading rate factor on shear strength of 1.25). However, because of the scarcity of the data, a conservative estimate that the dynamic shear strength is 1.2 times its static shear strength is recommended for use in practice. These findings are consistent with the recommendations of Augello et al. (1998). As the results presented in this paper are representative of waste material below field capacity, the potential for strength degradation due to pore pressure generation in wet waste subject to cyclic loading was not considered in developing this recommendation. Careful evaluation of the potential for strength loss due to pore pressures generated by cyclic loading is required when saturated waste will be subjected to cyclic loading.

Conclusions

A comprehensive large-scale laboratory testing program using direct shear, triaxial, and simple shear tests was performed to develop insights and a framework for interpreting the shear strength of MSW that is below its field capacity. The results of this testing program emphasized the important issues of waste composition and unit weight, fibrous particle orientation and stress path, stress-strain compatibility and interpretation of strength tests, confining stress, and rate of loading. For sliding parallel to the preferred orientation of the fibrous particles within MSW, the DS test appears to capture the load-displacement-strength response of MSW well. The more than 100 test results from this and other studies indicate that the static shear strength of MSW for this shearing mode is best characterized by using a stress-dependent Mohr-Coulomb strength criterion with: $c = 15$ kPa, $\phi_o = 36°$, and $\Delta\phi = 5°$. The DS conservative strength envelope is intended for use in practice for stability analyses in the absence of site-specific testing. Other shearing modes that engage the fibrous materials within MSW (e.g., TX) produce higher friction angles. The dynamic shear strength of MSW can be estimated to be a minimum of 20% greater than its static strength. Issues such as the undrained behavior of saturated waste and strength loss due to pore pressure generation resulting from cyclic loading have not been considered in developing these recommendations, as they apply to waste that is below its field capacity.

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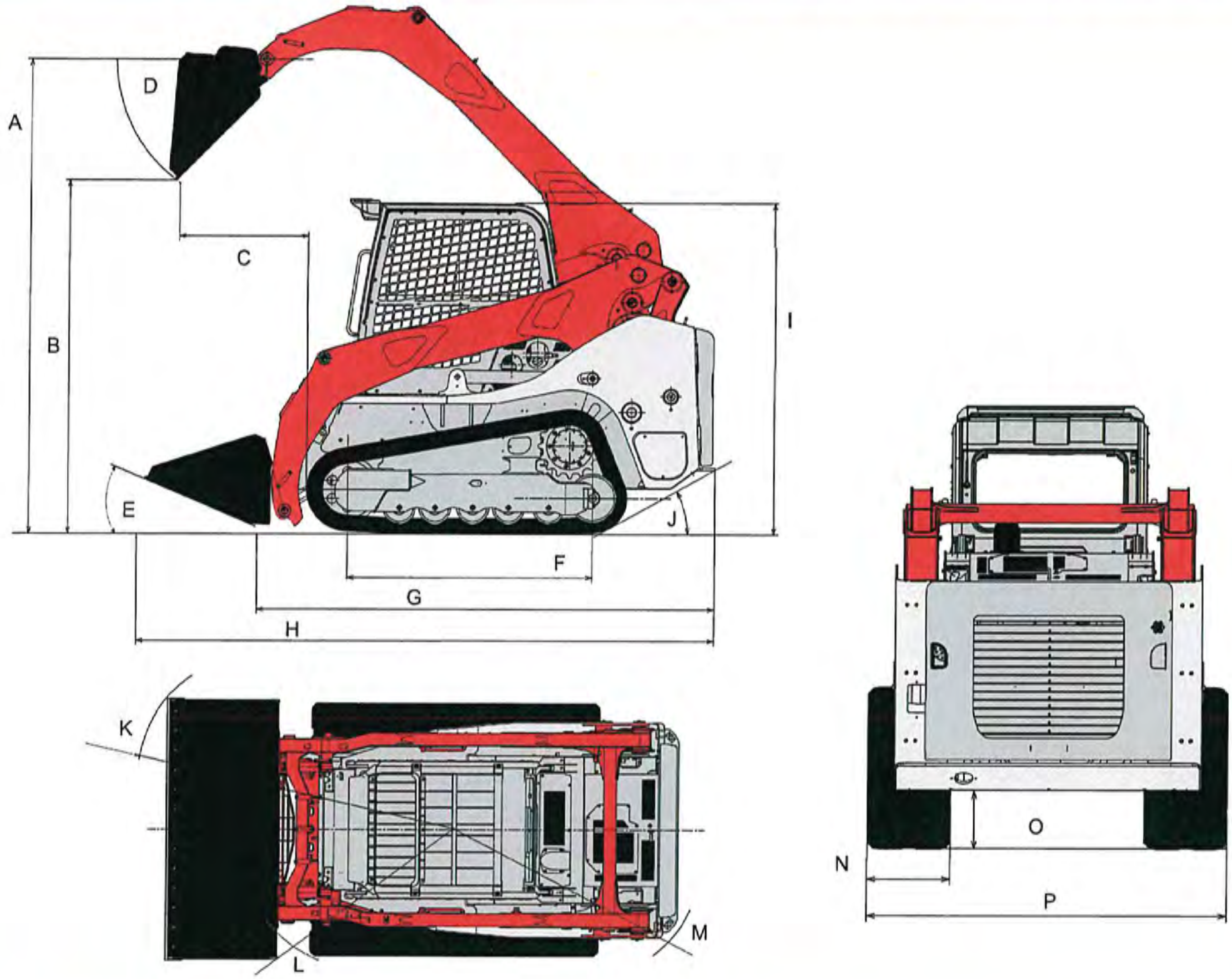
ATTACHMENT 2

LOAD DATA

SME
SEVEE & MAHER
ENGINEERS

TL12V2 Track Loader



MACHINE DIMENSIONS			
A	Max. Lift Height to Bucket Pin	10 ft 10 in	3,302 mm
B	Dump Height Fully Raised	8 ft 1.0 in	2,459 mm
C	Dump Reach Fully Raised	3 ft 0.4 in	924 mm
D	Dump Angle	46.8°	
E	Rollback Angle	30°	
F	Track Ground Contact Length	5 ft 7.6 in	1,717 mm
G	Machine Length	10 ft 6.2 in	3,205 mm
H	Transport Length	13 ft 3.3 in	4,045 mm
I	Transport Height	7 ft 7.7 in	2,330 mm
J	Departure Angle	30°	
K	Clearance Circle with Bucket	8 ft 2.6 in	2,505 mm
L	Clearance Circle without Bucket	5 ft 3.4 in	1,610 mm
M	Clearance Circle Rear	6 ft 0.8 in	1,848 mm
N	Track Width	17.7 in	450 mm
O	Ground Clearance	12.6 in	320 mm
P	Overall Width without Bucket	6 ft 5.2 in	1,960 mm

OPERATING PERFORMANCE

Operating Weight - Canopy	12,860 lb	(5,835 kg)
Cab	13,190 lb	(5,985 kg)
Tipping Load	11,737 lb	(5,324 kg)
Rated Operating Capacity @ 35%*	4,107 lb	(1,863 kg)
Operating Load @ 50% of Tip Load	5,868 lb	(2,662 kg)
Bucket Breakout Force	7,874 lb	(3,571 kg)
Lift Arm Breakout Force	7,109 lb	(3,225 kg)
Traction Force	14,010 lb	(6,353 kg)
Ground Pressure	4.8 psi	(33.0 kPa)
Travel Speed		
Low	5.0 mph	(8.1 km/hr)
High	7.3 mph	(11.6 km/hr)

*Rated Operating Capacity for compact track loaders is rated according to SAE J818 at no more than 35% of the tipping load.

HYDRAULIC SYSTEM

Auxiliary Flow - Primary Circuit	23.2 gpm	(88.0 Lpm)
Auxiliary Flow - High Flow (optional)	40.4 gpm	(153.0 Lpm)
Auxiliary Flow - 2nd Circuit (optional)	23.2 gpm	(88.0 Lpm)
Hydraulic System Pressure	3,481 psi	(24.0 MPa)

ENGINE

Make / Model	Kubota / V3800-TIF4B	
Engine Displacement	230 cu in	(3.8 L)
Horsepower @ 2,400 rpm	111.3 hp	(83.0 kW)
Maximum Torque @ 1,500 rpm	284 ft-lb	(385.0 Nm)

FLUID CAPACITIES

Engine Lubrication	13.9 qt	(13.2 L)
Cooling System	19.0 qt	(18.0 L)
DEF Fluid Tank Capacity	4.8 gal	(18.0 L)
Fuel Tank Capacity	31.6 gal	(119.5 L)
Fuel Consumption (65% of Full Load)	3.8 gal / hr	(14.4 L / hr)
Hydraulic Reservoir Capacity	13.2 gal	(50.0 L)
Hydraulic System Capacity	20.6 gal	(78.0 L)

5.7" Color Display

12 volt Accessory Outlet

LED Work Lights

Multi-Function Switch Bank

ATTACHMENTS

Takeuchi now offers attachments for all of your Takeuchi equipment.
See your authorized Takeuchi dealer for additional information and attachment options.

Grapple - Scrap

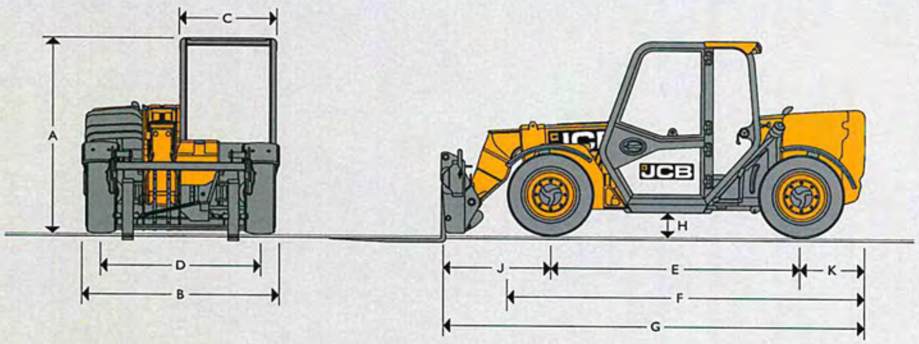
Dozer Blades

Pallet Forks

Trenchers

2/5

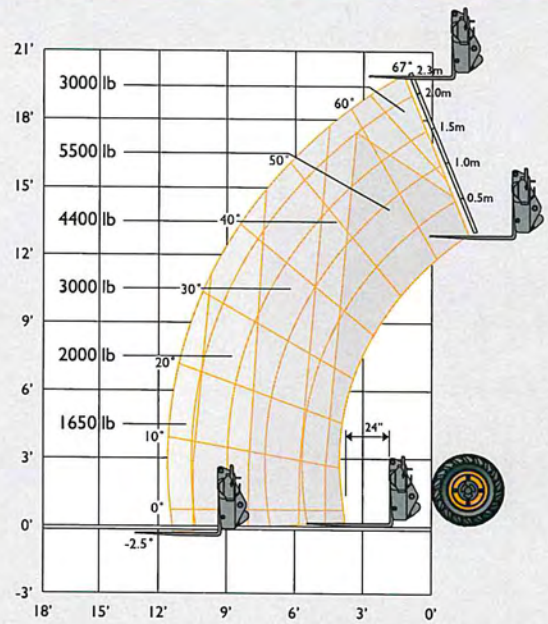
STATIC DIMENSIONS



A	Overall height*	ft-in (m)	6-2 (1.89)
B	Overall width (over tires)*	ft-in (m)	6-0 (1.84)
C	Inside width of cab	ft-in (m)	2-11 (0.88)
D	Front track	ft-in (m)	5-0 (1.53)
E	Wheelbase	ft-in (m)	7-10 (2.39)
F	Overall Length to front tires	ft-in (m)	11-1 (3.38)
G	Overall length to front carriage	ft-in (m)	13-1 (4)
H	Ground clearance	ft-in (m)	0-9 (0.23)
J	Front wheel center to carriage	ft-in (m)	3-4 (1.02)
K	Rear wheel center to rear face	ft-in (m)	2-0 (0.6)
	Outside turn radius (over tires)	ft-in (m)	12-1 (3.7)
	Carriage roll back angle	degrees	11
	Carriage dump angle	degrees	114
	Weight	lb (kg)	12100 (5490)
	Tires	industrial	12 x 16.5

*Dependent upon tire specified`

LIFT PERFORMANCE



Maximum lift capacity	lb (kg)	5500 (2500)
Lift capacity to full height	lb (kg)	3900 (1750)
Lift capacity at full reach	lb (kg)	1750 (800)
Lift height	ft-in (m)	20-0 (6)
Reach at maximum lift height	in (m)	-6 (-0.15)
Maximum forward reach (to front of carriage)	ft-in (m)	11-6 (3.5)
Reach with 2,600 lbs load	ft-in (m)	8-7 (2.64)

Complies with stability test ANSI B56.6.

3/5

ENGINE

Latest Tier 4 Final technology and advanced design provides low fuel consumption, reduced noise, high torque and power output, total reliability and minimal maintenance. Two-stage, dry type air filter with primary and safety elements. Territory dependent.

Manufacturer		JCB DIESEL BY KOHLER
Displacement	ltr	2.5
No. of cylinders		4
Bore size	in (mm)	3.46 (88)
Stroke	in (mm)	4 (102)
Aspiration		Turbocharged cooled
Power rating		
Power @ 2200rpm	hp (kW)	74 (55)
Torque rating		
Torque @ 1500rpm	lb-ft (Nm)	221 (300)

HYDRAULICS

Two stage gear pump, fitted with suction strainer and filter. One boom end auxiliary hydraulic service fitted as standard.

Operating system pressure	psi (bar)	3408 (235)
Flow at system pressure @ 2200rpm	g/min (l/min)	21 (80)
Hydraulic cycle times		**Seconds**
Boom raise		7.6
Boom lower		5.3
Boom extend		7.5
Retract		3.7
Bucket dump		1.9
Bucket crowd		2.9

TRANSMISSION

Closed loop variable displacement pump with a continuously variable hydrostatic drive. Comprising of a hydraulic motor and control unit. Permanent 4 wheel drive. Travel speed: 15mph (25kph).

		Forward	Reverse
Low range	mph (kph)	5 (8)	5 (8)
High range	mph (kph)	15 (25)	15 (25)

ELECTRICS

System voltage	Volt	12
Alternator output	Amp hour	80
Battery capacity	Amp hour	120

NOISE AND VIBRATION

			Uncertainty	Measurement conditions
Noise at the operator station	LpA	76 dB	+/- 1 dB	Determined in accordance with the test method defined in EN12053.
Noise emission from the machine	LWA	103 dB	+/- 1 dB	Guaranteed equivalent sound power (external noise) determined in accordance with the dynamic test conditions defined in 2000/14/EC.
Whole body vibration	m/s^2	0.37	0.18	ISO 2631-1:1997 normalised to an 8h reference period and based upon a test cycle defined in SAE J1166.
Hand-arm vibration	m/s^2	<2.5	N/A	ISO 5349-2:2001 dynamic test conditions.

AXLES

Front and rear drive axles: epicyclic hub reduction drive/steer axles with torque proportioning differentials.

BRAKES

Service brakes: Hydraulically operated self-adjusting, oil-immersed in-board multi-disc type mounted on front axle.

Parking brake: SAHR Handbrake self adjusting, oil immersed in-board multi disc type mounted on front axle operated by in-cab switch.

SERVICE FILL CAPACITIES

Hydraulic system	gal (litres)	17 (65)
Fuel tank	gal (litres)	20 (75)

BOOM AND CARRIAGE

Boom is manufactured from high tensile steel. Low maintenance, hard wearing pads. JCB Q-Fit, Skid-Steer.

STEERING

Hydrostatic power steering with power track rods on both axles.

Three steer mode options: Front wheel steer, all wheel steer, crab steer, operated from in the cab by a selection lever.

Option: In cab selector switch with Auto Align.

CAB

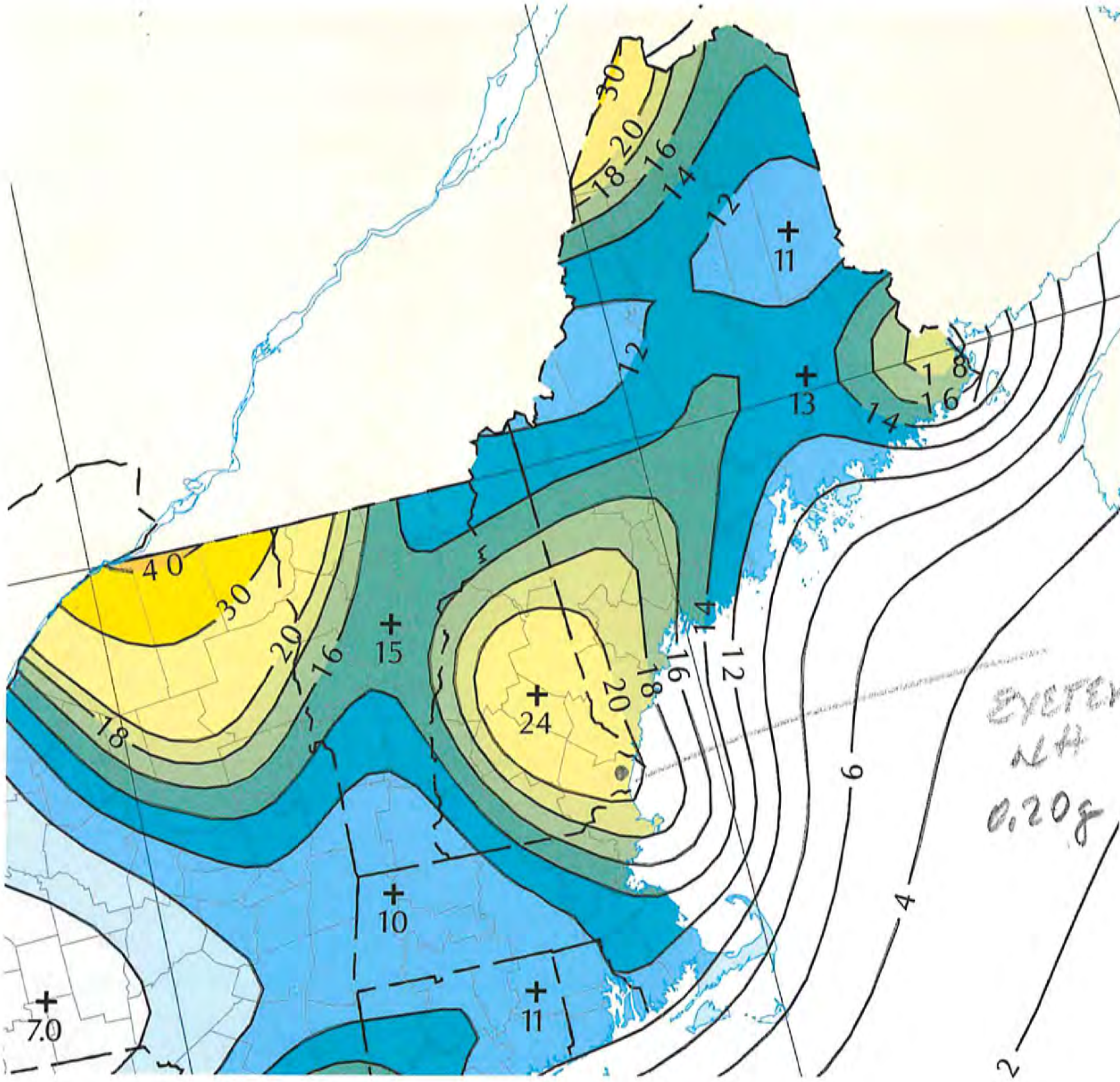
Quiet, safe and comfortable cab conforms to ROPS ISO 3471 and FOPS ISO 3449. Tinted, flat glass all around, with laminated roof screen. Roof bars, front screen with wipers and heater/screen demister. Rear opening window with wash/wipe. Audio-visual warning system for coolant temperature, engine oil pressure, air-cleaner, battery charge, transmission oil temperature and pressure, water in fuel, hourmeter, road speed indicator, fuel gauge, engine temperature, clock and inclinometer. Adjustable suspension seat, tilt steer column, park brake, floor mounted throttle and brake pedals.

Hydraulic controls: Single lever servo joystick, incorporating forward/neutral/reverse, with progressive extend/retract and auxiliary incorporating constant flow facility.

OPTIONS

Options: Canopy, front and rear working lights, rotating flashing beacon, fire extinguisher, front screen guard, air conditioning, 2 boom end auxiliary services, sunblind, radio kit, hydraulic locking carriage, limited slip differential in front axle, air suspension seat, 2-speed and intermittent front wash/wipers.

Attachments: Contact your local dealer for details of the comprehensive range, full road light kit, 12 volt in-cab socket, face level fan, tilt and rake steering column



Peak Horizontal Acceleration
With 2 Percent Probability of Exceedance in 50 Years

→ 90% prob of not being
Exceeded in 250 yr

→ Return Period ~ 2500 yr

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RACKING PRODUCT LINE

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REVISION: A

PERMIT SET/
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A P P R O V E D

SOLAR PHOTOVOLTAIC GROUND MOUNT

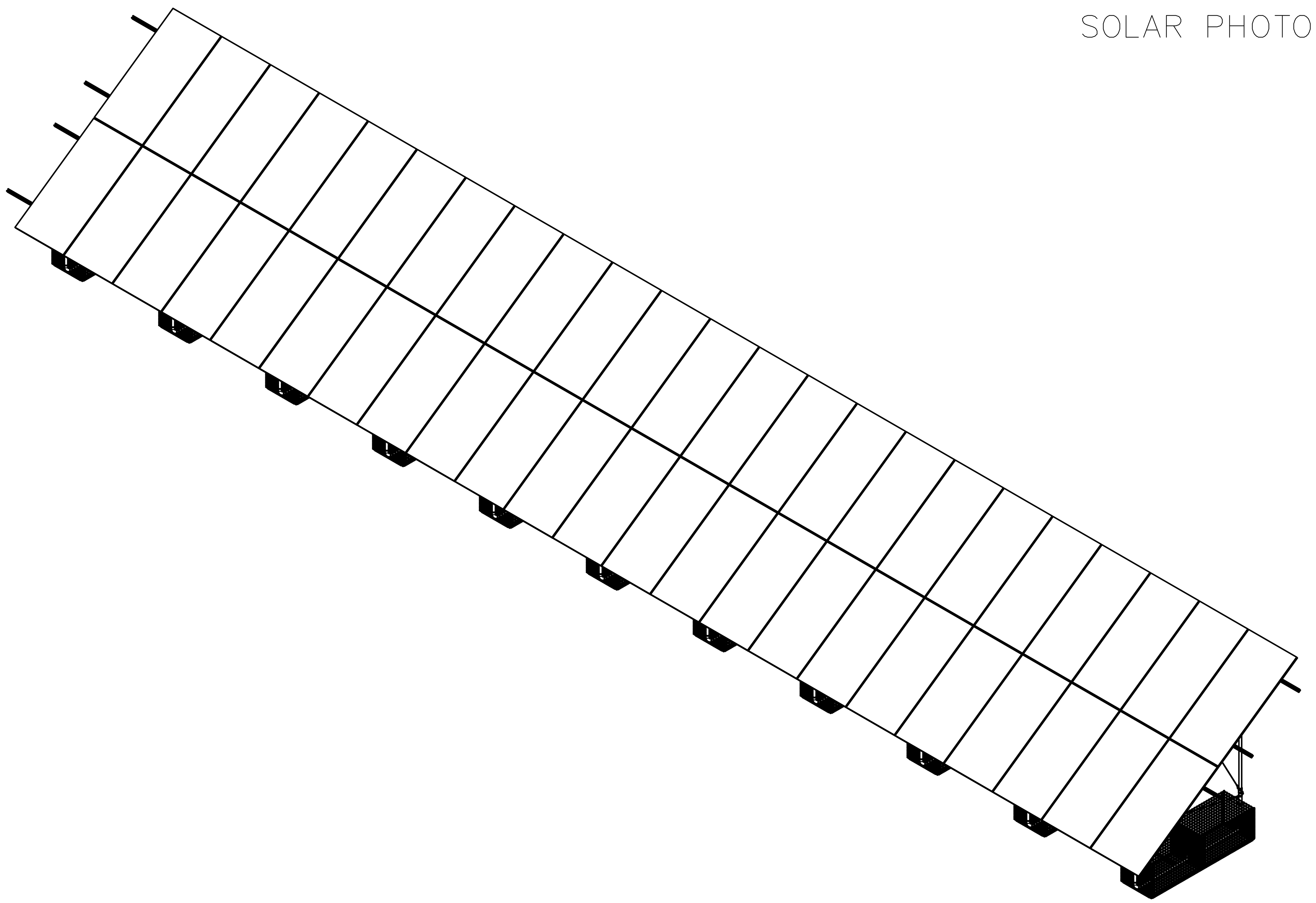


IMAGE FOR REFERENCE ONLY

SHEET INDEX		
STRUCTURAL		
S-000	A	STRUCTURAL COVER
S-100	A	RACKING SPECIFICATIONS OVERVIEW
S-200	A	STRUCTURAL BALLAST MEMBERS
S-300	A	STRUCTURAL PURLINS
S-500	A	GENERAL CONNECTIONS
S-501	A	BALLAST CONNECTIONS
S-600	A	ANCHOR BRACING
S-700	A	STRUCTURAL DESIGN & ANALYSIS SUMMARY

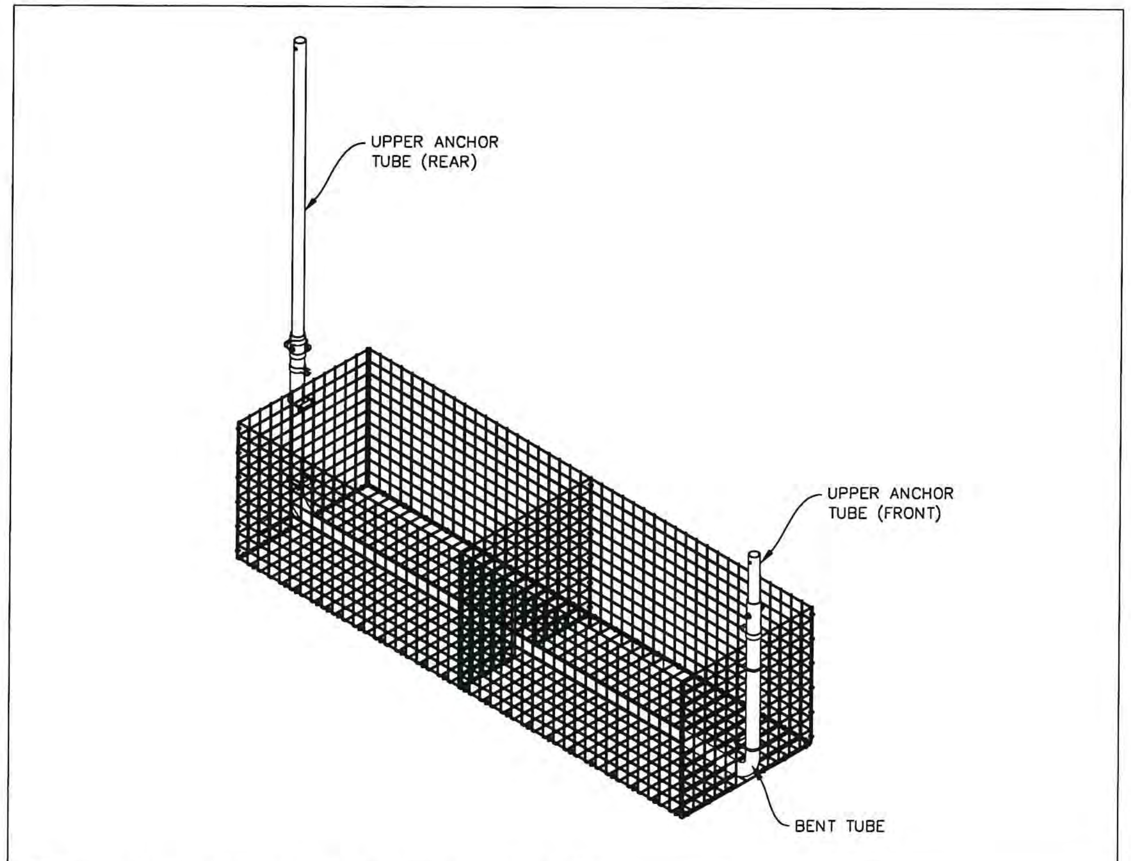
GOVERNING STRUCTURAL CODE/S

2015 INTERNATIONAL BUILDING CODE WITH MAINE STATE AMENDMENTS

PACKAGE COVERAGE – LOADING AND SETUP RANGES & CONSTANTS

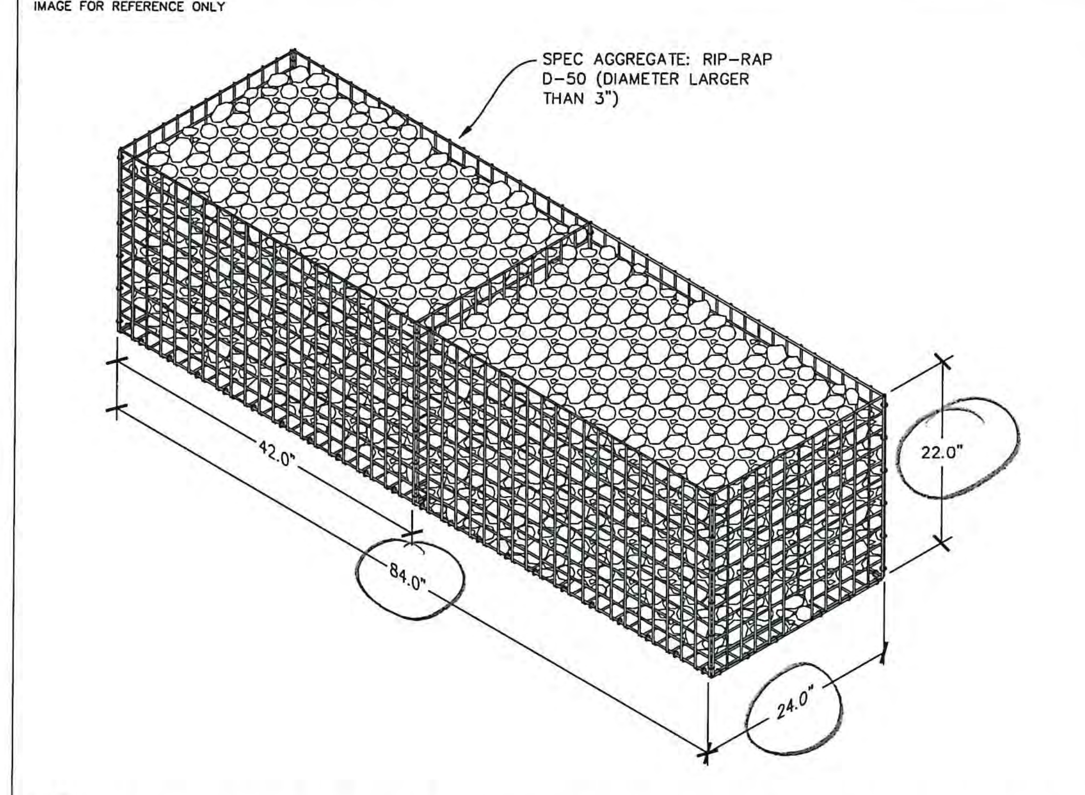
TILT ANGLES:	35°
MAX GROUND SNOW LOAD (PSF):	70
MAX WIND LOADS (MPH):	105
WIND EXPOSURE CATEGORY:	C
MAX SEISMIC Ss:	3.730 g
MAX SEISMIC S1:	1.390 g
PV MODULE:	
MAX. PANEL WIDTH:	39.50"
MAX. PANEL LENGTH:	79.00"
MAX. PANEL HEIGHT:	2.00"
MAX. PANEL WEIGHT:	60.00 LBS
RISK CATEGORY:	I
FRONT LIP CLEARANCE:	36"

*PER USGS MIN/MAX DESIGN VALUES FOR REGIONS, VALUES BASED ON MAX VALUES IN UNITED STATES. SEISMIC DOES NOT CONTROL.



C1 ISO VIEW: BALLAST & TUBE ASSEMBLY

IMAGE FOR REFERENCE ONLY



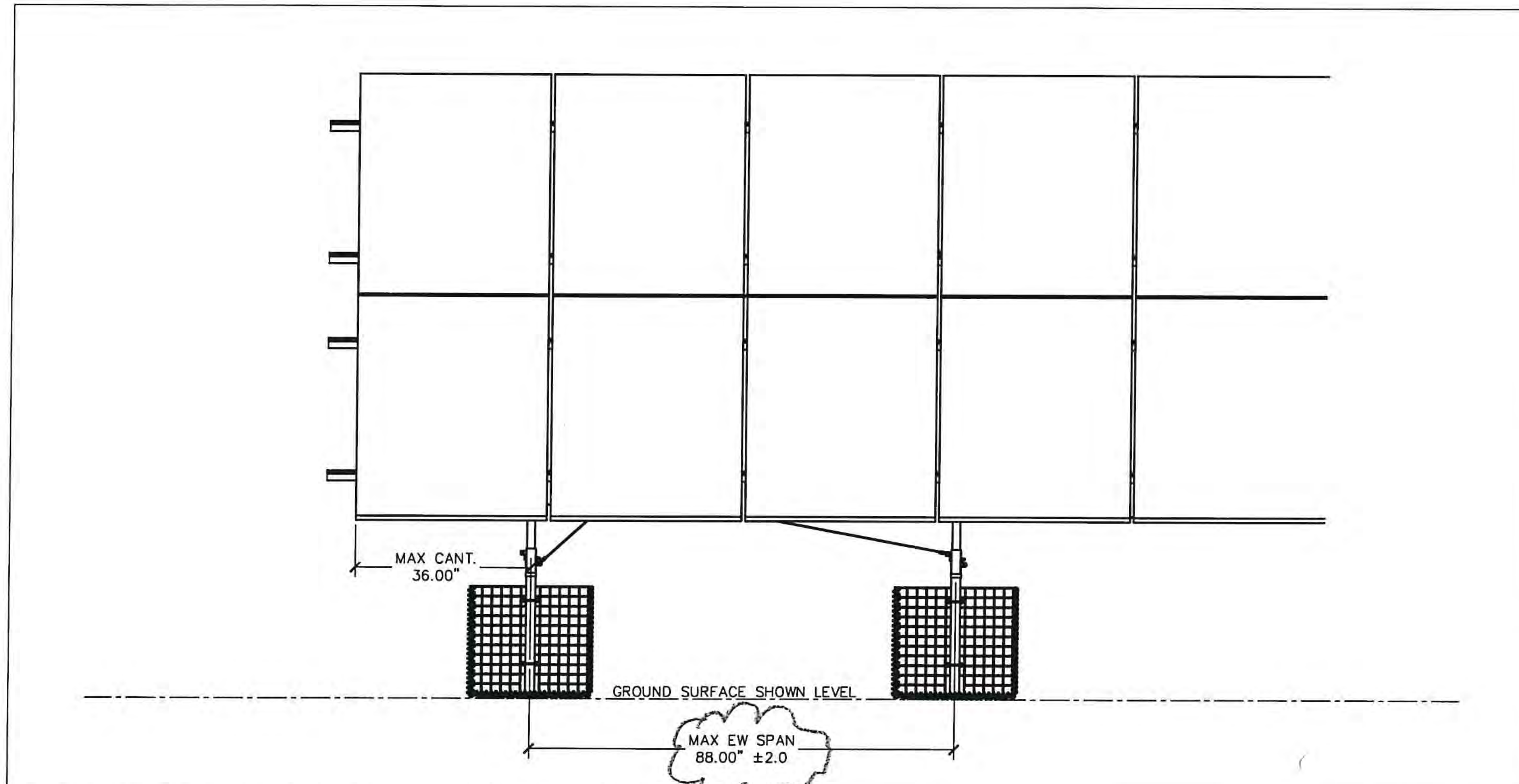
NOTES:
1. DIMENSIONS APPROXIMATE. DUE TO THE NATURE OF WIRE MESH AND FILL AGGREGATE, ACTUAL USABLE DIMENSIONS MAY VARY SLIGHTLY.

C3 BALLAST DIMENSIONS

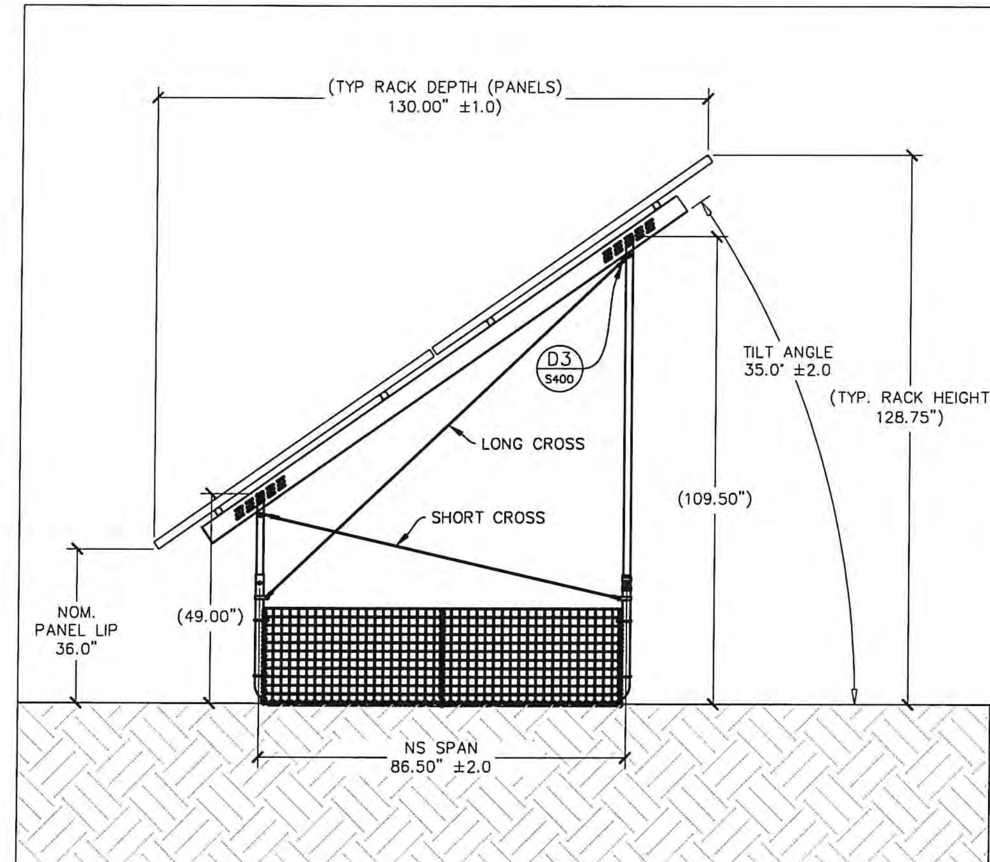
NOTES:

1. PLACE BALLAST AT DESIGNATED SURVEY POINTS
2. ASSEMBLE PER MANUFACTURER'S GUIDELINES AND THIS DOCUMENT.
3. APPROXIMATE VOLUME OF BALLAST: 25.67 CUBIC FEET. (0.95 CUBIC YARDS.)
4. FILLED BALLAST (BASKET AND AGGREGATE) VERIFIED TO MINIMUM OF 2220 LBS
5. CALCULATIONS:
   RIPRAP STD. DENSITY: 150 LBS PER CUBIC FOOT
   CALCULATED VOID PERCENTAGE: APPROX. 42%

   CALCULATED BALLAST WEIGHT:
   2230 LBS + DEAD (272 LBS) =
   MIN. 2500 LBS PER BALLAST
6. SPEC AGGREGATE: RIP-RAP, D-50, ROCK SIZE MUST BE LARGER THAN 3" IN DIAMETER. OTHER MATERIALS ACCEPTABLE BUT MUST BE APPROVED BY APA ENGINEERING AND MUST MEET MINIMUM WEIGHT & SIZE REQUIREMENTS.
7. IF LEVELING OF GROUND SURFACE IS REQUIRED, PLACE AND COMPACT AGGREGATE BASE COURSE (ABC) MATERIAL COMPOSED OF 3/4" OR GREATER CRUSHED STONE WITH FINES FOR PROPER BINDING.



A1 ELEVATION VIEW: STD. BALLAST RACKING TABLE



A4 PROFILE VIEW: STD. BALLAST RACKING TABLE

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SHEET REVISIONS

REV.	DESCRIPTION	DATE
A	INITIAL RELEASE	3/9/2020

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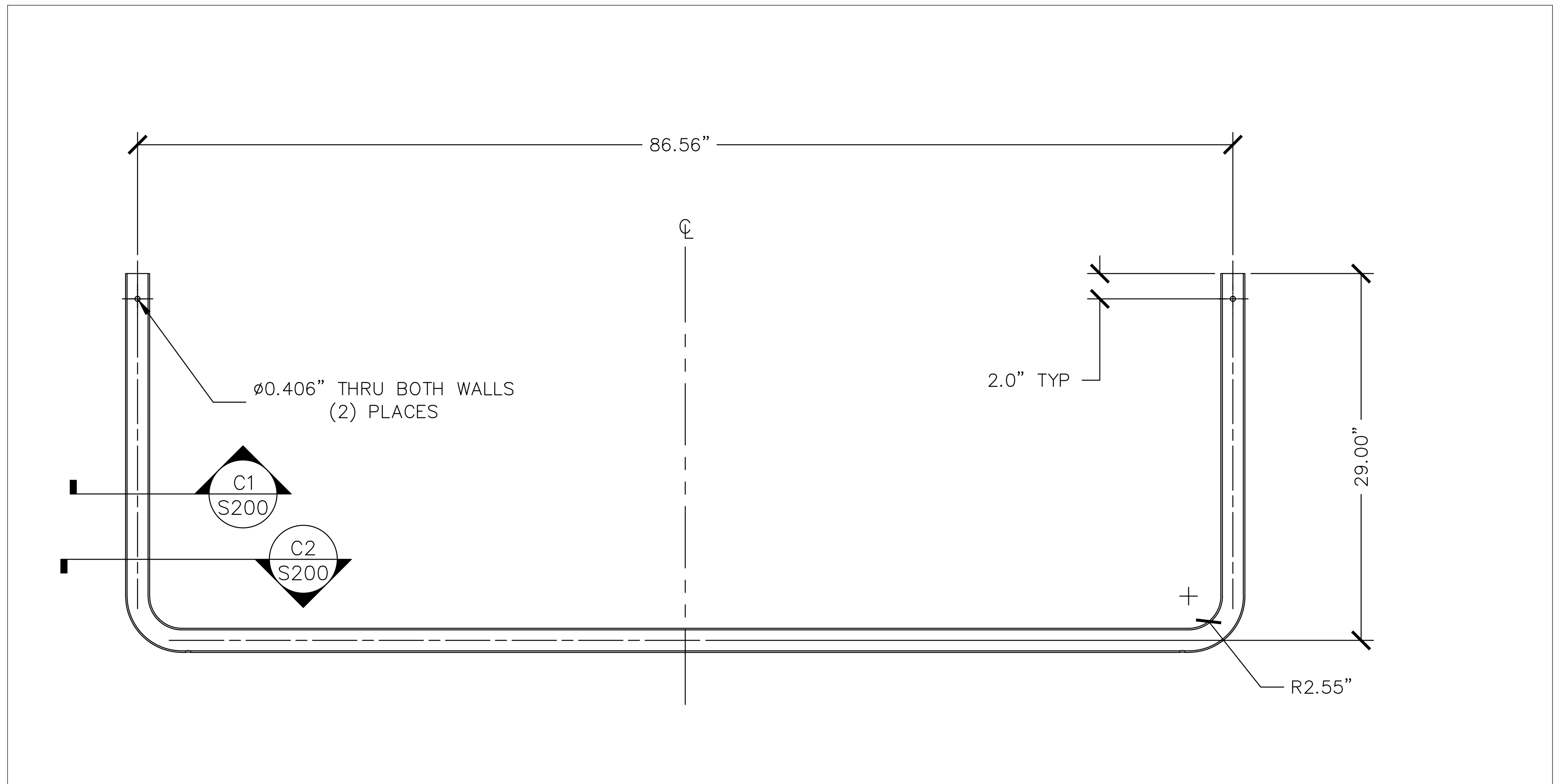
DRAWN	REVIEWED	APPROVED	SIZE
JK	JR	JDI	D

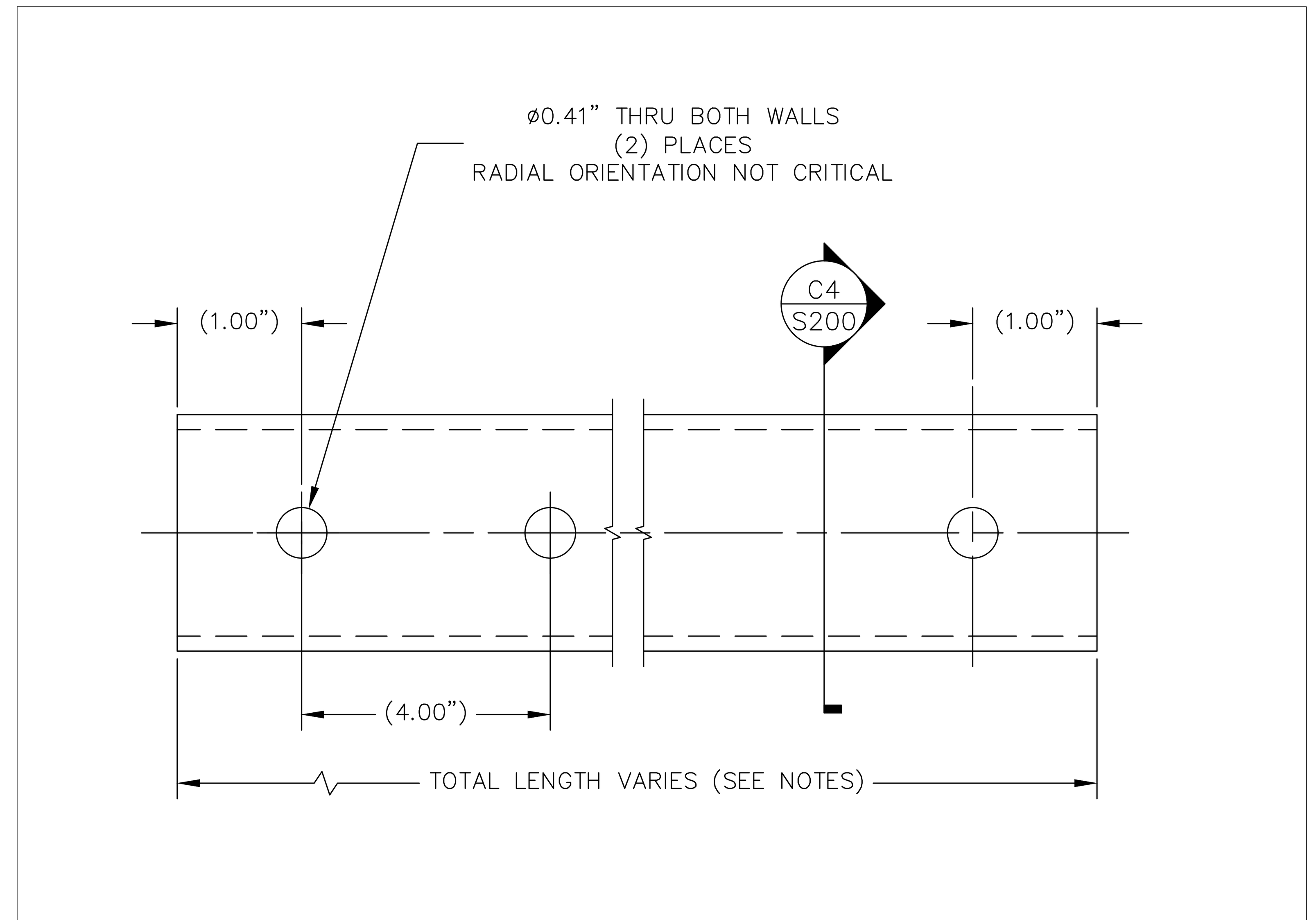
SHEET NAME: RACKING SPECIFICATIONS OVERVIEW

PROJECT NUMBER: GX35ME-001

DRAWING NUMBER: S.100 REV. A



D1 PART: BENT ANCHOR POST (LOWER)

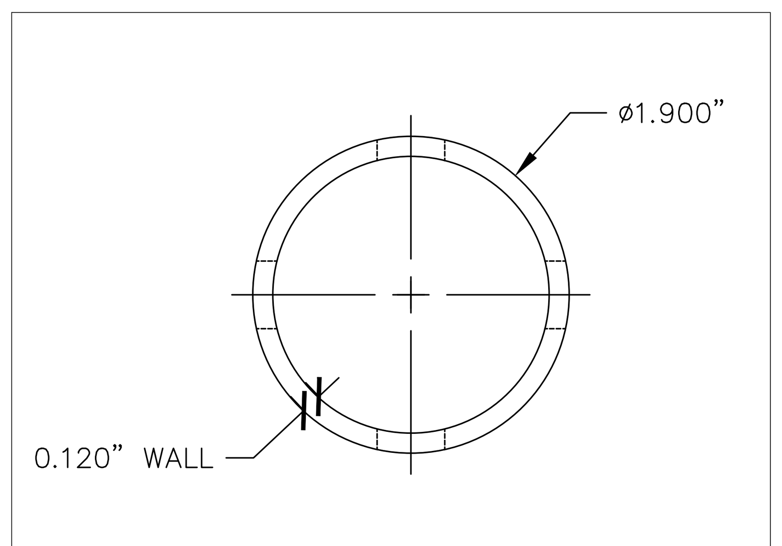


NOTES:
1. LENGTHS VARY, SEE SHEET NOTES

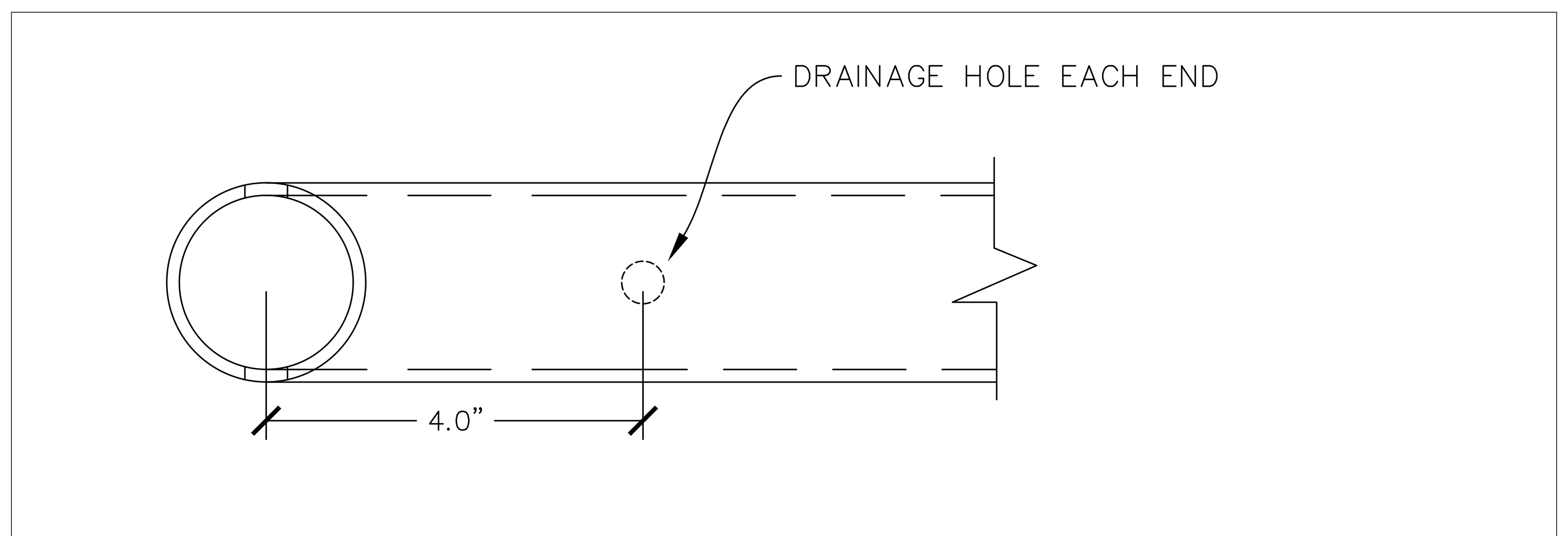
D2 PART: UPPER ANCHOR POST

NOTES:

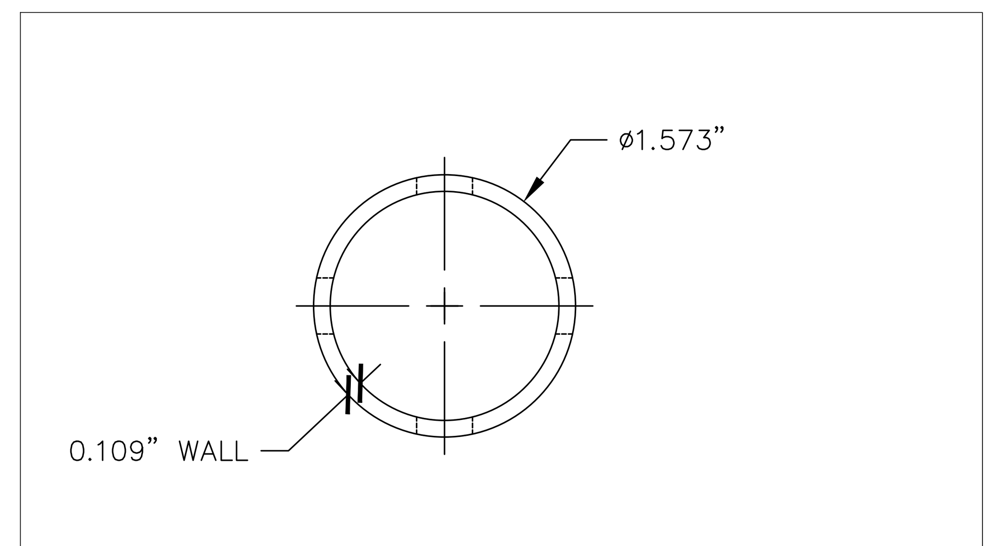
1. TUBE MATERIAL: 50 KSI MIN YIELD STRENGTH, 1010 STEEL
2. TUBE AND ANCHOR SYSTEM TO BE HOT DIPPED GALVANIZED TO ASTM A123 OR INLINE GALVANIZED TO ASTM A1057
3. ALL HARDWARE IS 300 SERIES STAINLESS STEEL.
4. RESISTANCE WELDING PER AWS D8.7–88
5. MESH PANELS HOT DIP GALVANIZED TO G90 MIN.
6. MESH PANELS MAY BE ADDITIONALLY PVC DIPPED AND COATED FOR AESTHETIC PURPOSES ONLY AND FOR ADDITIONAL WEATHER PROTECTION. THE PVC COATING IS NOT REQUIRED FOR THE PRODUCT LIFESPAN.
7. INSTALLATION:
   - 7.1. UNFOLD SEMI–ASSEMBLED WIRE FORM INSERT BENT TUBE INTO BOTTOM OF BOX THEN FOLD OVER BOTTOM AND FULLY ASSEMBLE BALLAST BOX AS SHOWN IN A1.
   - 7.2. BENT TUBE MUST BE IN CENTER END PANELS.
   - 7.3. U–CLAMP PLACEMENT SECURES BENT TUBE IN PLACE, 2 PLACES.
   - 7.4. ANCHOR TUBE TO BE INSTALLED INTO BENT TUBE. ANCHOR TUBE SLEEVE FIT INTO BENT TUBE. THEN ALIGNED WITH HOLE AND BOLT TOGETHER.
   - 7.5. BALLAST MUST BE FILLED WITH PROPER SPEC AGGREATE BEFORE REST OF RACKING IS INSTALLED.
8. ANCHOR POST TOLERANCES
   - 8.1. ± 2" VARIATION IN HEIGHT.
   - 8.2. ± 2" VARIATION IN NORTH–SOUTH DIRECTION.
   - 8.3. ± 2" VARIATION IN EAST–WEST DIRECTION.
   - 8.4. ± 2° VARIATION IN POST PLUMBNESS.
9. ACCURATELY LOCATE AND INSTALL ANCHOR POSTS BY SUCH METHODS AND EQUIPMENT SO AS NOT TO IMPAIR THE ANCHOR STRENGTH OR DAMAGE ANCHORS OR ADJACENT CONSTRUCTION.
10. EXPOSED DISTURBED GALVANIZED SURFACES SHALL BE TOUCHED UP WITH AN APPROVED COLD GALVANIZING COMPOUND.
11. BALLAST SHOULD BE FILLED TO TOP OF WIRE EDGE WITH SPECIFIED AGGREGATE. FILL SLOWLY AND ON LEVEL SURFACE TO AVOID DEFORMING OR BULGING OF BALLAST



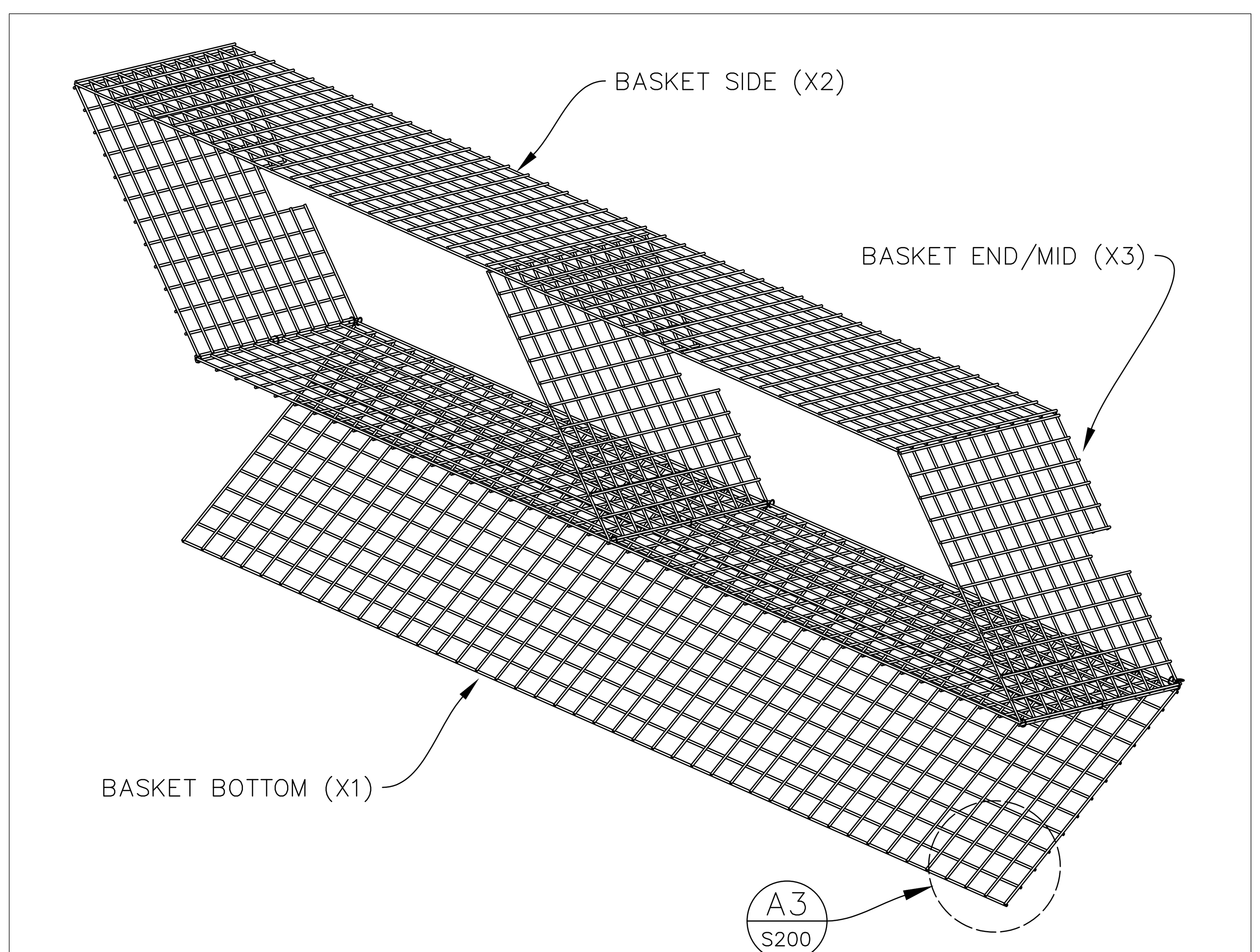
C1 SEC.: BENT ANCHOR POST



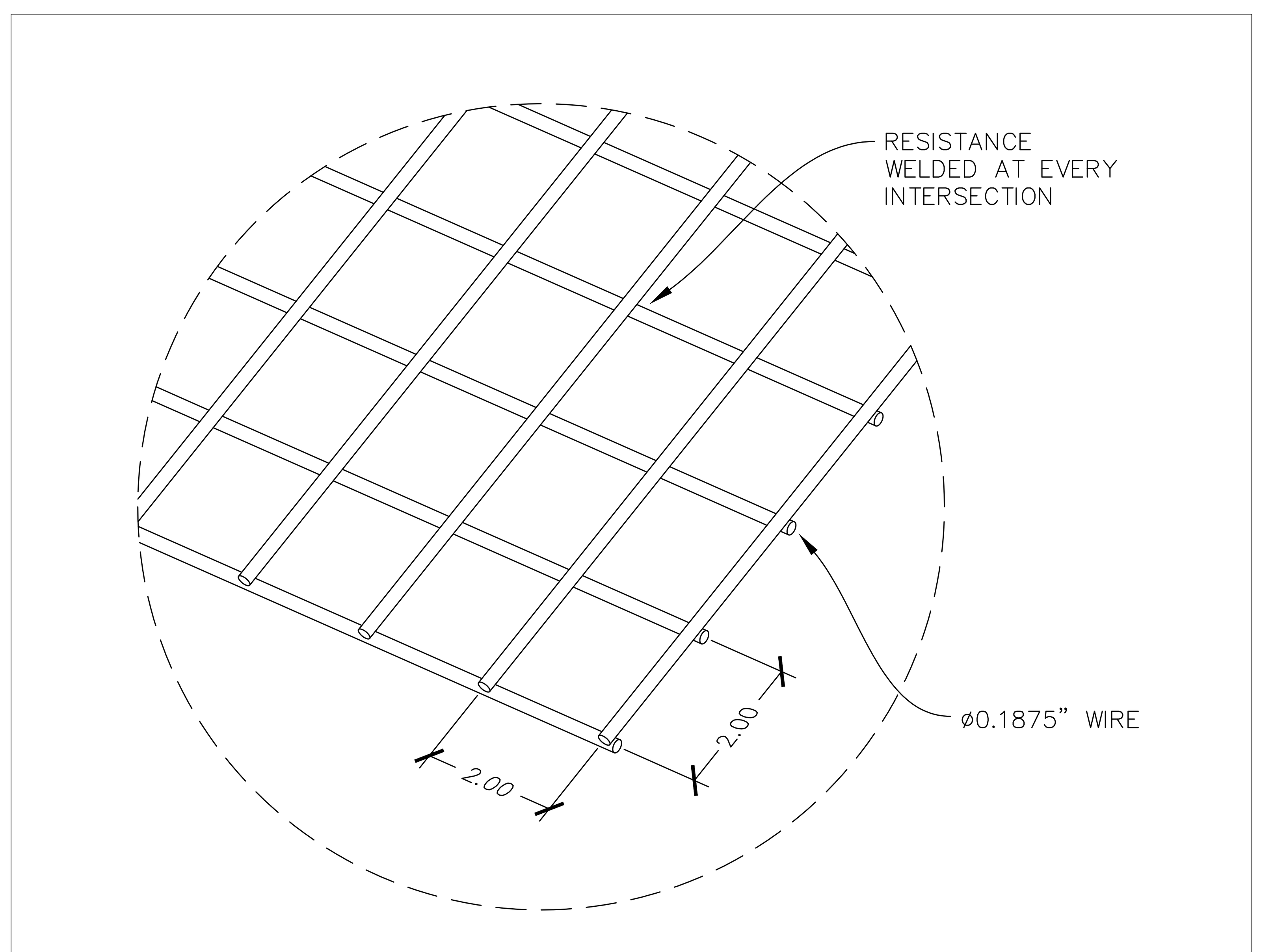
C2 DETAIL: BENT ANCHOR POST HOLES



C4 SEC.: UPPER ANCHOR



A1 PART: WIRE MESH BASKET – UNFOLDED



A3 DETAIL: WIRE MESH BASKET

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SHEET REVISIONS

REV.	DESCRIPTION	DATE
A	INITIAL RELEASE	5/8/2020

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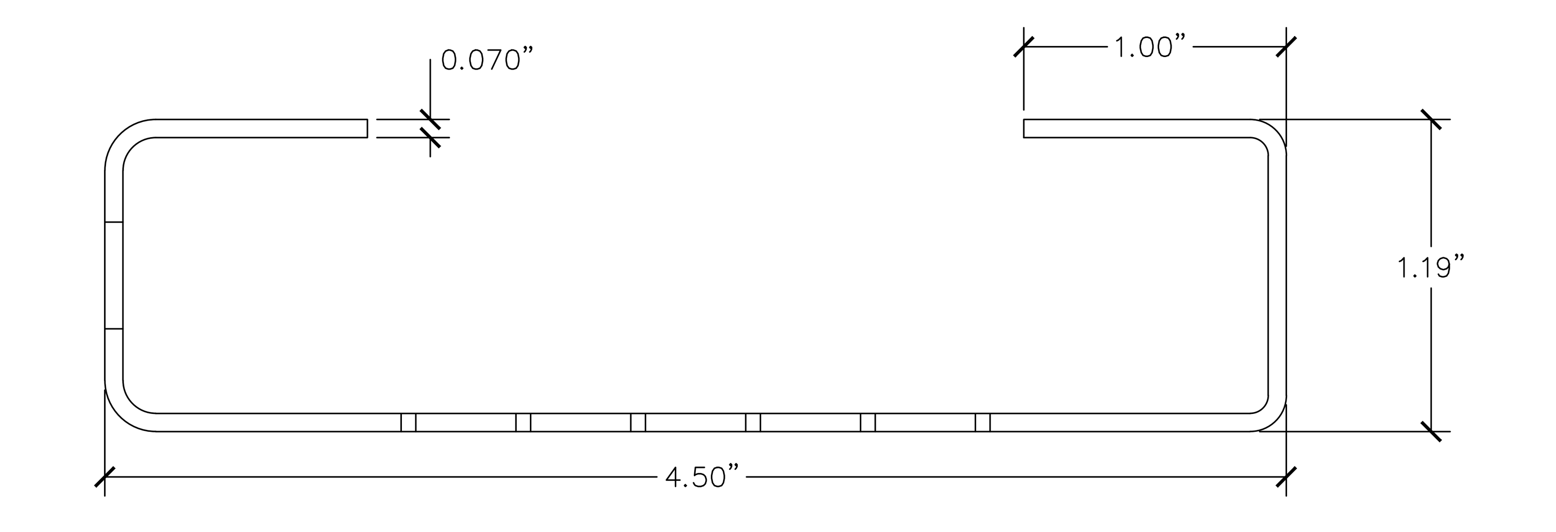
DRAWN	REVIEWED	APPROVED	SIZE
JK	JR	JDI	D

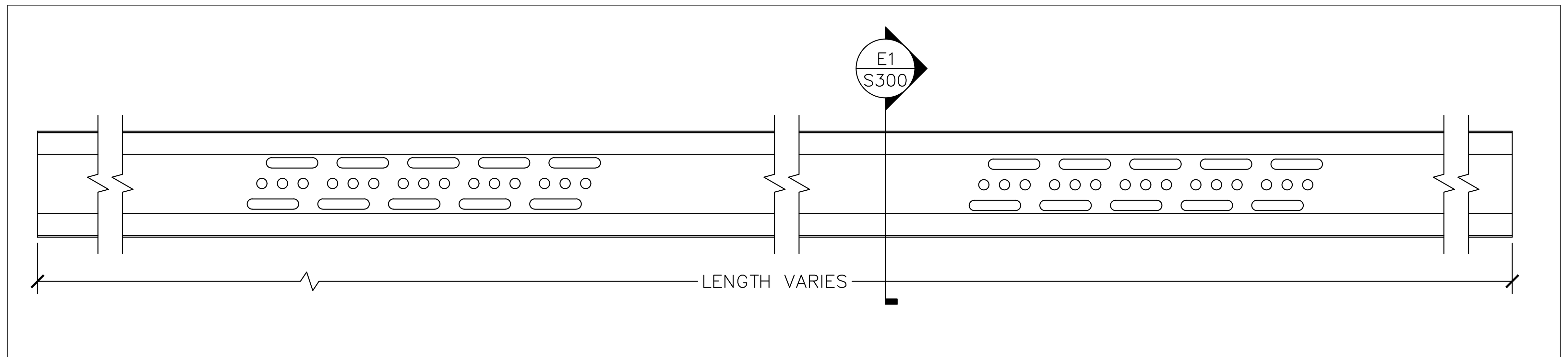
SHEET NAME: STRUCTURAL BALLAST MEMBERS

PROJECT NUMBER: GX35ME-001

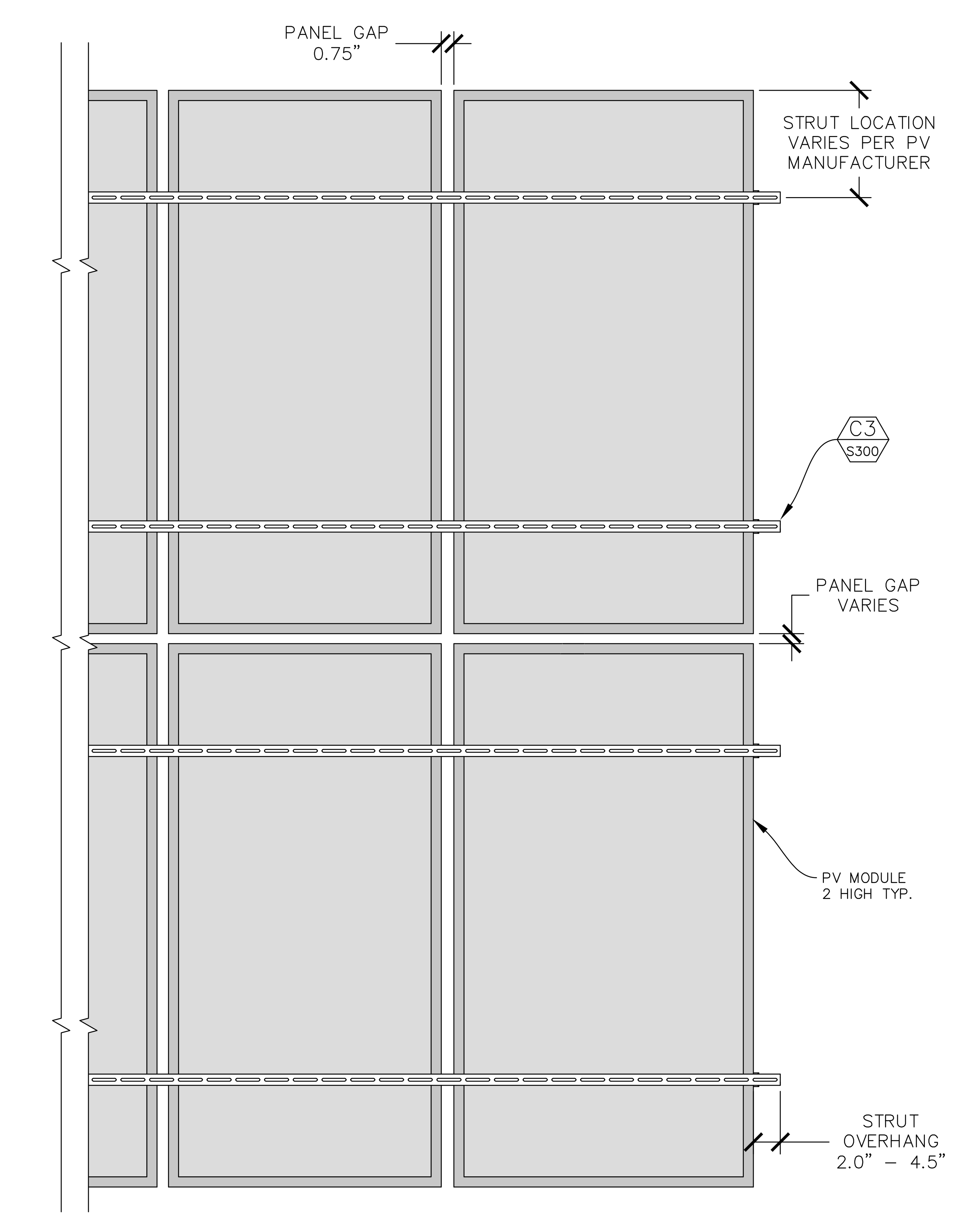
DRAWING NUMBER: S.200 | REV.: A



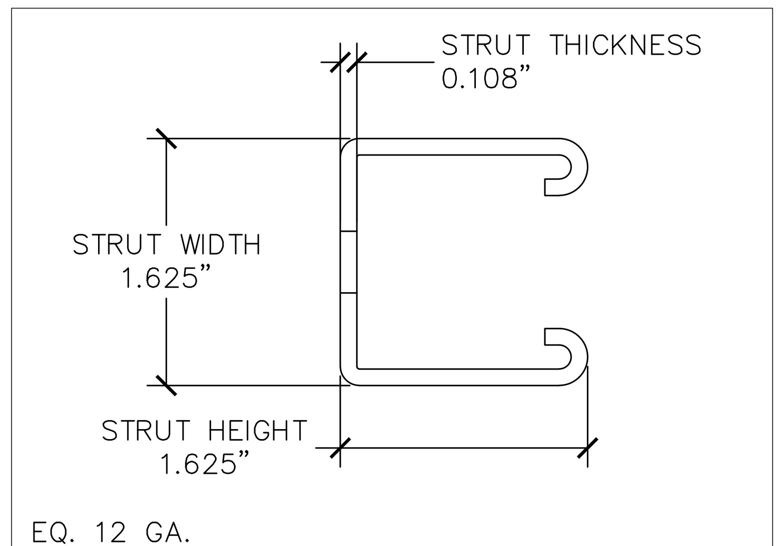
E1 PART: NS (VERTICAL) CEE PURLIN



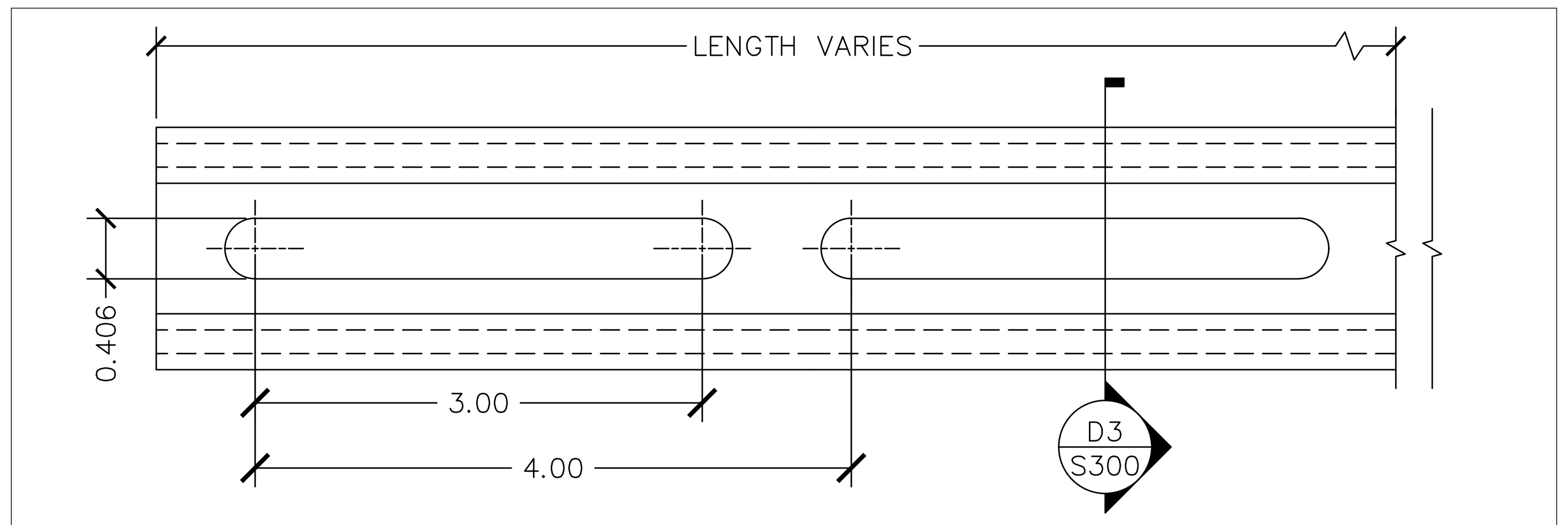
E3 VIEW: NS CEE PURLINS



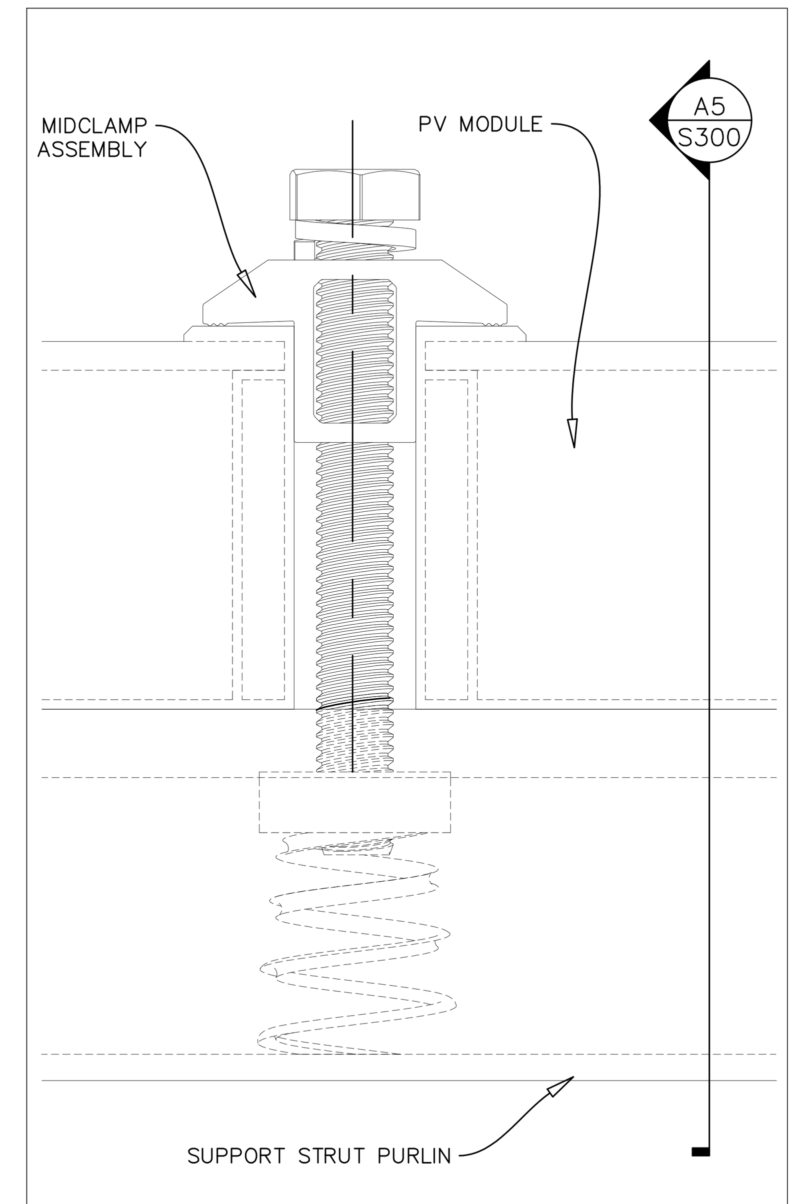
A1 ASSEMBLY: PANELS TO EW STRUTS – BOTTOM VIEW



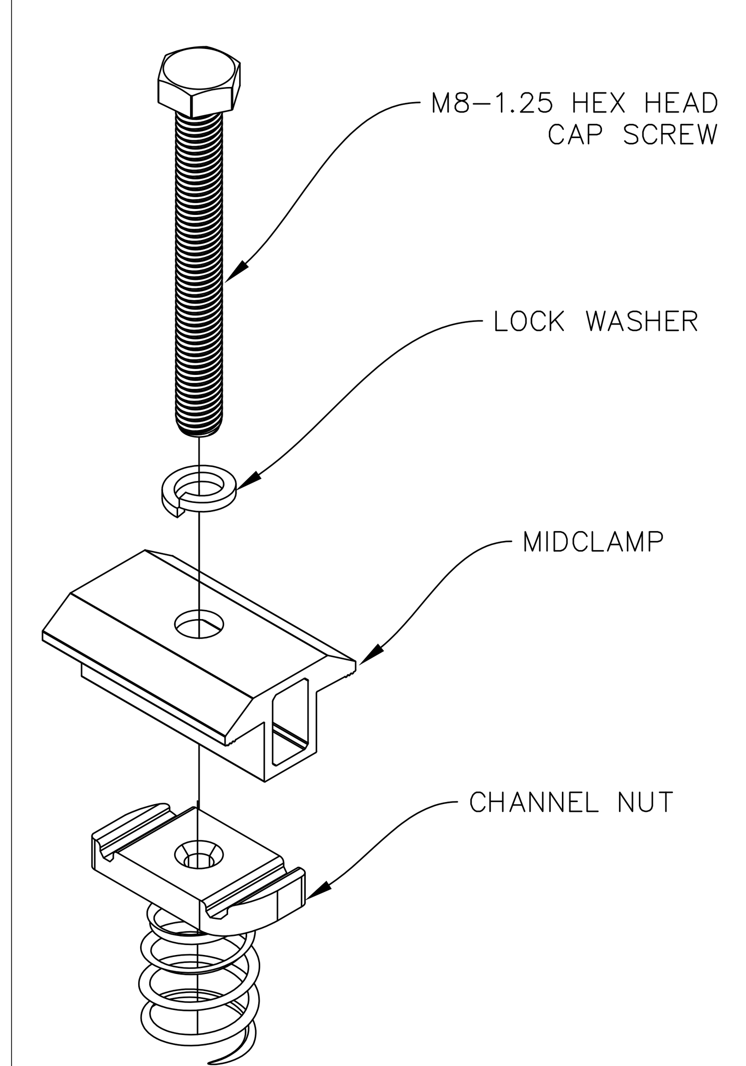
D3 SECTION: EW STRUT



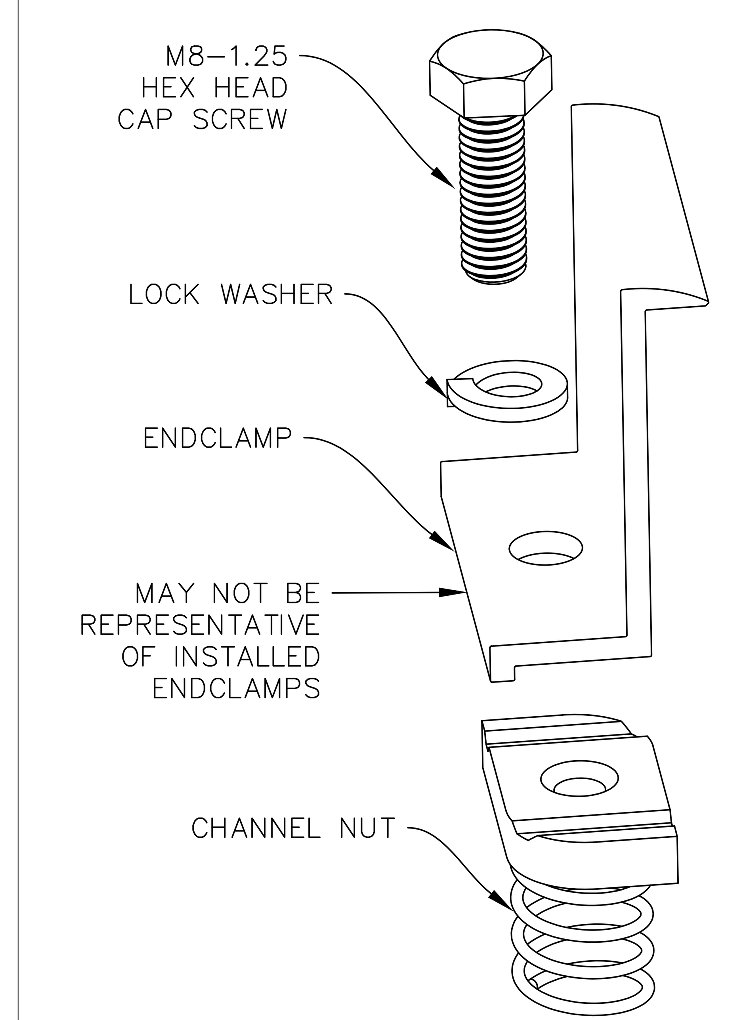
C3 PART: STRUT CHANNEL WITH LONG SLOTS



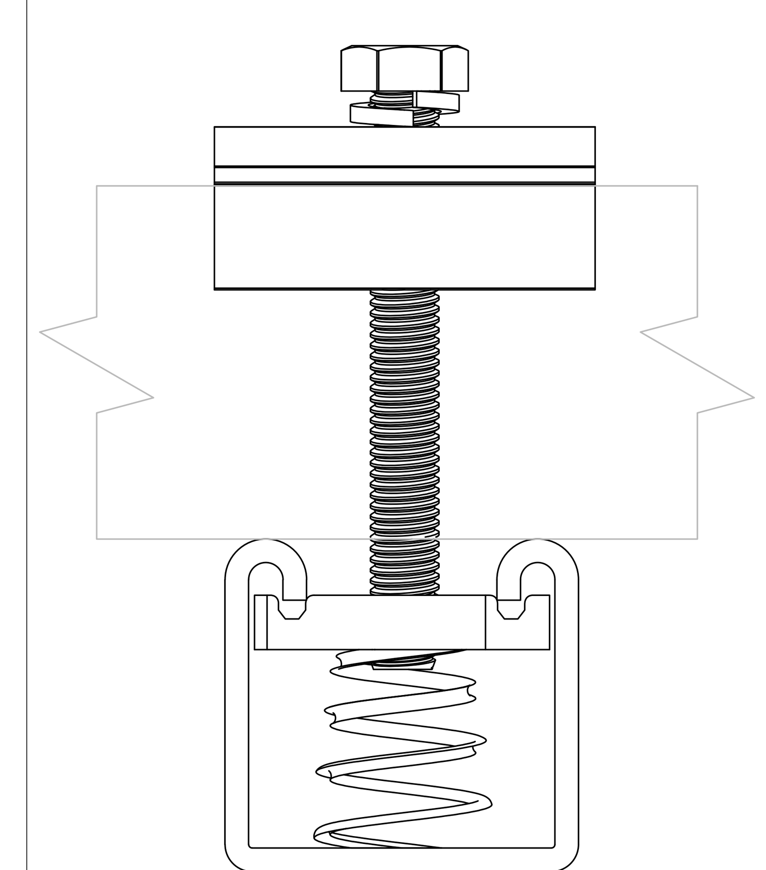
C5 CONNECTION: PV–TO–STRUT



A3 CONNECTION: MIDCLAMP



A4 CONNECTION: ENDCLAMP



A5 CONNECTION: PV–TO–STRUT

NOTES

1. STRUT PURLIN MATERIAL AND FINISH ARE MANUFACTURED TO SPECIFICATIONS THAT EXCEED OUR STANDARD PRODUCT WARRANTY.
2. STRUT PURLIN GALVANIZED TO CONFORM TO A MINIMUM THICKNESS DESIGNATION EQUAL TO G90 OR INLINE GALVANIZED TO COMPARABLE THICKNESS AS PER ASTM A1057.
3. ALL PURLINS MANUFACTURED USING ASTM A1011/A1011M STRUCTURAL STEEL.
4. MINIMUM STEEL Fy YIELD STRENGTH OF STRUT PURLINS TO BE 50 KSI.
5. MINIMUM STEEL Fy YIELD STRENGTH OF CEE CHANNEL TO BE 50 KSI.
6. SLOT DIMENSIONS FOR REFERENCE ONLY. ALTERNATE HOLE PATTERNS MAY BE SUBSTITUTED.
7. LENGTH OF PURLINS VARIES BY PROJECT AND LOCATION WITHIN ARRAY. LENGTH OF PURLINS DOES NOT AFFECT STRUCTURAL CAPACITY.
8. PANEL DIMENSIONS VARY. REFER TO MANUFACTURER'S SPEC SHEET.
9. STRUT PLACEMENT IN RELATIONSHIP TO PANEL DICTATED BY MANUFACTURER, SEE MANUFACTURER'S INSTALL MANUAL.
10. CLAMP PLACEMENT DETERMINED BY STRUT PLACEMENT.
11. ENDCLAMPS MUST BE INSTALLED AT BOTH ENDS OF THE ROW, AT THE EAST AND WEST END (TYP.) OF EACH STRUT.
12. STAINLESS STEEL HARDWARE)

    NOMINAL TORQUE VALUE
    M8–1.25: 15.6 FT–LBS

    MIN/MAX TORQUE VALUES
    M8–1.25: 14.0 – 32 FT–LBS

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SHEET REVISIONS

REV.	DESCRIPTION	DATE
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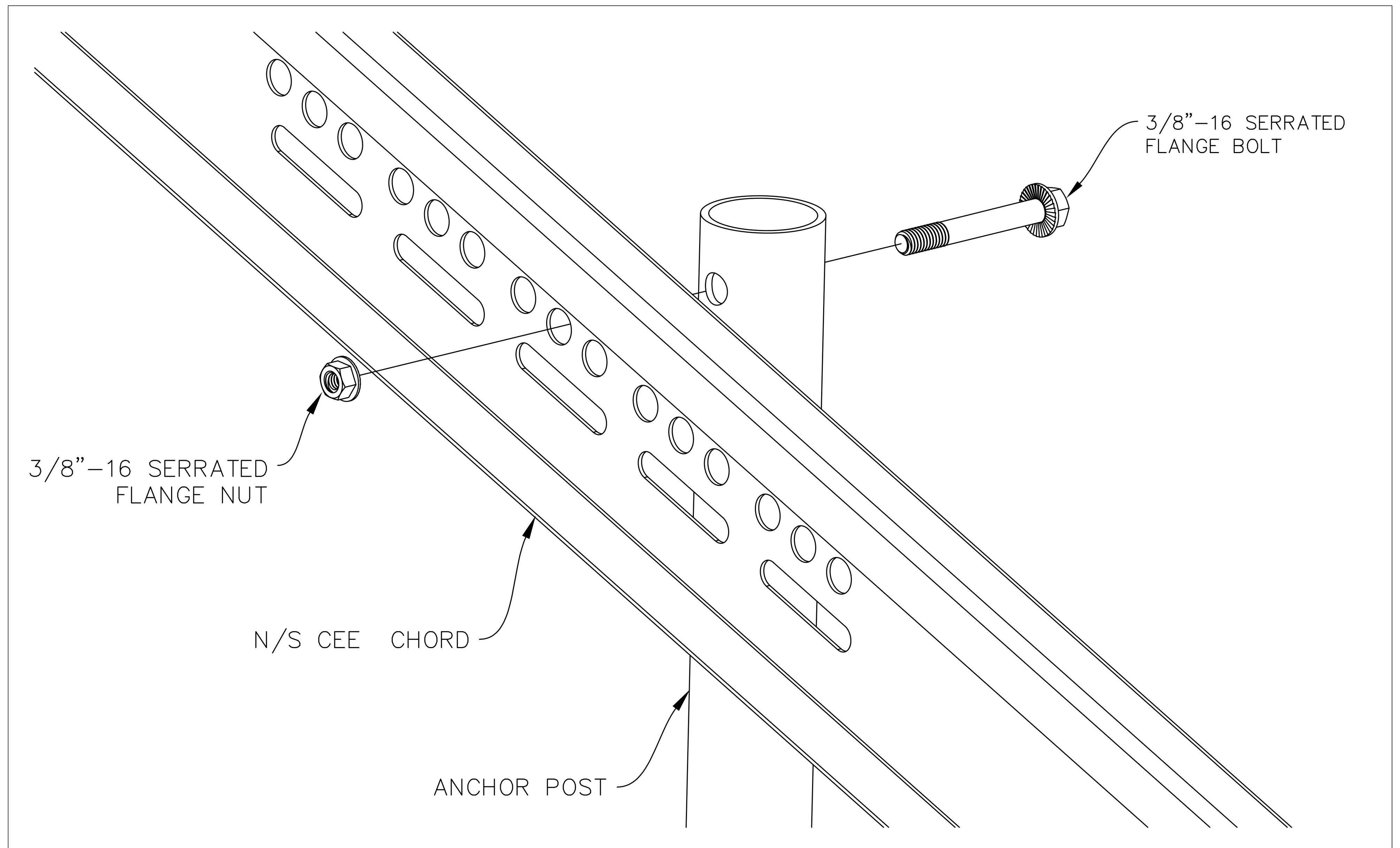
DRAWN	REVIEWED	APPROVED	SIZE
JK	JR	JDI	D

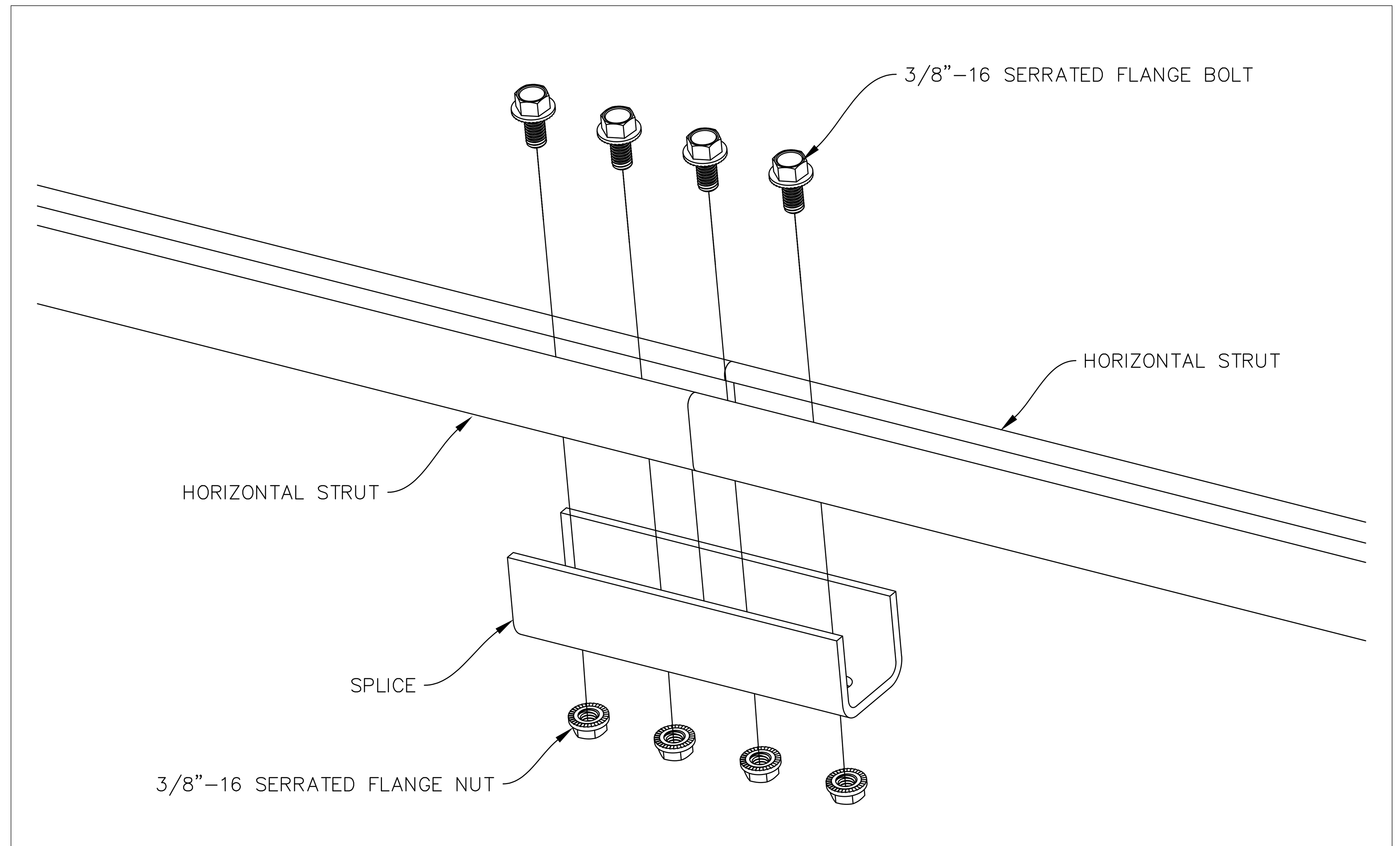
SHEET NAME: STRUCTURAL PURLINS

PROJECT NUMBER: GX35ME–001

DRAWING NUMBER: S.300 REV.: A



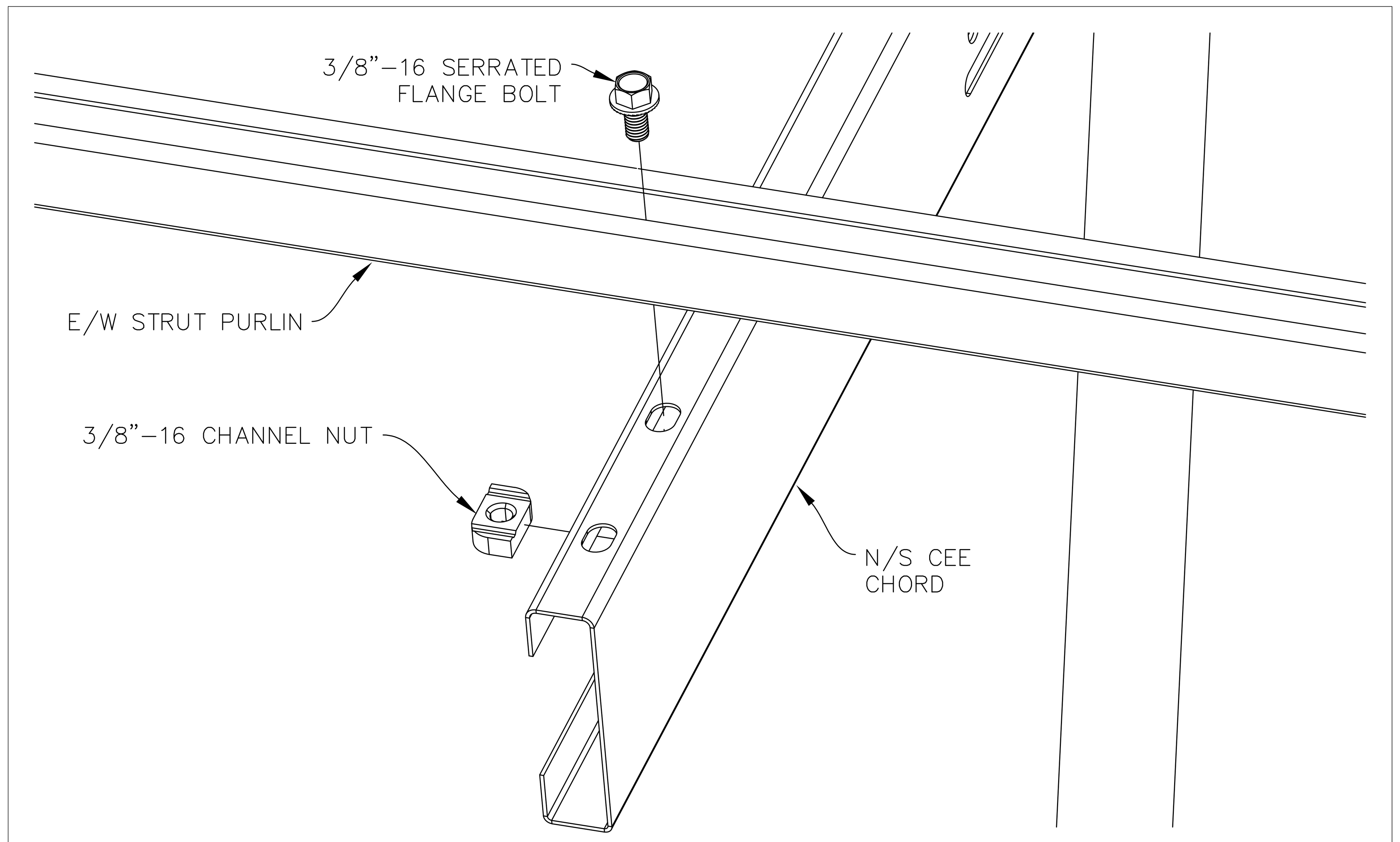
D1 CONNECTION: CEE–TO–POST



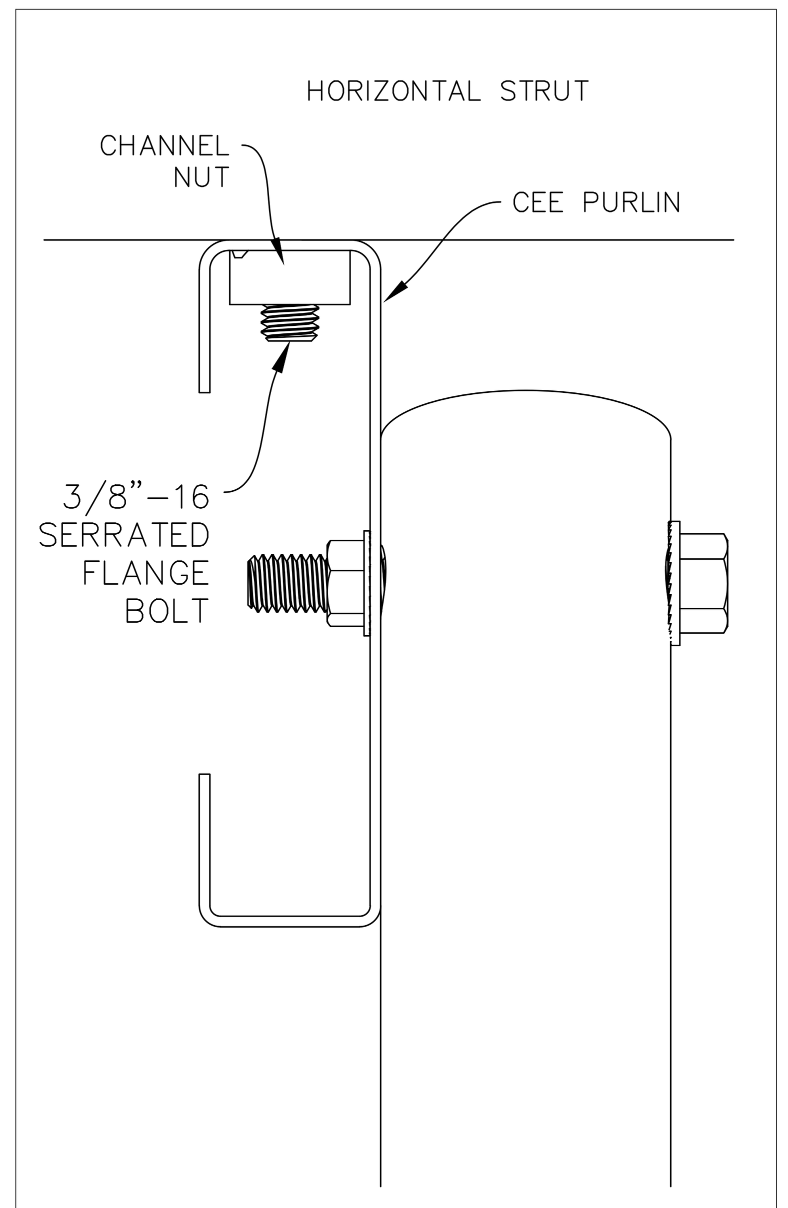
D3 CONNECTION: STRUT–TO–STRUT SPLICE

NOTES

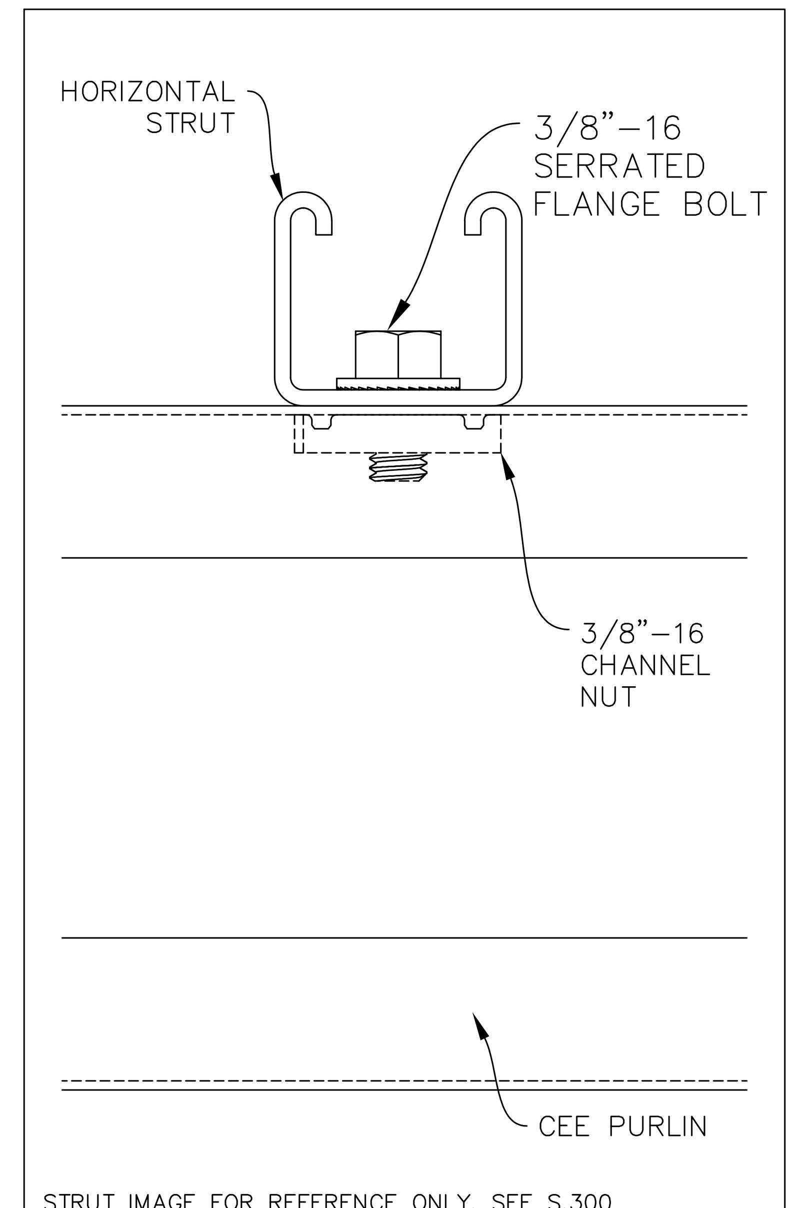
1. RECOMMENDED TORQUE VALUES (FOR STAINLESS STEEL HARDWARE)
   1.1. 3/8–16: 19.6 FT–LBS
2. MIN/MAX TORQUE VALUES (FOR STAINLESS STEEL HARDWARE)
   2.1. 3/8–16: 17.5 – 50.0 FT–LBS
3. DEPICTED HARDWARE AND PART PLACEMENT NOT INDICATIVE OF PREFERRED OR REQUIRED POSITIONS.
4. TILT ANGLE IS SETUP BY ANCHOR POST HEIGHTS.
5. CEE CHANNEL ALLOWS FOR HEIGHT ADJUSTMENT, FORWARD/REAR ADJUSTMENT, AND MULTIPLE TILT ANGLES.
6. OTHER SPECIFIC CONNECTIONS ELSEWHERE IN PRINT SET.
7. STRUT PURLINS MUST CONNECT TO THE CORRECT HOLES IN CEE CHANNEL, AS DEFINED IN CONSTRUCTION PRINTS (INNER, MIDDLE, OR OUTER TYPICALLY), AND AS DETERMINED BY PV MODULE MANUFACTURERS.
8. USE CORRECT NOMINAL HOLES IN CEE TO CONNECT TO ANCHOR POST, AS INDICATED IN CONSTRUCTION PRINTS. ADJACENT HOLES AND SLOTS ONLY FOR IN–FIELD ADJUSTMENTS.
9. SERRATED HARDWARE MAY BE REPLACED WITH EQUIVALENT HARDWARE WITH WASHERS IF NECESSARY.



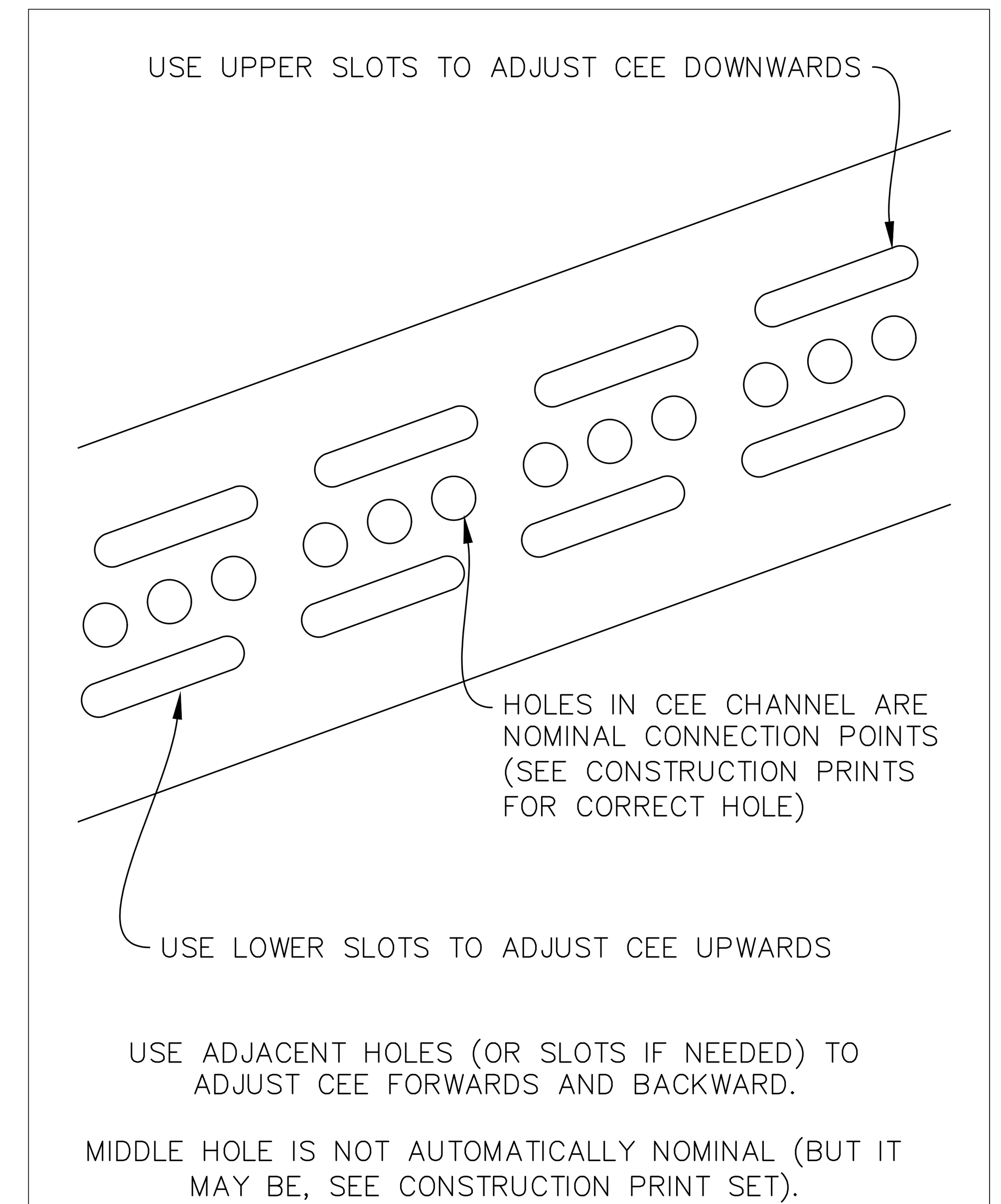
B1 CONNECTION: STRUT–TO–CEE



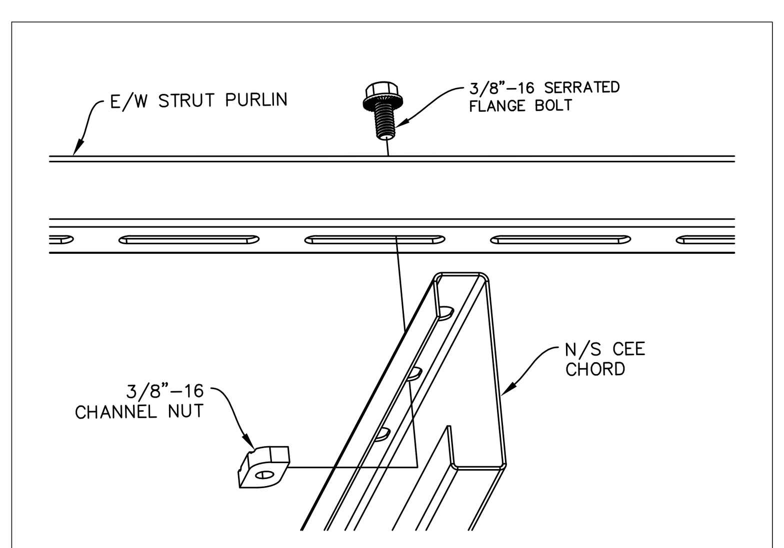
B3 DETAIL B1 FRONT VIEW



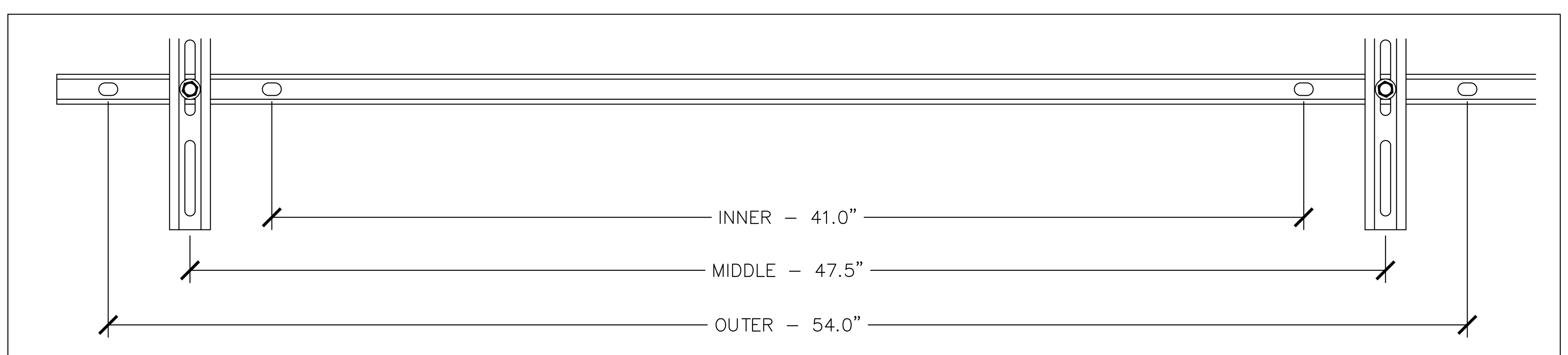
B4 DETAIL B1 SIDE VIEW



B5 DETAIL: CEE–TO–POST ADJUSTMENT



A1 DETAIL B1 UNDERSIDE



A2 DETAIL: STRUT–TO–CEE CONNECTION ZONES

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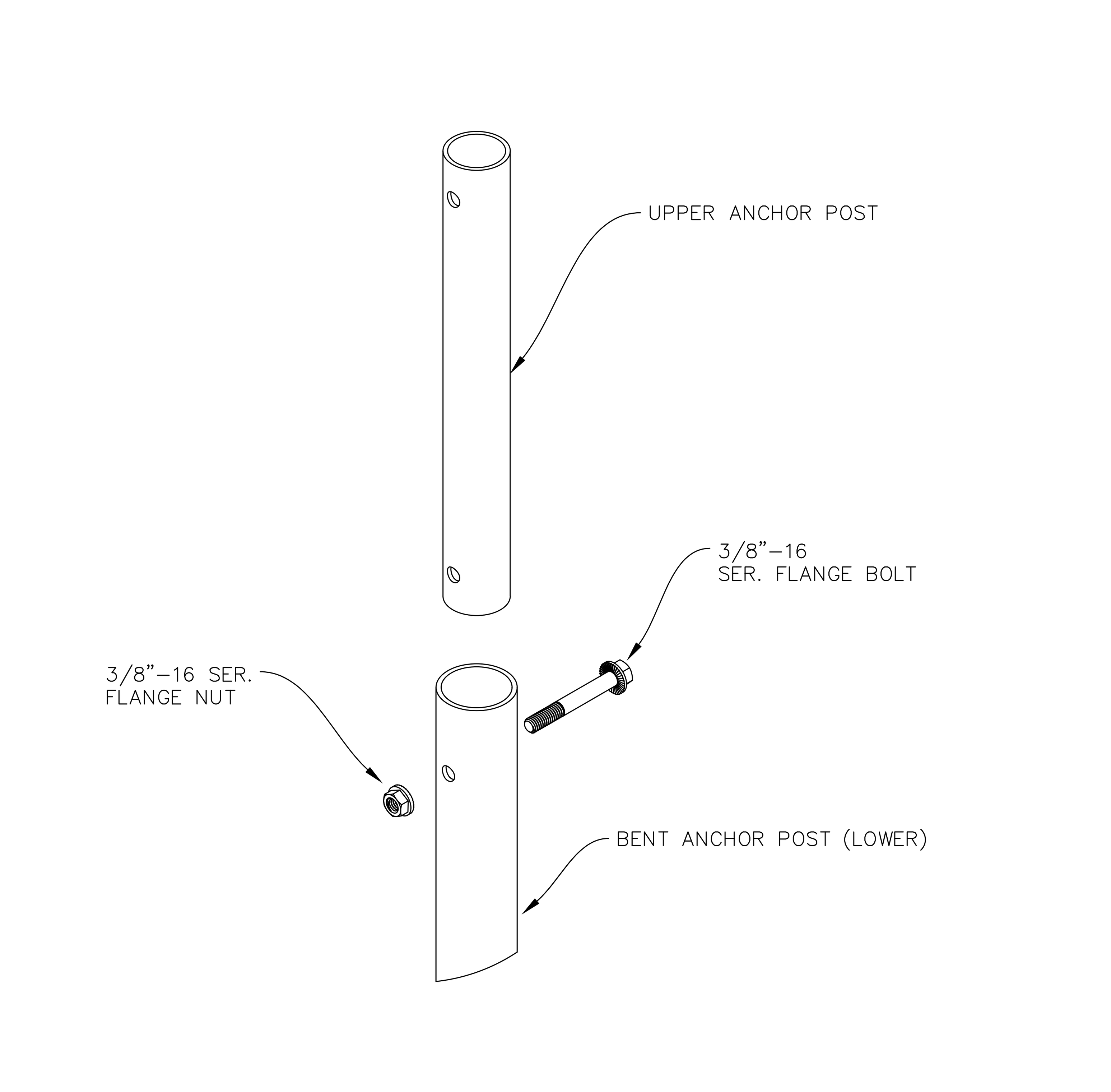
JK	JR	JDI	D

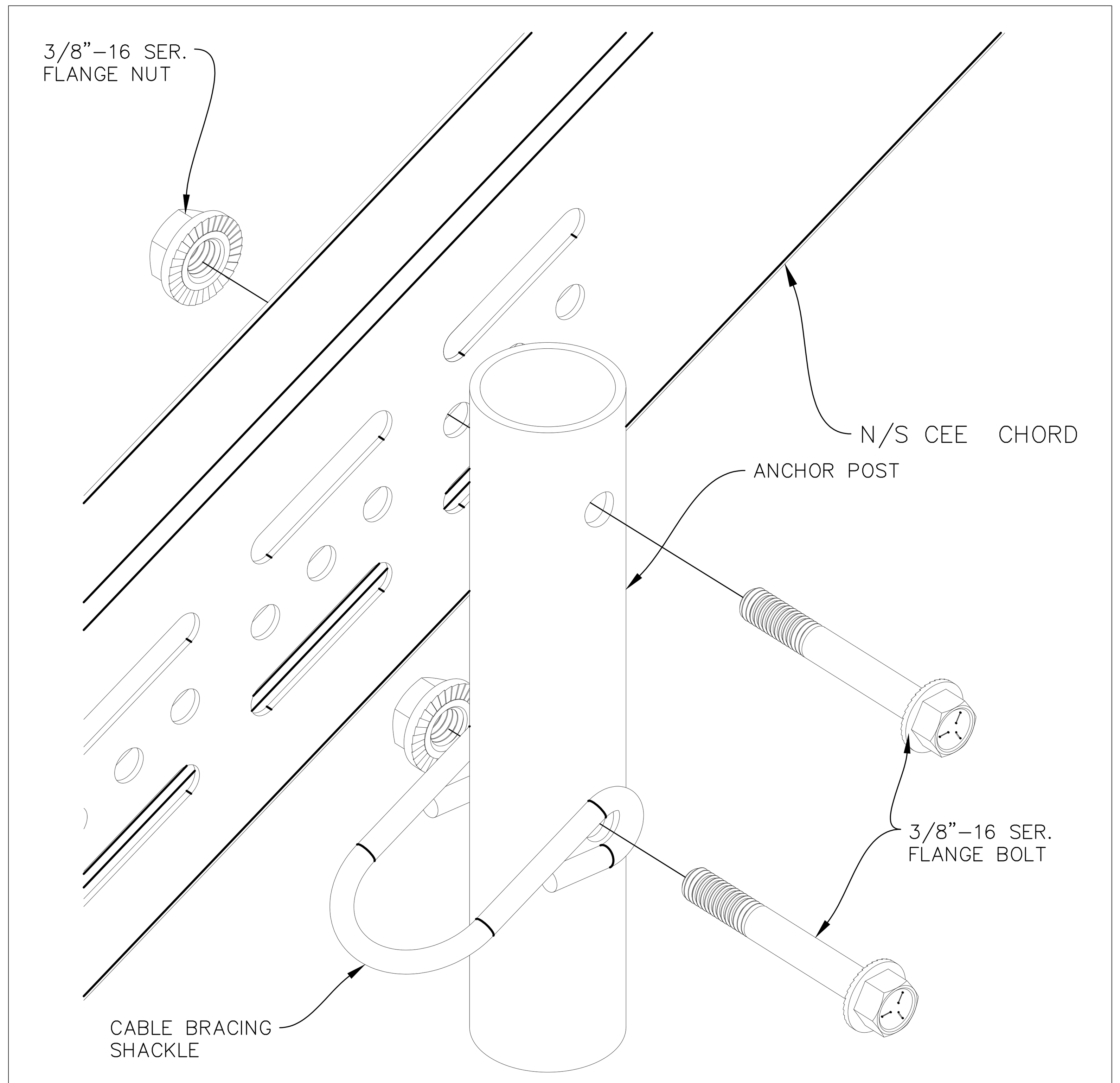
SHEET NAME: CONNECTIONS OVERVIEW

PROJECT NUMBER: GX35ME-001

DRAWING NUMBER: S.500 REV. A

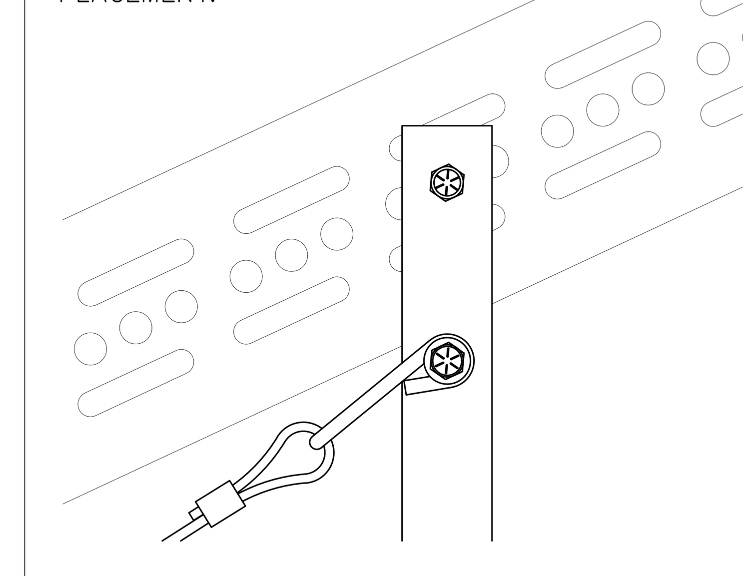


C1 CONNECTION: UPPER ANCHOR–TO–LOWER ANCHOR

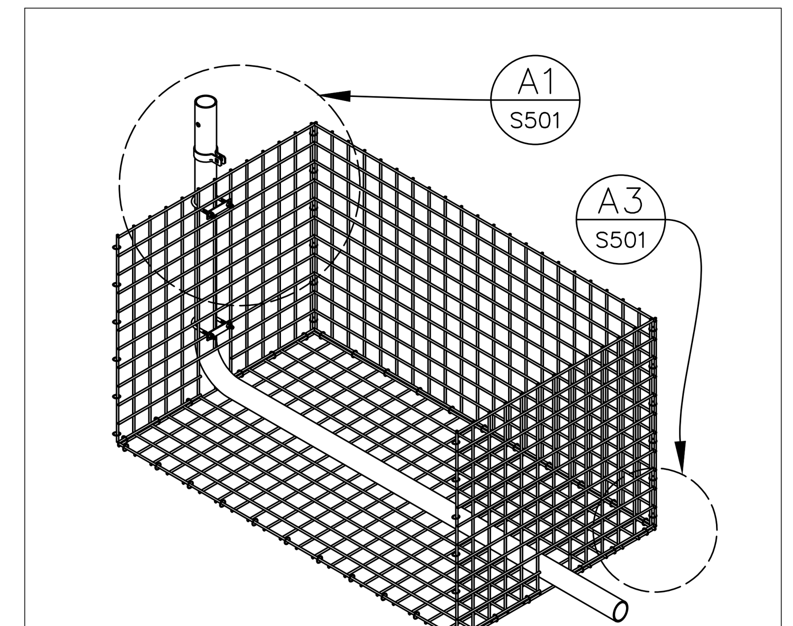


C3 CONNECTION: UPPER ANCHOR POST–TO–CEE

NOTE:
IMAGE FOR REFERENCE ONLY. SEE LAYOUT DRAWING FOR PROPER PLACEMENT.



D5 DETAIL: CEE TO POST

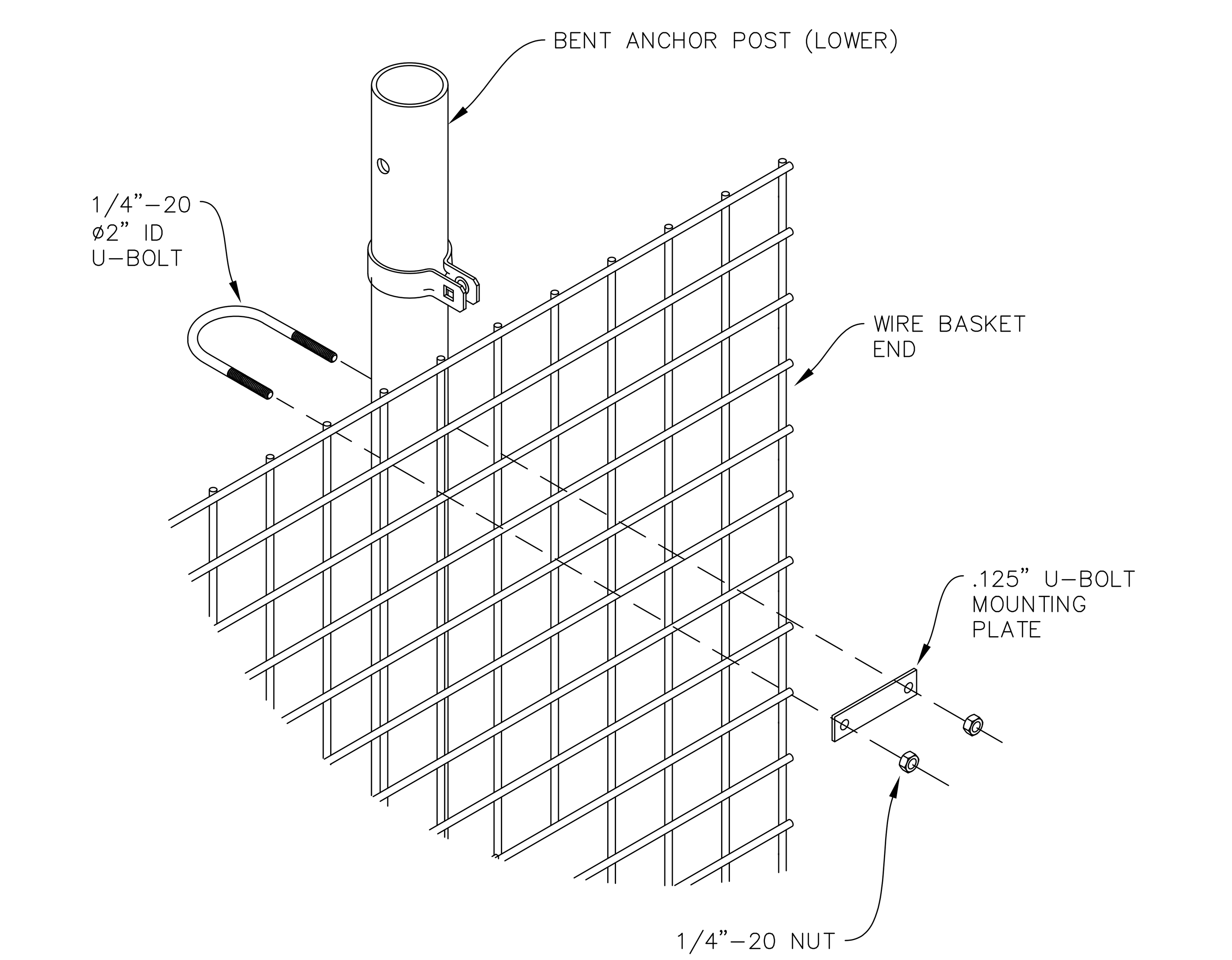


NOTES:
U–BOLT 2 PLC. BELOW WIRE AT TOP, ABOVE AT BOTTOM

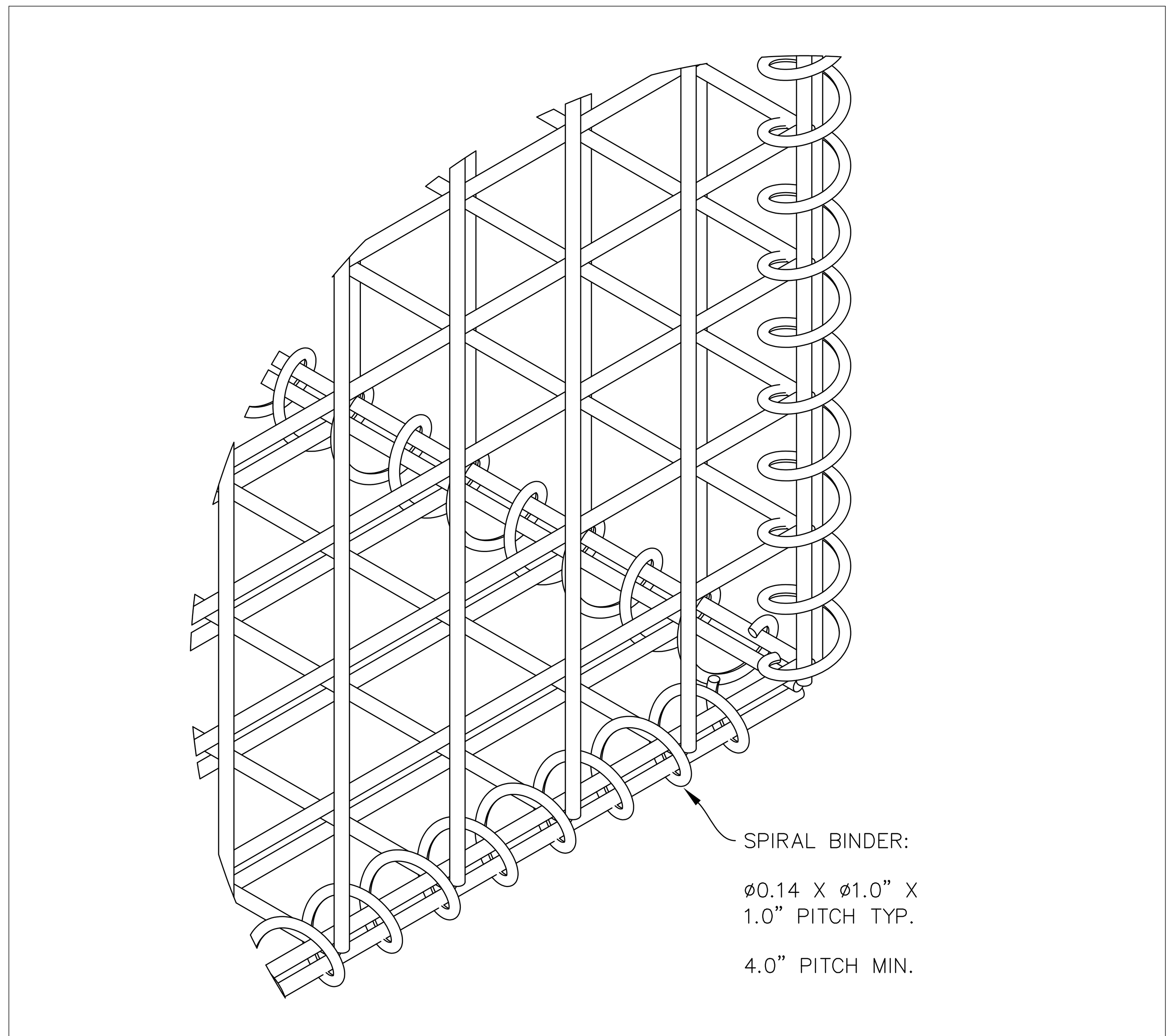
C5 U–BOLT PLACEMENT

NOTES:

1. RECOMMENDED TORQUE VALUES FOR STAINLESS STEEL HARDWARE:
   3/8"–16: 19.6 FT–LBS
   1/4"–20: 7.0 FT–LBS
2. MIN/MAX TORQUE VALUES FOR STAINLESS STEEL HARDWARE
   3/8"–16: 17.5 – 50.0 FT–LBS
   1/4"–20: 6.3 – 7.8 FT–LBS
3. DEPICTED HARDWARE AND PART PLACEMENT NOT INDICATIVE OF PREFERRED OR REQUIRED POSITIONS.
4. TILT ANGLE IS SETUP BY ANCHOR POST HEIGHTS.
5. OTHER SPECIFIC CONNECTIONS ELSEWHERE IN PRINT SET.
6. SPIRAL BINDERS SHALL CAPTURE A MAJORITY OF THE EDGE WIRES. IF NEEDED, ENDS SHALL BE CRIMPED.



A1 CONNECTION: BENT (LOWER) ANCHOR–TO–WIRE BASKET



NOTES:
1. ALL ADJOINING EDGES OF WIRE MESH BASKET MUST BE FASTENED WITH SPIRAL BINDERS ALONG ENTIRE EDGE.

A3 CONNECTION: WIRE MESH–TO–WIRE MESH

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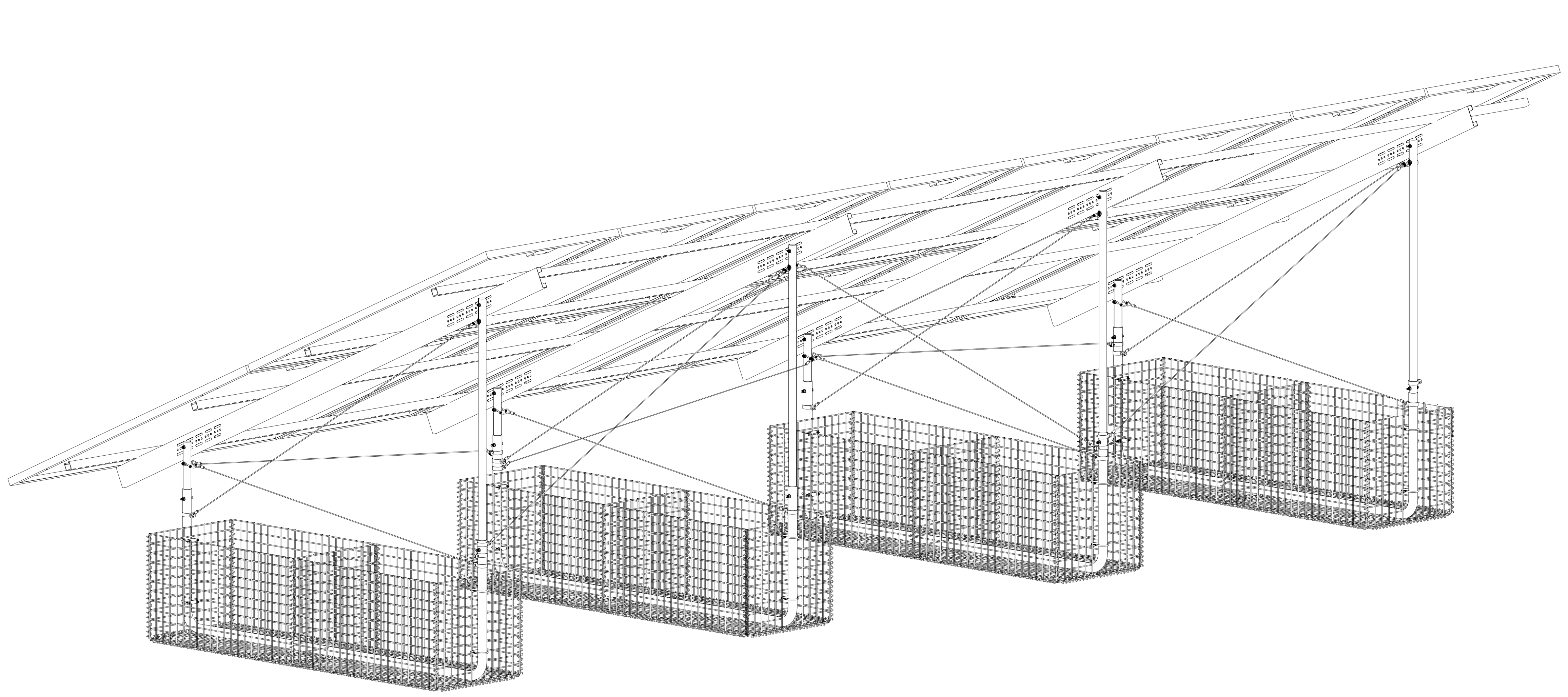
DRAWN	REVIEWED	APPROVED	SIZE
JK	JR	JDI	D

SHEET NAME: BALLAST CONNECTIONS

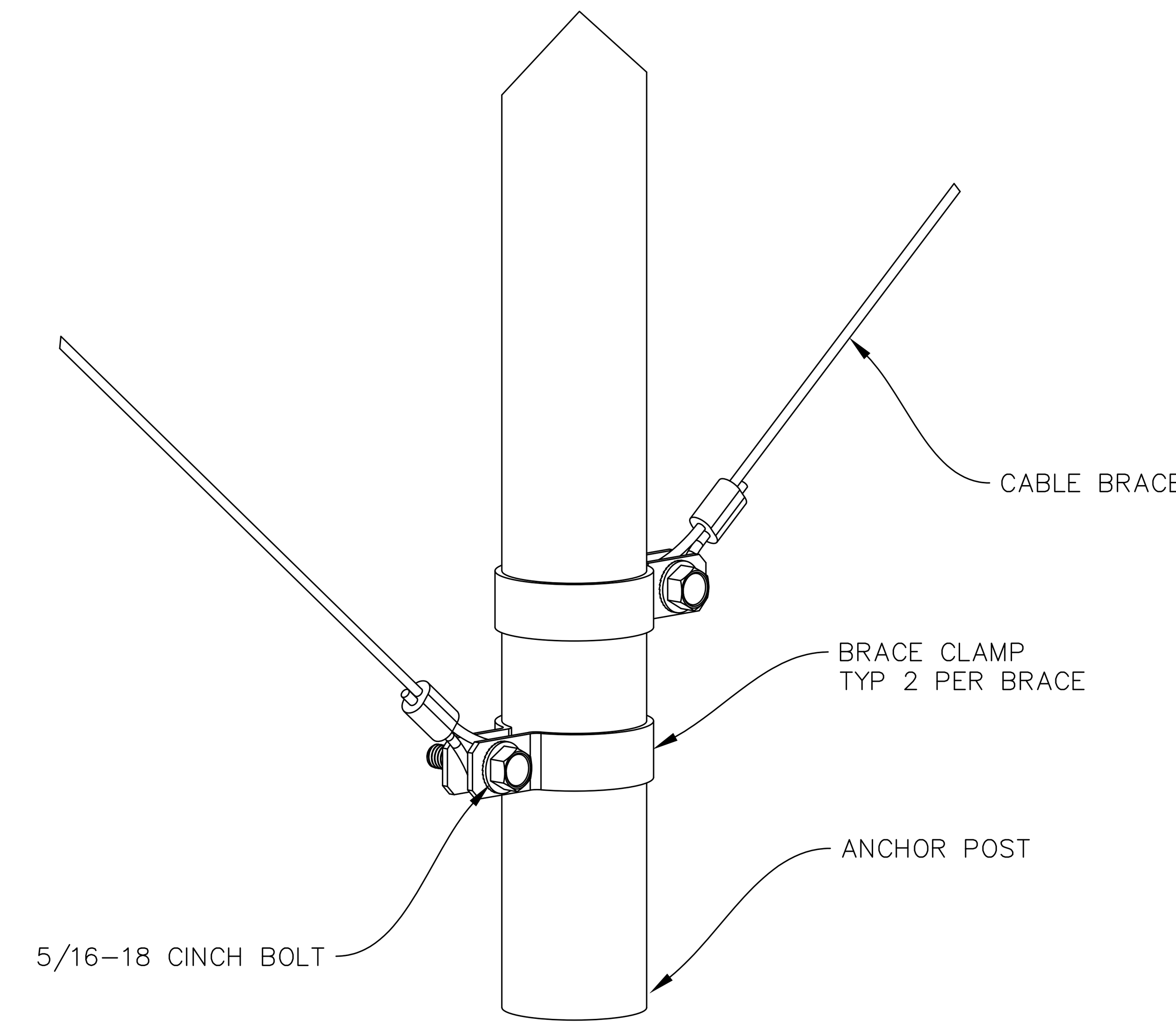
PROJECT NUMBER: GX35ME–001

DRAWING NUMBER: S.501

REV.: A



D1 VIEW: TYPICAL END OF ROW BRACING

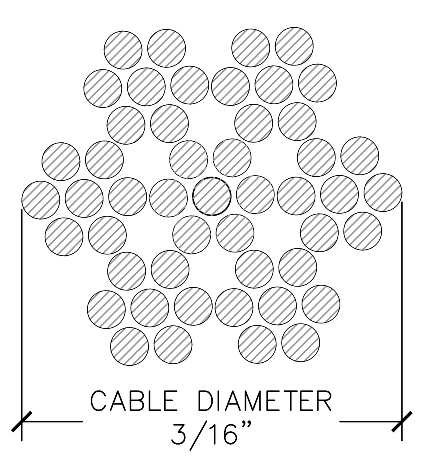


D4 DETAIL: BRACING CONNECTIONS

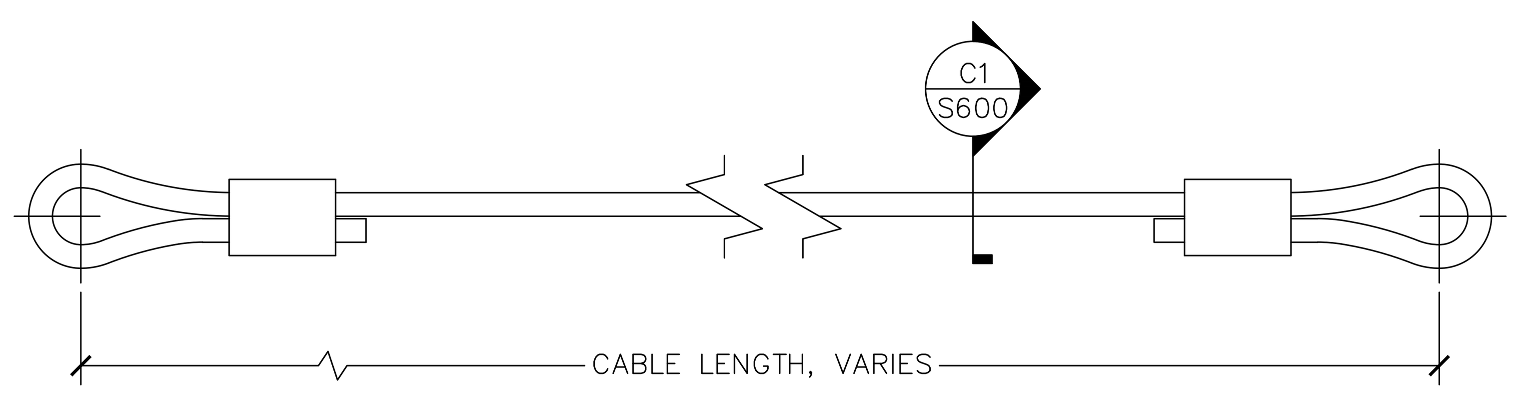
NOTES:

1. C1 CABLE TO BE INSTALLED BETWEEN EVERY NORTH AND SOUTH ANCHOR. (100%)
2. B1 CABLE BRACING (VEE CABLES) TO BE INSTALLED IN THE SPACE BETWEEN ANCHOR SETS (BAY).
3. BRACE CLAMPS TO BE LOCATED NO FURTHER THAN 5 INCHES FROM MIDPLANE OF CLAMP TO TOP OF BASKET.
4. CABLE TO BE STAINLESS STEEL AIRCRAFT CABLE.
5. CABLE MAY BE OF ANY CONFIGURATION (IE. 7X7 OR 7X19) AS LONG AS IT MEETS THE REQUIREMENTS LISTED ON THIS SHEET.
6. LENGTH OF BRACES WILL VARY DEPENDENT ON PROJECT SPECIFICS: BALLAST BASKET SPANS & ANCHOR HEIGHTS.
7. CABLE BRACING SHALL BE INSTALLED TAUT. IT IS A MOTION LIMITING ELEMENT.

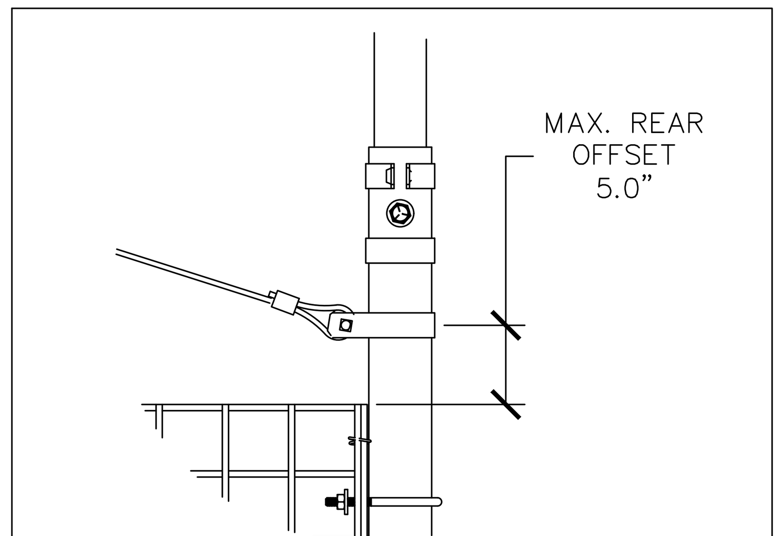
MIN. BREAKING STRENGTH: 3,600 LBS



C1 SEC.: NS CABLE BRACE

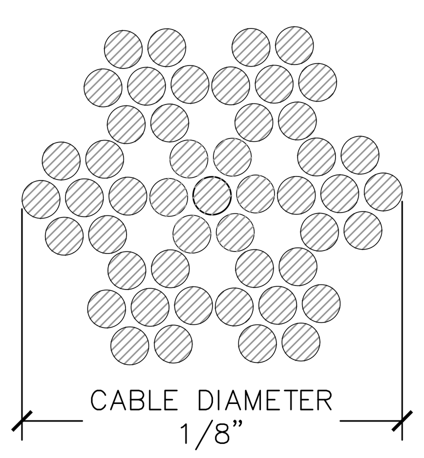


C2 PART: CABLE BRACE

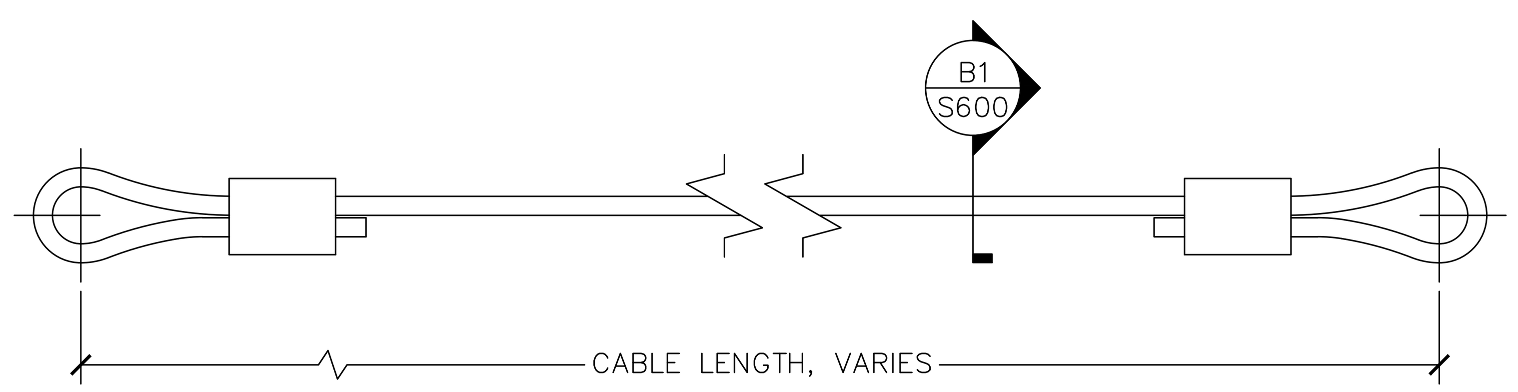


D6 NS BRACE OFFSET

MIN. BREAKING STRENGTH: 1,700 LBS

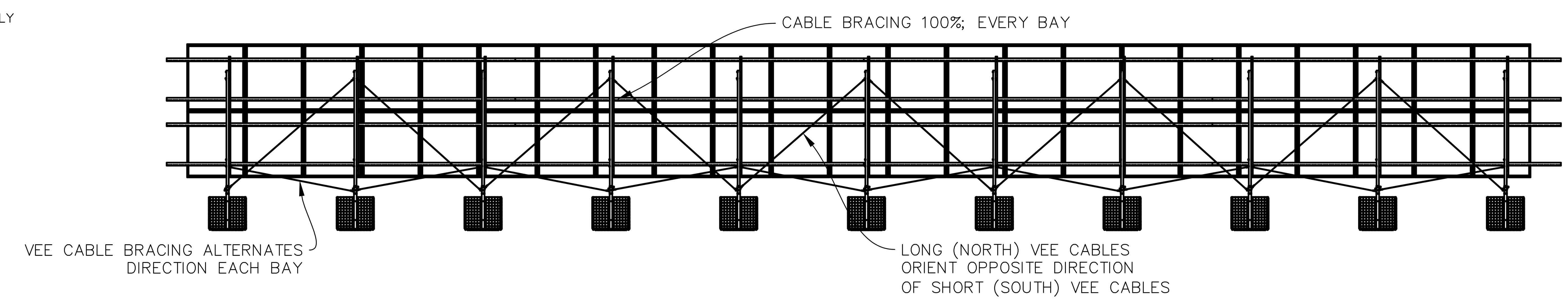


B1 SEC.: CABLE BRACE



B2 PART: CABLE BRACE

IMAGE FOR REFERENCE ONLY



A1 VIEW: TYPICAL END AND MID ROW CONDITIONS

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SHEET NAME: ANCHOR BRACING OVERVIEW

PROJECT NUMBER: GX35ME-001

DRAWING NUMBER: S.600 REV. A

1. MODULE CONSTANTS

MAX. MODULE DIMS.				
WIDTH	39.50	IN	3.29	FT
LENGTH	79.00	IN	6.58	FT
HEIGHT	2.00	IN	0.17	FT
WEIGHT	60.00	LBS		
AREA	21.67	SQ FT		

2. DESIGN CONSTANTS

SNOW LOAD CONSTANTS		
TERRAIN TYPE	C	
EXPOSURE CONDITION	FULLY EXPOSED	
EXPOSURE FACTOR	0.90	Ce
THERMAL CONDITION	UNHEATED	
THERMAL FACTOR	1.20	Ct
IMPORTANCE CATEGORY	I	
IMPORTANCE FACTOR	0.80	Is
ROOF SURFACE TYPE	SLIPPERY	
VENTILATION	VENTILATED	

WIND LOAD CONSTANTS		
RISK CATEGORY	I	
VELOCITY PRESSURE COEFF.	.85	Kd
EXPOSURE CATEGORY	C	
GUST EFFECT FACTOR	0.85	
TOPOGRAPHY FACTOR	1.0	Kzt

SEISMIC LOAD CONSTANTS		
RISK CATEGORY	I	
RESPONSE MODIFICATION FACTOR	1.25	
SYSTEM OVERSTRENGTH FACTOR	1.25	
DEFLECTION AMPLIFICATION FACTOR	1.25	
SEISMIC FORCE-RESISTING SYSTEM	CANTILEVERED COLUMN SYSTEMS; STEEL ORDINARY CANTILEVER	
SEISMIC IMPORTANCE FACTOR	1.00	
STRUCTURE TYPE	ALL OTHER SYSTEMS	
LONG-PERIOD TRANSITION PERIOD	8.00	SEC

3. SITE DESIGN LOADS

DEAD LOADS		
PER PANEL		
MODULES WEIGHT	60.00	LBS
EW STRUTS WEIGHT	11.85	LBS
MISC HARDWARE WEIGHT	5.00	LBS
TOTAL DEAD LOAD	76.85	LBS
PRESSURE	3.55	PSF
DISTRIBUTED LOAD	11.67	LB/FT

LIVE ROOF LOADS		
PER PANEL		
LOAD	108.35	LBS
PRESSURE	5.00	PSF
DISTRIBUTED LOAD	16.46	LB/FT

SNOW LOADS		
PER PANEL		
GROUND SNOW LOAD	70	PSF
TILT ANGLE	35	DEGREES
WIDTH	3.29	FT
DEPTH	5.39	FT
SLOPED SNOW LOAD	26.94	PSF
AREA	17.75	SQ FT
RESULTANT FORCE	478.24	LBS
DISTRIBUTED LOAD	72.64	LB/FT

WIND LOADS		
PER CARTRIDGE		
ENVELOPE WIDTH	3.29	FT
ENVELOPE HEIGHT	3.78	FT
AREA	12.43	SQ FT
WIND SPEED (3-SEC PEAK GUST), Vult	105	MPH
VELOCITY PRESSURE	20.37	PSF
RESULTANT FORCE	400.00	LBS
DISTRIBUTED LOAD	60.76	LBS

Wind

SEISMIC LOADS		
PER CARTRIDGE		
MAX SHORT PERIOD ACCELERATION, Ss	3.730	G
MAX 1 SEC PERIOD ACCELERATION, S1	1.390	G
SITE COEF. SHORT PERIOD, FA	1.00	
SITE COEF. 1 SEC. PERIOD, FV	1.50	
SITE CLASS	D	
DESIGN CATEGORY	E	
MAX HEIGHT	8.22	FT
Cs	0.80	
WEIGHT OF STRUCTURE	12,420	LB
SEISMIC BASE SHEAR	9,936	LBS
SEISMIC BASE SHEAR - PER RACK	9,936	LBS
LOAD PER POST	292.23	LBS

4. LOAD COMBINATIONS

LOAD COMBINATIONS	
LRFD	
CODE	FORMULA
D1	1.4DL
D2	1.2DL+0.5LLR
D3	1.2DL+0.5SL
D4	1.2DL+1.6LLR
D5	1.2DL+1.6SL
D6	1.2DL+0.5WLH1
D7	1.2DL+0.5WLH2
D8	1.2DL+1.6LLR+0.5WLH1
D9	1.2DL+1.6LLR+0.5WLH2
D10	1.2DL+1.6SL+0.5WLH1
D11	1.2DL+1.6SL+0.5WLH2
D12	1.2DL+WLH1
D13	1.2DL+WLH2
D14	1.2DL+0.5LLR+WLH1
D15	1.2DL+0.5LLR+WLH2
D16	1.2DL+0.5SL+WLH1
D17	1.2DL+0.5SL+WLH2
D18	1.2DL+0.2SL
D19	1.2DL+EL1
D20	1.2DL+EL2
D21	1.2DL+EL3
D22	1.2DL+EL4
D23	1.2DL+0.2SL+EL1
D24	1.2DL+0.2SL+EL2
D25	1.2DL+0.2SL+EL3
D26	1.2DL+0.2SL+EL4
D27	0.9DL+WLH1
D28	0.9DL+WLH2
D29	0.9DL+EL1
D30	0.9DL+EL2
D31	0.9DL+EL3
D32	0.9DL+EL4

LOAD COMBINATIONS	
ASD	
CODE	FORMULA
D1	DL
D2	DL+LLR
D3	DL+SL
D4	DL+0.75SL
D5	DL+0.75LLR
D6	DL+0.6WLH1
D7	DL+0.6WLH2
D8	DL+0.7EL1
D9	DL+0.7EL2
D10	DL+0.7EL3
D11	DL+0.7EL4
D12	DL+0.75SL+0.45WLH1
D13	DL+0.75SL+0.45WLH2
D14	DL+0.75LLR+0.45WLH1
D15	DL+0.75LLR+0.45WLH2
D16	DL+0.75SL+0.525EL1
D17	DL+0.75SL+0.525EL2
D18	DL+0.75SL+0.525EL3
D19	DL+0.75SL+0.525EL4
D20	DL+0.75LLR+0.525EL1
D21	DL+0.75LLR+0.525EL2
D22	DL+0.75LLR+0.525EL3
D23	DL+0.75LLR+0.525EL4
D24	0.6DL+0.6WLH1
D25	0.6DL+0.6WLH2
D26	0.6DL+0.7EL1
D27	0.6DL+0.7EL2
D28	0.6DL+0.7EL3
D29	0.6DL+0.7EL4

5. FINAL DESIGN LOADS

FORCES				
ABBRV.	NAME	RESULTANT LOAD	DISTRIBUTED LOAD (LB/FT/PC.)	DIR.
DL	DEAD LOAD	76.85	-11.67	-Y
LLR	ROOF LIVE LOAD	108.35	-16.46	-Y
SL	SNOW LOAD	478.24	-72.64	-Y
WLH1	WIND HORIZONTAL AT (LRFD)	400.00	60.76	+Z
WLH2	WIND HORIZONTAL AWAY (LRFD)	400.00	-60.76	-Z
		LB/POST		
EL1	SEISMIC LEFT	292.23		+X
EL2	SEISMIC RIGHT	-292.23		-X
EL3	SEISMIC NORTH	292.23		+Z
EL4	SEISMIC SOUTH	-292.23		-Z

6. ANALYSIS RESULTS: LRFD

STEEL CODE CHECK SUMMARY					
DESC.	CTRL EQ.	⊕ DIST.	RATIO	STATUS	REF.
ANCHOR POST	D10	97.92%	0.73	OK	C5.2.2-1
CABLE BRACE	D26	0.00%	0.52	OK	EQ. SEC. D2
EW PURLIN	D10	0.00%	0.90	OK	C5.2.2-3
NS CABLE BRACE	D27	15.63%	0.72	OK	EQ.H1-1A
NS CORD	D10	36.25%	0.85	OK	C5.2.2-3

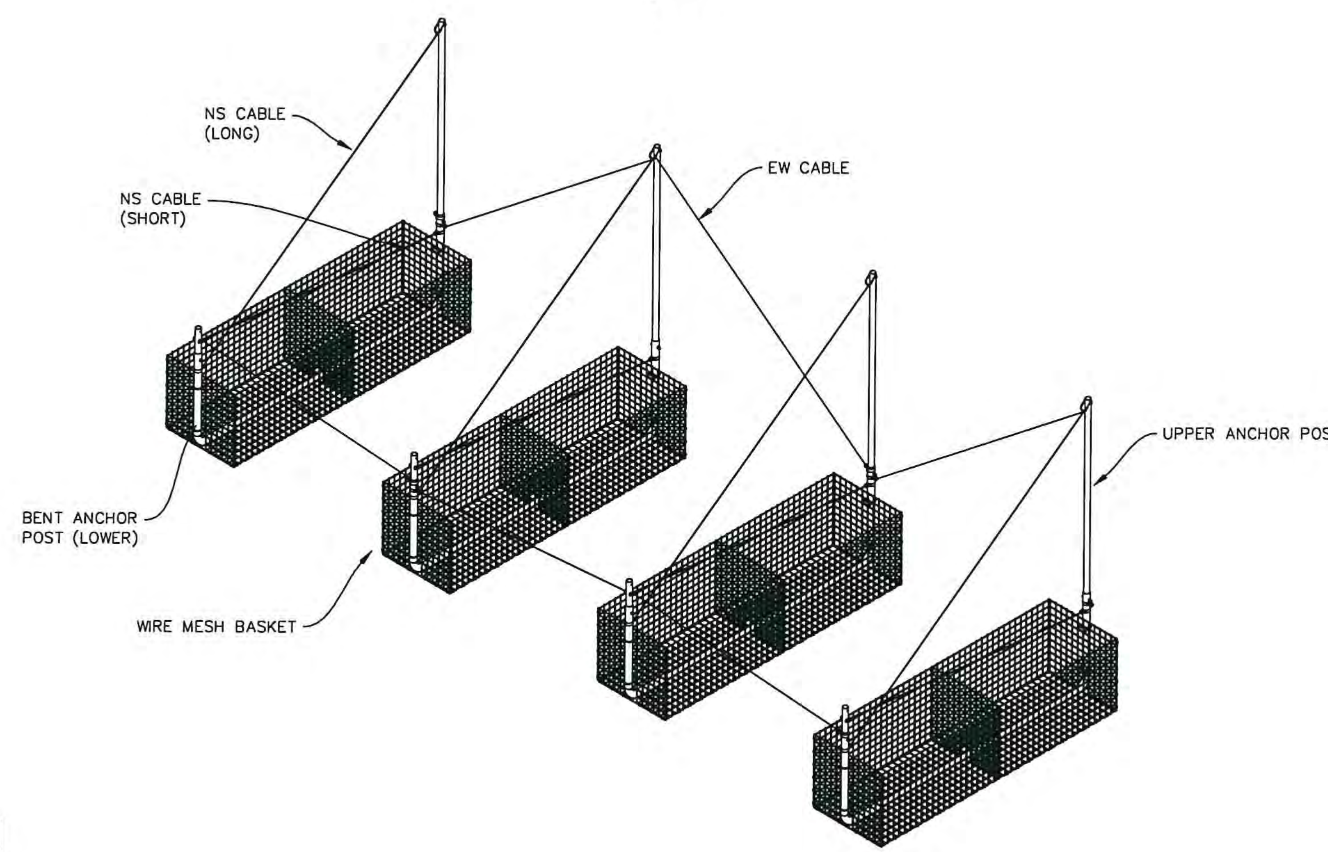
7. ANALYSIS RESULTS: ASD

MAX/MIN SUPPORT REACTIONS			
DIR.	SIGN	LOAD (LBS)	LOAD COMB.
X	MAX	513.8	D9
	MIN	-513.8	D8
Y	MAX	1461.7	D12
	MIN	-523.3	D25
Z	MAX	1131.2	D25
	MIN	-1084.6	D6

Post

8. ANALYSIS RESULTS (BALLAST): ASD

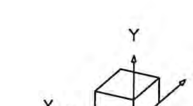
MAX/MIN COMBINED SUPPORT REACTIONS			
DIR.	SIGN	LOAD (LBS)	LOAD COMB.
X	MAX	508.4	D9
	MIN	-508.3	D8
Y	MAX	2474.1	D3
	MIN	-203.5	D27
Z	MAX	1069.8	D25
	MIN	-1070.1	D6



MEMBER SUMMARY		
DESC.	SECTION	MATERIAL
UPPER ANCHOR POST	ANCHOR POST 1.57X0.109	A1011 GR50 COLD FORM
BENT ANCHOR POST	ANCHOR POST 1.9X0.120	A1011 GR50 COLD FORM
VEE BRACE (EW)	CABLE BRACE 1/8	A36
CABLE BRACE (NS)	CABLE BRACE 1/8	A36
NS CHORD	CEE 4-1/2 X 1-3/16	A1011 GR50 COLD FORM
EW PURLIN	STRUT 1-5/8 X 1-5/8	A1011 GR50 COLD FORM

BALLAST SECTION

READYRACK
35° TILT
70 PSF SNOW
105 WIND



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JK	JR	JDI	D

SHEET NAME: DESIGN ANALYSIS AND SUMMARY

PROJECT NUMBER: GX35ME-001

DRAWING NUMBER: S.700 REV. A

SCALE IS REDUCED WHEN SHEET SIZE IS 11" x 17".

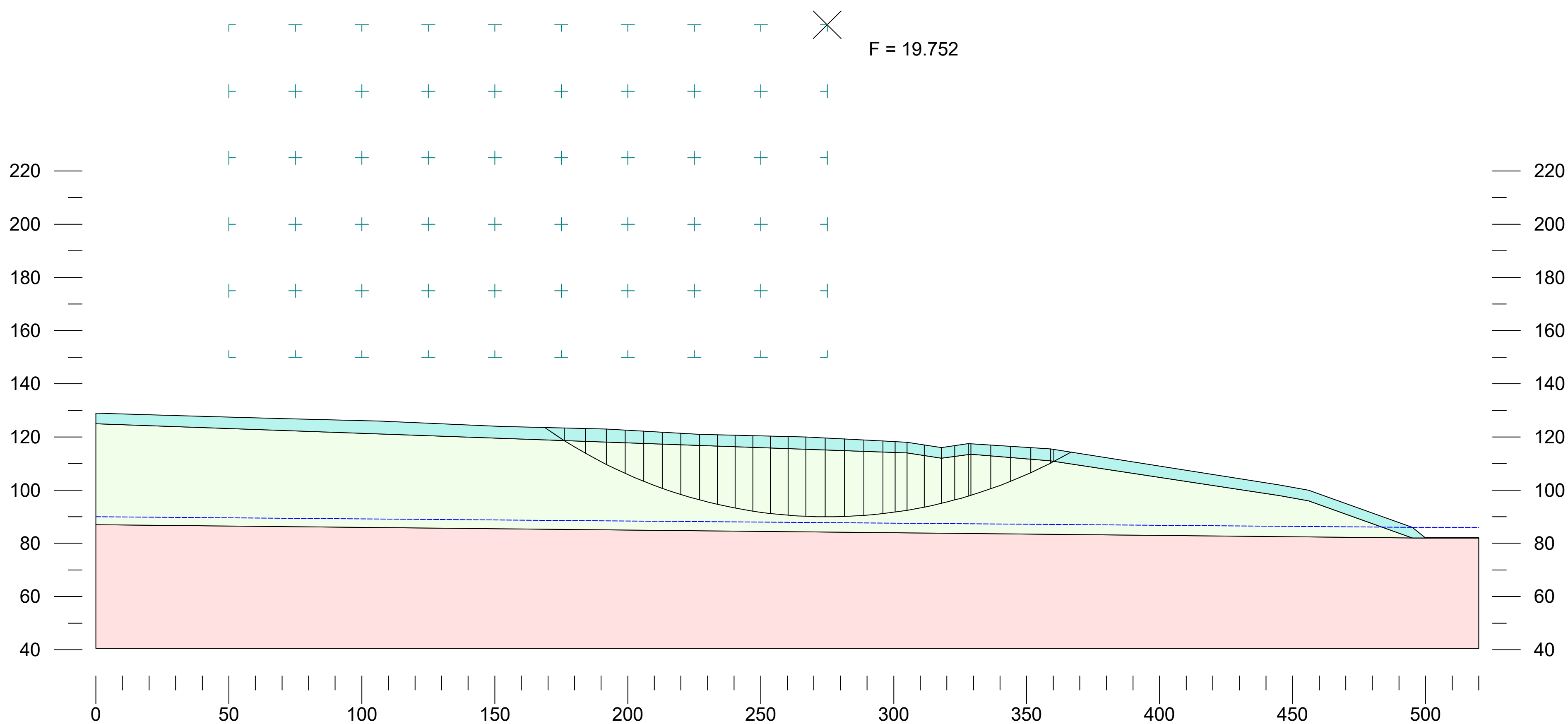
ATTACHMENT 3

GRAPHICAL RESULTS OF GSLOPE ANALYSES

SME
SEVEE & MAHER
ENGINEERS

	Gamma pcf	C psf	Phi deg	Piezo Surf.
Cover Soil + Snow	129	0	33	1
Waste Deposit	75	104	36	1
Foundation	120	0	35	1

Sevee & Maher Engineers - Cumberland Center, ME
9 Cross Road
Exeter, NH
Jan 2024
Section AA



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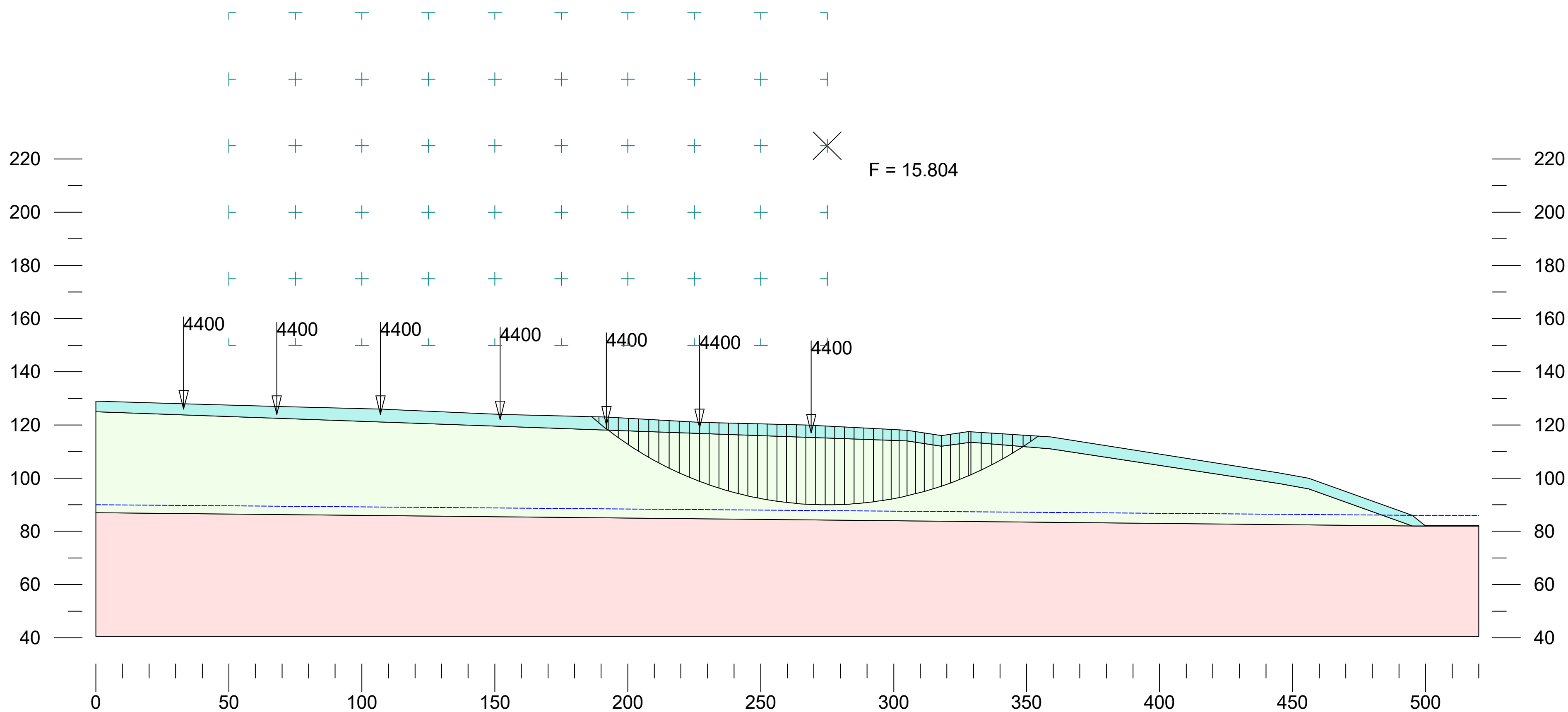
AA-PA-C.1

	Gamma pcf	C psf	Phi deg	Piezo Surf.
Cover Soil + Snow	129	0	33	1
Waste Deposit	75	104	36	1
Foundation	120	0	35	1

Sevee & Maher Engineers - Cumberland Center, ME
9 Cross Road
Exeter, NH
Jan 2024
Section AA



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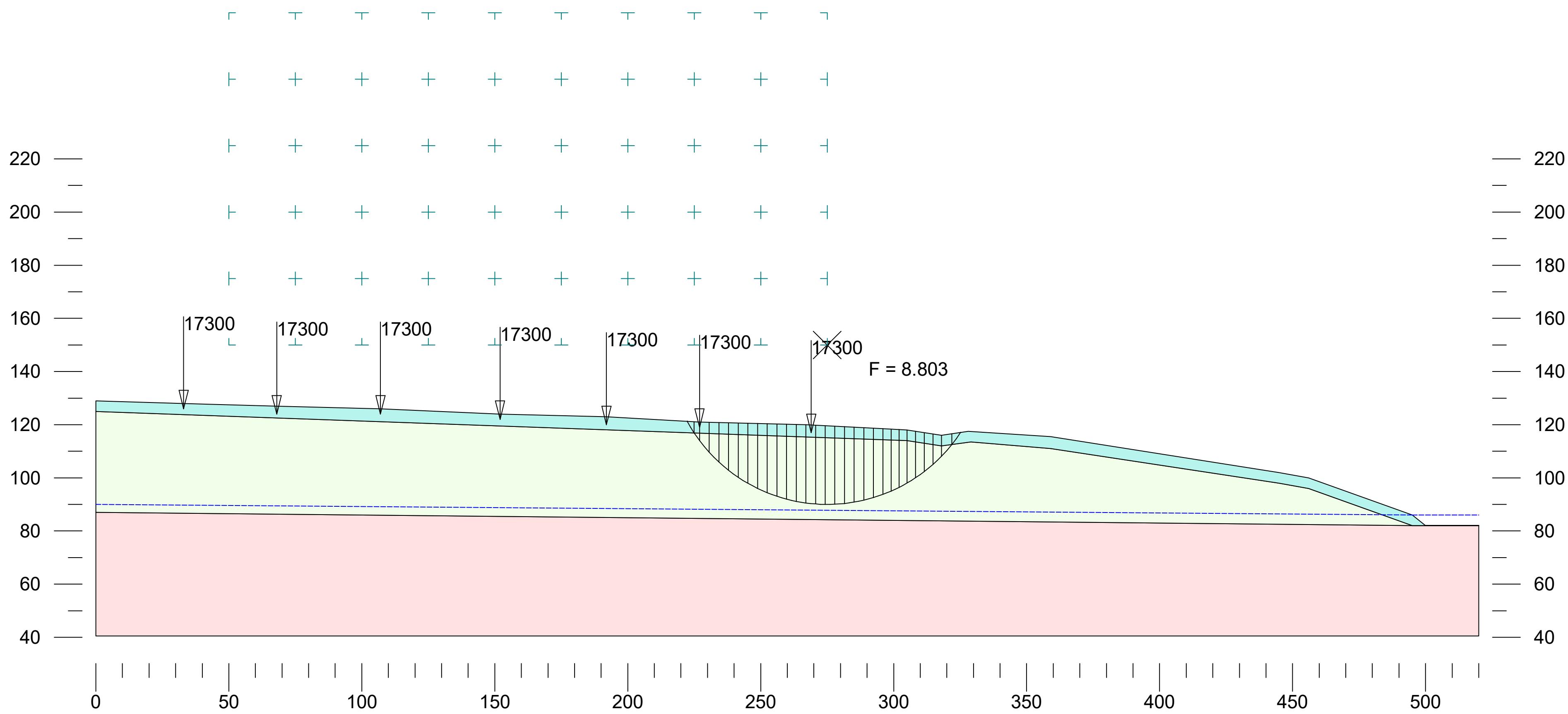
AA-PA-C.2

	Gamma pcf	C psf	Phi deg	Piezo Surf.
Cover Soil + Snow	129	0	33	1
Waste Deposit	75	104	36	1
Foundation	120	0	35	1

Sevee & Maher Engineers - Cumberland Center, ME
9 Cross Road
Exeter, NH
Jan 2024
Section AA



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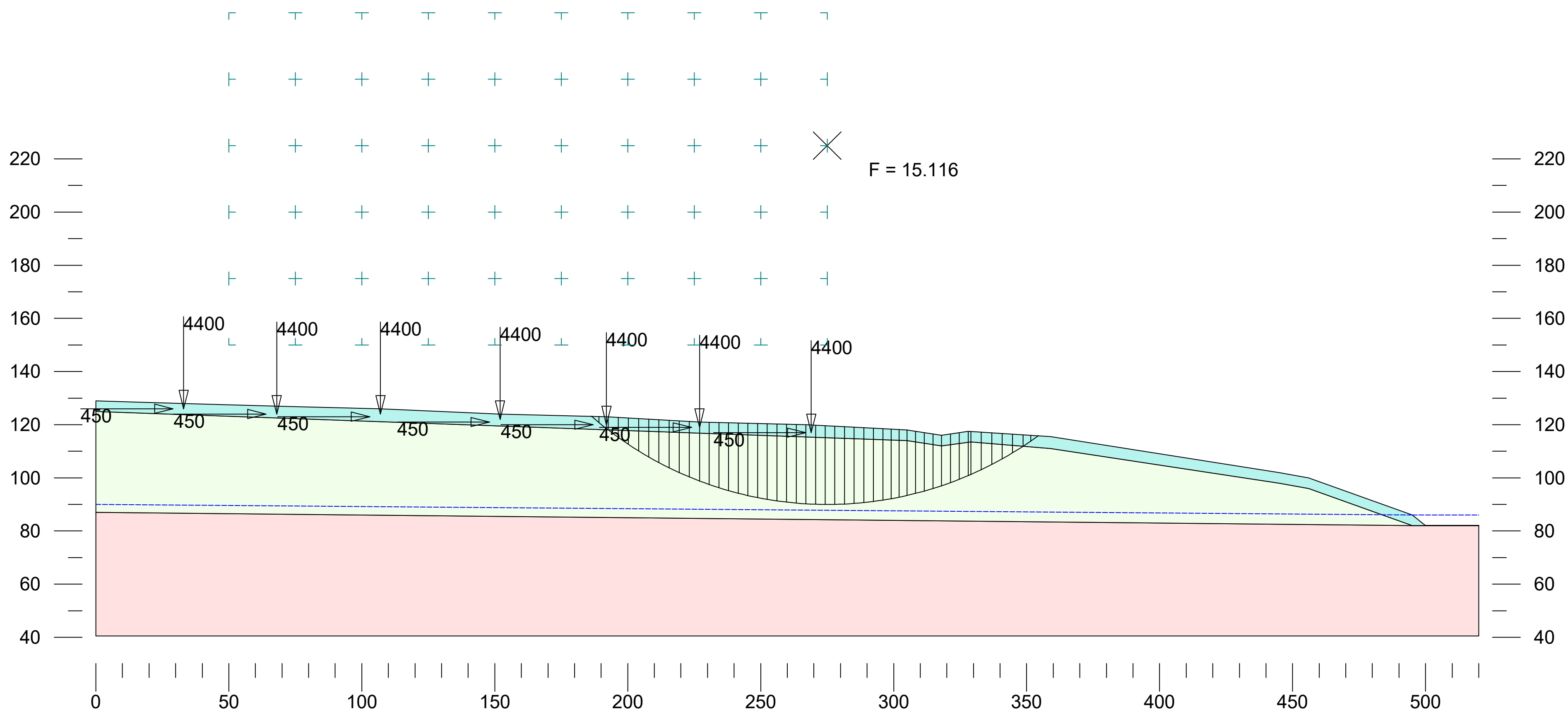
AA-PA-C.3

	Gamma pcf	C psf	Phi deg	Piezo Surf.
Cover Soil + Snow	129	0	33	1
Waste Deposit	75	104	36	1
Foundation	120	0	35	1

Sevee & Maher Engineers - Cumberland Center, ME
9 Cross Road
Exeter, NH
Jan 2024
Section AA

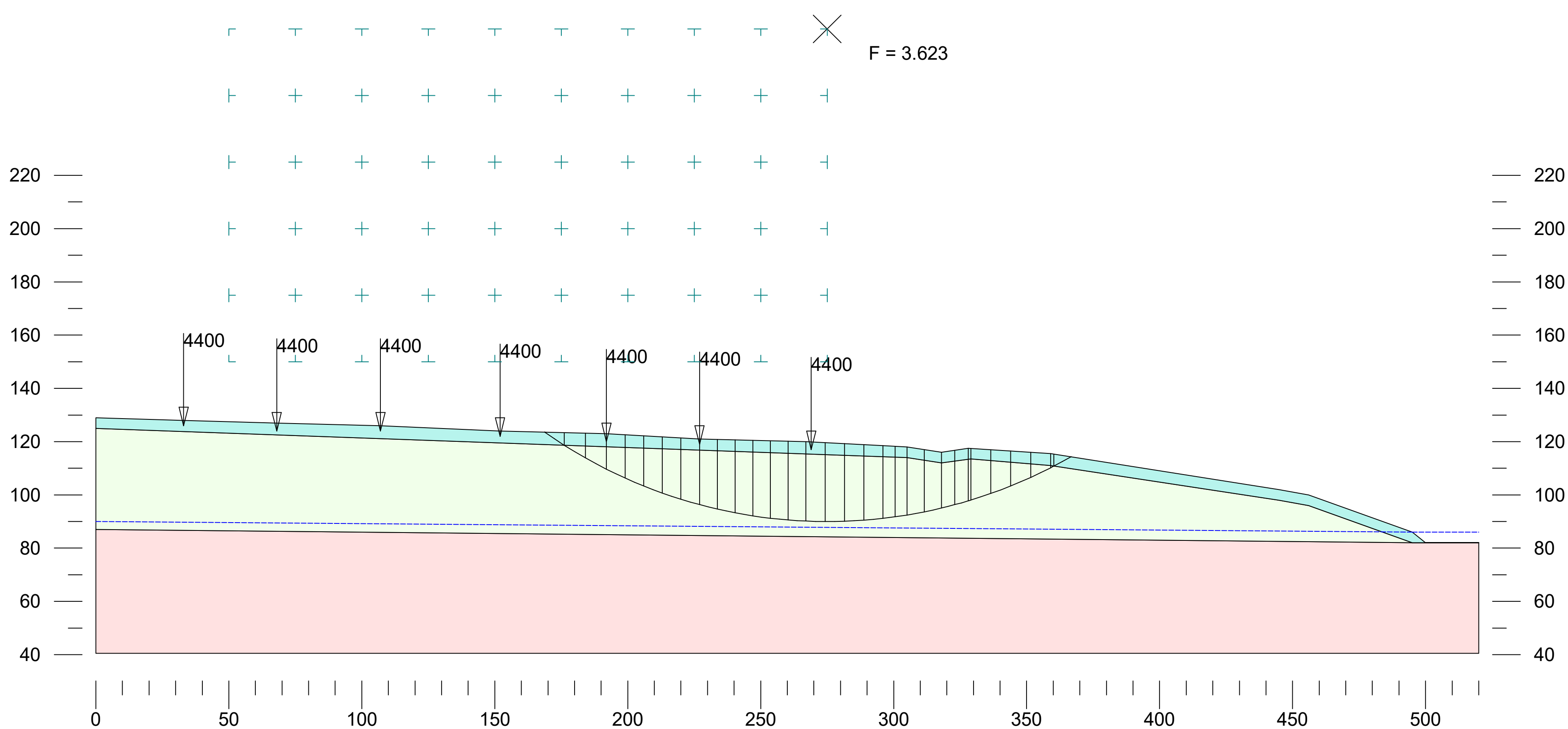


AA-PA-C.4

	Gamma pcf	C psf	Phi deg	Piezo Surf.
Cover Soil + Snow	129	0	33	1
Waste Deposit	75	104	36	1
Foundation	120	0	35	1

Seismic coefficient = 0.20

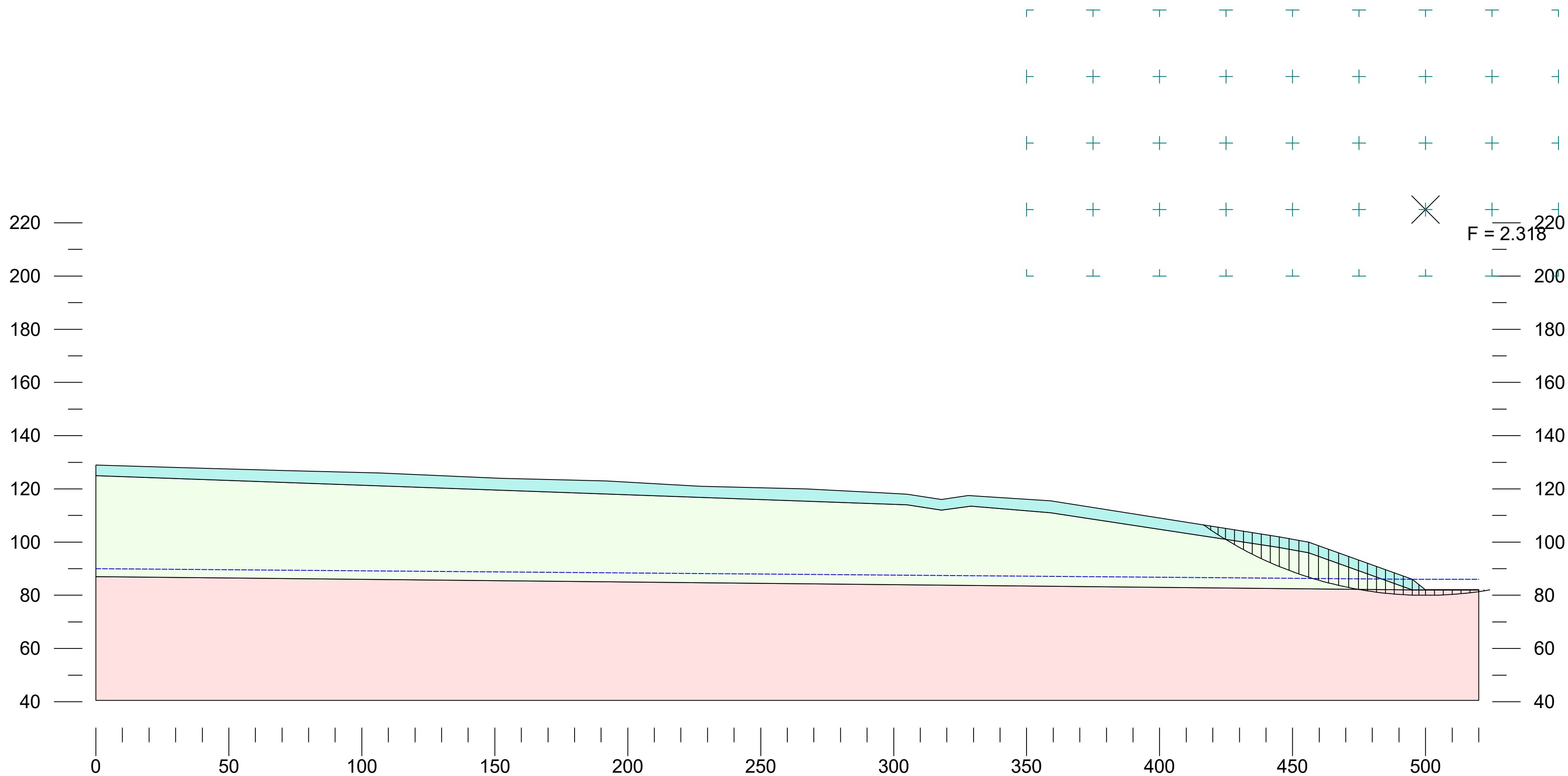
Sevee & Maher Engineers - Cumberland Center, ME
9 Cross Road
Exeter, NH
Jan 2024
Section AA



AA-PA-C.5

	Gamma pcf	C psf	Phi deg	Piezo Surf.
Cover Soil + Snow	129	0	33	1
Waste Deposit	75	104	36	1
Foundation	120	0	35	1

Sevee & Maher Engineers - Cumberland Center, ME
9 Cross Road
Exeter, NH
Jan 2024
Section AA



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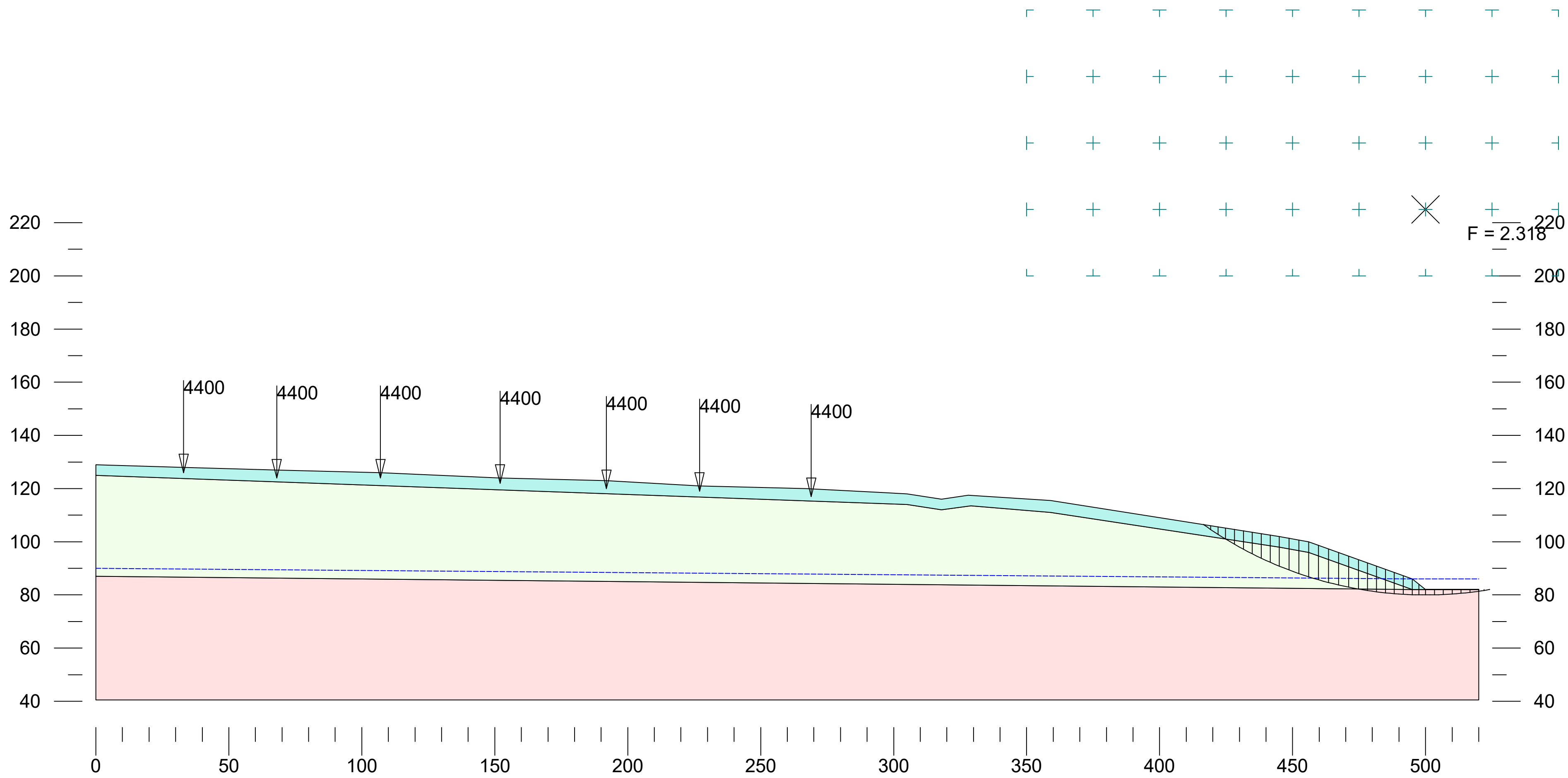
AA-SS-C.1

	Gamma pcf	C psf	Phi deg	Piezo Surf.
Cover Soil + Snow	129	0	33	1
Waste Deposit	75	104	36	1
Foundation	120	0	35	1

Sevee & Maher Engineers - Cumberland Center, ME
9 Cross Road
Exeter, NH
Jan 2024
Section AA



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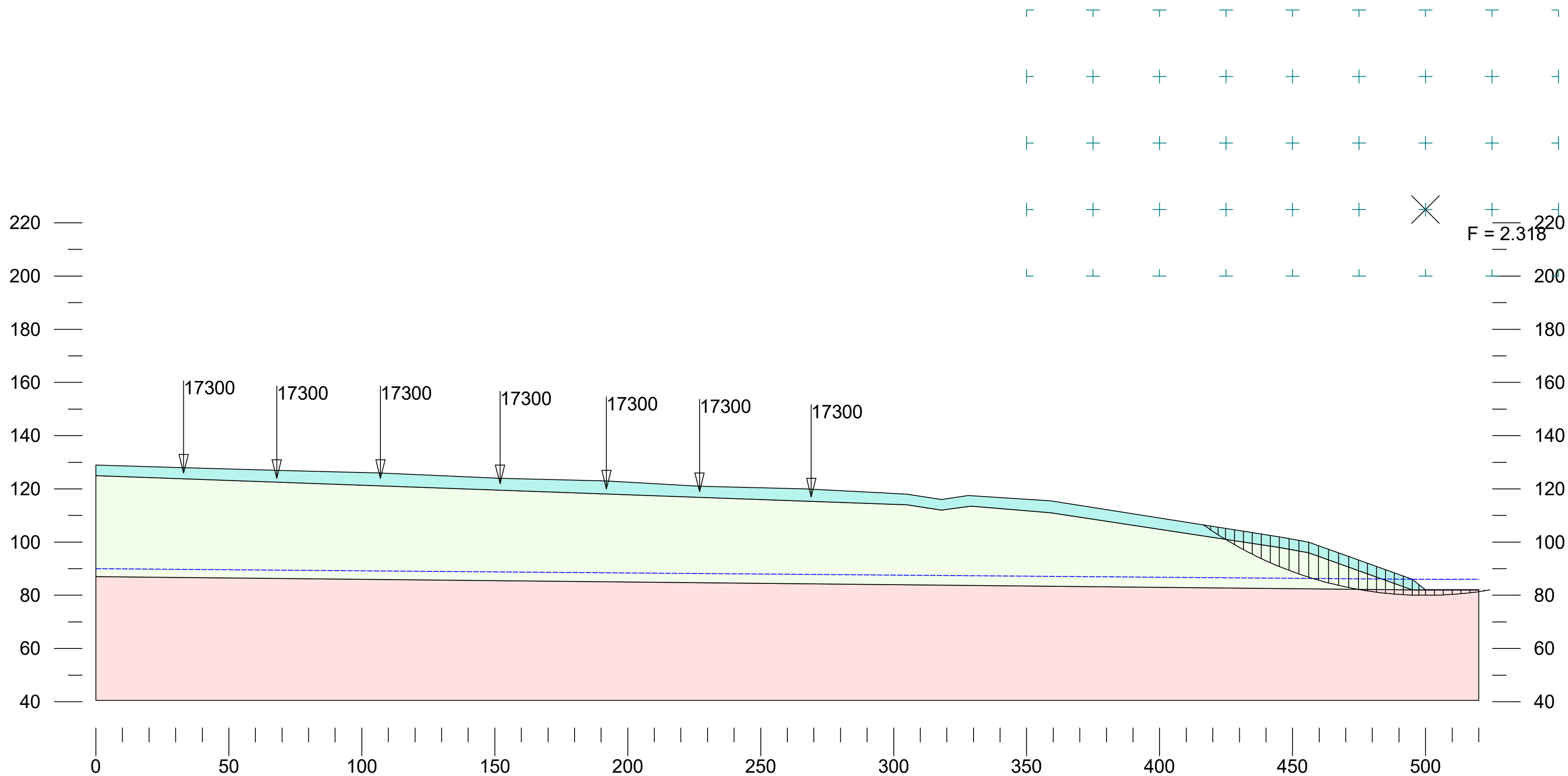
AA-SS-C.2

	Gamma pcf	C psf	Phi deg	Piezo Surf.
Cover Soil + Snow	129	0	33	1
Waste Deposit	75	104	36	1
Foundation	120	0	35	1

Sevee & Maher Engineers - Cumberland Center, ME
9 Cross Road
Exeter, NH
Jan 2024
Section AA



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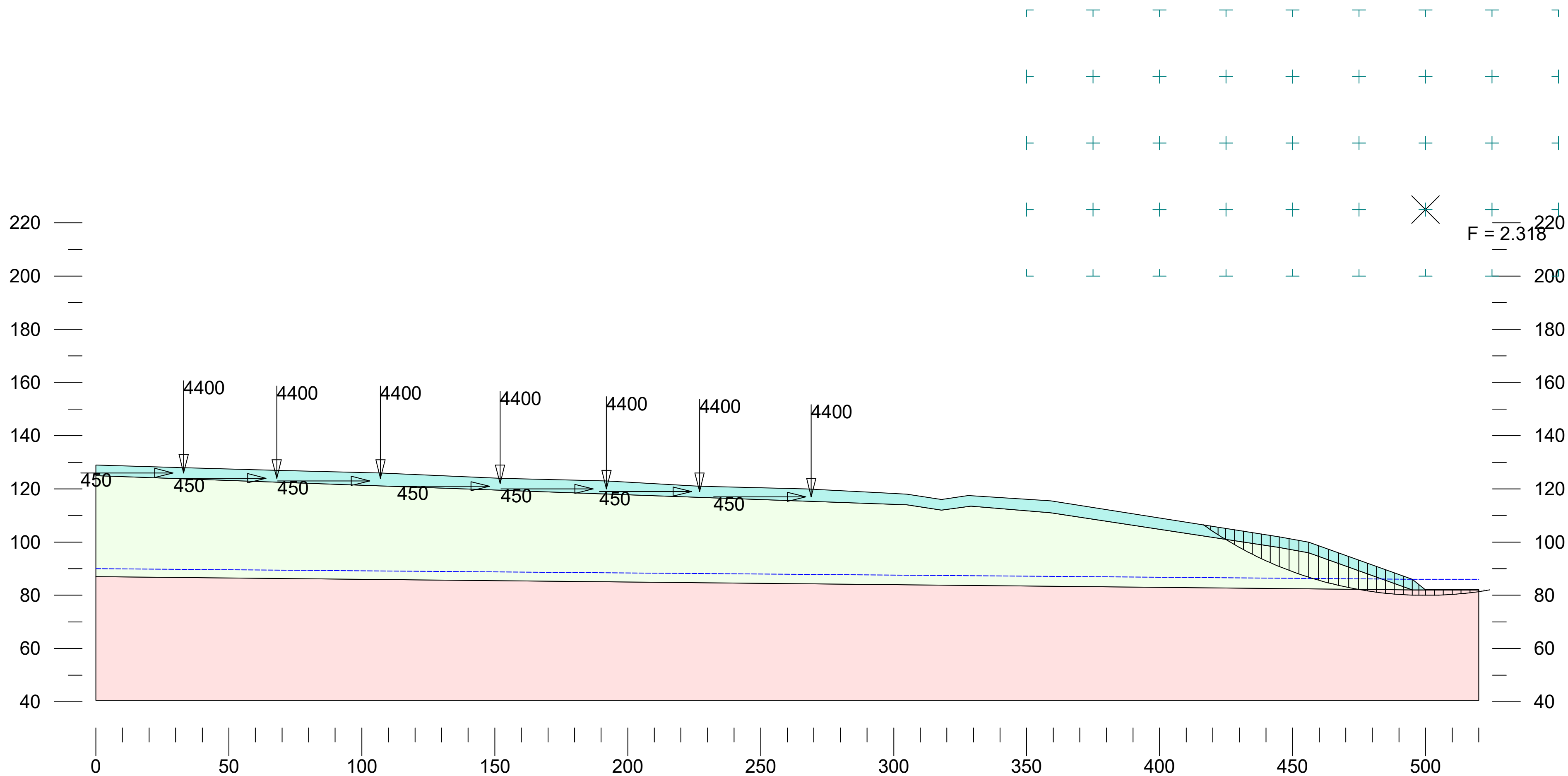
AA-SS-C.3

	Gamma pcf	C psf	Phi deg	Piezo Surf.
Cover Soil + Snow	129	0	33	1
Waste Deposit	75	104	36	1
Foundation	120	0	35	1

Sevee & Maher Engineers - Cumberland Center, ME
9 Cross Road
Exeter, NH
Jan 2024
Section AA



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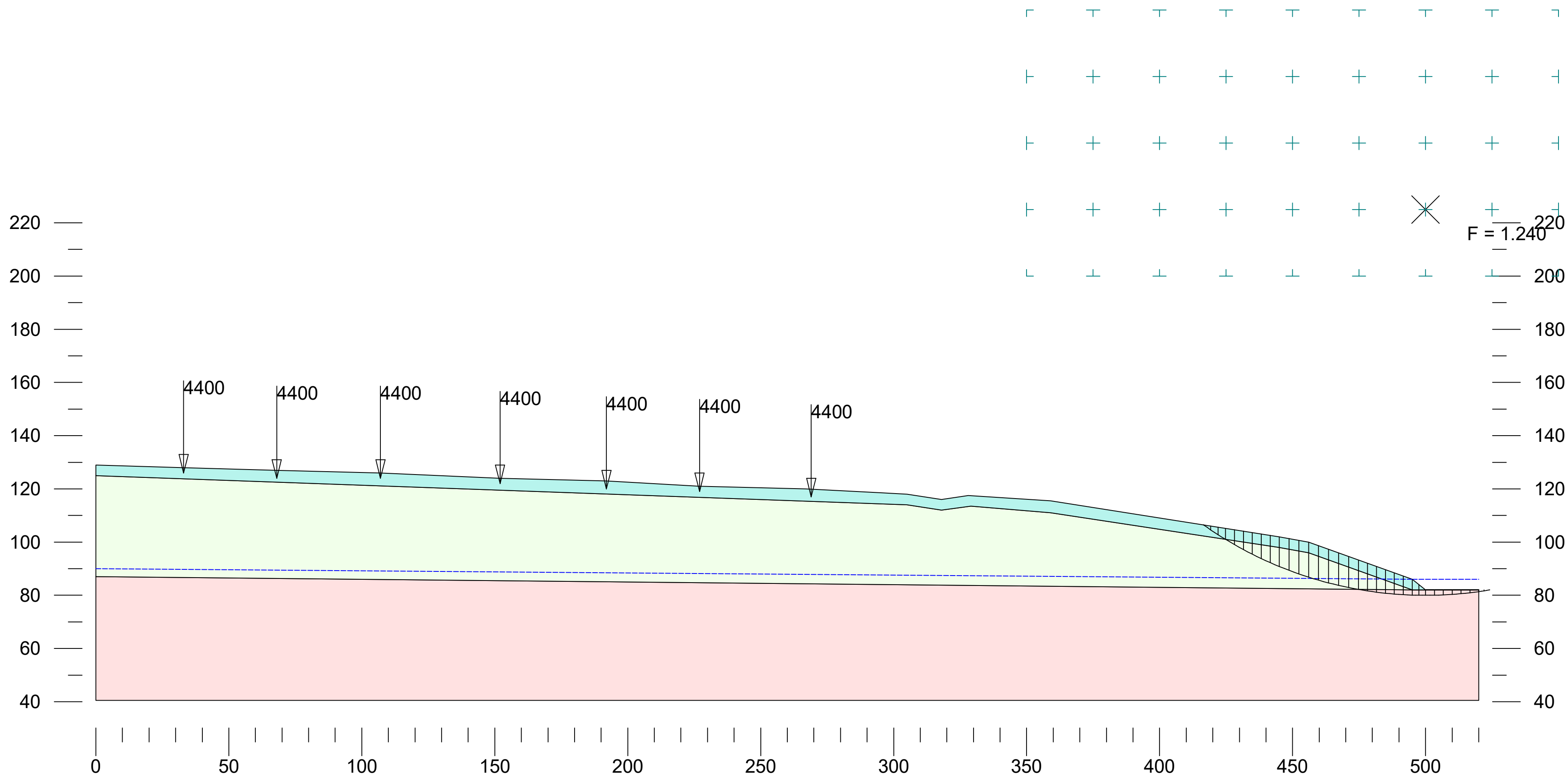
AA-SS-C.4

	Gamma pcf	C psf	Phi deg	Piezo Surf.
Cover Soil + Snow	129	0	33	1
Waste Deposit	75	104	36	1
Foundation	120	0	35	1

Seismic coefficient = 0.20

Sevee & Maher Engineers - Cumberland Center, ME
9 Cross Road
Exeter, NH
Jan 2024
Section AA



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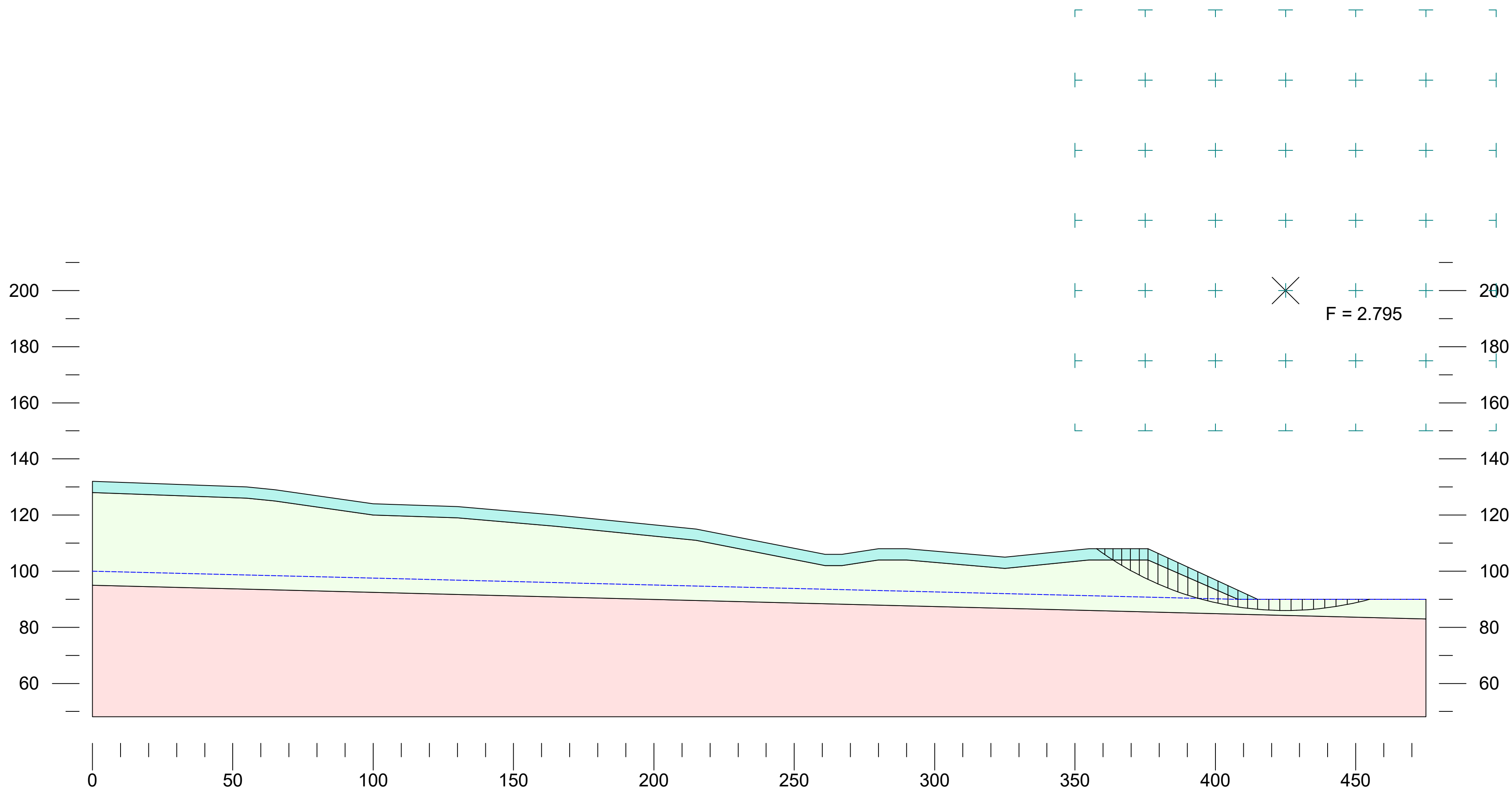
AA-SS-C.5

	Gamma pcf	C psf	Phi deg	Piezo Surf.
Cover Soil + Snow	129	0	33	1
Waste Deposit	75	104	36	1
Foundation	120	0	36	1

Sevee & Maher Engineers - Cumberland Center, ME
9 Cross Road
Exeter, NH
Jan 2024
Section BB



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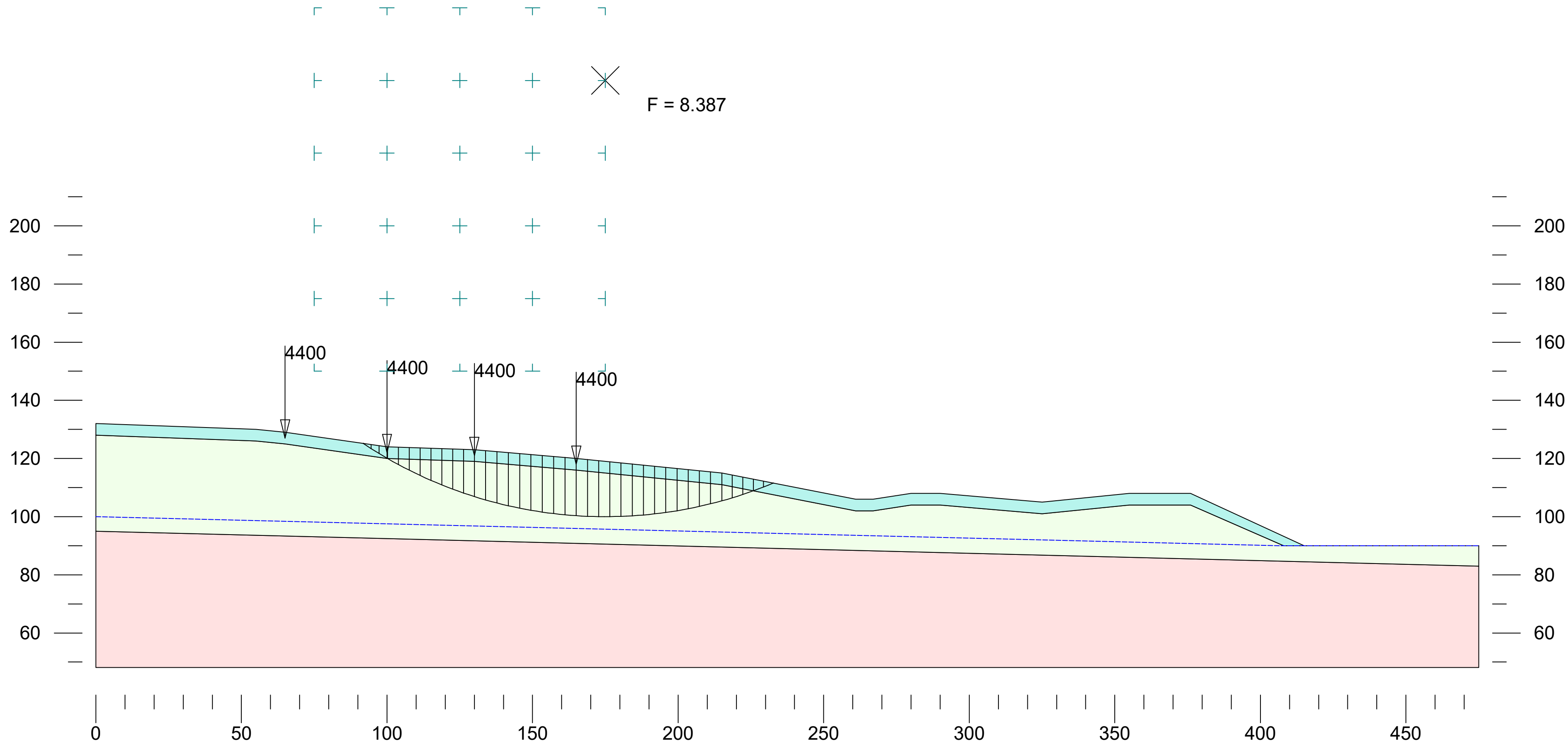
BB-SS-C.1

	Gamma pcf	C psf	Phi deg	Piezo Surf.
Cover Soil + Snow	129	0	33	1
Waste Deposit	75	104	36	1
Foundation	120	0	36	1

Sevee & Maher Engineers - Cumberland Center, ME
9 Cross Road
Exeter, NH
Jan 2024
Section BB



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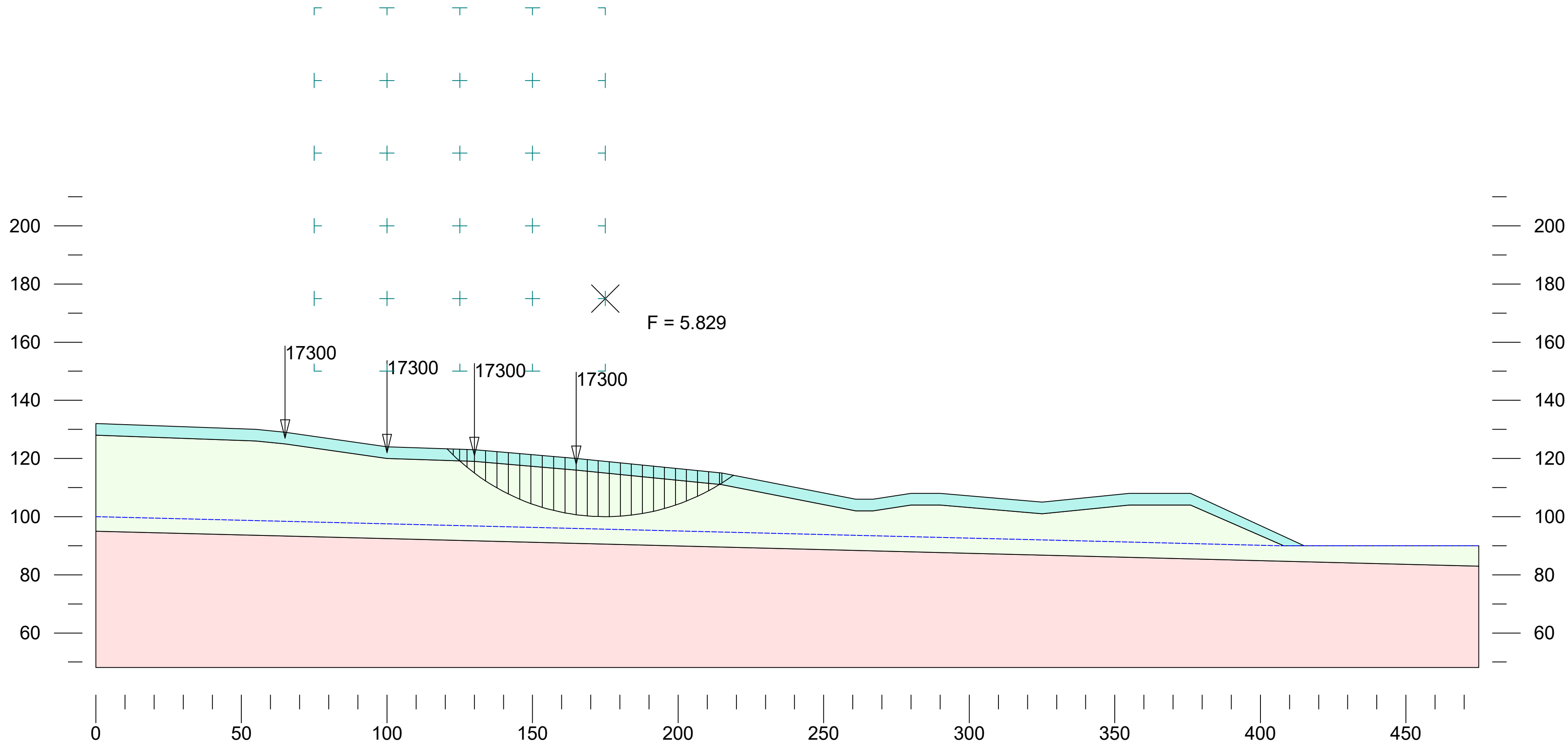
BB-PA-C.2

	Gamma pcf	C psf	Phi deg	Piezo Surf.
Cover Soil + Snow	129	0	33	1
Waste Deposit	75	104	36	1
Foundation	120	0	36	1

Sevee & Maher Engineers - Cumberland Center, ME
9 Cross Road
Exeter, NH
Jan 2024
Section BB



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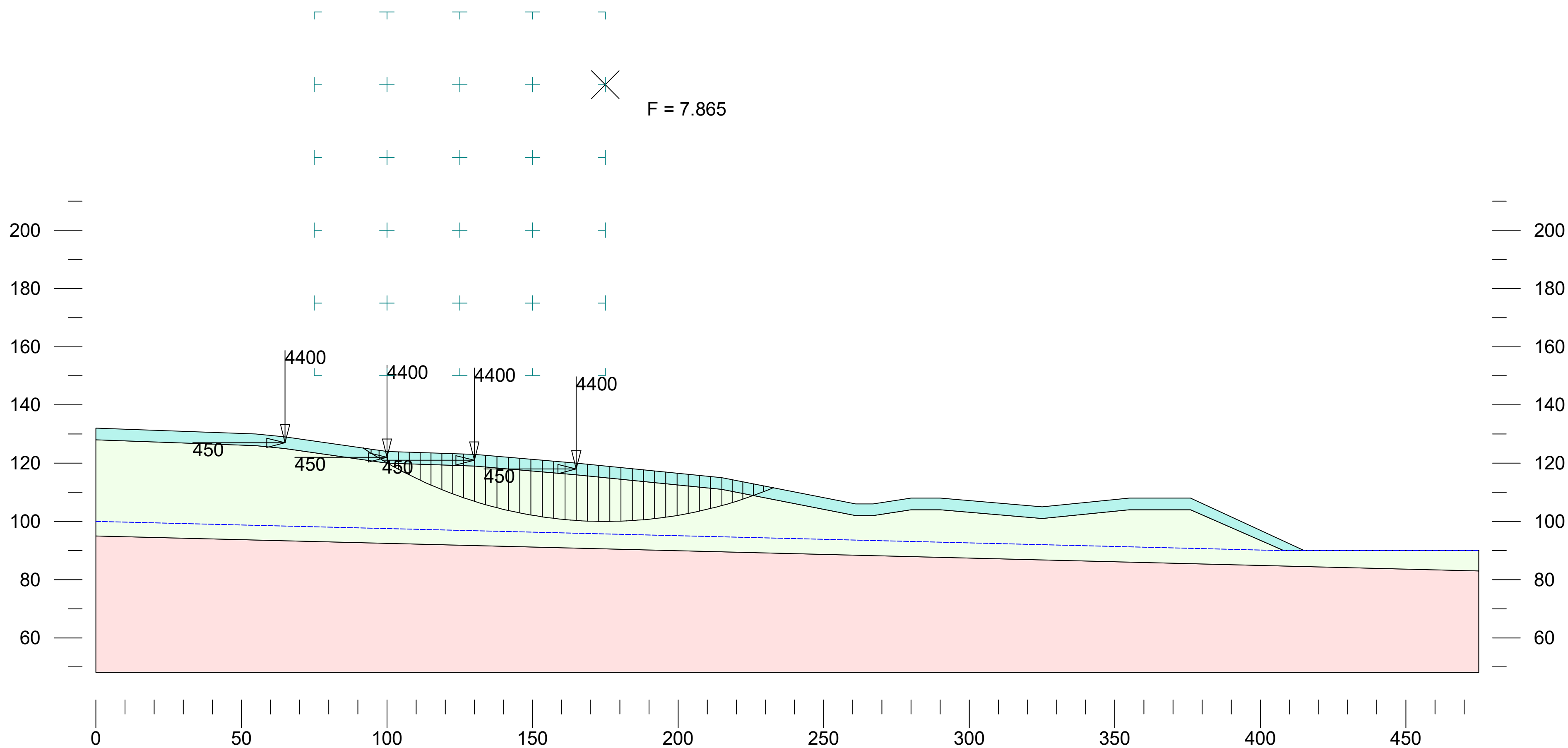
BB-PA-C.3

	Gamma pcf	C psf	Phi deg	Piezo Surf.
Cover Soil + Snow	129	0	33	1
Waste Deposit	75	104	36	1
Foundation	120	0	36	1

Sevee & Maher Engineers - Cumberland Center, ME
9 Cross Road
Exeter, NH
Jan 2024
Section BB

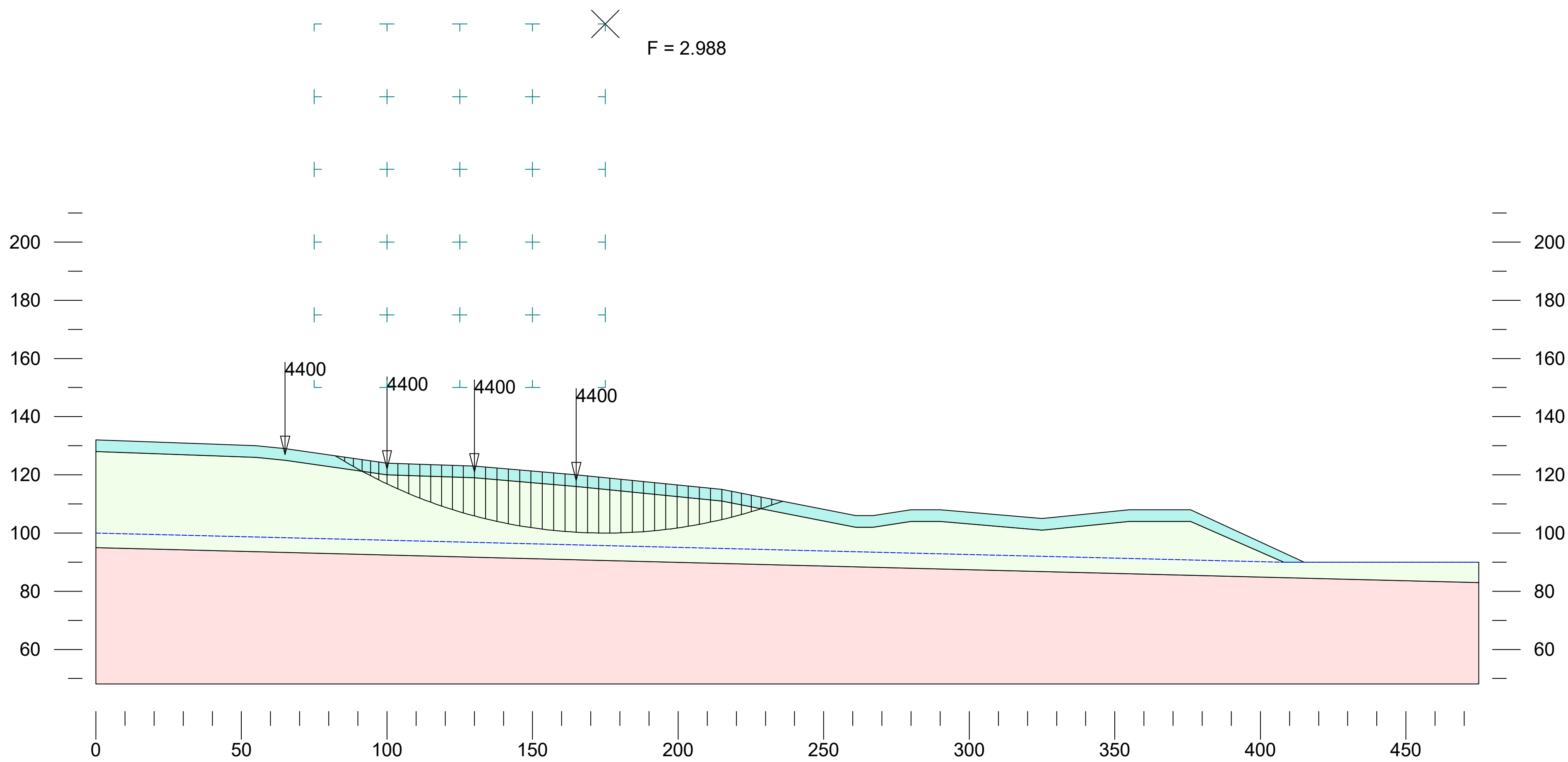


BB-PA-C.4

	Gamma pcf	C psf	Phi deg	Piezo Surf.
Cover Soil + Snow	129	0	33	1
Waste Deposit	75	104	36	1
Foundation	120	0	36	1

Seismic coefficient = 0.20

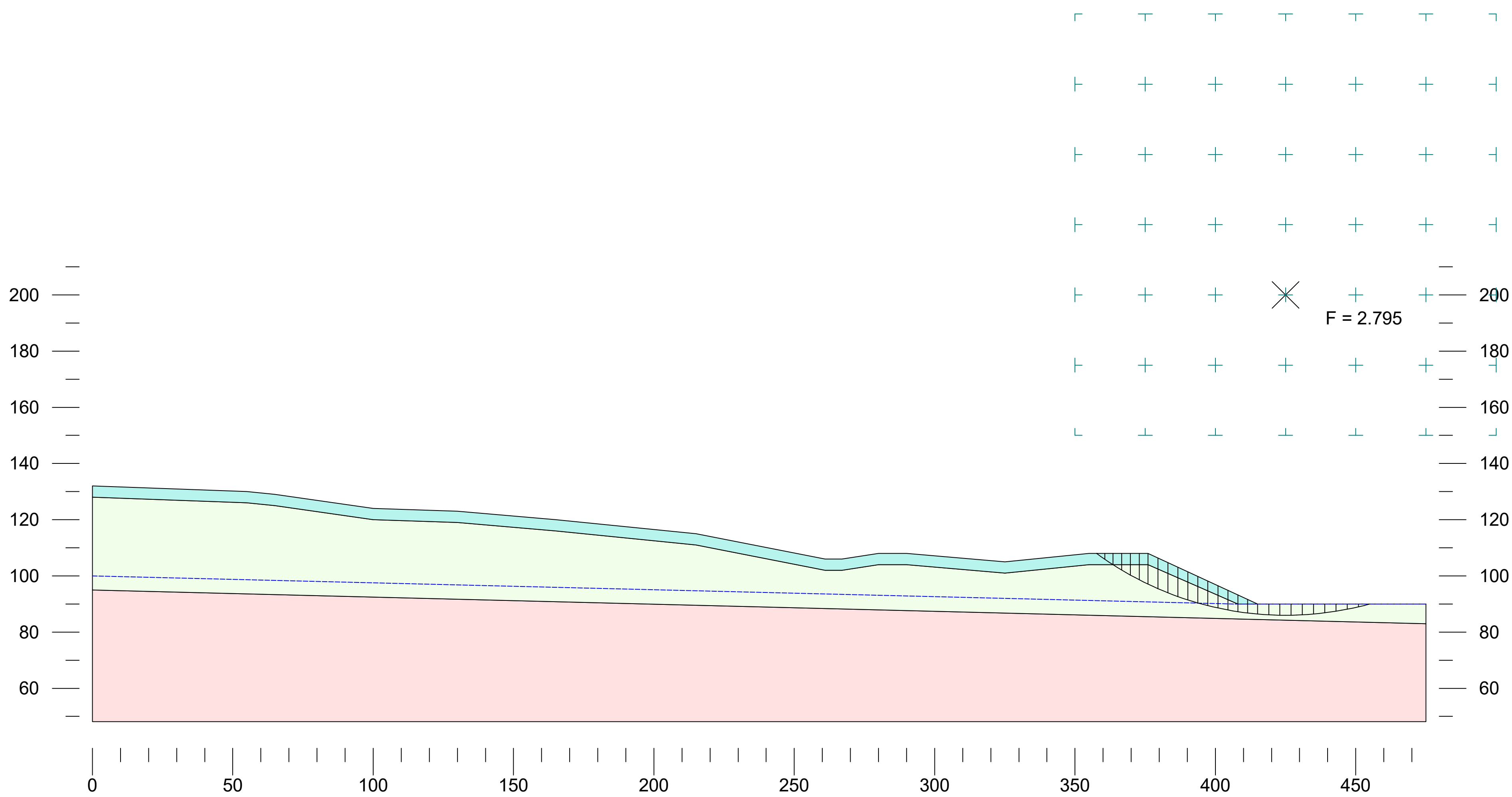
Sevee & Maher Engineers - Cumberland Center, ME
9 Cross Road
Exeter, NH
Jan 2024
Section BB



BB-PA-C.5

	Gamma pcf	C psf	Phi deg	Piezo Surf.
Cover Soil + Snow	129	0	33	1
Waste Deposit	75	104	36	1
Foundation	120	0	36	1

Sevee & Maher Engineers - Cumberland Center, ME
9 Cross Road
Exeter, NH
Jan 2024
Section BB



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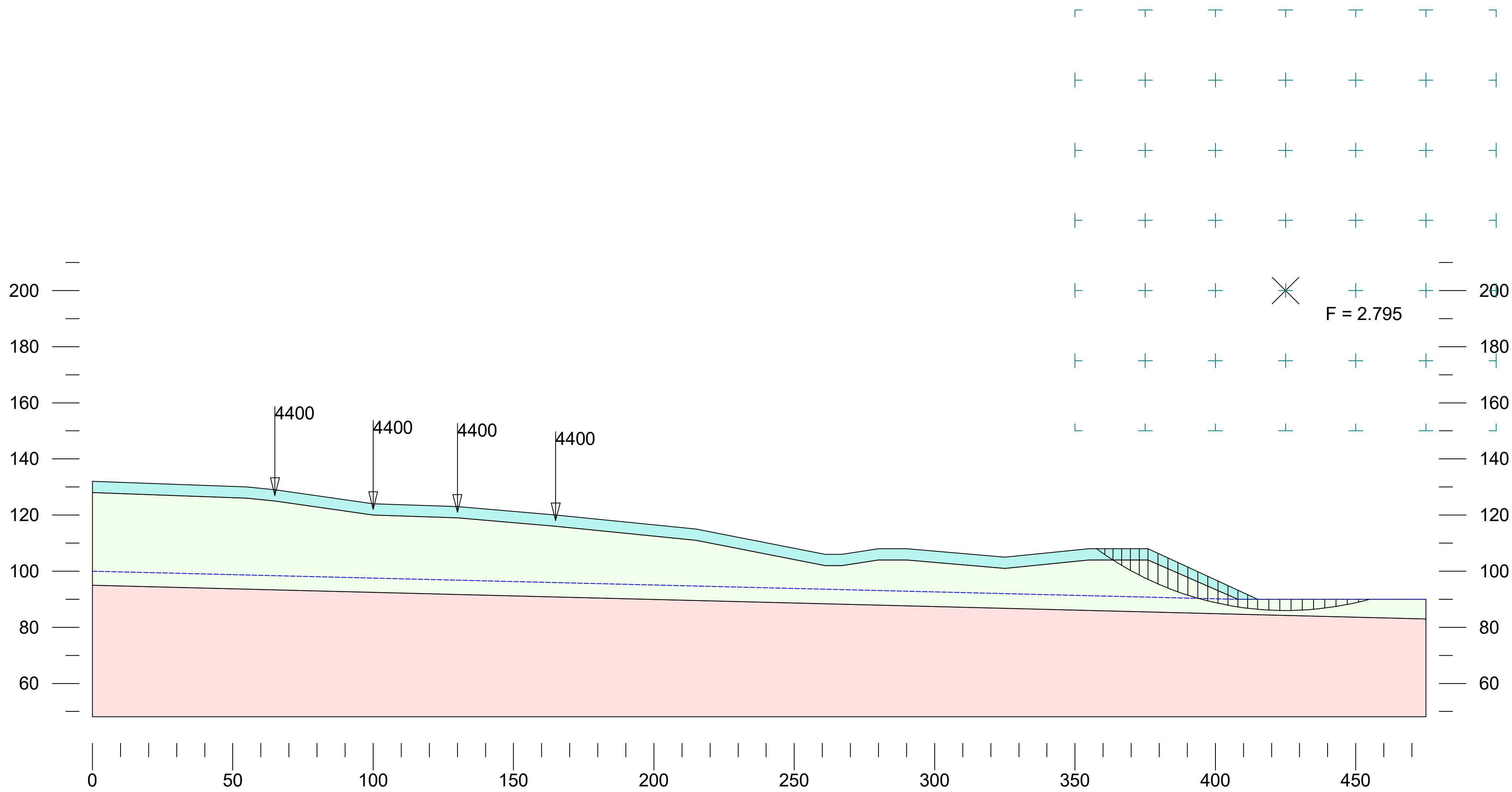
BB-SS-C.1

	Gamma pcf	C psf	Phi deg	Piezo Surf.
Cover Soil + Snow	129	0	33	1
Waste Deposit	75	104	36	1
Foundation	120	0	36	1

Sevee & Maher Engineers - Cumberland Center, ME
9 Cross Road
Exeter, NH
Jan 2024
Section BB



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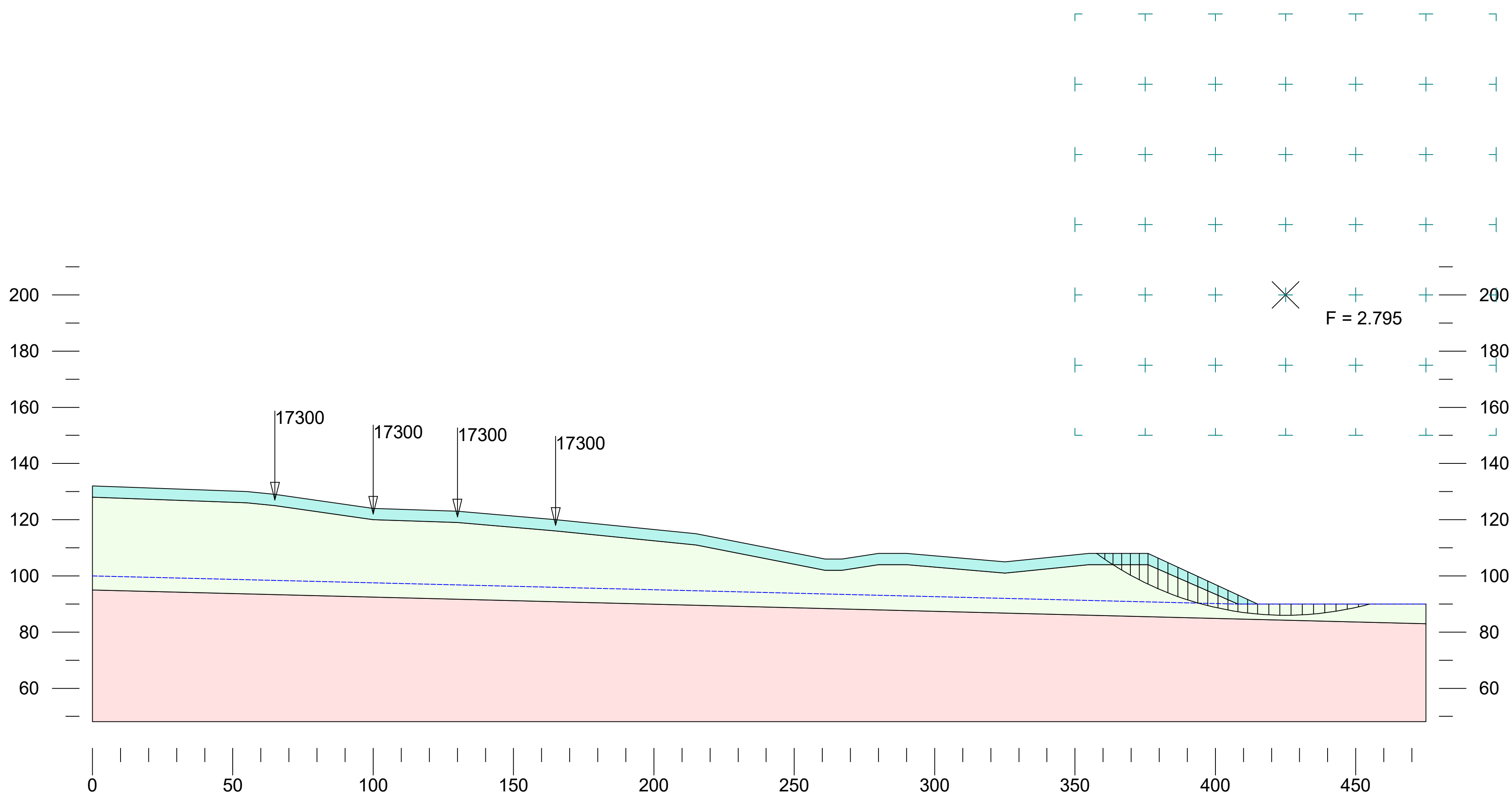
BB-SS-C.2

	Gamma pcf	C psf	Phi deg	Piezo Surf.
Cover Soil + Snow	129	0	33	1
Waste Deposit	75	104	36	1
Foundation	120	0	36	1

Sevee & Maher Engineers - Cumberland Center, ME
9 Cross Road
Exeter, NH
Jan 2024
Section BB



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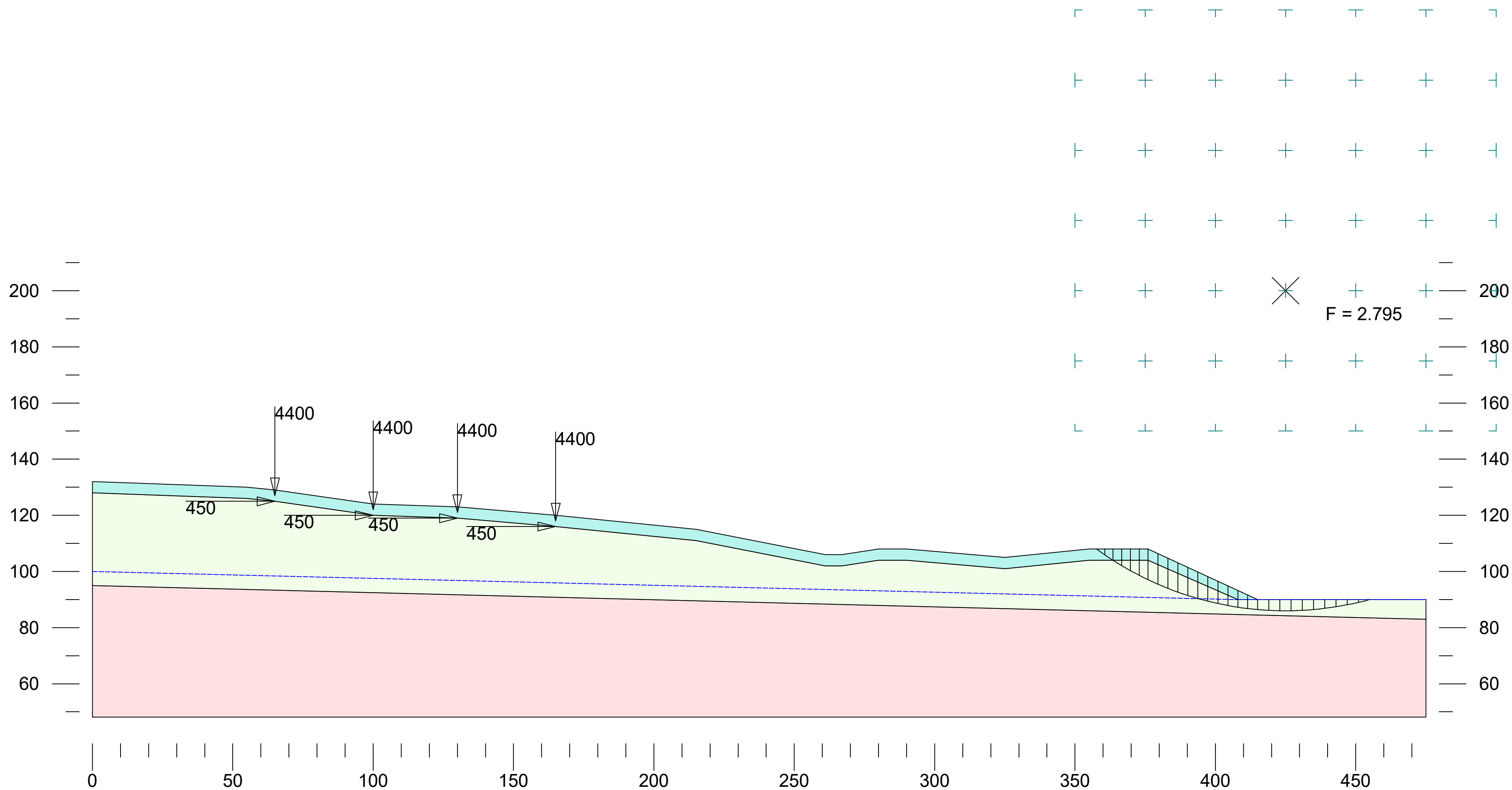
BB-SS-C.3

	Gamma pcf	C psf	Phi deg	Piezo Surf.
Cover Soil + Snow	129	0	33	1
Waste Deposit	75	104	36	1
Foundation	120	0	36	1

Sevee & Maher Engineers - Cumberland Center, ME
9 Cross Road
Exeter, NH
Jan 2024
Section BB



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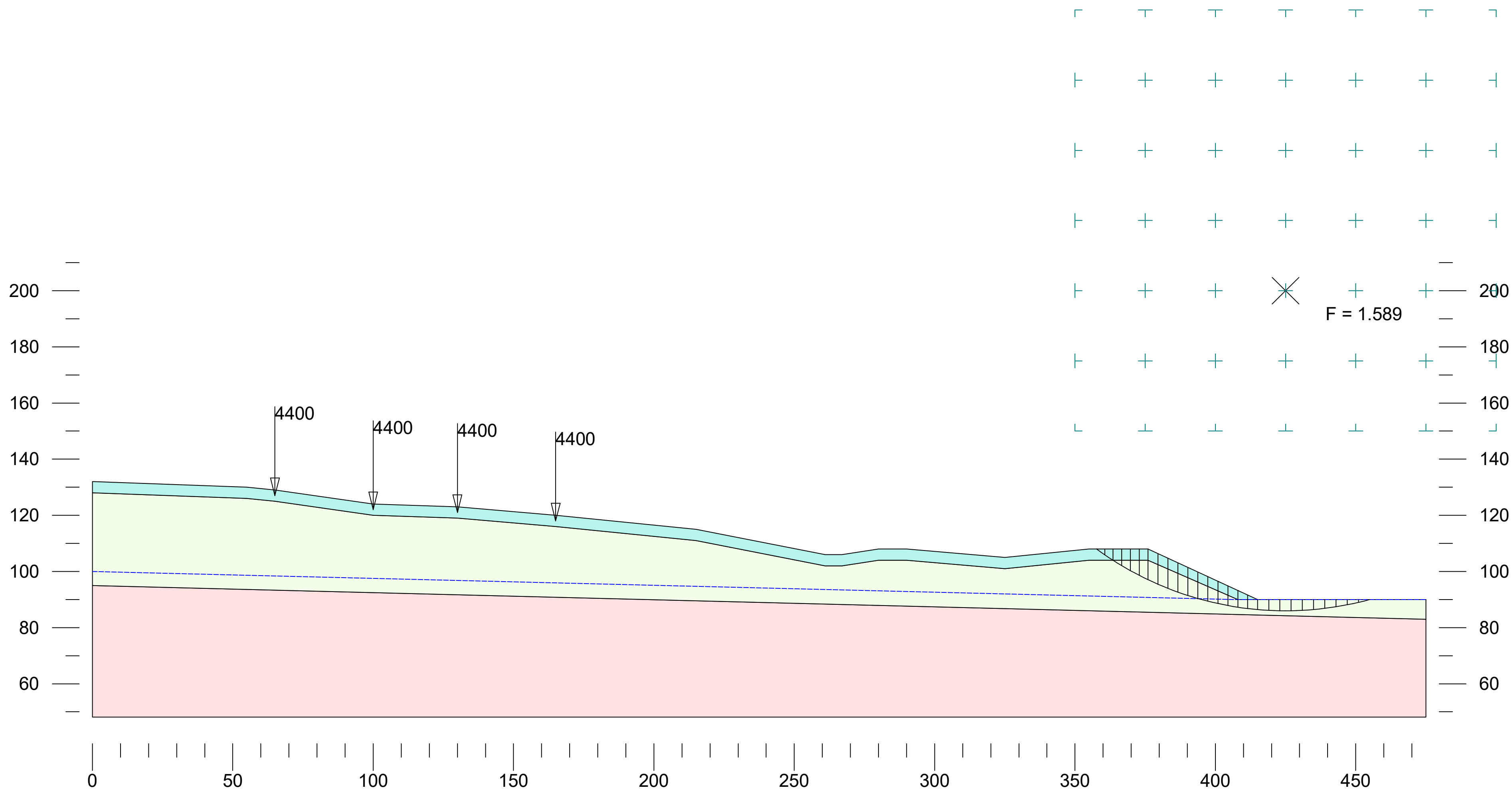
BB-SS-C.4

	Gamma pcf	C psf	Phi deg	Piezo Surf.
Cover Soil + Snow	129	0	33	1
Waste Deposit	75	104	36	1
Foundation	120	0	36	1

Seismic coefficient = 0.20

Sevee & Maher Engineers - Cumberland Center, ME
9 Cross Road
Exeter, NH
Jan 2024
Section BB



1/16/2024 9:31:28 AM \\nserver\cfs\ReVision Energy\Exeter-NH\Geotech\BB-SS-C.5.gsl Sevee & Maher Engineers - Cumberland Center, ME F = 1.589

BB-SS-C.5

ATTACHMENT 3

ELECTRICAL COMPONENTS

SME
SEVEE & MAHER
ENGINEERS

APA SOLAR RACKING

APASOLAR.COM
WHERE INNOVATION MEETS AUTOMATION

GEOBALLAST FOUNDATION

The **Geoballast Foundation** was developed after years of installing ballasted solar projects. Concrete, whether pre-cast or pour in place, proved to be an expensive and time-consuming method. Our innovative engineering and R&D teams developed a revolutionary process for ballasted projects. The goal was to remove all concrete and take the idea of a standard gabion basket and engineer it to excel as a ballast solution. Our highly engineered Geoballast box has the fastest installation time available, and is one of the most cost effective products on the market.

NO MORE CONCRETE

By utilizing locally sourced quarry rock, simply drop the weight in and you're done. No more waiting on concrete trucks, renting concrete pumps, or washing out trucks onsite. No more labor hours for setting up temporary concrete molds. No more waiting 24 hours for concrete to cure. The flow and speed of your job is 100% in your control.

RAPID SETUP

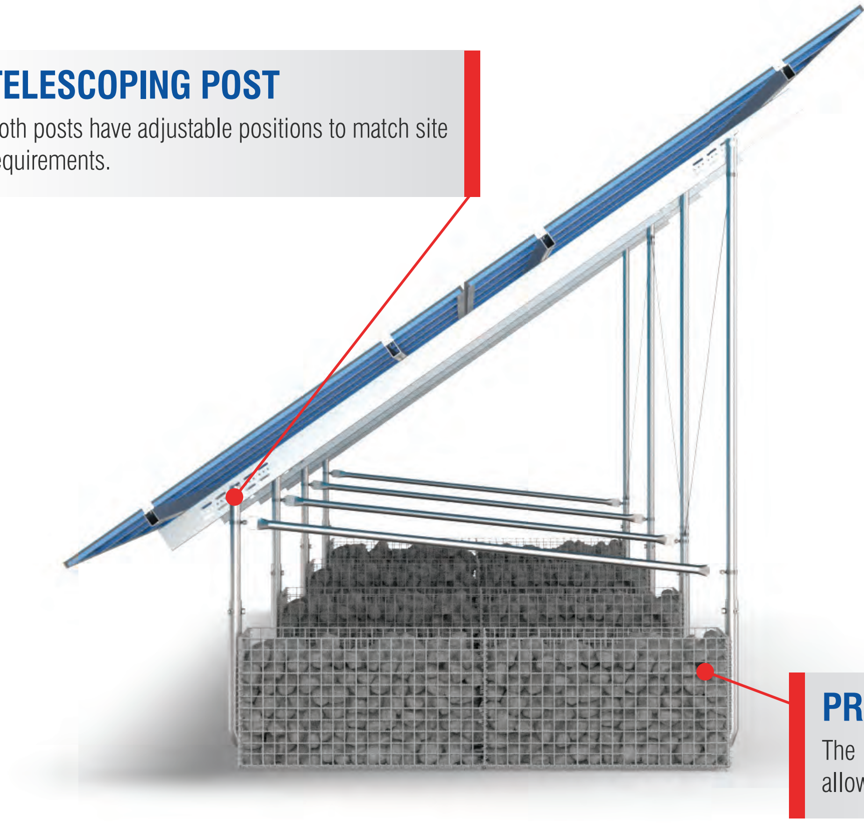
The galvanized steel wire box is delivered to the site over 70% pre-assembled. Simply unfold the box, install the spiral wires and connect the anchor tubes. The Geoballast foundation is then fully assembled and can be moved to the proper position in the row and filled with quarry rock. It's easy to assemble, stage, and stringline.

In business since 2008, APA offers a versatile line of racking and foundation solutions for projects in even the most challenging environments. With projects nationwide, APA is a trusted racking partner.

20-345 COUNTY ROAD X \\ P.O. BOX 224 \\ RIDGEVILLE CORNERS, OH 43555

419.267.5280 // SALES@APASOLAR.COM

WHY USE A GEOBALLAST FOUNDATION?



TELESCOPING POST

Both posts have adjustable positions to match site requirements.

STANDARD SPECIFICATIONS

Engineering: APA Drawings can be PE stamped for all 50 States and territories

Tilt Angles: 5°-35° Tilt Options

Wind Loading: Up to 130mph

Snow Loading: Up to 100psf

Mounting Orientation: 2-High in Portrait

Weight Requirement: 2,250 lbs per basket

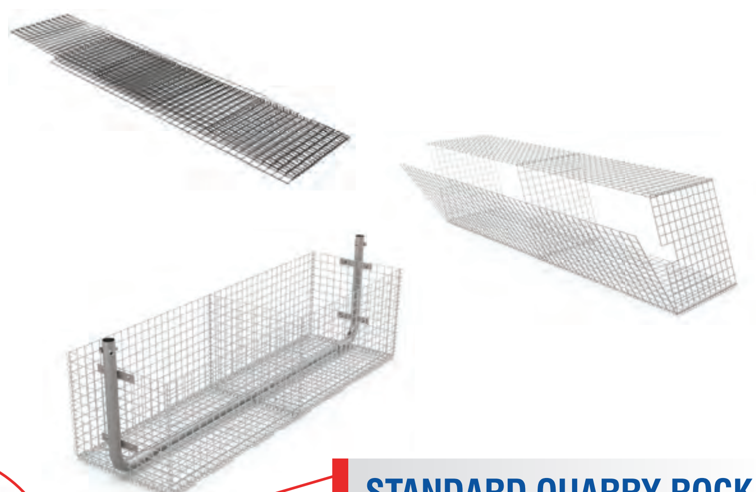
Foundation Coating: Galvanized with PVC coating for added protection

PRE-ASSEMBLED BASKET

The ballast is shipped 70% assembled, which allows for lower labor cost and quick deployment.

SIMPLE SETUP PROCESS

- Place folded ballast basket on the ground
- Unfold basket and insert lower tube
- Install spiral retainers and u-bolt connections
- Place in desired location and fill with quarry rock



STANDARD QUARRY ROCK

Rock can be sourced from local quarries to reduce shipping costs.

1500VDC Disconnect Combiners

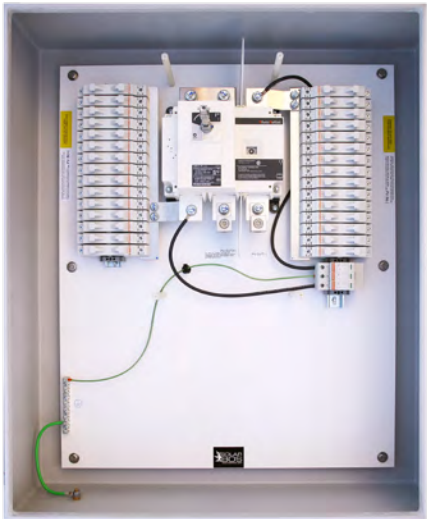
SolarBOS Disconnect Combiners for 1500 VDC photovoltaic systems are ETL listed to UL-1741. They provide direct cost savings by increasing the number of modules per source circuit(s), resulting in fewer circuits and fewer BOS components. The combiners feature load break disconnect switches up to 400A and can be customized to fit the solar integrators' specific needs.

Product features

- ETL listed to UL-1741
- 10k SCCR
- Up to 36 input circuits
- 90C terminals
- NEMA-3R, 4 & 4X enclosures

Available options

- Transient surge suppression
- Provisions for compression lugs
- Dual output lugs
- Floating / Bi-polar configurations
- Pre-terminated input conductors
- Touch safe cover over live parts
- Breather and drain vents
- Padlockable enclosures



Floating Disconnect Combiner, 1500VDC, 275A disconnect, 15 input circuits, transient surge protection, NEMA-4X fiberglas enclosure

Specifications

Disconnect Ampacity	275 A / 320 A / 400 A		
Maximum Number of Input Circuits	18	28	36
Input Conductor Size (AWG)	#14 - 8	#14 - 8	#14 - 8
Max Fuse Size (Amps)	32	32	32
Max Rated Current (ADC Continuous)	275 / 320 / 400		
Number of Output Conductors (Per Polarity)	1 or 2	1 or 2	1 or 2
Output Conductor Size Range (AWG) *	#6 to 350	#2 to 600	#2 to 600
Steel Enclosure Internal Dimensions (Inches) *	24x24x8	30x24x8	30x30x8
Appox. Weight - Powder Coated or Stainless Steel (Pounds) *	55	65	95
Fiberglass Enclosure Internal Dimensions (Inches) *	24x24x8	30x24x8	30x30x8
Appox. Weight - Fiberglass (Pounds) *	50	60	90
Enclosure NEMA Ratings	3R / 4 / 4X	3R / 4 / 4X	3R / 4 / 4X

* Other options available upon request. Please note dimensions and weight may vary for any custom solutions. Contact us for details.

Q.PEAK DUO XL-G11S SERIES

590 - 605 Wp | 156 Cells
21.7 % Maximum Module Efficiency

MODEL Q.PEAK DUO XL-G11S.3 / BFG

Bifacial energy yield gain of up to 21%

Bifacial Q.ANTUM solar cells make efficient use of light shining on the module rear-side for radically improved LCOE.

Low electricity generation costs

Q.ANTUM DUO technology with optimized module layout to boost module power and improve LCOE.

A reliable investment

Double glass module design enables extended lifetime with 12-year product warranty and improved 30-year performance warranty[1].

Enduring high performance

Long-term yield security with Anti LID and Anti PID Technology[2], Hot-Spot Protect.

Frame for versatile mounting options

High-tech aluminum alloy frame protects from damage, enables use of a wide range of mounting structures and is certified regarding IEC for high snow (5400 Pa) and wind loads (2400 Pa).

Innovative all-weather technology

Optimal yields, whatever the weather with excellent low-light and temperature behavior.

[1] See data sheet on rear for further information.
[2] APT test conditions according to IEC / TS 62804-1:2015 method B (−1500 V, 168 h) including post treatment according to IEC 61215-1-1 Ed. 2.0 (CD)

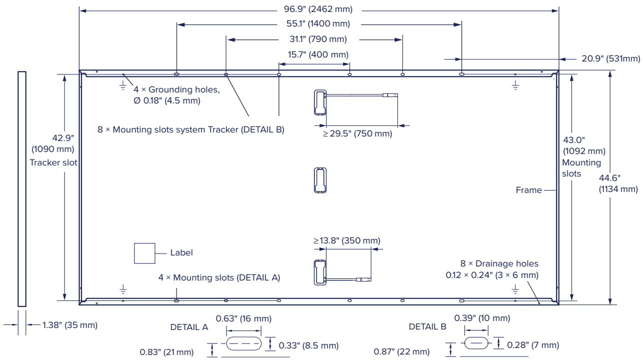
The ideal solution for:

Ground-mounted solar power plants

Q.PEAK DUO XL-G11S SERIES

■ Mechanical Specification

Format	96.9 in × 44.6 in × 1.38 in (including frame) (2462 mm × 1134 mm × 35 mm)
Weight	76.9 lbs (34.9kg)
Front Cover	0.08 in (2.0 mm) thermally pre-stressed glass with anti-reflection technology
Back Cover	0.08 in (2.0 mm) semi-tempered glass
Frame	Anodised aluminium
Cell	6 × 26 monocrystalline Q.ANTUM solar half cells
Junction box	2.09-3.98 × 1.26-2.36 × 0.59-0.71 in (53-101 mm × 32-60 mm × 15-18 mm), Protection class IP67, with bypass diodes
Cable	4 mm² Solar cable; (+) ≥ 29.5 in (750 mm), (−) ≥ 13.8 in (350 mm)
Connector	Stäubli MC4; Stäubli MC4-Evo2; - IP68



■ Electrical Characteristics

POWER CLASS			590		595		600		605	
MINIMUM PERFORMANCE AT STANDARD TEST CONDITIONS, STC¹ (POWER TOLERANCE +5 W / −0 W)										
				BSTC*		BSTC*		BSTC*		BSTC*
Minimum — Power at MPP¹	P_{MPP}	[W]	590	645.4	595	650.8	600	656.3	605	661.8
Short Circuit Current¹	I_{SC}	[A]	13.74	15.04	13.77	15.07	13.80	15.10	13.82	15.13
Open Circuit Voltage¹	V_{OC}	[V]	53.60	53.79	53.63	53.82	53.66	53.85	53.68	53.87
Current at MPP	I_{MPP}	[A]	13.12	14.36	13.17	14.41	13.22	14.46	13.27	14.52
Voltage at MPP	V_{MPP}	[V]	44.96	44.95	45.18	45.17	45.39	45.38	45.60	45.59
Efficiency¹	η	[%]	≥ 21.1		≥ 21.3		≥ 21.5		≥ 21.7	

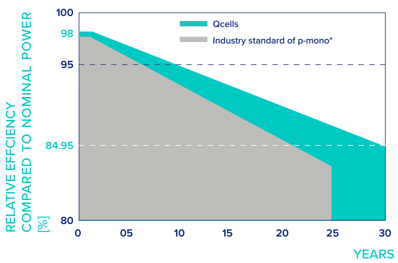
Bifaciality of P_{MPP} and I_{SC} 70 % ± 5 % • Bifaciality given for rear side irradiation on top of STC (front side) • According to IEC 60904-1-2

¹Measurement tolerances P_{MPP} ± 3 %; I_{SC}, V_{OC} ± 5 % at STC: 1000 W/m²; *at BSTC: 1000 W/m² + φ × 135 W/m², φ = 70 %, 25 ± 2 °C, AM 1.5 according to IEC 60904-3

MINIMUM PERFORMANCE AT NORMAL OPERATING CONDITIONS, NMOT²w						
Minimum — Power at MPP	P_{MPP}	[W]	444.2	448.0	451.8	455.5
Short Circuit Current	I_{SC}	[A]	11.07	11.09	11.11	11.13
Open Circuit Voltage	V_{OC}	[V]	50.69	50.72	50.75	50.77
Current at MPP	I_{MPP}	[A]	10.34	10.38	10.42	10.47
Voltage at MPP	V_{MPP}	[V]	42.97	43.15	43.34	43.52

¹Measurement tolerances P_{MPP} ± 3 %; I_{SC}; V_{OC} ± 5 % at STC: 1000 W/m², 25 ± 2 °C, AM 1.5 according to IEC 60904-3 • ²800 W/m², NMOT, spectrum AM 1.5

Qcells PERFORMANCE WARRANTY

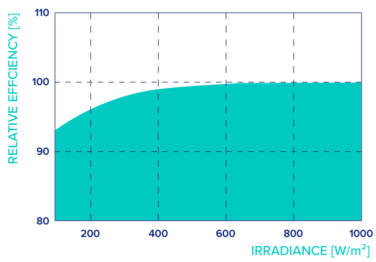


At least 98 % of nominal power during first year. Thereafter max. 0.45 % degradation per year. At least 93.95 % of nominal power up to 10 years. At least 84.95 % of nominal power up to 30 years.

All data within measurement tolerances. Full warranties in accordance with the warranty terms of the Qcells sales organisation of your respective country.

*Standard terms of guarantee for the 5 PV companies with the highest production capacity in 2021 (February 2021)

PERFORMANCE AT LOW IRRADIANCE



Typical module performance under low irradiance conditions in comparison to STC conditions (25 °C, 1000 W/m²).

TEMPERATURE COEFFICIENTS

Temperature Coefficient of I_{SC}	α	[% / K]	+0.04	Temperature Coefficient of V_{OC}	β	[% / K]	−0.27
Temperature Coefficient of P_{MPP}	γ	[% / K]	−0.34	Nominal Module Operating Temperature	NMOT	[°F]	108 ± 5.4 (42 ± 3 °C)

■ Properties for System Design

Maximum System Voltage	V_{SYS}	[V]	1500
Maximum Series Fuse Rating		[A DC]	30
Max. Push Load, Design³ / Test³		[lbs / ft²]	75 (3600 Pa) / 113 (5400 Pa)
Max. Pull Load, Design³ / Test³		[lbs / ft²]	52 (2500 Pa) / 78 (3750 Pa)

³ See Installation Manual

PV module classification	Class II
Fire Rating based on ANSI / UL 61730	TYPE 29⁴
Permitted Module Temperature on Continuous Duty	−40 °F up to +185 °F (−40 °C up to +85 °C)

⁴ New Type is similar to Type 3 but with metallic frame

■ Qualifications and Certificates

UL61730-1 & UL61730-2, CE-compliant,
IEC 61215:2016,
IEC 61730:2016,
U.S. Patent No. 9,893,215
(solar cells)

TÜVRheinland C US · CE · TÜVRheinland CERTIFIED www.tuv.com ID 1111220277

* Contact your Qcells Sales Representative for details regarding the module's eligibility to be Buy American Act (BAA) compliant.

Find product recycling details at QR code above

Qcells pursues minimizing paper output in consideration of the global environment.

Note: Installation instructions must be followed. Contact our technical service for further information on approved installation of this product.

Hanwha Q CELLS America Inc. 400 Spectrum Center Drive, Suite 1400, Irvine, CA 92618, USA I TEL +1 949 748 59 96 I EMAIL hqc-inquiry@qcells.com I WEB www.qcells.com

Qcells

/ SHP 125-US-21 / SHP 150-US-21 / SHP 165-US-21 / SHP 172-US-21

Sunny Highpower PEAK3-US

125 / 150 / 165 / 172

A superior distributed generation solution for large-scale power plants

25 YEAR DESIGN LIFE

SMA Smart Connected

c UL us

Cost effective

- Modular architecture reduces BOS and maximizes system uptime
- Compact design and high power density maximize transportation and logistical efficiency

Maximum flexibility

- Scalable 1,500 VDC building block with best-in-class performance
- Flexible architecture creates scalability while maximizing land usage

Simple install, commissioning

- Ergonomic handling and simple connections enable quick installation
- Centralized commissioning and control with SMA Data Manager

Highly innovative

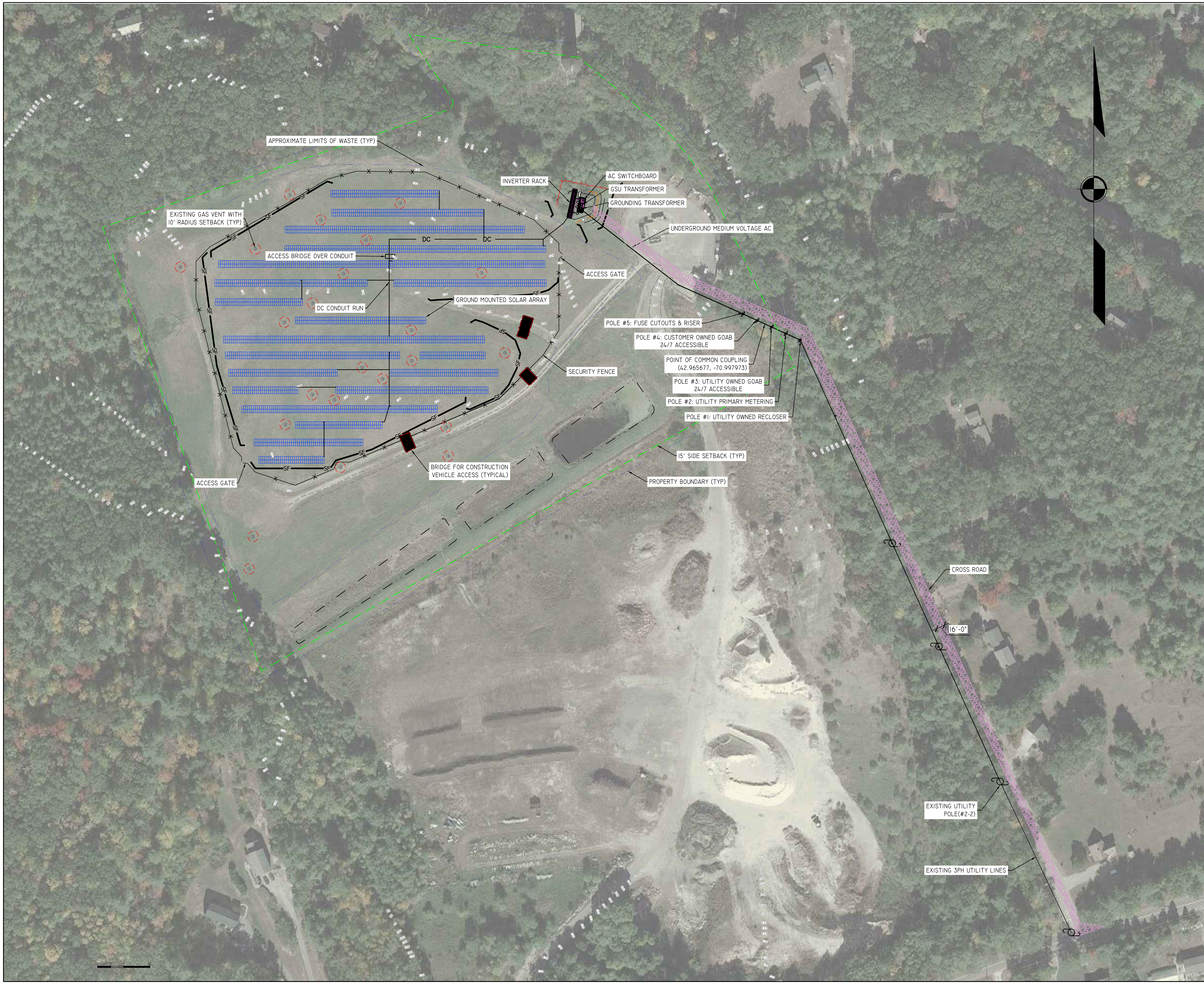
- SMA Smart Connected reduces O&M costs and simplifies field-service
- Powered by award winning ennexOS cross sector energy management platform

The Sunny Highpower PEAK3 1,500 VDC inverter offers high power density in a modular architecture that achieves a cost-optimized solution for large-scale PV integrators.

With fast, simple installation and commissioning, the PEAK3 is accelerating the path to energization. SMA has also brought its field-proven Smart Connected technology to the PEAK3, which simplifies O&M and contributes to lower lifetime service costs. The PEAK3 power plant solution is powered by the ennexOS cross sector energy management platform, 2018 winner of the Intersolar smarter E AWARD.

Technical Data	Sunny Highpower PEAK3 125-US	Sunny Highpower PEAK3 150-US	Sunny Highpower PEAK3 165-US	Sunny Highpower PEAK3 172-US
Input (DC)				
Maximum array power [1]	250 kWp	300 kWp	330 kWp	344 kWp
Maximum system voltage	1500 Vdc			
Rated MPP voltage range	705 V ... 1450 V	880 V ... 1450 V	924 V ... 1450 V	968 V ... 1450 V
MPPT operating voltage range	684 V ... 1500 V	855 V ... 1500 V	898 V ... 1500 V	941 V ... 1500 V
MPP trackers	1			
Maximum operating input current	180 A			
Maximum input short-circuit current	325 A			
Output (AC)				
Nominal AC power	125 kW	150 kW	165 kW	172 kW
Maximum apparent power	125 kVA	150 kVA	165 kVA	172 kVA
Output phases / line connections	3 / 3-PE			
Nominal AC voltage	480 V	600 V	630 V	660 V
Compatible transformer winding configuration	Wye-grounded			
Maximum output current	151 A			
Rated grid frequency	60 Hz			
Grid frequency / range	50 Hz, 60 Hz / -6 Hz ... +6 Hz			
Power factor at rated power / adjustable displacement	1 / 0.8 leading ... 0.8 lagging			
Harmonics (THD)	<3%			
Efficiency				
CEC efficiency	98.5 %	99.0 %	99.0 %	99.0 %
Protection and safety features				
Ground fault monitoring: Riso / Differential current	● / ●			
DC reverse polarity protection	●			
AC short circuit protection	●			
Monitored surge protection (Type 2): DC / AC	● / ●			
Protection class / overvoltage category (as per UL 840)	I / IV			
General data				
Device dimensions (W / H / D)	770 / 830 / 462 mm (30.3 / 32.7 / 18.2 in)			
Device weight	99 kg (218 lbs)			
Operating temperature range	-25°C ... +60°C (-13°F ... +140°F)			
Storage temperature range	-40°C ... +70°C (-40°F ... +158°F)			
Audible noise emission (full power @ 1m and 25°C)	< 69 dB(A)			
Internal consumption at night	< 5 W			
Topology	Transformerless			
Cooling concept	OptiCool (forced convection, variable speed fans)			
Enclosure protection rating	Type 4X			
Maximum permissible relative humidity (non-condensing)	100%			
Additional information				
Mounting	Rack mount			
DC connection	Terminal lug (up to 600 kcmil CU/AL)			
AC connection	Screw terminal (up to 300 kcmil CU/AL)			
LED indicators (Status/Fault/Communication)	●			
SMA Speedwire (Ethernet network interface)	● (2 x RJ45 ports)			
Data protocols: SMA Modbus / SunSpec Modbus	● / ●			
Integrated Plant Control / Q on Demand 24/7	● / ●			
Off-grid capable / SMA Hybrid Controller compatible	– / ●			
Monitoring				
SMA Sunny Portal (monitoring portal)	No cost for the lifetime of the system			
SMA Smart Connected (monitoring and remote O&M service)	No cost on inverters under warranty			
Supported protocols for outbound data	SMA external API, Modbus, FTP			
Certifications				
Certifications and approvals (pending)	UL 62109, UL 1998, CAN/CSA-C22.2 No.62109			
Manufacturer's Declaration of Design Life	25 years			
FCC compliance	FCC Part 15, Class A			
Grid interconnection standards	IEEE 1547:2018, UL 1741-SA - CA Rule 21, HECO Rule 14H, UL1741SB			
Advanced grid support capabilities	L/HFRT, L/HVRT, Volt-VAr, Volt-Watt, Frequency-Watt, Ramp Rate Control, Fixed Power Factor			
Warranty				
Standard	5 years			
Optional extensions (total warranty coverage cannot exceed 25 years)	+5 / +10 / +15 / +20 years			
1) Higher DC array power permitted via site inverter load modeling in SMA Sunny Design				
Type designation	SHP 125-US-21	SHP 150-US-21	SHP 165-US-21	SHP 172-US-21
● Standard features ○ Optional features – Not available				

SHP-US-DS-en-23 Changes to products and services, including those resulting from country-specific requirements, as well as deviations from technical data are subject to change at any time without notice. SMA assumes no liability for typographical or other errors. Please visit www.SMA-Solar.com for the latest information.



SYSTEM SUMMARY	
DC SYSTEM SIZE	1,791.240 kW DC
AC SYSTEM SIZE	1,500.000 kW AC
PROJECT TYPE	GROUND MOUNT
TILT / AZIMUTH	35° / 180°

EQUIPMENT SUMMARY

ITEM	DESCRIPTION	QTY
MODULE	HANWHA Q CELLS, Q.PEAK DUO XL-G11S.3 590/BFG (590)	3,036
INVERTER	SMA HIGHPOWER PEAK3 125-US-21	12
DAS	ALSOENERGY	1

REVISION ENERGY
758 WESTBROOK STREET
SOUTH PORTLAND, ME 04106
(207) 221-6342

CLIENT:

TOWN OF EXETER

PROJECT ADDRESS:

9 CROSS ROAD
EXETER, NH

SYSTEM TYPE:

GROUND MOUNT
PHOTOVOLTAIC ARRAY

NOT FOR CONSTRUCTION

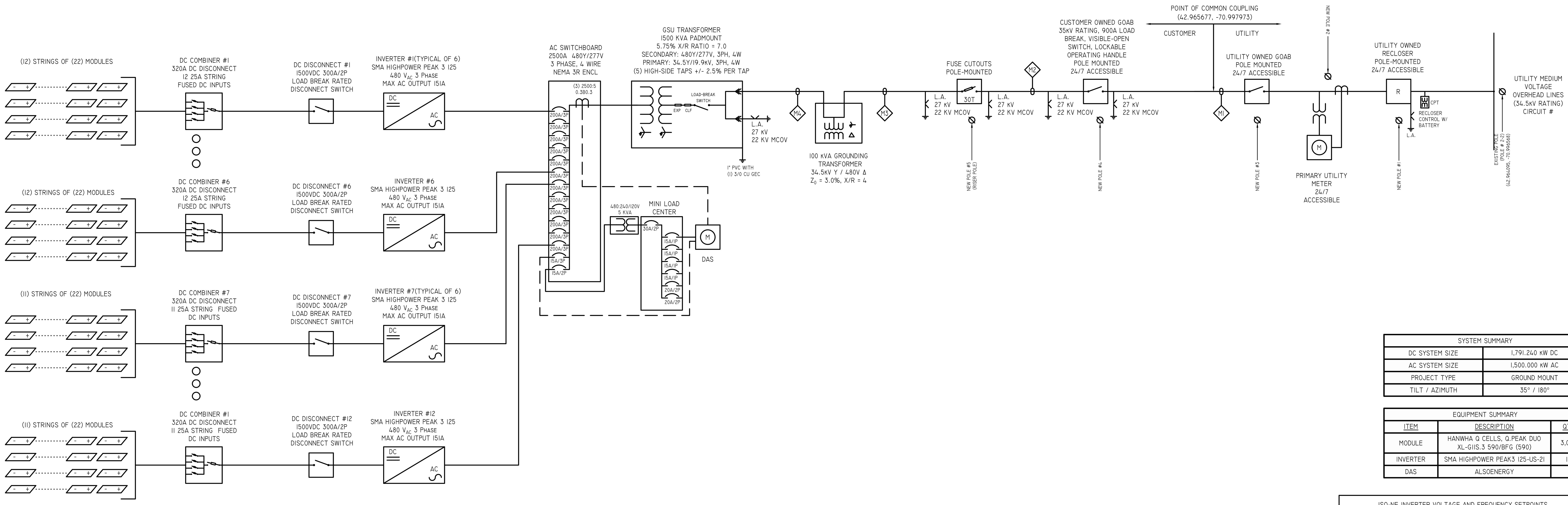
STATE OF NEW HAMPSHIRE
ROBERT C SMITH
No.08628
LICENSED
PROFESSIONAL ENGINEER

REV	BY	DATE	STATUS
000	IS	09/18/2023	ISSUED FOR INTERCONNECTION
001	IS	01/31/2024	UPDATED PER SIS FOR INTERCONNECTION

DESIGNED BY: IS
PRINT SIZE: 24" X 36"
SCALE: 1" = 80'
DATE: JANUARY 31, 2024

DWG TITLE
SITE PLAN

DWG NUMBER
E100



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DAS	ALSOENERGY	1

ISO-NE INVERTER VOLTAGE AND FREQUENCY SETPOINTS					
ANSI ELEMENT		PICKUP		TOTAL CLEARING TIME	
				SECONDS	CYCLES
27-1	UNDER VOLTAGE	88%	422V (L-L)	2	120
27-2	UNDER VOLTAGE	50%	240V (L-L)	1.1	66
59-1	OVER VOLTAGE	110%	528V (L-L)	2	120
59-2	OVER VOLTAGE	120%	576V (L-L)	0.16	9.6
81U-1	UNDER FREQUENCY	58.5 Hz		300	18000
81U-2	UNDER FREQUENCY	56.5 Hz		0.16	9.6
81O-1	OVER FREQUENCY	61.2 Hz		300	18000
81O-2	OVER FREQUENCY	62 Hz		0.16	9.6
NOTES: BASE VOLTAGE = 480V					

INTERCONNECTION APPLICATION TABLE		
MAX FAULT CURRENT CONTRIBUTION	7953A AT 480V	INSTANTANEOUS
TOTAL HARMONIC DISTORTION (THD)	THD <3% (IEEE 1547)	
START UP REQUIREMENTS	5 MINUTES HEALTHY UTILITY VOLTAGE AND FREQUENCY PER IEEE 1547.	
INVERTER CERTIFICATION	IEEE 1547:2018, UL1699B, UL1741, UL1741 SA, UL1741 SB, UL1998, UL62109	

MV WIRE AND CONDUIT SCHEDULE									OVERHEAD - OHMS / MILE UNDERGROUND - OHMS / 1000 FEET				PER UNIT VALUES (100MVA BASE)			
TAG	FROM / TO	CONDUCTORS	WIRE TYPE	WIRE INSTALLATION LOCATION	VOLTAGE RATING, kV	CONDUIT	CONDUIT FILL	LENGTH (FT)	R1	X1	R0	X0	R1	X1	R0	X0
M1	UTILITY OWNED GOAB / CUSTOMER OWNED GOAB	(4) 77.47 AMES	AAAC	OVERHEAD	35	FREE AIR	NA	30	1.67756	0.88989	1.96317	3.10207	0.00080	0.00042	0.00094	0.00148
M2	CUSTOMER OWNED GOAB / FUSE CUTOUTS	(4) 77.47 AMES	AAAC	OVERHEAD	35	FREE AIR	NA	30	1.67756	0.88989	1.96317	3.10207	0.00080	0.00042	0.00094	0.00148
M3	FUSE CUTOUTS / GROUNDING TRANSFORMER	(3) 1/0 1C AWG AL W CONC NEUTRAL	MV-90	UNDERGROUND	35	4" PVC-80	30%	410	0.20079	0.05565	0.40157	0.11131	0.00692	0.00192	0.01383	0.00383
M4	GROUNDING TRANSFORMER / GSU TRANSFORMER	(3) 1/0 1C AWG AL W CONC NEUTRAL	MV-90	UNDERGROUND	35	4" PVC-80	30%	15	0.20079	0.05565	0.40157	0.11131	0.00025	0.00007	0.00051	0.00014

REVISION ENERGY
758 WESTBROOK STREET
SOUTH PORTLAND, ME 04106
(207) 221-6342

CLIENT:

TOWN OF EXETER

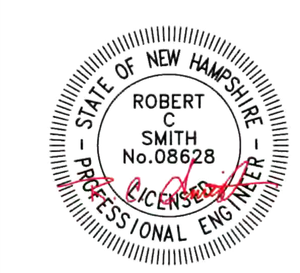
PROJECT ADDRESS:

9 CROSS ROAD
EXETER, NH

SYSTEM TYPE:

GROUND MOUNT
PHOTOVOLTAIC ARRAY

NOT FOR CONSTRUCTION



REV	BY	DATE	STATUS
000	IS	09/18/2023	ISSUED FOR INTERCONNECTION
001	IS	01/31/2024	UPDATED PER SIS FOR INTERCONNECTION

DESIGNED BY: IS
PRINT SIZE: 24" X 36"
SCALE: NA
DATE: JANUARY 31, 2024

DWG TITLE
ONE-LINE DIAGRAM

DWG NUMBER
E400

ATTACHMENT 4

CLOSURE PLAN

SME
SEVEE & MAHER
ENGINEERS

ENV-SW 1106.04
CLOSURE PLAN CONTENT AND FORMAT

Section 1. Facility Identification

Facility name:	Exeter Municipal Landfill
Mailing Address:	10 Front St, Exeter, NH
Location:	9 Cross Rd, Exeter, NH
Permit Number:	DES-SW-SP-1992-001

Section 2. Closure Schedule

The Exeter Municipal Landfill was closed in 1994.

Section 3. Waste Identification

The Exeter Municipal Landfill received municipal solid waste.

Section 4. Notifications

The Exeter Municipal Landfill is closed. No notifications are required for this project.

Section 5. Closure requirements

"Landfill Closure Design and Specifications, Cross Road Landfill, Exeter, New Hampshire," prepared by GZA Geo Environmental Inc. dated March 30, 1994, is on file with NHDES under administrative order no. WMD 87-136.

Section 6. Post-closure requirements

The addition of the solar array will not change the ongoing landfill post-closure testing, inspection, maintenance or monitoring that is currently being performed at the facility. Reference DES permit number DES-SW-SP-1992-001 for applicable historical landfill post-closure reports. Attachment 4b includes an Inspection and Maintenance manual outlining the maintenance and monitoring for the third-party to conduct.

The Decommissioning Plan is included as an attachment to the closure plan in Attachment 4a. This is included as an attachment to the closure plan at the request of NHDES.

Section 7. Recordkeeping and reporting

Copies of all records and reports will be maintained on site during construction. Copies of these files will be transferred to NHDES at the completion of construction for Department records. All recordkeeping and reporting obligations required of the facility following completion of the closure work are identified in Section 5 of the Closure Plan.

Section 8. Other permits

Other permits required for this project include a NHDES Alteration of Terrain (AoT) permit. NHDES Permit Application Number 231107-221 is currently under review with NHDES.

Section 9. Closure Cost Estimate

A closure cost estimate prepared in accordance with Env-Sw 1403.02 for post-closure landfill care and maintenance and solar decommissioning is attached. The Town of Exeter intends to use the approved LOGO test for financial assurance to meet the requirements of Env-Sw 315 and Env-Sw 1400.

ATTACHMENT 4a

DECOMMISSIONING PLAN

SME
SEVEE & MAHER
ENGINEERS

ATTACHMENT 4a
DECOMMISSIONING PLAN

A. OVERVIEW

The proposed Exeter Landfill Solar Project (“Project”) in the Town of Exeter, NH will consist of approximately 3,036 photovoltaic (PV) panels and will have an installed capacity of up to 1.5 megawatts (MW) alternating current (AC) of electricity. The Project will interconnect to Unitil’s existing distribution line on Cross Road via an overhead three phase electrical line. No on-site substation will be required. Other Project components include a seven-foot-tall perimeter fence surrounding the Project, a metal above-ground ballasted racking system, PV inverters to convert the power to AC, a step-up transformer to condition the power to the local grid voltage, a series of above-ground electrical collector lines extending from the panels and connecting to the transformer, an underground electrical line run outside of the landfill limits of waste, and several new electrical poles where the project connects to Unitil’s distribution line on Cross Road.

If properly maintained, the panels have an expected usable life of 25 to 40 years; or up to 50 years with equipment replacement. Under the Project decommissioning plan, all solar facility components will be physically removed at the end of the useful life of the system.

Decommissioning will involve removal of system components and rehabilitation of the site to as close to pre-construction conditions as is feasible. Typical activities involved in decommissioning and site restoration include:

- Facility de-energizing;
- PV module removal;
- Dismantling and removal of racking and structural equipment;
- Dismantling and removal of aboveground and belowground electrical equipment;
- Debris management, including hauling and disposal;
- Installation of temporary erosion controls; and
- Removal of security fencing.

B. FACILITY MATERIALS

PV facilities are constructed using the same basic materials and methods of installation common to their application. Materials include:

Metals: Steel from foundations, racking, conduits, electrical enclosures, fencing, and storage containers; aluminum from racking, module frames, electrical wire, and transformers; stainless steel from fasteners, electrical enclosures, and racking; copper from electrical wire, transformers, and inverters.

Concrete: Equipment pads and footings.

PV Cells: PV modules are typically constructed of glass front sheets (some use a glass back sheet as well), plastic back sheets and laminates, silicon cells, internal electrical conductors (aluminum or copper), silver solder, plus a variety of micro materials. The semiconductor PV cell materials represent a very small part of a PV module's weight, between 1 and 2 percent. The most commonly used semiconductor material for the construction of PV modules is silicon. Glass, aluminum, and copper are easily recyclable materials, and silicon can be recycled by specialty electronics recyclers.

Glass: Most PV modules are approximately 80 percent glass by weight.

Plastics: A limited amount of plastic materials are used in PV systems due to a system's continuous exposure to the elements and long operational lifetime. Plastics typically are found in PV facilities as wire insulation, electrical enclosures, control and monitoring equipment, and inverter components.

Additionally, plastic laminate films are used in most PV module assemblies.

C. DECOMMISSIONING SEQUENCE

The following sequence for the removal of the components will be used:

Site Preparation:

- Establish temporary erosion control measures where needed.

PV Array:

- Disconnect PV facility from the utility power grid;
- Disconnect all aboveground wirings, cables, and electrical interconnections and recycle off-site by an approved recycling facility;
- Remove concrete foundations. Electric components and their foundations will be removed and recycled off-site by a concrete recycler;
- Remove PV modules and ship to recycling facilities for recycling and material reuse;
- Remove metal racking system structures and recycle off-site by an approved metal recycler;
- Remove all waste; and
- Remove the perimeter fence and recycle off-site by an approved metal recycler.

Inverters/Transformers:

- Disconnect all electrical equipment;
- Remove all on-site inverters, transformers, meters, fans, lighting fixtures, and other electrical components and recycle off-site by an approved recycler; and
- Remove all waste.

Below-Ground Structure Decommissioning:

- Disconnect and remove all underground cables and transmission lines to a depth of 24 inches below grade, or the depth of bedrock if less than 24 inches, and recycle off-site by an approved recycling facility.

D. SITE RESTORATION

Following the removal of Project components, the site will be returned to existing conditions.

ATTACHMENT 4b

INSPECTION AND MAINTENANCE MANUAL

SME
SEVEE & MAHER
ENGINEERS

ATTACHMENT 4b
EXETER LANDFILL INSPECTION AND MAINTENANCE

Verification of PV system functionality will be enabled by web-based production monitoring. Inspection of the racking and geoballast foundation units and electrical equipment will be completed annually by a qualified technician. Industry-standard projections estimate a 40-year service life for solar equipment.

A 7-foot-tall perimeter fence will be installed to keep out unauthorized personnel and vehicles. Exposed array conductors will be protected from access by unqualified personnel in accordance with National Electric Code requirements. Lockable electrical enclosures and equipment requiring tools to open will be used to restrict access to all equipment by unauthorized personnel.

The Town will continue to mow vegetated areas regularly, including areas under and around the solar equipment. Additional work or remediation required to correct for erosion, settlement, or other event created by the installation of the PV array is the responsibility of the Town.

ATTACHMENT 5

CLOSURE COST ESTIMATE

SME
SEVEE & MAHER
ENGINEERS

Cost Estimate Form for Post-Closure of a Landfill

(lined or unlined)

Submit to:

Waste Management Division, SWMB

PO Box 95, Concord, NH 03302-0095

(603) 271-2925 or solidwasteinfo@des.nh.gov

https://www.des.nh.gov

RSA 149-M/Env-Sw 1400

Facility Name: Exeter Municipal Landfill	
Facility Address: Cross Road, Exeter, NH 03833	
NHDES Permit #: DES-SW-SP-1992-001	
Owner: Town of Exeter	
Phase: N/A - Post Closure	**Acreage: 18.3 acres**

	Task	Unit	Unit Cost	Quantity	Total Cost
I	**Water Monitoring**				
	Surface Water Sampling & Analysis		*Performed Annually by GZA**		
	Other (Permit Requirement) ______________________________				
	Ground Water Sampling & Analysis				
	Other (Permit Requirement) ______________________________				
	Other				
II	**Gas Monitoring**				
	Landfill Gas Migration Monitoring		*Performed Annually by GZA**		
	Replacing 20% of the Active Gas Collection System				
	Other				
III	**Settlement Monitoring**				
	Field Survey		*Performed Annually by GZA**		
	Data Tabulation				
	Other				
IV	**Leachate Collection/Monitoring**				
	Sewer Charges		N/A**		
	Electricity		N/A**		
	Maintenance of Collection System		N/A**		
	Sampling & Analysis		N/A**		
	Other		N/A**		
V	**Clean Air Act Requirements**				
	Monitoring & Analysis		N/A**		
	Emissions Fees		N/A**		
VI	**Repair & Site Maintenance Costs**				
	Snow Removal	*LS*	$0.00	1	$0.00
	Roadway Maintenance	*LS*	$500.00	1	$500.00
	Mowing	*LS*	$3,660.00	2	$7,320.00
	Soil Cover Maintenance and Planting	*LS*	$2,000.00	1	$2,000.00
	Maintenance of Gas Venting System		NA**		$0.00
	Subsidence Repair	*LS*	$2,000.00	1	$2,000.00
	Stormwater Maintenance	*LS*	$1,000.00	1	$1,000.00
	Other		NA**		$0.00
VII	**Inspections**				
	Annual Report	*LS**	$7,500.00	1	$7,500.00
	Annual Site Inspections		*Performed Annually by GZA**		
	Other				
VIII	**Other**				
	Decomissioning over Solar Array (annual cost)	*LS*	$47,408.00	0.03	$1,422.24
	Sub-total				$21,742.24
	Contingency (10 % minimum)				$2,174.22
	Total Yearly Cost				$23,916.46
	Total 30-Year Cost				$717,493.92

Signature of Preparer: ______________________ Date: February 2, 2024

(Must be a Professional Engineer)

STATE OF NEW HAMPSHIRE – BRIAN D. PIERCE No. 13062 – LICENSED PROFESSIONAL ENGINEER – 2/1/2024

This form provides a basis for estimating post-closure costs for a lined or unlined landfill. This form is not inclusive of all costs that may be associated with the landfill's post-closure monitoring and maintenance requirements. The cost estimate must include all expenses associated with compliance of all NHDES permits. Please use the spaces provided above noted as "Other" or attach additional sheets if necessary.

Notes:

1 Opinion of cost is based on 2024 dollars and current maintenance costs at similar landfill solar sites in northern New England.

2 SME is not responsible for nor have we reviewed the costs provided to the Town by GZA.

3 LS = lump sum, AC = as completed

* Water monitoring, gas monitoring, Settlement Monitoring, Stormwater Maintenance, and Annual Inspections are performed by GZA per original closure order and contract with Town of Exeter totalling $7500.00 annually

** Leachate Collection and Monitoring and Clean Air Act Requirements are performed per original closure order by the Town of Exeter.

Project: Exeter Landfill
System Size (MW AC): 1.5

Task	**Est. Cost ($) per MW**	**Est. Total Cost ($)**
Erosion & Sedimentation Control	$ 1,500	$ 2,250
Remove Rack Wiring	$ 1,230	$ 1,845
Remove Panels	$ 1,225	$ 1,838
Dismantle Racks	$ 6,175	$ 9,263
Remove Electrical Equipment	$ 925	$ 1,388
Breakup and Remove Concrete Pads	$ 750	$ 1,125
Remove Racks	$ 3,900	$ 5,850
Remove Cable	$ 3,250	$ 4,875
Remove Ground Screws and Power Poles	$ 6,925	$ 10,388
Remove Fence	$ 2,475	$ 3,713
Grading	$ 2,000	$ 3,000
Seed Disturbed Areas	$ 125	$ 188
Truck to Recycling Center	$ 1,125	$ 1,688
Total	**$ 31,605**	**$ 47,408**

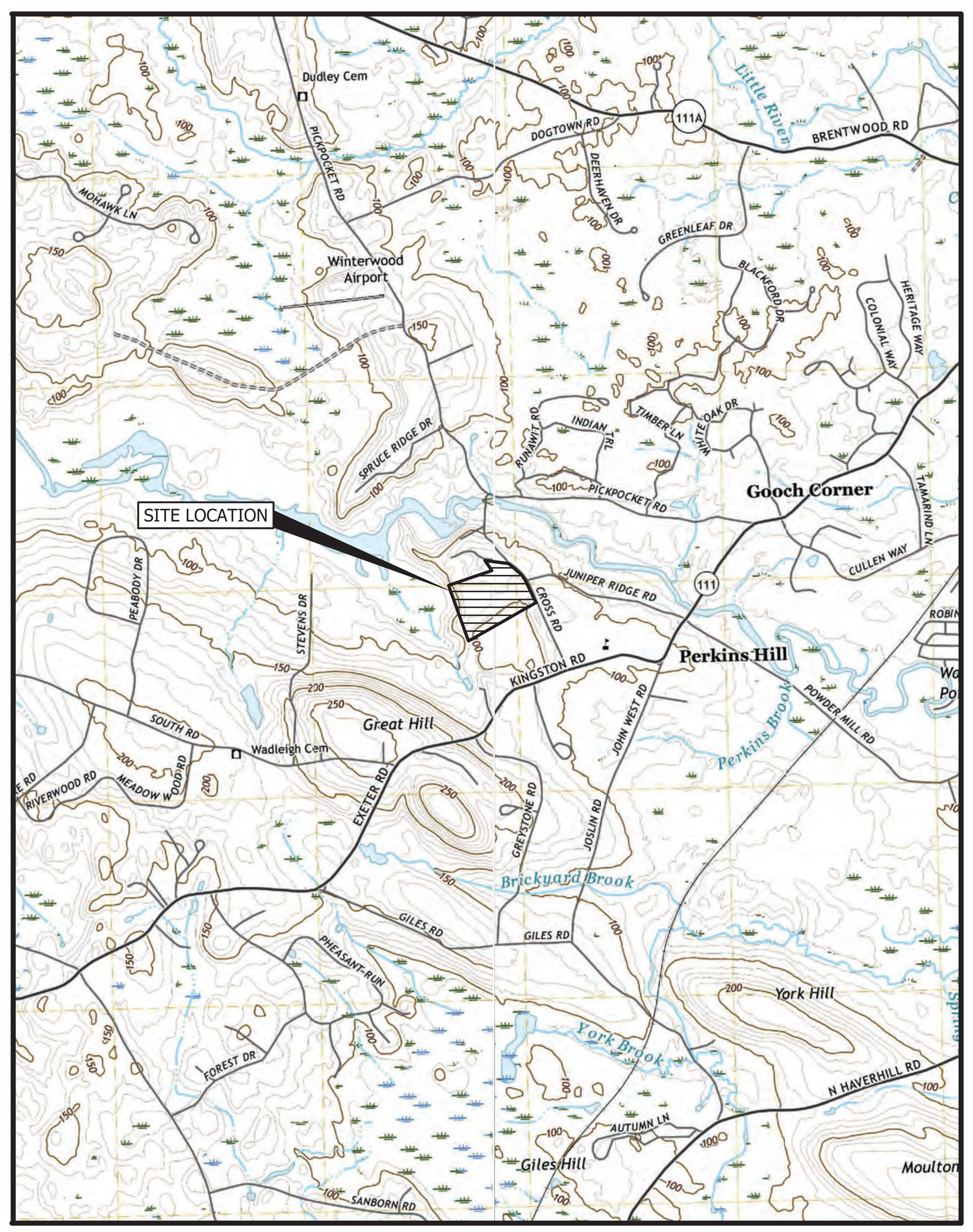
ATTACHMENT 6

PLAN SET

SME
SEVEE & MAHER
ENGINEERS

1.5 MW AC SOLAR ARRAY
REVISION ENERGY
9 CROSS ROAD
EXETER, NEW HAMPSHIRE
NHDES PERMIT NO. DES-SW-SP-1992-001

LOCATION MAP



FEBRUARY 2024
REISSUED FOR NHDES REVIEW

SME
SEVEE & MAHER ENGINEERS
ENVIRONMENTAL • CIVIL • GEOTECHNICAL • WATER • COMPLIANCE
4 Blanchard Road, PO Box 85A, Cumberland, Maine 04021
Phone 207.829.5016 • Fax 207.829.5692 • smemaine.com

WILDLIFE PROTECTION NOTES (ENV-WQ 1504.17):

- ALL OBSERVATIONS OF THREATENED OR ENDANGERED SPECIES SHALL BE REPORTED IMMEDIATELY TO THE NEW HAMPSHIRE FISH AND GAME DEPARTMENT NONGAME AND ENDANGERED WILDLIFE ENVIRONMENTAL REVIEW PROGRAM BY PHONE AT 603-271-2461 AND BY EMAIL AT NHFGREVIEW@WILDLIFE.NH.GOV. EMAIL SUBJECT LINE: NHB23-0910, 1.5 MW AC SOLAR ARRAY, WILDLIFE SPECIES OBSERVATION.
- PHOTOGRAPHS OF THE OBSERVED SPECIES AND NEARBY ELEMENTS OF HABITAT OR AREAS OF LAND DISTURBANCE SHALL BE PROVIDED TO NHF&G IN DIGITAL FORMAT AT THE ABOVE EMAIL ADDRESS FOR VERIFICATION AS FEASIBLE;
- IN THE EVENT A THREATENED OR ENDANGERED SPECIES IS OBSERVED ON THE PROJECT SITE DURING THE TERM OF THE PERMIT, THE SPECIES SHALL NOT BE DISTURBED, HANDLED, OR HARMED IN ANY WAY PRIOR TO CONSULTATION WITH NHF&G AND IMPLEMENTATION OF CORRECTIVE ACTIONS RECOMMENDED BY NHF&G, IF ANY, TO ASSURE THE PROJECT DOES NOT APPRECIABLY JEOPARDIZE THE CONTINUED EXISTENCE OF THREATENED AND ENDANGERED SPECIES AS DEFINED IN FIS 1002.04
- THE NHF&G, INCLUDING ITS EMPLOYEES AND AUTHORIZED AGENTS, SHALL HAVE ACCESS TO THE PROPERTY DURING THE TERM OF THE PERMIT.

REVISED FEBRUARY 2024

GENERAL SITE NOTES:

1. BASEMAP FROM SURVEY PERFORMED BY SME, DATED MARCH 22, 2023. ADDITIONAL SITE FEATURES FROM GOOGLE EARTH.
   HORIZONTAL DATUM: STATE PLAN NAD83 NEW HAMPSHIRE
   VERTICAL DATUM: NORTH AMERICAN VERTICAL DATUM 1988
2. PROPERTY BOUNDARIES AND EXISTING TOPOGRAPHY FROM NH GRANIT GIS SERVICE.
3. LIMITS OF WASTE FROM PLAN TITLED "GRADING PLAN" FROM THE EXETER LANDFILL CLOSURE RECORD DRAWINGS, BY GZA GEOENVIRONMENTAL, INC., OF MANCHESTER, NEW HAMPSHIRE, DATED APRIL 1996.
4. WETLAND DELINEATION WITHIN THE LIMITS OF WORK WAS PERFORMED BY FB ENVIRONMENTAL ON JANUARY 15, 2023 AND INDICATED NO WATER FEATURES WERE FOUND. (1)
5. SOIL TYPES FROM A CUSTOM SOIL RESOURCE REPORT BY UNITED STATES DEPARTMENT OF AGRICULTURE NATURAL RESOURCES CONSERVATION SERVICE.
6. AERIAL IMAGE FROM GOOGLE EARTH.
7. EXISTING GAS VENT LOCATIONS SURVEYED BY SME ON MARCH 22, 2023.
8. STANDARD PRACTICE DICTATES THAT PLANS COMPILED IN THIS MANNER SHOULD BE FIELD VERIFIED BY THE CONTRACTOR PRIOR TO CONSTRUCTION. REPORT ANY DISCREPANCIES TO ENGINEER. THE ACCURACY AND COMPLETENESS OF SUBSURFACE INFORMATION IS NOT GUARANTEED. VERIFY SITE CONDITIONS INCLUDING TEST PITS FOR LOCATIONS AND INVERTS OF UTILITIES AND REPORT ANY DISCREPANCIES TO THE ENGINEER PRIOR TO PROCEEDING WITH THAT PORTION OF THE WORK.
9. EXCAVATE AND STOCKPILE ON-SITE TOPSOIL. TOPSOIL IS TO REMAIN THE PROPERTY OF THE OWNER DURING CONSTRUCTION, AND SHALL NOT BE REMOVED FROM THE SITE. AFTER FINAL LOAM AND SEED, EXCESS TOPSOIL SHALL BE REMOVED FROM SITE BY CONTRACTOR.

ZONING NOTES:

1. OWNER/DEVELOPER:
   - OWNER: TOWN OF EXETER, 10 FRONT ST, EXETER, NH 03833
   - DEVELOPER: REVISION ENERGY, 758 WESTBROOK ST, SOUTH PORTLAND, MAINE 04106
2. PROJECT: 1.5 MC AC SOLAR ARRAY, EXETER MUNICIPAL LANDFILL
3. ZONING DISTRICT: LOW DENSITY RESIDENTIAL (R1), AQ - AQUIFER PROTECTION ZONE (CODE 1)
4. ZONE STANDARDS:

ZONE STANDARDS	REQUIRED	PROVIDED
MINIMUM LOT SIZE	2 AC	22.65 AC
SETBACKS		
FRONT	25 FEET	>25 FEET
SIDE	15 FEET	>15 FEET
REAR	25 FEET	>25 FEET
BUILDING COVERAGE	15%	<15%
MAX BUILDING HEIGHT	35 FEET	<35 FEET

5. TAX MAP 98, LOT 3.
6. PROPOSED USE: MUNICIPAL (WDL-00)
7. PARKING SUMMARY:
   - EXISTING PARKING: 0 SPACES
   - PROPOSED PARKING: 0 SPACES
8. THE PROPERTY IS OUTSIDE OF THE 100 YEAR FLOODPLAIN AS REFERENCED ON FEMA COMMUNITY PANELS NO. 33015 C0384 E, DATED MAY 17, 2005 AND NO. 33015 C0403 E, DATED MAY 17, 2005.

UTILITY NOTES:

1. EXISTING UTILITIES IN CROSS ROAD INCLUDE:
   OVERHEAD ELECTRIC
   OVERHEAD COMMUNICATIONS
2. EXISTING UNDERGROUND AND ABOVE GROUND UTILITIES ARE NOT SHOWN ON THIS PLAN. PRIOR TO WORK THE CONTRACTOR SHALL USE PRIVATE UTILITY LOCATION SERVICE TO LOCATE ALL UNDERGROUND AND ABOVE GROUND UTILITIES WITHIN THE LIMITS OF WORK. LOCATION AND ELEVATION OF ALL UTILITIES SHALL BE SURVEYED BY THE CONTRACTOR AND PROVIDED TO THE OWNER ON AS-BUILT DRAWINGS PRIOR TO PROJECT COMPLETION.
3. THE ACCURACY AND COMPLETENESS OF SUBSURFACE INFORMATION IS NOT GUARANTEED. VERIFY SITE CONDITIONS INCLUDING TEST PITS OUTSIDE THE LANDFILL LIMIT FOR LOCATIONS AND INVERTS OF UTILITIES AND REPORT ANY DISCREPANCIES TO THE ENGINEER PRIOR TO PROCEEDING WITH THAT PORTION OF THE WORK.
4. COORDINATE WORK ON UTILITY LINES WITH THE TOWN OF EXETER.

DIG SAFE NOTES:

PRIOR TO EXCAVATION, VERIFY THE UNDERGROUND UTILITIES, PIPES, STRUCTURES AND FACILITIES. PROVIDE THE FOLLOWING MINIMUM MEASURES:

1. PRE-MARK THE BOUNDARIES OF YOUR PLANNED EXCAVATION WITH WHITE PAINT, FLAGS OR STAKES, SO UTILITY CREWS KNOW WHERE TO MARK THEIR LINES.
2. CALL DIG SAFE, AT 811, AT LEAST THREE BUSINESS DAYS - BUT NO MORE THAN 30 CALENDAR DAYS - BEFORE STARTING WORK. DO NOT ASSUME SOMEONE ELSE WILL MAKE THE CALL.
3. IF BLASTING, NOTIFY DIG SAFE AT LEAST ONE BUSINESS DAY IN ADVANCE.
4. WAIT THREE BUSINESS DAYS FOR LINES TO BE LOCATED AND MARKED WITH COLOR-CODED PAINT, FLAGS OR STAKES. NOTE THE COLOR OF THE MARKS AND THE TYPE OF UTILITIES THEY INDICATE. TRANSFER THESE MARKS TO THE AS-BUILT DRAWINGS.
5. CONTACT THE LANDOWNER AND OTHER "NON-MEMBER" UTILITIES (WATER, SEWER, GAS, ETC.). FOR THEM TO MARK THE LOCATIONS OF THEIR UNDERGROUND FACILITIES. TRANSFER THESE MARKS TO THE AS-BUILT DRAWINGS.
6. RE-NOTIFY DIG SAFE AND THE NON-MEMBER UTILITIES IF THE DIGGING, DRILLING OR BLASTING DOES NOT OCCUR WITHIN 30 CALENDAR DAYS, OR IF THE MARKS ARE LOST DUE TO WEATHER CONDITIONS, SITE WORK ACTIVITY OR ANY OTHER REASON.
7. HAND DIG WITHIN 18 INCHES IN ANY DIRECTION OF ANY UNDERGROUND LINE UNTIL THE LINE IS EXPOSED. MECHANICAL METHODS MAY BE USED FOR INITIAL SITE PENETRATION, SUCH AS REMOVAL OF PAVEMENT OR ROCK.
8. DIG SAFE REQUIREMENTS ARE IN ADDITION TO TOWN, CITY AND/OR STATE DOT STREET OPENING PERMIT REQUIREMENTS.
9. FOR COMPLETE DIG SAFE REQUIREMENTS, CALL THE PUBLIC UTILITIES COMMISSION (PUC) AT 1-800-852-3793 OR VISIT HTTPS://WWW.PUC.NH.GOV/
10. IF YOU DAMAGE, DISLOCATE OR DISTURB ANY UNDERGROUND UTILITY LINE, IMMEDIATELY NOTIFY THE AFFECTED UTILITY. IF DAMAGE CREATES SAFETY CONCERNS, CALL THE FIRE DEPARTMENT AND TAKE IMMEDIATE STEPS TO SAFEGUARD HEALTH AND PROPERTY.
11. ANY TIME AN UNDERGROUND LINE IS DAMAGED OR DISTURBED OR IF LINES ARE IMPROPERLY MARKED, YOU MUST FILE AN INCIDENT REPORT WITH THE PUC FOR AN INCIDENT REPORT FORM VISIT HTTPS://WWW.PUC.NH.GOV/ OR CALL THE PUC AT 1-800-852-3793.

EROSION CONTROL AND GRADING NOTES: (1)

1. ADD 6" LOAM, SEED AND MULCH TO DISTURBED AREAS UNLESS OTHERWISE NOTED. PROVIDE EROSION CONTROL MESH ON ALL SLOPES 6:1 OR STEEPER, AND ALONG DITCH CHANNELS. THERE SHALL BE NO PLASTIC, OR MULTI-FILAMENT OR MONOFILAMENT POLYPROPYLENE NETTING OR MESH WITH AN OPENING SIZE OF GREATER THAN 1/8 INCHES MATERIAL UTILIZED.
2. MAINTAIN TEMPORARY EROSION CONTROL MEASURES FOR THE FULL DURATION OF CONSTRUCTION. INSPECT WEEKLY AND AFTER EACH STORM AND REPAIR AS NEEDED. PLACE IN AREA OF LOW EROSION POTENTIAL, AND STABILIZE WITH SEED AND MULCH. REMOVE SEDIMENTS FROM THE SITE.
3. PERIMETER CONTROLS MUST BE INSTALLED PRIOR TO EARTH MOVING OPERATIONS.
4. EROSION CONTROL PRACTICES ARE TO BE INSPECTED WEEKLY AND AFTER 0.5" OF RAINFALL.
5. IN AREAS THAT WILL NOT BE PAVED, "STABLE" MEANS THAT:
   - A MINIMUM OF 85% OF VEGETATIVE COVER HAS BEEN ESTABLISHED;
   - A MINIMUM OF 3 INCHES OF NON-EROSIVE MATERIAL SUCH AS STONE OR RIPRAP HAS BEEN INSTALLED; OR
   - EROSION CONTROL BLANKETS HAVE BEEN INSTALLED IN ACCORDANCE WITH ENV-WQ 1506.03.
6. IN AREAS TO BE PAVED, BASE COURSE GRAVELS MEETING THE REQUIREMENTS OF NHDOT STANDARD FOR ROAD AND BRIDGE CONSTRUCTION, 2016, ITEM 304.2 HAVE BEEN INSTALLED.
7. UNSTABILIZED AREAS SHALL BE TEMPORARILY STABILIZED WITHIN 72 HOURS OF FINAL GRADING, OR PRIOR TO A 0.25" STORM OCCURRING AFTER THE DISTURBANCE, WHICHEVER OCCURS SOONER.
8. TEMPORARY STABILIZATION MEASURES MUST REMAIN IN PLACE THROUGHOUT CONSTRUCTION AND BE MAINTAINED AS NECESSARY TO MEET THE REQUIREMENTS OF ENV-WQ 1506.01 UNTIL FINAL SEEDING IS PLACED.
9. WHEN EARTH DISTURBANCE WILL OCCUR WITHIN 50 FEET OF A SURFACE WATER OF THE STATE, AND WETLANDS AS DEFINED IN RSA 482-A, A DOUBLE ROW OF PERIMETER CONTROLS MUST BE INSTALLED ALONG THE LIMITS OF THE EARTH DISTURBANCE.
10. SOILS WITH A DEPTH TO BEDROCK OF 12 INCHES OR LESS SHALL BE ENHANCED BY THE ADDITION OF AT LEAST 4 INCHES OF TOP SOIL.
11. ANY OVERBURDEN ERODED IN AREAS WITH A DEPTH OF BEDROCK OF 12 INCHES OR LESS SHALL BE REPLACED.
12. THE SITE SHALL BE STABILIZED BY ESTABLISHING AT LEAST 85% VEGETATIVE COVER UNIFORMLY DISTRIBUTED.

LEGEND

EXISTING		PROPOSED
	PROPERTY LINE	
	BUILDING	
	EDGE OF PAVEMENT	
	CURB	
100	CONTOUR	100
	SPOT GRADE	114.23
	FENCE	
	UTILITY POLE	
OHE	OVERHEAD ELECTRIC	OHE
UGU	UNDERGROUND ELECTRIC	UGE
	BALLASTED ELECTRICAL CONDUIT	
	TRANSFORMER	T
	TREELINE	
	CONCRETE	
	GRAVEL	
	GAS VENT	
	NWI WETLANDS	
	NWI STREAM	
	STREAM SETBACK	
	SOIL BOUNDARY (1)	
	SOIL TYPE (1)	WmB

EROSION CONTROL LEGEND

	STABILIZED CONSTRUCTION ENTRANCE
SF	SILT FENCE
EC	EROSION CONTROL MIX BERM

TYPICAL ABBREVIATIONS:

ACCMP	ASPHALT COATED CMP
ACP	ASBESTOS CEMENT PIPE
AC	ACRE
AGG	AGGREGATE
ALUM	ALUMINUM
APPD	APPROVED
APPROX	APPROXIMATE
ARMH	AIR RELEASE MANHOLE
ASB	ASBESTOS
ASP	ASPHALT
AUTO	AUTOMATIC
AUX	AUXILIARY
AVE	AVENUE
AZ	AZIMUTH
BCCMP	BITUMINOUS COATED CMP
BM	BENCH MARK
BIT	BITUMINOUS
BLDG	BUILDING
BOT	BOTTOM
BRG	BEARING
BV	BALL VALVE
CB	CATCH BASIN
CEN	CENTER
CEM LIN	CEMENT LINED
CMP	CORRUGATED METAL PIPE
CO	CLEAN OUT
CF	CUBIC FEET
CFS	CUBIC FEET PER SECOND
CI	CAST IRON
CL	CLASS
CONC	CONCRETE
CONST	CONSTRUCTION
CONTR	CONTRACTOR
CS	CURB STOP
CTR	CENTER
CU	COPPER
CY	CUBIC YARD
D	DEGREE OF CURVE
DBL	DOUBLE
DEG OR °	DEGREE
DEPT	DEPARTMENT
DI	DUCTILE IRON
DIA OR	DIAMETER
DIM	DIMENSION
DIST	DISTANCE
DN	DOWN
DR	DRAIN
DWG	DRAWING
EA	EACH
EG	EXISTING GROUND OR GRADE
ELEC	ELECTRIC
EL	ELEVATION
ELB	ELBOW
EOP	EDGE OF PAVEMENT
EQUIP	EQUIPMENT
EST	ESTIMATED
EXC	EXCAVATE
EXIST	EXISTING
FI	FIELD INLET
FG	FINISH GRADE
FBRGL	FIBERGLASS
FDN	FOUNDATION
FLEX	FLEXIBLE
FLG	FLANGE
FLR	FLOOR
FPS	FEET PER SECOND
FT OR '	FEET
FTG	FOOTING
GA	GAUGE
GAL	GALLON
GALV	GALVANIZED
GPD	GALLONS PER DAY
GPM	GALLONS PER MINUTE
HDPE	HIGH DENSITY POLYETHYLENE
HORIZ	HORIZONTAL
HP	HORSEPOWER
HYD	HYDRANT
ID	INSIDE DIAMETER
IN OR "	INCHES
INV	INVERT
INV EL	INVERT ELEVATION
LB	POUND
LC	LEACHATE COLLECTION
LD	LEAK DETECTION
LF	LINEAR FEET
LOC	LOCATION
LT	LEACHATE TRANSPORT
MH	MANHOLE
MJ	MECHANICAL JOINT
MATL	MATERIAL
MAX	MAXIMUM
MFR	MANUFACTURE
MIN	MINIMUM
MISC	MISCELLANEOUS
MON	MONUMENT
NITC	NOT IN THIS CONTRACT
NTS	NOT TO SCALE
N/F	NOW OR FORMERLY
NO OR #	NUMBER
OC	ON CENTER
OD	OUTSIDE DIAMETER
PC	POINT OF CURVE
PD	PERIMETER DRAIN
PI	POINT OF INTERSECTION
PIV	POST INDICATOR VALVE
PT	POINT OF TANGENT
PERF	PERFORATED
PP	POWER POLE
PSI	POUNDS PER SQUARE INCH
PVC	POLYVINYL CHLORIDE
PVMT	PAVEMENT
QTY	QUANTITY
RCP	REINFORCED CONCRETE PIPE
ROW	RIGHT OF WAY
RAD	RADIUS
REQD	REQUIRED
RT	RIGHT
RTE	ROUTE
S	SLOPE
SCH	SCHEDULE
SF	SQUARE FEET
SHT	SHEET
SMH	SANITARY MANHOLE
ST	STREET
STA	STATION
SY	SQUARE YARD
TAN	TANGENT
TDH	TOTAL DYNAMIC HEAD
TEMP	TEMPORARY
TYP	TYPICAL
UD	UNDERDRAIN
V	VOLTS
VA TEE	VALVE ANCHORING TEE
VERT	VERTICAL
WG	WATER GATE
W/	WITH
W/O	WITHOUT
YD	YARD

REV.	BY	DATE	STATUS
1	DPD	2/2024	REISSUED FOR NHDES REVIEW
	DPD	9/2023	ISSUED FOR NHDES REVIEW

STATE OF NEW HAMPSHIRE – BRIAN D. PIERCE No. 18001 – LICENSED – PROFESSIONAL ENGINEER

1.5 MW AC SOLAR ARRAY
REVISION ENERGY
9 CROSS ROAD
EXETER, NEW HAMPSHIRE

GENERAL NOTES, LEGEND, AND ABBREVIATIONS

SME SEVEE & MAHER ENGINEERS
ENVIRONMENTAL • CIVIL • GEOTECHNICAL • WATER • COMPLIANCE
4 Blanchard Road, PO Box 85A, Cumberland, Maine 04021
Phone 207.829.5016 • Fax 207.829.5692 • smemaine.com

DESIGN BY:	JTR
DRAWN BY:	JRL
DATE:	9/2023
CHECKED BY:	DPD
LMN:	NONE
CTB:	SME-STD

JOB NO. 220241.00 DWG FILE GEN-NOTES

C-100

NOTE:
1. SEE DRAWING C-100 FOR GENERAL SITE NOTES AND PLAN REFERENCES.

40 0 80 160 FEET

REV.	BY	DATE	STATUS
	DPD	9/2023	ISSUED FOR NHDES REVIEW

STATE OF NEW HAMPSHIRE — BRIAN D. PIERCE No. 18001 LICENSED — PROFESSIONAL ENGINEER

1.5 MW AC SOLAR ARRAY
REVISION ENERGY
9 CROSS ROAD
EXETER, NEW HAMPSHIRE

EXISTING CONDITIONS AND CLEARING PLAN

SME
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DESIGN BY: JTR
DRAWN BY: JRL
DATE: 9/2023
CHECKED BY: DPD
LMN: EXCON
CTB: SME-STD

JOB NO. 220241.00 DWG FILE BASE

C-101

NOTES:
1. SEE DRAWING C-100 FOR GENERAL SITE NOTES AND PLAN REFERENCES.
2. DAMAGE TO THE LANDFILL COVER SYSTEM AND EXISTING LANDFILL GAS VENTS SHALL BE REPAIRED TO TOWN AND NHDEP SPECIFICATIONS.

40 0 80 160 FEET

REV.	BY	DATE	STATUS
	DPD	9/2023	ISSUED FOR NHDES REVIEW

STATE OF NEW HAMPSHIRE – BRIAN D. PIERCE No. 18001 LICENSED – PROFESSIONAL ENGINEER

1.5 MW AC SOLAR ARRAY
REVISION ENERGY
9 CROSS ROAD
EXETER, NEW HAMPSHIRE

SITE OVERVIEW PLAN

SME
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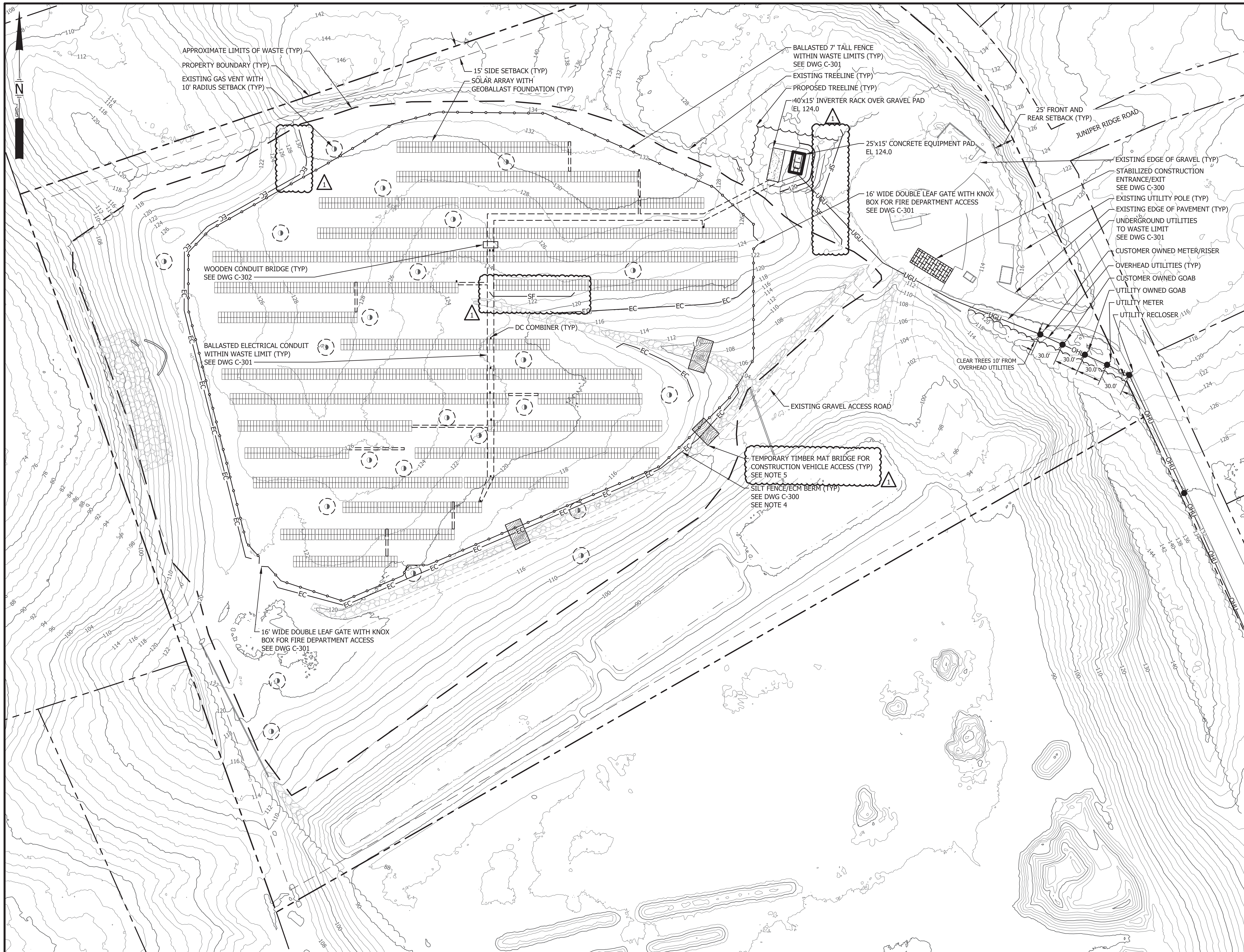
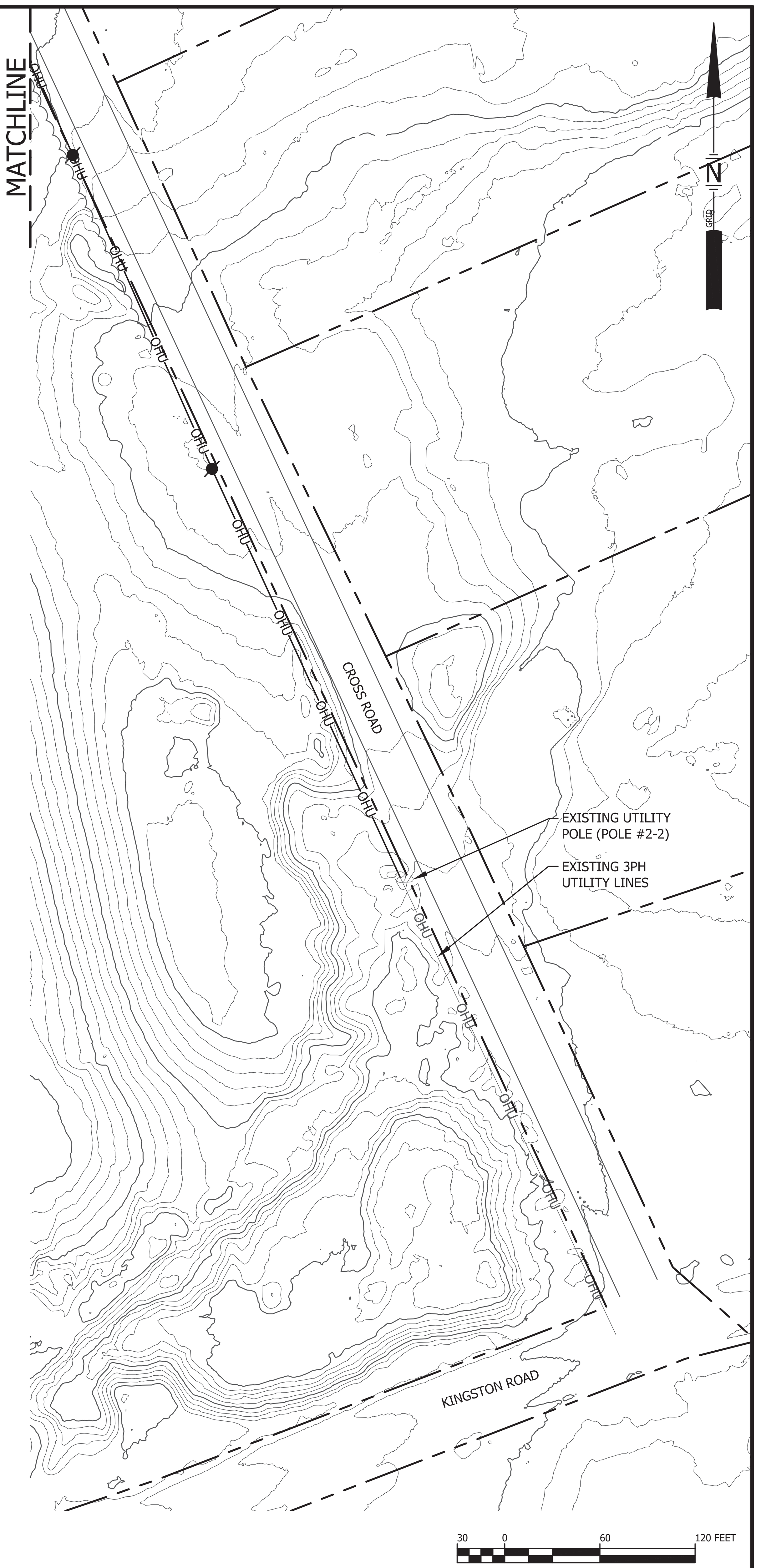
4 Blanchard Road, PO Box 85A, Cumberland, Maine 04021
Phone 207.829.5016 • Fax 207.829.5692 • sme-engineers.com

DESIGN BY: JTR
DRAWN BY: JRL
DATE: 9/2023
CHECKED BY: DPD
LMN: SITE-OVER
CTB: SME-STD

JOB NO. 220241.00 DWG FILE BASE

C-102





REV.	BY	DATE	STATUS
1	DPD	1/2024	REISSUED FOR NHDES REVIEW
	DPD	9/2023	ISSUED FOR NHDES REVIEW

△1

NOTES:

1. SEE DRAWING C-100 FOR GENERAL SITE NOTES AND PLAN REFERENCES.
2. SEE ELECTRICAL DRAWINGS FOR UTILITY POLE AND EQUIPMENT DETAILS.
3. SURVEY CONTROL POINTS TO BE SET BY SME PRIOR TO CONSTRUCTION.
4. PROVIDE ECM BERM WITHIN LIMITS OF WASTE. NO STAKES SHALL BE USED WITHIN THE LIMIT OF WASTE.
5. THE CONTRACTOR SHALL USE LOW GROUND PRESSURE (LGP) EQUIPMENT (GROUND PRESSURE OF 5.0 PSI OR LESS) OR TIMBER MATS WHEN TRAVELING WITHIN THE LIMIT OF WASTE TO DISTRIBUTE LOADS AND MINIMIZE IMPACT TO THE EXISTING LANDFILL COVER SYSTEM.
6. DAMAGE TO THE LANDFILL COVER SYSTEM AND EXISTING LANDFILL GAS VENTS SHALL BE REPAIRED TO TOWN AND NHDES SPECIFICATIONS.

STATE OF NEW HAMPSHIRE — BRIAN D. PIERCE No. 9002 — LICENSED — PROFESSIONAL ENGINEER

1.5 MW AC SOLAR ARRAY
REVISION ENERGY
9 CROSS ROAD
EXETER, NEW HAMPSHIRE

SITE PLAN

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DESIGN BY: JTR
DRAWN BY: JRL
DATE: 9/2023
CHECKED BY: DPD
LMN: SITEPLAN
CTB: SME-STD

JOB NO. 220241.00 DWG FILE BASE

C-103

EROSION CONTROL NOTES:

A. CONSTRUCTION PHASING

1. All soil erosion and sedimentation control shall be done in accordance with: (1) the New Hampshire Stormwater Manual Vol. 3: Erosion and Sediment Controls During Construction, New Hampshire Department of Environmental Services (NHDES) December 2008.
2. The site Contractor (to be determined) will be responsible for the inspection and repair/replacement/maintenance of all erosion control measures, disturbed areas, material storage areas, and vehicle access points until all disturbed areas are stabilized.
3. All areas of exposed or disturbed soil should be temporarily stabilized as soon as practicable but no later than 45 days from the time of initial disturbance, unless a shorter time is specified by local authorities, the construction sequence approved as part of the issued permit, or an independent monitor. All areas of exposed or disturbed soil should be permanently stabilized as soon as practicable but no later than 3 days following final grading.
4. The area of unstabilized soil should not exceed 5 acres at any time unless project permits specifically provide for a greater area of disturbance. Any such greater area of disturbance requires, as part of the permitting process:
   a. Documentation that the required areas of earth cuts and fills are such that an area of disturbance of 5 acres or less would unreasonably limit the construction schedule;
   b. An approved construction sequence plan, developed by a professional engineer licensed to practice in the state of
   c. New Hampshire or a Certified Professional in Erosion and Sediment Control as certified by the CPESC Council of EnviroCert International, Inc.; and
   d. Employment or retainment of a professional engineer licensed to practice in the state of New Hampshire or a Certified Professional in Erosion and Sediment Control as certified by the CPESC Council of EnviroCert International, Inc. to serve as an environmental monitor during construction.
5. Only disturb, clear, or grade areas necessary for construction. Flag or otherwise delineate areas not to be disturbed. Exclude vehicles and construction equipment from these areas to preserve natural vegetation.
6. All graded or disturbed areas including slopes should be protected during clearing and construction in accordance with an approved erosion and sediment control plan until they are permanently stabilized. There shall be no plastic, or multi-filament or mono-filament polypropylene netting or mesh with an opening size greater than 1/8 inches material utilized. (1)
7. All erosion and sediment control practices and measures should be constructed, applied and maintained in accordance with the approved erosion and sediment control plan.
8. Topsoil required for the establishment of vegetation should be stockpiled in the amount necessary to complete finished grading and protected from erosion.
9. Stockpiles, borrow areas and spoils should be stabilized as described under "Soil Stockpile Practices."
10. Slopes should not be created so close to property lines as to endanger adjoining properties without adequate protection against sedimentation, erosion, slippage, settlement, subsidence or other related damages.
11. Areas to be filled should be cleared, grubbed and stripped of topsoil to remove trees, vegetation, roots or other objectionable materials.
12. Areas should be scarified to a minimum depth of 3 inches prior to placement of topsoil. Topsoil should be placed without significant compaction to provide a loose bedding for placement of seed.
13. All fills should be compacted in accordance with project specifications to reduce erosion, slippage, settlement, subsidence or other related problems. Fill intended to support buildings, structures, site utilities, conduits, and other facilities, should be compacted in accordance with local requirements or codes.
14. In general, fills should be placed and compacted in layers ranging from 6 to 24 inches in thickness. The contractor should review the project geotechnical report for specific guidance. Fill material should be free of brush, rubbish, rocks, logs, stumps, building debris, frozen material and other objectionable materials that would interfere with or prevent construction of satisfactory lifts.
15. Frozen material or soft, mucky or highly compressible materials are susceptible to accelerated settlement and potential accelerated erosion. Work in these materials should be performed under the direction of a professional engineer.
16. The outer face of the fill slope should be allowed to stay loose, not rolled, compacted, or bladed smooth. A bulldozer may run up and down the fill slope so the dozer treads (cleat tracks) create grooves perpendicular to the slope. If the soil is not too moist, excessive compaction will not occur.
17. Roughen the surface of all slopes during the construction operation to retain water, increase infiltration, and facilitate vegetation establishment.
18. Use slope breaks, such as diversions, benches, or contour furrows as appropriate, to reduce the length of cut-and-fill slopes to limit sheet and rill erosion and prevent gully erosion. All benches should be kept free of sediment during all phases of development.
19. Seeps or springs encountered during construction should be evaluated by a professional engineer to determine if the proposed design should be revised to properly manage the condition.
20. Stabilize all graded areas with vegetation, crushed stone, compost blanket, or other ground cover as soon as grading is completed or if work is interrupted for 21 working days or more. Use mulch or other approved methods to stabilize areas temporarily where final grading must be delayed.

B. TEMPORARY MEASURES

1. TEMPORARY CONSTRUCTION EXIT
   a. A stabilized construction exist consists of a pad of stone aggregate placed on a geotextile filter fabric, located at any point where traffic will be leaving a construction site to an existing access roadway or other paved surface. See detail for specifications.
   b. The pad should be maintained or replaced when mud and soil particles clog the voids in the stone such that mud and soil particles are tracked off-site.
2. SILT FENCE
   a. Silt fence should be installed prior to any soil disturbance of the contributing drainage area above them.
   b. Silt fences (synthetic filter) can be used for 60 days or longer depending on ultraviolet stability and manufacturer's recommendations. However, silt fences generally have a useful life of one season, and should be periodically replaced on longer duration construction projects.
   c. Silt fences should be removed when they have served their useful purpose, but not before the upslope areas have been permanently stabilized.
   d. Silt Fence s should be inspected and maintained immediately after each rainfall and at least daily during prolonged rainfall. Any required repairs will be made immediately. If there are signs of undercutting at the center or the edges of the barrier, or impounding of large volumes of water behind them, sediment barriers should be replaced with a temporary check dam.
   e. Sediment deposition should be removed, at a minimum, when deposition accumulates to one-half the height of the fence, and moved to an appropriate location so the sediment is not readily transported back toward the silt fence.
3. EROSION CONTROL MIX BERMS
   a. The barrier must be placed along a relatively level contour. It may be necessary to cut tall grasses or woody vegetation to avoid creating voids and bridges that would enable fines to wash under the barrier through the grass blades or plant stems.
   b. Where approved, erosion control mix berms may be used as a substitute for silt fence. See the details in this drawing set for specifications.
4. TEMPORARY CHECK DAMS
   a. Check dams should be installed before runoff is directed to the swale or drainage ditch.
   b. The check dam may be left in place permanently to avoid unnecessary disturbance of the soil on removal, but only if the project design has accounted for their hydraulic performance and construction plans call for them to be retained.
   c. If it is necessary to remove a stone check dam from a grass- lined channel that will be mowed, care should be taken to ensure that all stones are removed. This includes stone that has washed downstream.
   d. Check dams should be inspected after each rainfall and at least daily during prolonged rainfall and necessary repairs should be made immediately. Check dams should be checked for sediment accumulation after each significant rainfall. Sediment should be removed when it reaches one half of the original height or before.
   e. Temporary structures should be removed once the swale or ditch has been stabilized or when it is no longer needed.
5. TEMPORARY VEGETATION (1)
   a. stabilize disturbed areas that will not be brought to final grade for a year or less and to reduce problems associated with mud and dust production from exposed soil surfaces during construction with temporary seeding.
   b. Areas seeded between May 15th and August 15th should be covered with hay or straw mulch, according to the "Temporary and Permanent Mulching" practice.
   c. Temporary seeding should occur prior to September 15.
   d. Vegetated growth covering at least 85% of the disturbed area should be achieved prior to October 15th. If this condition is not achieved, implement other temporary stabilization measures for overwinter protection.

TEMPORARY SEEDING SPECIFICATIONS

SPECIES	PER ACRE POUNDS (LBS)	PER 1,000SF
WINTER RYE	112	2.5
OATS	80 LBS	2 LBS
ANNUAL RYEGRASS	40 LBS	1 LB
PERENNIAL RYEGRASS	30 LBS	0.7 LBS

6. TEMPORARY MULCHING

Use temporary mulch in the following locations or circumstances:
   a. In sensitive areas (within 100 feet of streams, wetland and in lake watersheds) temporary mulch will be applied within 7 days of exposing soil or prior to any storm event.
   b. In other areas, the time period can range from 14 to 30 days, the length of time varying with site conditions (soil erodibility, season of year, extent of disturbance, proximity to sensitive resources) and the potential impact of erosion on adjacent areas. Other state or local restrictions may also apply.
   c. Areas that have been temporarily or permanently seeded should be mulched immediately following seeding.
   d. Areas that cannot be seeded within the growing season should be mulched for over-winter protection. The area should be seeded at the beginning of the next growing season.
   e. Mulch can be used in conjunction with tree, shrub, vine, and ground cover plantings.
   f. Mulch anchoring should be used on slopes with gradients greater than 5% in late fall (past September 15), and over-winter (September 15 - May 15).
   g. The choice of materials for mulching should be based on site conditions, soils, slope, flow conditions, and time of year.

The following materials may be used for temporary mulch:
   (1) h. Hay or Straw material shall be air-dried, free of undesirable seeds and coarse materials. Apply 2 bales (70-90 lbs) per 1000 sf or 1.5 to 2 tons (90 - 100 bales) per acre to cover 75 - 90% of the ground surface. Hay or straw mulch should be anchored to prevent displacement by wind or flowing water, using one of the following methods:
      - Netting: Install jute, wood fiber, or biodegradable plastic netting over hay or straw to anchor it to the soil surface. Install netting material according to manufacturer's recommendation. There shall be no plastic, or multi-filament or mono-filament polypropylene netting or mesh with an opening size greater than 1/8 inches material utilized. Netting should be used judiciously, as wildlife can become entangled in the materials.
      - Tackifier: Apply polymer or organic tackifier to anchor hay or straw mulch. Application rates vary by manufacturer: typically 40-60 lbs/acre for polymer material, and 80-120 lbs/acre for organic material. Liquid mulch binders are also typically applied heavier at edges, in valleys, and at crests than other areas.
   i. Wood chips or ground bark should be applied to a thickness of 2 to 6 inches. Wood chips or ground bark should be applied at a rate of 10 to 20 tons per acre or 460 to 920 pounds per 1,000 square feet.
   j. Erosion control mix can be manufactured on or off the project site. It must consist primarily of organic material, separated at the point of generation, and may include shredded bark, stump grindings, composted bark, or acceptable manufactured products. Wood and bark chips, ground construction debris or reprocessed wood products will not be acceptable as the organic component of the mix. The barrier must be a minimum of 12" high, as measured on the uphill side of the barrier, and a minimum of two feet wide.
   k. Erosion Control Mats: Mats are manufactured combinations of mulch and netting designed to protect against erosion, and also to retain soil moisture and modify soil temperature. During the growing season (April 15 - September 15) use mats (or mulch and netting) on:
      - The base of grassed waterways
      - Steep slopes (15% or greater)
      - Any disturbed soil within 100 feet of lakes, streams and wetlands

   During the late fall and winter (September 15 - April 15) use heavy grade mats on all areas noted above plus use lighter grade mats (or mulch and netting) on:
      - Side slopes of grassed waterways
      - Moderate slopes (greater than 8%) There may be cases where mats will be needed on slopes flatter than 8%, depending on site conditions and the length of the slope.

C. TEMPORARY DUST CONTROL

To prevent the blowing and movement of dust from exposed soil surfaces, and reduce the presence of dust, use water, or other dust inhibiting agents or tackifiers, as approved by the NHDES.

D. CONSTRUCTION DE-WATERING

1. Water from construction de-watering operations shall be cleaned of sediment before reaching wetlands, streams, water bodies, or site boundaries. Use temporary basins or sediment traps, and manufactured fabric bags designed for filtering pumped discharges.
2. Temporary basin designs include but are not limited to:
   - An enclosure of Jersey Barriers lined with Geotextile Fabric
   - A temporary enclosure constructed with hay bales, silt fence, or both. Erosion control mix also may be incorporated with silt fence or hay bales. Silt fence must be supported to prevent it from collapsing under the weight of impounded water.
   - Chambered settling system fabricated of concrete or steel and designed for sediment removal.
   - Excavated or bermed sedimentation trap designed in accordance with the NHDES Stormwater Manual Vol. 3.
   - A sediment basin (including temporarily modified stormwater detention ponds), if designed in accordance with the NHDES Stormwater Manual Vol. 3.

E. PERMANENT MEASURES (1)

1. Topsoil, Seed, and mulch: All areas disturbed during construction, but not subject to other restoration (paving, riprap, etc.) will be loamed, limed, fertilized, seeded, and mulched. At a minimum, 85% of the soil surface should be covered by vegetation.

Seed Preparation: Work lime and fertilizer into the soil as nearly as practical to a depth of 4 inches with a disc, spring tooth harrow or other suitable equipment. The final harrowing operation should be on the general contour. Continue tillage until a reasonably uniform, fine seedbed is prepared. All but clay or silty soils and coarse sands should be rolled to firm the seedbed wherever feasible. Remove all stones 2 inches or larger in any dimension and any other debris from surface. On slopes 4:1 or steeper, the final preparation should include creating horizontal grooves perpendicular to the direction of the slope to catch seed and reduce runoff. Grade as needed.
   a. Seeding will be completed by August 15 of each year. Late season seeding may occur between August 15 - September 15. Areas not seeded or achieved 85% growth of the disturbed area by October 15 will be temporarily stabilized in accordance to overwinter protections and complete permanent seed stabilization during the next growing season.
   b. Where feasible, except where either a cultipacker type seeder or hydroseeder is used, the seedbed should be firmed following seeding operations with a roller, or light drag.
   c. Select a seed mixture that is appropriate for the soil type and moisture content as found at the site, for the amount of sun exposure and for level of use.

SEED MIXTURE BASED ON SOIL TYPE

USE	SEED MIX (SEE TABLE)	SOIL DRAINAGE DROUGHT	WELL DRAINED	MODERATELY WELL DRAINED	POORLY DRAINED
Steep cuts and fills,	A	FAIR	GOOD	GOOD	FAIR
borrow and	B	POOR	GOOD	FAIR	FAIR
disposal areas	C	POOR	GOOD	EXCELLENT	GOOD
	D	FAIR	FAIR	GOOD	EXCELLENT
	E	FAIR	EXCELLENT	EXCELLENT	POOR
Waterways,	A	GOOD	GOOD	GOOD	FAIR
Emergency	C	GOOD	EXCELLENT	EXCELLENT	FAIR
spillways,	D	GOOD	EXCELLENT	EXCELLENT	FAIR
and other channels					
with flowing water					
Lightly used parking	A	GOOD	GOOD	GOOD	FAIR
lots, odd areas,	B	GOOD	GOOD	FAIR	POOR
unused lands, and	C	GOOD	EXCELLENT	EXCELLENT	FAIR
low intensity use	D	FAIR	GOOD	GOOD	EXCELLENT
recreation sites					
Play areas and	F	FAIR	EXCELLENT	EXCELLENT	SEE NOTE 2
athletic fields. (Top-	G	FAIR	EXCELLENT	EXCELLENT	SEE NOTE 2
soil is essential for					
good turf.)					
Gravel Pit	See source document for recommendations or consult with USDA Natural Resource Conservation Service.				

SEED MIXTURES FOR PERMANENT VEGETATION

MIXTURE	SPECIES	PER ACRE POUNDS (LBS)	PER 1,000SF
A	Tall fescue	20	0.45
	Creeping red fescue	20	0.45
	Redtop	2	0.05
	Total	42	0.95
B[3]	Tall fescue	15	0.35
	Creeping red fescue	10	0.25
	Crown Vetch	15	0.35
	Or Flatpea	30	0.75
	Total	40 or 55	0.95 or 1.35
C[3]	Tall fescue	20	0.45
	Creeping red fescue	20	0.45
	Redtop	8	0.20
	Total	48	1.10
D[3]	Birdsfoot Trefoil	10	0.25
	Redtop	5	0.10
	Reed Canarygrass[1]	15	0.35
	Total	30	0.70
E	Tall fescue	20	0.45
	Flatpea	30	0.75
	Total	50	1.20
F	Creeping red fescue[2]	50	1.15
	Kentucky Bluegrass[2]	50	1.15
	Total	100	2.30
G	Tall Fescue	15	03.60

Notes:

1. Reed canary grass is on the invasive species watch list due to its rapid, aggressive growth and its ability to move into wetlands and out-compete other desirable wetland plants. Caution should be used when planted near wetlands.
2. For heavy use athletic fields, consult the University of New Hampshire Cooperative Extension Turf Specialist for current varieties and seeding rates.
3. The University of New Hampshire Cooperative Extension recommends red clover to substitute for crown vetch or birdsfoot trefoil if they are going to be mowed to a height of 4 inches or less. Red clover (Alsike variety) should be seeded at a rate of 20 pounds per acre.
   a. Mulch in accordance with specifications for temporary mulching.

F. WINTER CONSTRUCTION AND STABILIZATION

To adequately protect water quality during cold weather and during spring runoff, the following stabilization techniques should be employed during the period from October 15th through May 15th.

1. The area of exposed, unstabilized soil should be limited to one acre and should be protected against erosion by the methods described in this section prior to any thaw or spring melt event. Subject to applicable regulations, the allowable area of exposed soil may be increased if activities are conducted according to a winter construction plan, developed by a professional engineer licensed to practice in the state of New Hampshire or a Certified Professional in Erosion and Sediment Control as certified by the CPESC Council of EnviroCert International, Inc.
2. Mulching:
   a. All mulch applied during winter should be anchored (e.g., by netting, tracking, wood cellulose fiber).
   b. When mulch is applied to provide protection over winter (past the growing season), it should be applied to a depth of four inches (150-200 pounds of hay or straw per 1000 square feet, or double standard application rate). Seeding cannot generally be expected to grow up through this depth of mulch and will be smothered. If vegetation is desired, the mulch will need to be removed in the springtime and the area seeded and mulched.
   c. Installation of anchored hay mulch or erosion control mix should not occur over snow of greater than one inch in depth.
   d. Installation of erosion control blankets should not occur over snow of greater than one inch in depth or on frozen ground.
3. Soil Stockpiles: Stockpiles of soil materials should be mulched for over winter protection with hay or straw at twice the normal rate or with a four-inch layer of erosion control mix. Mulching should be done within 24 hours of stocking, and re-established prior to any rainfall or snowfall. No soil stockpile should be placed (even covered with mulch) within 100 feet from any wetland or other water resource area. Frozen materials, (e.g., frost layer that is removed during winter construction), should be stockpiled separately and in a location that is away from any area needing to be protected. Stockpiles of frozen material can melt in the spring and become unworkable and difficult to transport due to the high moisture content in the soil.
4. Ditches and Channels:
   a. All grass-lined ditches and channels should be constructed and stabilized by September 1. All ditches or swales which do not exhibit a minimum of 85% vegetative growth by October 15th, or which are disturbed after October 15th, should be stabilized temporarily with stone or erosion control blankets appropriate for the design flow conditions, as determined by a qualified Professional Engineer or a Certified Professional in Erosion and Sediment Control as certified by the CPESC Council of EnviroCert International, Inc. If a stone lining is necessary, the contractor may need to re-grade the ditch as required to provide adequate cross-section after placement of the stone.
   b. All stone-lined ditches and channels must be constructed and stabilized by October 15.
5. Road and Parking areas: After October 15th, incomplete road or parking areas where active construction of the road or parking area has stopped for the winter season should be protected with a minimum 3 inch layer of sand and gravel with a gradation such that less than 12% of the sand portion, or material passing the number 4 sieve, by weight, passes the number 200 sieve. (1)
6. Sediment Barriers: Sediment barriers that are installed during frozen conditions should consist of erosion control mix berms, or continuous contained berms. Silt fences and hay bales should not be installed when frozen conditions prevent proper embedment of these barriers.
7. Seeding: If seeding cannot be done within the specified seeding dates, mulch according to the "Temporary and Permanent Mulching practice," and delay seeding until the next recommended seeding period.
8. Maintenance: Maintenance measures should continue as needed throughout construction, including the over-winter period. After each rainfall, snowstorm, or period of thawing and runoff, the site contractor should conduct an inspection of all installed erosion control measures and repair damage as needed to ensure their continuing function. For any area stabilized by temporary or permanent seeding prior to the onset of the winter season, the contractor should conduct an inspection in the spring to ascertain the condition of vegetation cover, and repair any damage areas or bare spots and reseed as required to achieve an established vegetative cover (at least 85% of vegetated area with healthy, vigorous growth).

G. OVERWINTER CONSTRUCTION CONTROL MEASURES

1. Stabilization as follows should be completed within a day of establishing the grade that is final or that otherwise will exist for more than 5 days:
   a. All proposed vegetated areas having a slope of less than 15% which do not exhibit a minimum of 85% vegetative growth by October 15th, or which are disturbed after October 15th, should be seeded and covered with 3 to 4 tons of hay or straw mulch per acre secured with anchored netting, or 2 inches of erosion control mix (see description of erosion control mix berms for material specification).
   b. All proposed vegetated areas having a slope of greater than 15% which do not exhibit a minimum of 85% vegetative growth by October 15th, or which are disturbed after October 15th, should be seeded and covered with properly installed and anchored erosion control blanket or with a minimum 4 inch thickness of erosion control mix, unless otherwise specified by the manufacturer. Note that compost blankets should not exceed 2 inches in thickness or they may overheat.
2. All stone-covered slopes must be constructed and stabilized by October 15.

H. MAINTENANCE PLAN

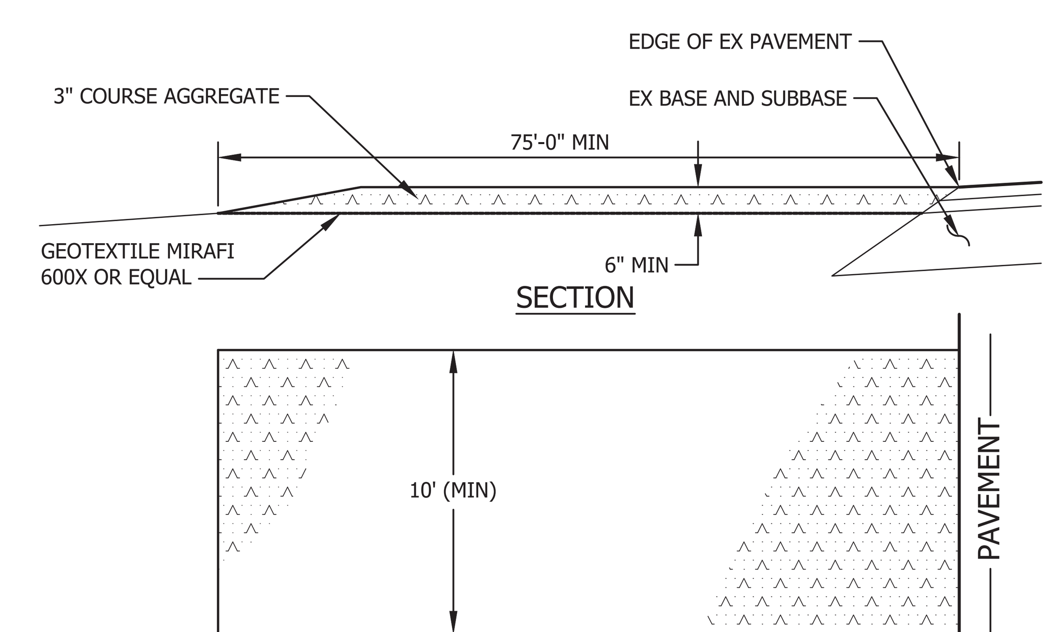
1. Routine Maintenance: Inspection will be performed as outlined in the project's Erosion Control Plan. Inspection will be by a qualified person during wet weather to ensure that the facility performs as intended. Inspection priorities will include checking erosion controls for accumulation of sediments.

I. Housekeeping.

1. Spill prevention. Controls must be used to prevent pollutants from being discharged from materials on site, including storage practices to minimize exposure of the materials to stormwater, and appropriate spill prevention, containment, and response planning and implementation.
2. Groundwater protection. During construction, liquid petroleum products and other hazardous materials with the potential to contaminate groundwater may not be stored or handled in areas of the site draining to an infiltration area. An "infiltration area" is any area of the site that by design or as a result of soils, topography and other relevant factors accumulates runoff that infiltrates into the soil. Dikes, berms, sumps, and other forms of secondary containment that prevent discharge to groundwater may be used to isolate portions of the site for the purposes of storage and handling of these materials.
3. Fugitive sediment and dust. Actions must be taken to ensure that activities do not result in noticeable erosion of soils or fugitive dust emissions during or after construction. Oil may not be used for dust control. If off-site tracking occurs roadways should be swept immediately and no loss once a week and prior to significant storm events.
4. Debris and other materials. Litter, construction debris, and chemicals exposed to stormwater must be prevented from becoming a pollutant source.
5. Trench or foundation de-watering. Trench de-watering is the removal of water from trenches, foundations, coffer dams, ponds, and other areas within the construction area that retain water after excavation. In most cases the collected water is heavily silted and hinders correct and safe construction practices. The collected water must be removed from the ponded area, either through gravity or pumping, and must be spread through natural wooded buffers or removed to areas that are specifically designed to collect the maximum amount of sediment possible, like a cofferdam sedimentation basin. Avoid allowing the water to flow over disturbed areas of the site. Equivalent measures may be taken if approved by the department.
6. Care must be exercised to prevent contact of water from construction dewatering with oil, grease, other petroleum products, or toxic and hazardous materials. Contaminated runoff must be contained, treated, and discharged or removed in accordance with NHDES requirements.
7. Additional requirements. Additional requirements may be applied on a site-specific basis.

J. CONSTRUCTION SEQUENCE

In general, the expected sequence of construction for each phase is provided below. Construction is proposed to start in Spring 2024 and end in 2025.
- Mobilization
- Install temporary erosion control measures
- Clearing and grubbing
- Site Grading
- Install gravel access road
- Install site utilities and solar panels
- Site stabilization, loam and seed, and landscaping

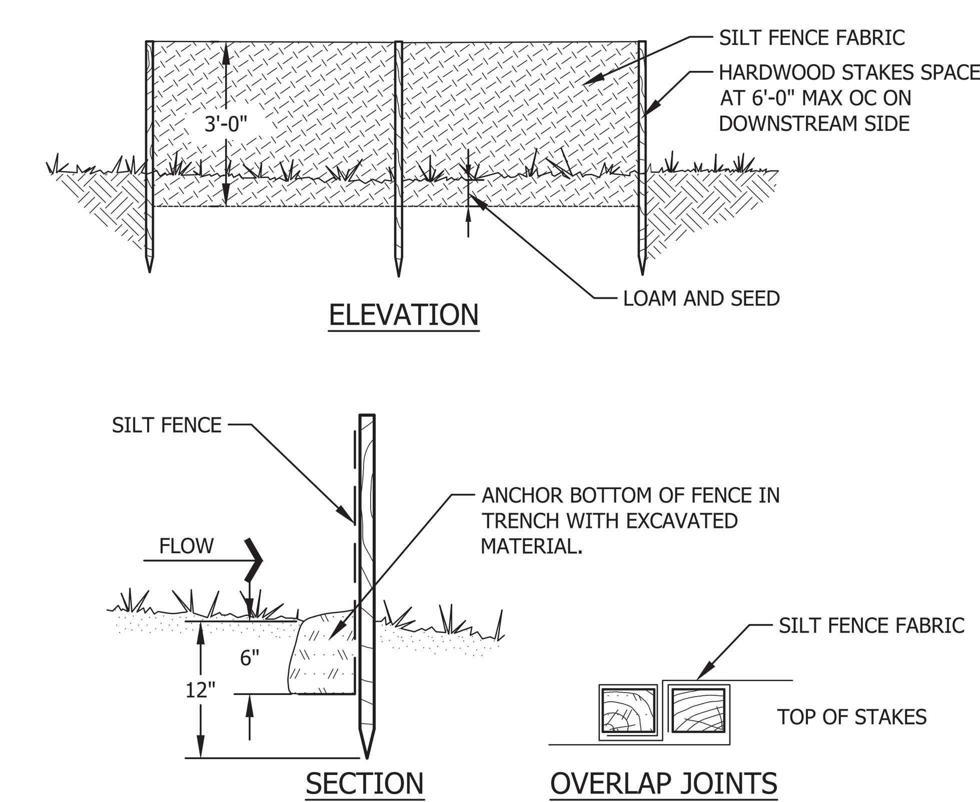


NOTES:

1. MAINTAIN ENTRANCE IN A CONDITION THAT WILL PREVENT TRACKING OF SEDIMENT ONTO PUBLIC RIGHT-OF-WAY. IF WASHING IS REQUIRED PREVENT SEDIMENT FROM ENTERING WATERWAYS, DITCHES OR STORM DRAINS.
2. REMOVE STABILIZED CONSTRUCTION ENTRANCE TO FINISH ROAD CONSTRUCTION AND PAVEMENT.

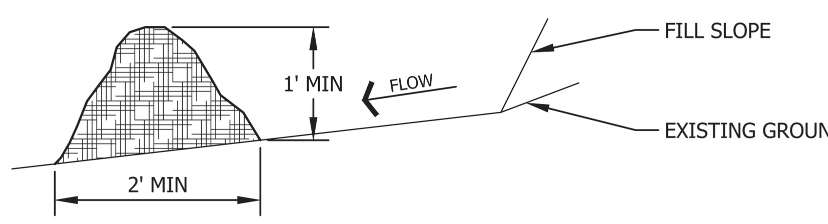
STABILIZED CONSTRUCTION ENTRANCE DETAIL

NTS



SILT FENCE

NOTE:
CONTRACTORS OPTION TO USE SEDIMENT BARRIER OR SILT FENCE FOR SLOPE PROTECTION.



EROSION CONTROL MIX SEDIMENT BARRIER

NOTES:

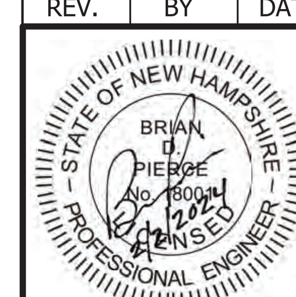
1. EROSION CONTROL MIX CAN BE MANUFACTURED ON OR OFF THE SITE. IT MUST CONSIST PRIMARILY OF ORGANIC MATERIAL SEPARATED AT THE POINT OF GENERATION, AND MAY INCLUDE: SHREDDED BARK, STUMP GRINDINGS, COMPOSTED BARK, OR FLUME GRIT AND FRAGMENTED WOOD GENERATED FROM WATER-FLUME LOG HANDLING SYSTEMS. WOOD CHIPS, GROUND CONSTRUCTION DEBRIS, REPROCESSED WOOD PRODUCTS OR BARK CHIPS WILL NOT BE ACCEPTABLE AS THE ORGANIC COMPONENT OF THE MIX. EROSION CONTROL MIX SHALL CONTAIN A WELL-GRADED MIXTURE OF PARTICLE SIZES AND MAY CONTAIN ROCKS LESS THAN 4" IN DIAMETER. EROSION CONTROL MIX MUST BE FREE OF REFUSE, PHYSICAL CONTAMINANTS, AND MATERIAL TOXIC TO PLANT GROWTH.

   THE MIX COMPOSITION SHALL MEET THE FOLLOWING STANDARDS:
   A. ORGANIC MATERIAL: BETWEEN 20% - 100% (DRY WEIGHT BASIS)
   B. PARTICLE SIZE: BY WEIGHT, 100% PASSING 6" SCREEN, 70-85% PASSING 0.75" SCREEN
   C. THE ORGANIC PORTION NEEDS TO BE FIBROUS AND ELONGATED.
   D. LARGE PORTIONS OF SILTS, CLAYS OR FINE SANDS ARE NOT ACCEPTABLE IN THE MIX.
   E. SOLUBLE SALTS CONTENT SHALL BE LESS THAN 4.0 MMHOS/CM.
   F. PH: 5.0 - 8.0
2. ON SLOPES LESS THAN 5% OR AT THE BOTTOM OF SLOPES 2:1 OR LESS UP TO 20 FEET LONG, THE BARRIER MUST CONFORM TO THE ABOVE DIMENSIONS. ON THE LONGER OR STEEPER SLOPES, THE BARRIER SHOULD BE WIDER TO ACCOMMODATE THE ADDITIONAL FLOW.
3. THE BARRIER MUST BE PLACED ALONG A RELATIVELY LEVEL ELEVATION. IT MAY BE NECESSARY TO CUT TALL GRASSES OR WOODY VEGETATION TO AVOID CREATING VOIDS AND BRIDGES THAT WOULD ENABLE FINES TO WASH UNDER THE BARRIER THROUGH THE GRASS BLADES OR PLANT STEMS.
4. LOCATIONS WHERE OTHER BMP'S SHOULD BE USED:
   A. AT LOW POINTS OF CONCENTRATED FLOW
   B. BELOW CULVERT OUTLET APRONS
   C. WHERE A PREVIOUS STAND-ALONE EROSION CONTROL MIX APPLICATION HAS FAILED
   D. AT THE BOTTOM OF STEEP PERIMETER SLOPES THAT ARE MORE THAN 50 FEET FROM TOP TO BOTTOM (LARGE UPGRADIENT WATERSHED)
   E. AROUND CATCH BASINS AND CLOSED STORM DRAIN SYSTEMS
5. THE EROSION CONTROL MIX BARRIERS SHOULD BE INSPECTED REGULARLY AND AFTER EACH LARGE RAINFALL. REPAIR ALL DAMAGED SECTIONS OF BERM IMMEDIATELY BY REPLACING OR ADDING ADDITIONAL MATERIAL PLACED ON THE BERM TO THE DESIRED HEIGHT AND WIDTH.
6. IT MAY BE NECESSARY TO REINFORCE THE BARRIER WITH SILT FENCE OR STONE CHECK DAMS IF THERE ARE SIGNS OF UNDERCUTTING OR THE IMPOUNDMENT OF LARGE VOLUMES OF WATER.
7. SEDIMENT DEPOSITS SHOULD BE REMOVED WHEN THEY REACH APPROXIMATELY ONE-HALF THE HEIGHT OF THE BARRIER.
8. REPLACE SECTIONS OF BERM THAT DECOMPOSE, BECOME CLOGGED WITH SEDIMENT OR OTHERWISE BECOME INEFFECTIVE. THE BARRIER SHOULD BE RESHAPED AS NEEDED.
9. EROSION CONTROL MIX BARRIERS CAN BE LEFT IN PLACE AFTER CONSTRUCTION. ANY SEDIMENT DEPOSITS REMAINING IN PLACE AFTER BARRIER IS NO LONGER REQUIRED SHOULD BE SPREAD TO CONFORM TO THE EXISTING GRADE AND BE SEEDED AND MULCHED. WOODY VEGETATION CAN BE PLANTED INTO THE BARRIERS, OR THEY CAN BE OVER-SEEDED WITH LEGUMES. IF THE BARRIER NEEDS TO BE REMOVED, IT CAN BE SPREAD OUT INTO THE LANDSCAPE.
10. IF TEMPORARY BERMS ARE USED AS SILT BARRIERS, THEY ARE PROHIBITED AT THE BASE OF SLOPES STEEPER THAN 8% OR WHERE THERE IS FLOWING WATER WITHOUT THE SUPPORT OF ADDITIONAL MEASURES SUCH AS SILT FENCE.

SURFACE DRAINAGE SEDIMENT CONTROL

NTS

REV.	BY	DATE	STATUS
1	DPD	2/2024	REISSUED FOR NHDES REVIEW
	DPD	9/2023	ISSUED FOR NHDES REVIEW



1.5 MW AC SOLAR ARRAY
REVISION ENERGY
9 CROSS ROAD
EXETER, NEW HAMPSHIRE

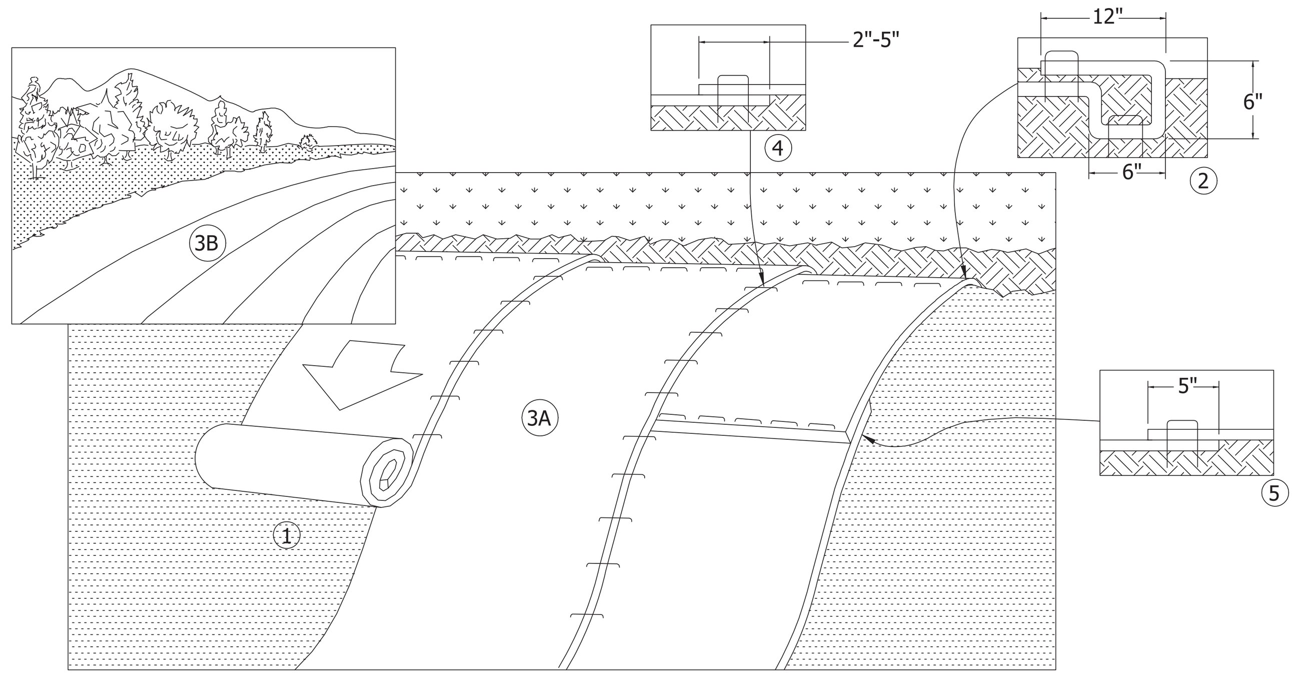
EROSION CONTROL NOTES AND DETAILS

SME
SEVEE & MAHER ENGINEERS
ENVIRONMENTAL • CIVIL • GEOTECHNICAL • WATER • COMPLIANCE
4 Blanchard Road, PO Box 85A, Cumberland, Maine 04021
Phone 207.829.5016 • Fax 207.829.5692 • smemaine.com

DESIGN BY:	JTR
DRAWN BY:	JRL
DATE:	9/2023
CHECKED BY:	DPD
LMN:	NONE
CTB:	SME-STD

JOB NO. 220241.00 DWG FILE DETAILS

C-300



NOTES:

1. PREPARE SOIL BEFORE INSTALLING ROLLED EROSION CONTROL PRODUCTS (RECP'S) INCLUDING ANY NECESSARY APPLICATION OF LIME, FERTILIZER AND SEED.
2. THERE SHALL BE NO PLASTIC, OR MULTI-FILAMENT OR MONOFILAMENT POLYPROPYLENE NETTING OR MESH WITH AN OPENING SIZE OF GREATER THAN 1/8 INCHES MATERIAL UTILIZED (1)
3. BEGIN AT THE TOP OF THE SLOPE BY ANCHORING THE RECP'S IN A 6" DEEP X 6" WIDE TRENCH WITH APPROXIMATELY 12" OF RECP'S EXTENDED BEYOND THE UP-SLOPE PORTION OF THE TRENCH. ANCHOR THE RECP'S WITH A ROW OF STAPLES/STAKES APPROXIMATELY 12" APART IN THE BOTTOM OF THE TRENCH. BACKFILL AND COMPACT THE TRENCH AFTER STAPLING. APPLY SEED TO COMPACTED SOIL AND FOLD REMAINING 12" PORTION OF THE RECP'S BACK OVER THE SEED AND COMPACTED SOIL. SECURE RECP'S OVER COMPACTED SOIL WITH A ROW OF STAPLES SPACED APPROXIMATELY 12" ACROSS THE WIDTH OF THE RECP'S.
4. ROLL CENTER RECP'S (A) DOWN OR (B) ACROSS THE SLOPE. RECP'S WILL UNROLL WITH APPROPRIATE SIDE AGAINST THE SOIL SURFACE. ALL RECP'S MUST BE SECURELY FASTENED TO SOIL SURFACE BY PLACING STAPLES IN APPROPRIATE LOCATIONS AS SHOWN IN THE STAPLE PATTERN GUIDE. WHEN USING THE DOT SYSTEM™, STAPLES SHOULD BE PLACED THROUGH EACH OF THE COLORED DOTS CORRESPONDING TO THE APPROPRIATE STAPLE PATTERN.
5. THE EDGES OF PARALLEL RECP'S MUST BE STAPLED WITH APPROXIMATELY 2"-5" OVERLAP DEPENDING ON RECP'S TYPE.
6. CONSECUTIVE RECP'S SPLICED DOWN THE SLOPE MUST BE PLACED END OVER END (SHINGLE STYLE) WITH AN APPROXIMATE 3" OVERLAP. STAPLE THROUGH OVERLAPPED AREA, APPROXIMATELY 12" APART ACROSS THE ENTIRE RECP'S WIDTH.

* IN LOOSE SOIL CONDITIONS, THE USE OF STAPLE OR STAKE LENGTHS GREATER THAN 6" MAY BE NECESSARY TO PROPERLY ANCHOR THE RECP'S.

EROSION CONTROL BLANKET SLOPE INSTALLATION

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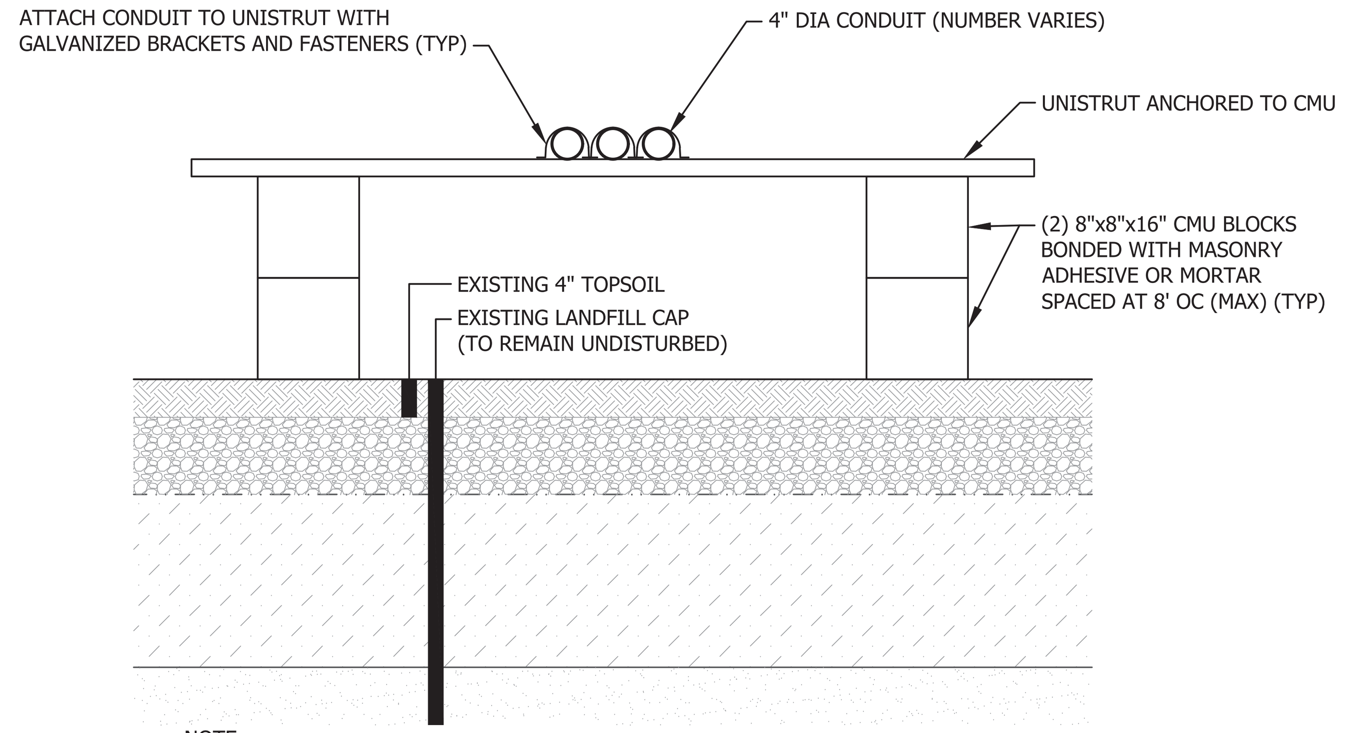
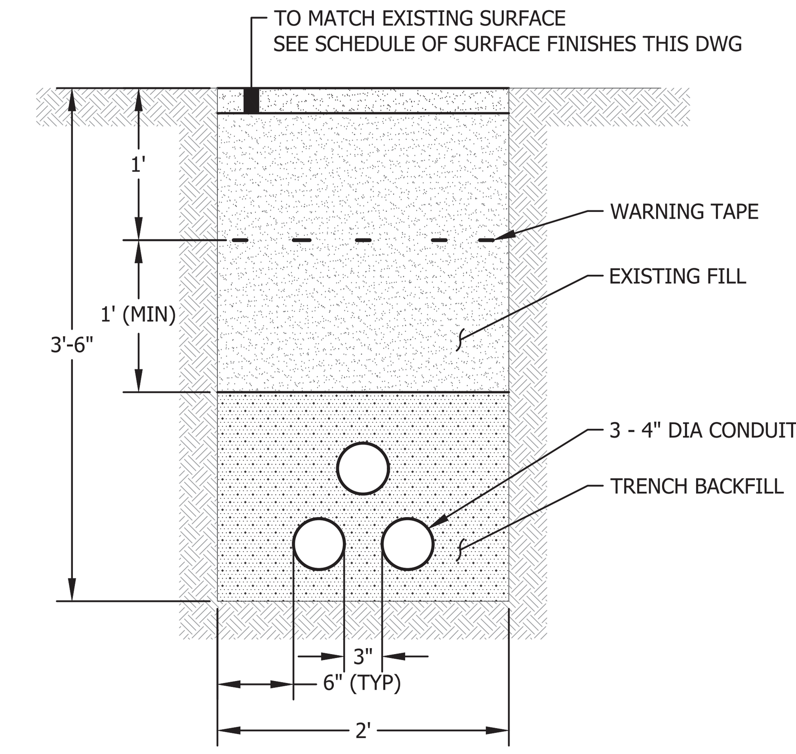


NOTE:
BALLASTED ELECTRICAL CONDUIT SUPPORTS TO BE INSTALLED TO MATCH EXISTING GRADES. FOR STEEP SLOPES GRAVEL LEVELING PADS MAY BE INSTALLED TO IMPROVE SUPPORT STABILITY. GRAVEL LEVELING PADS SHALL BE STABILIZED WITH LOAM, SEED, AND MULCH TO MATCH EXISTING VEGETATIVE COVER ON THE LANDFILL CAP.

BALLASTED ELECTRICAL CONDUIT - INSIDE LANDFILL LIMIT

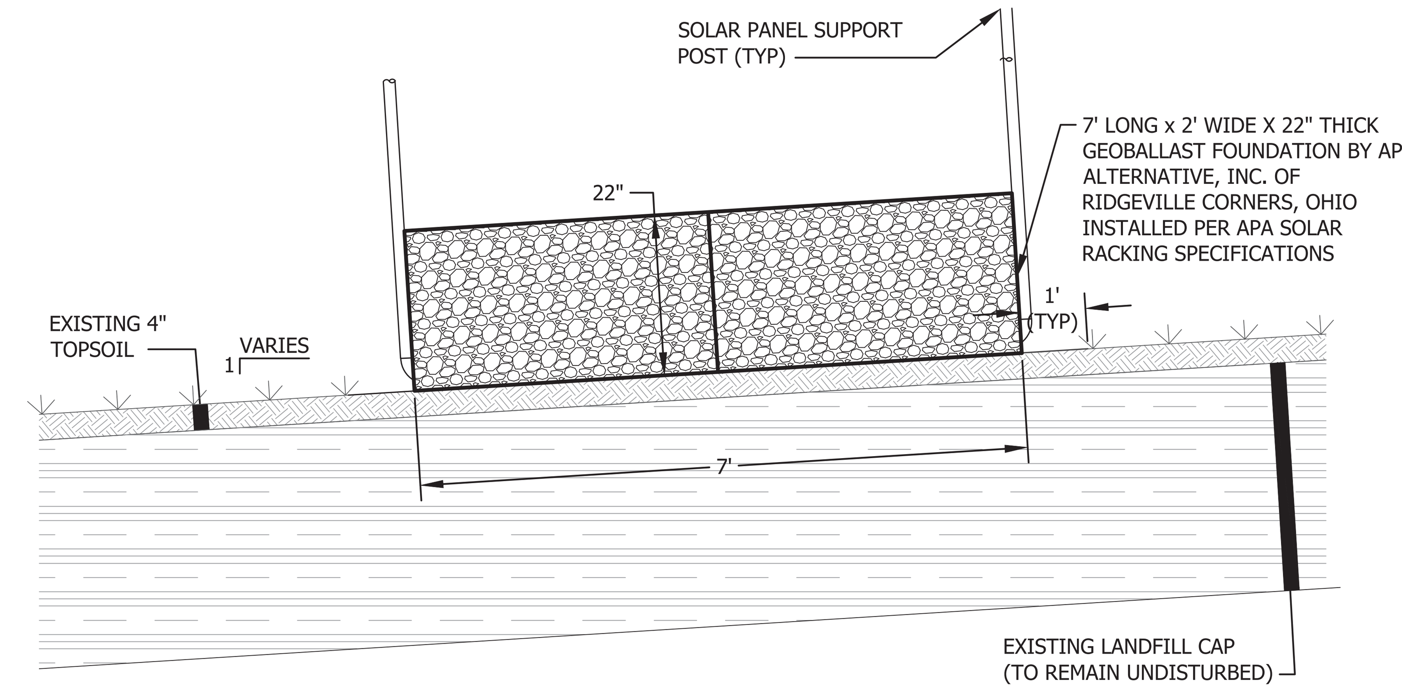
NTS



NOTE:
1. WHERE DUCT BANK CROSSES GRAVEL OR PAVED ROAD SECTIONS, MATCH EXISTING SURFACE.

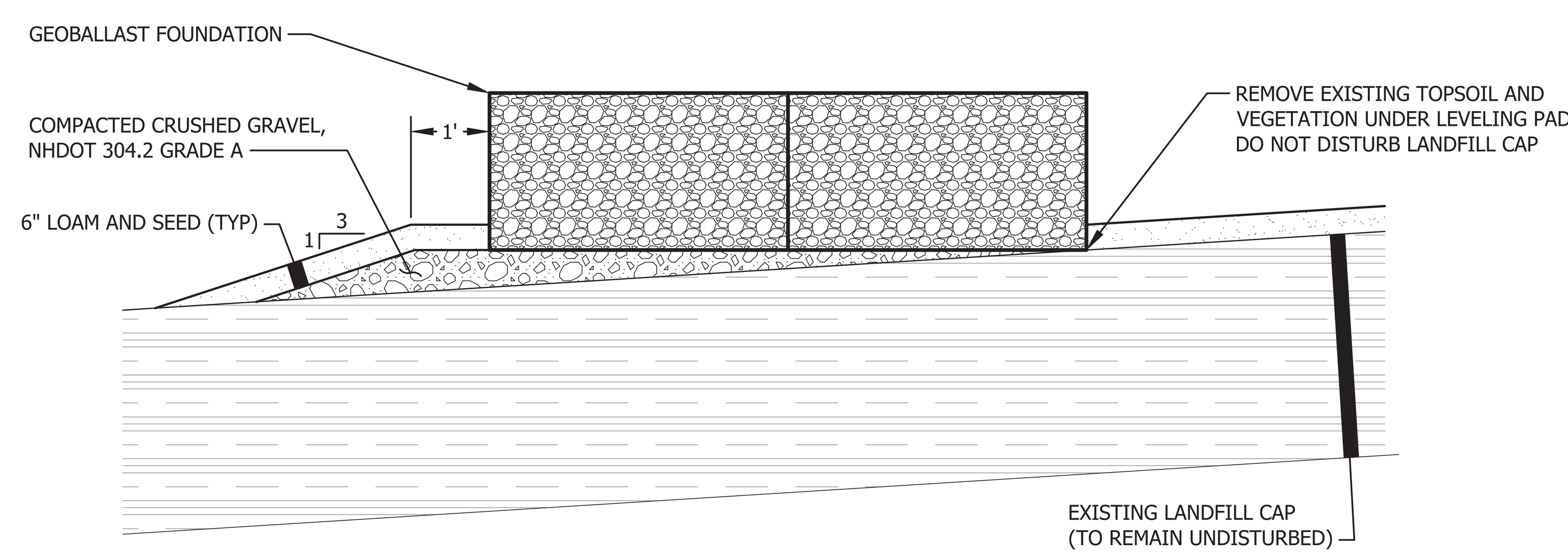
UNDERGROUND ELECTRICAL CONDUIT - OUTSIDE LANDFILL LIMIT

NTS



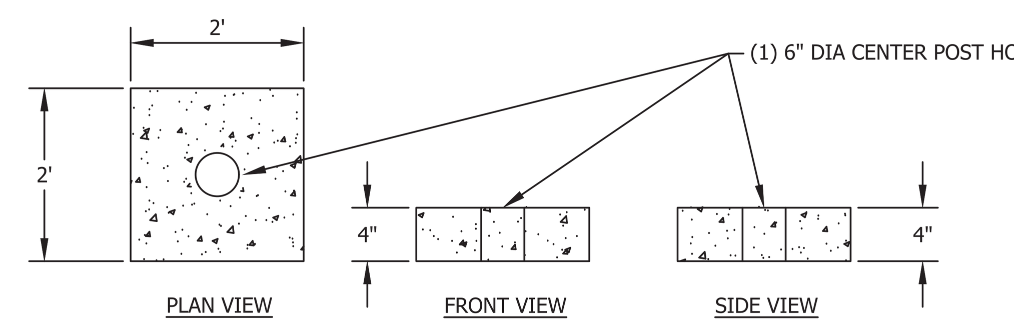
GEOBALLAST FOUNDATION FOR SOLAR PANEL RACK

NTS



GEOBALLAST FOUNDATION LEVELING

NTS

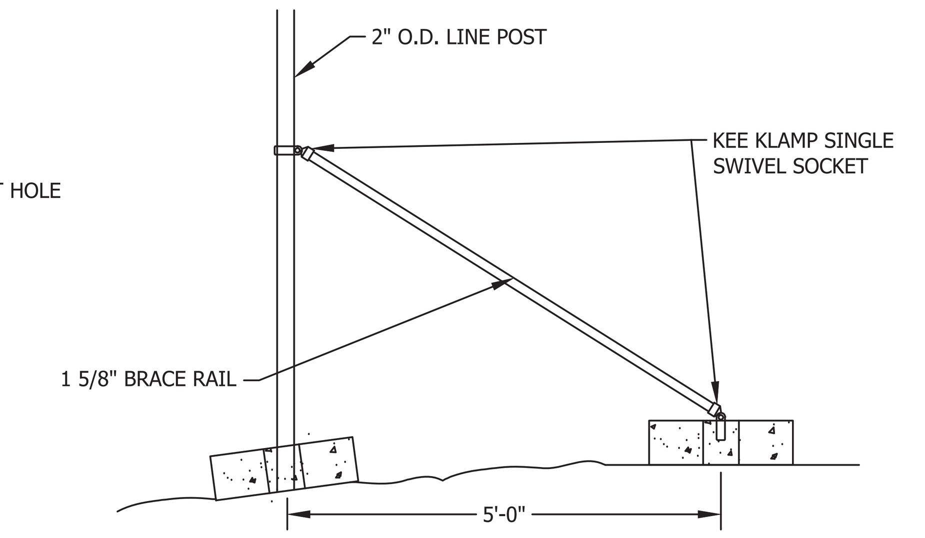


CONCRETE ANCHOR PADS

NOTE:
CONCRETE: 4,000 PSI MINIMUM AFTER 28 DAYS.

DIMS	ITEM NO	WEIGHT
2'x2'x4"	CONCRETE PADS	240#

NOTE:
SEE WILDLIFE FENCE DETAIL THIS DWG FOR LEAF GATE AND STRAIGHT SECTION DETAILS.

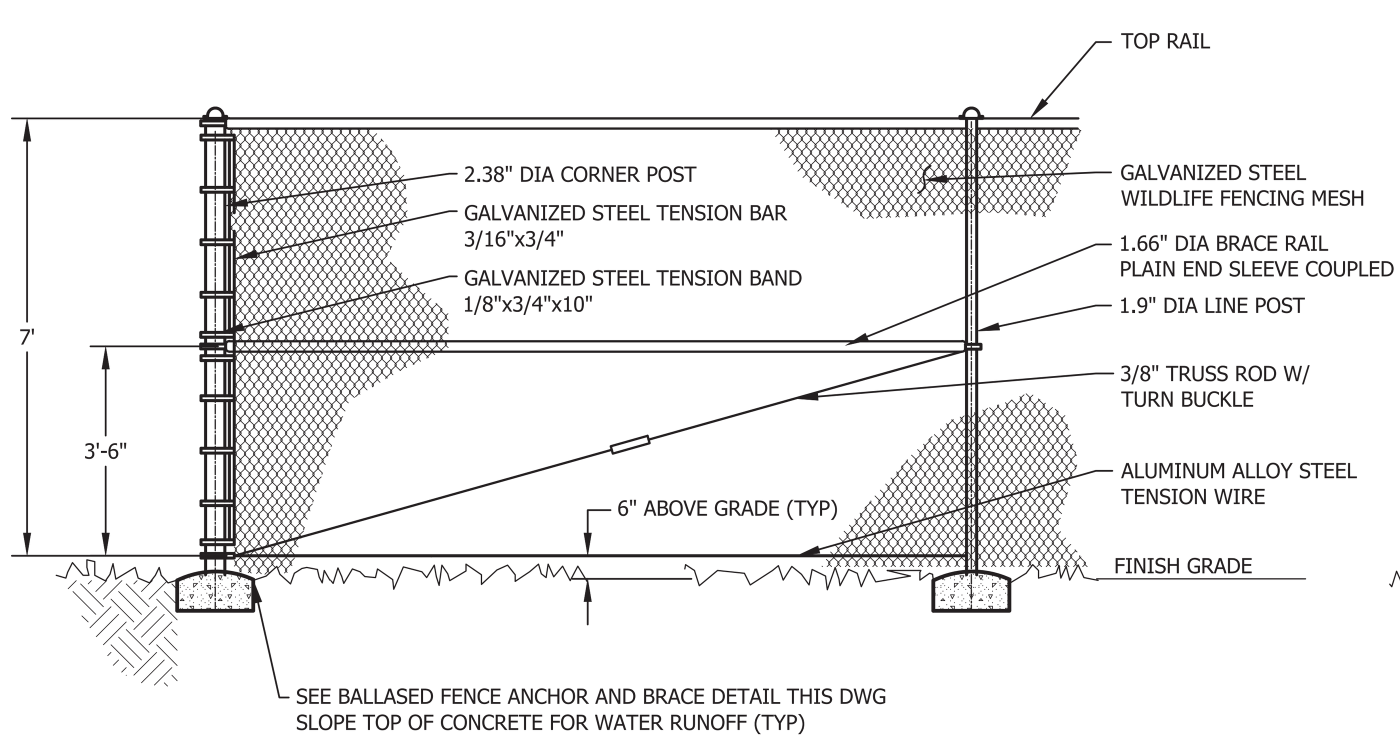


BACK BRACING METHOD

NOTE:
BACK BRACING METHOD TO BE INSTALLED @ EVERY 50'.

BALLASTED WILDLIFE FENCE ANCHOR AND BRACE - INSIDE LANDFILL LIMIT

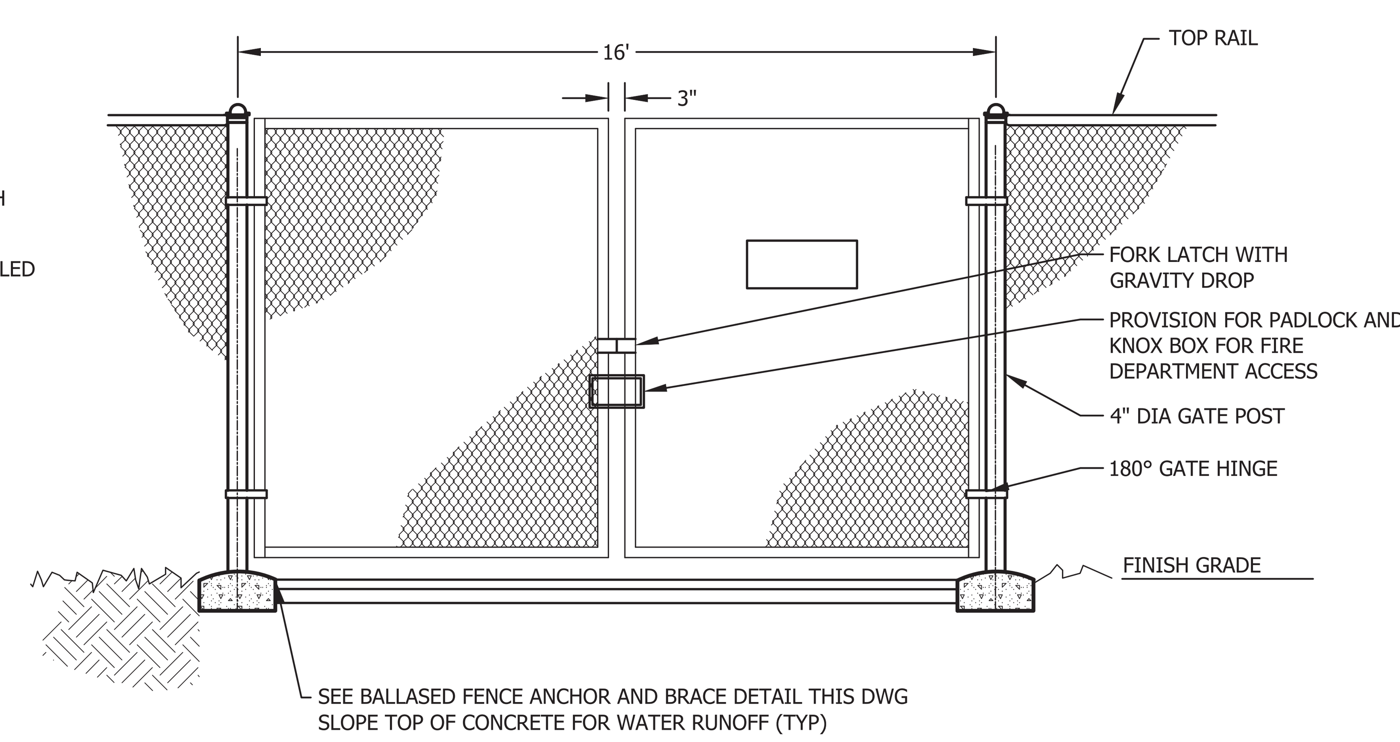
NTS



NOTES:
1. FENCE FABRIC, POSTS, AND HARDWARE TO BE GALVANIZED. ASTM F1083 SCHED 40 GALVANIZED STEEL PIPE, WELDED CONSTRUCTION, MINIMUM YIELD STRENGTH OF 25 KSI.
2. INSTALL FRAMEWORK, FABRIC, ACCESSORIES AND GATE IN ACCORDANCE WITH ASTM F567.
3. HARDWARE TO BE GALVANIZED TO ASTM A153/A153M, 1.8OZ/SQFT COATING.

WILDLIFE FENCE CORNER AND STRAIGHT SECTIONS

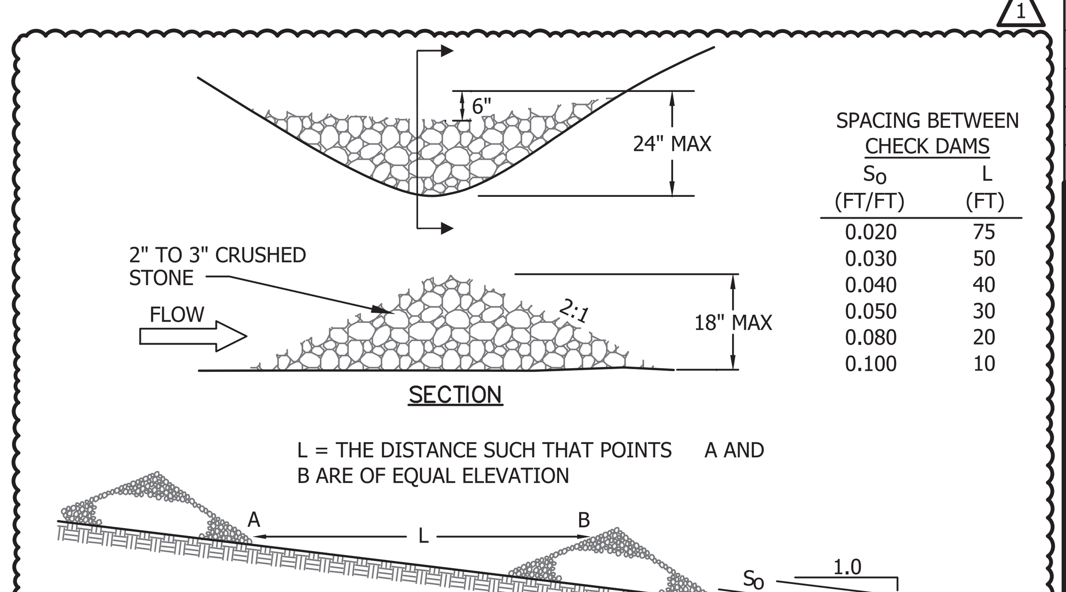
NTS



NOTES:
1. FENCE FABRIC, POSTS, AND HARDWARE TO BE GALVANIZED. ASTM F1083 SCHED 40 GALVANIZED STEEL PIPE, WELDED CONSTRUCTION, MINIMUM YIELD STRENGTH OF 25 KSI.
2. INSTALL FRAMEWORK, FABRIC, ACCESSORIES AND GATE IN ACCORDANCE WITH ASTM F567.
3. HARDWARE TO BE GALVANIZED TO ASTM A153/A153M, 1.8OZ/SQFT COATING.

WILDLIFE FENCE DOUBLE LEAF GATE

NTS



SPACING BETWEEN CHECK DAMS

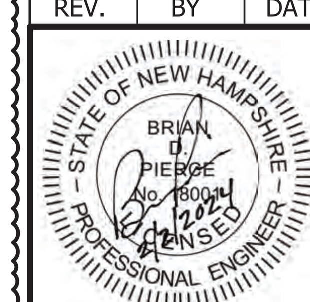
S_0 (FT/FT)	L (FT)
0.020	75
0.030	50
0.040	40
0.050	30
0.080	20
0.100	10

NOTE:
USE AT ALL NEWLY CONSTRUCTED GRASS LINED DITCHES AS A TEMPORARY EROSION CONTROL MEASURE AND WHERE OTHERWISE NOTED ON PLANS.

STONE CHECK DAM

NTS

REV.	BY	DATE	STATUS
1	DPD	2/2024	REISSUED FOR NHDES REVIEW
	DPD	9/2023	ISSUED FOR NHDES REVIEW



1.5 MW AC SOLAR ARRAY
REVISION ENERGY
9 CROSS ROAD
EXETER, NEW HAMPSHIRE

SECTIONS AND DETAILS

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DESIGN BY:	JTR
DRAWN BY:	JRL
DATE:	9/2023
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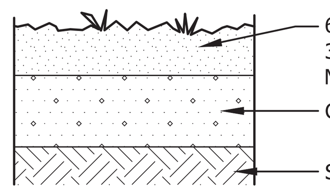
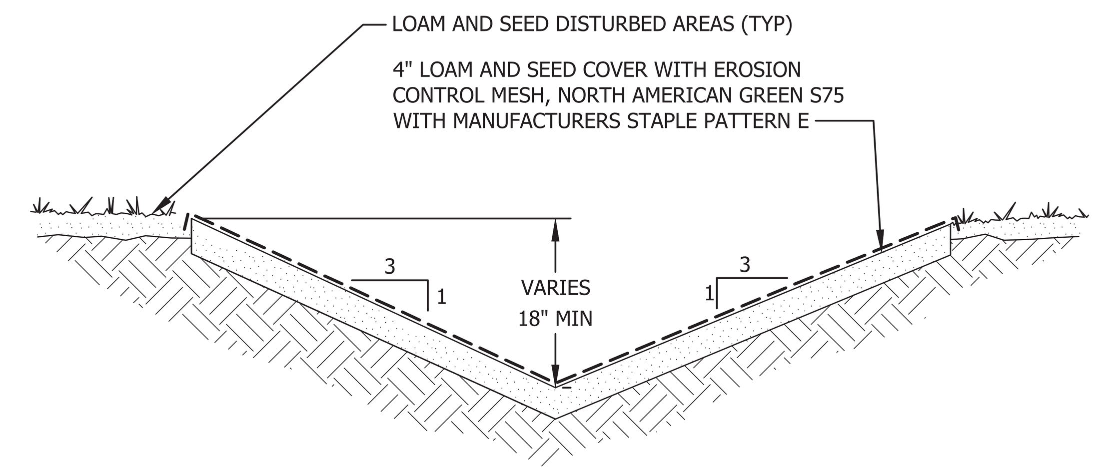
C-301

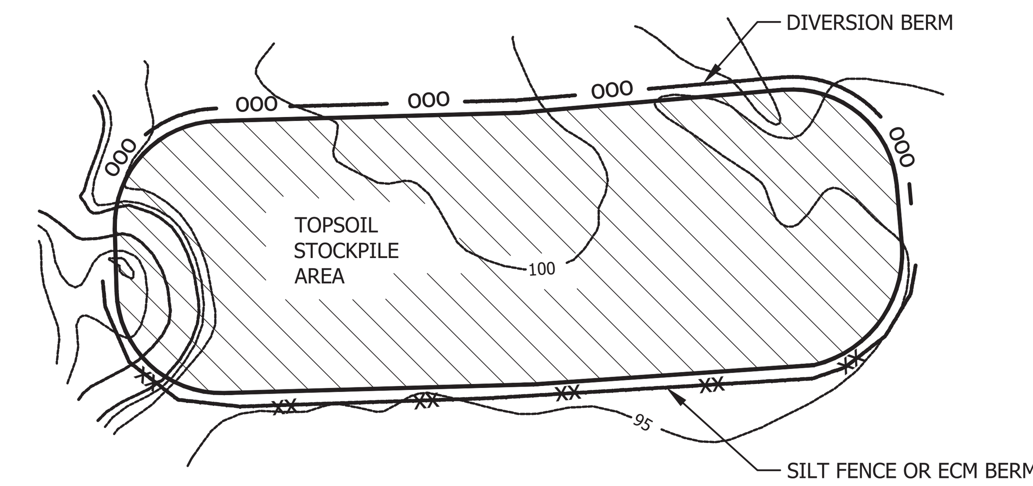
CONSTRUCTION	USE
	GRASS ALL DISTURBED AREAS AND UNDER ARRAY

NOTES:
1. HMA = HOT MIX ASPHALT.
   NHDOT = NEW HAMPSHIRE DEPARTMENT OF TRANSPORTATION.
2. COMPACT SUBGRADE AND EACH LAYER OF BORROW , SUBBASE MATERIAL, AND BASE MATERIAL TO MINIMUM 95% OF MATERIAL MAXIMUM DRY DENSITY PER ASTM D1557.

SCHEDULE OF SURFACE FINISHES
NTS



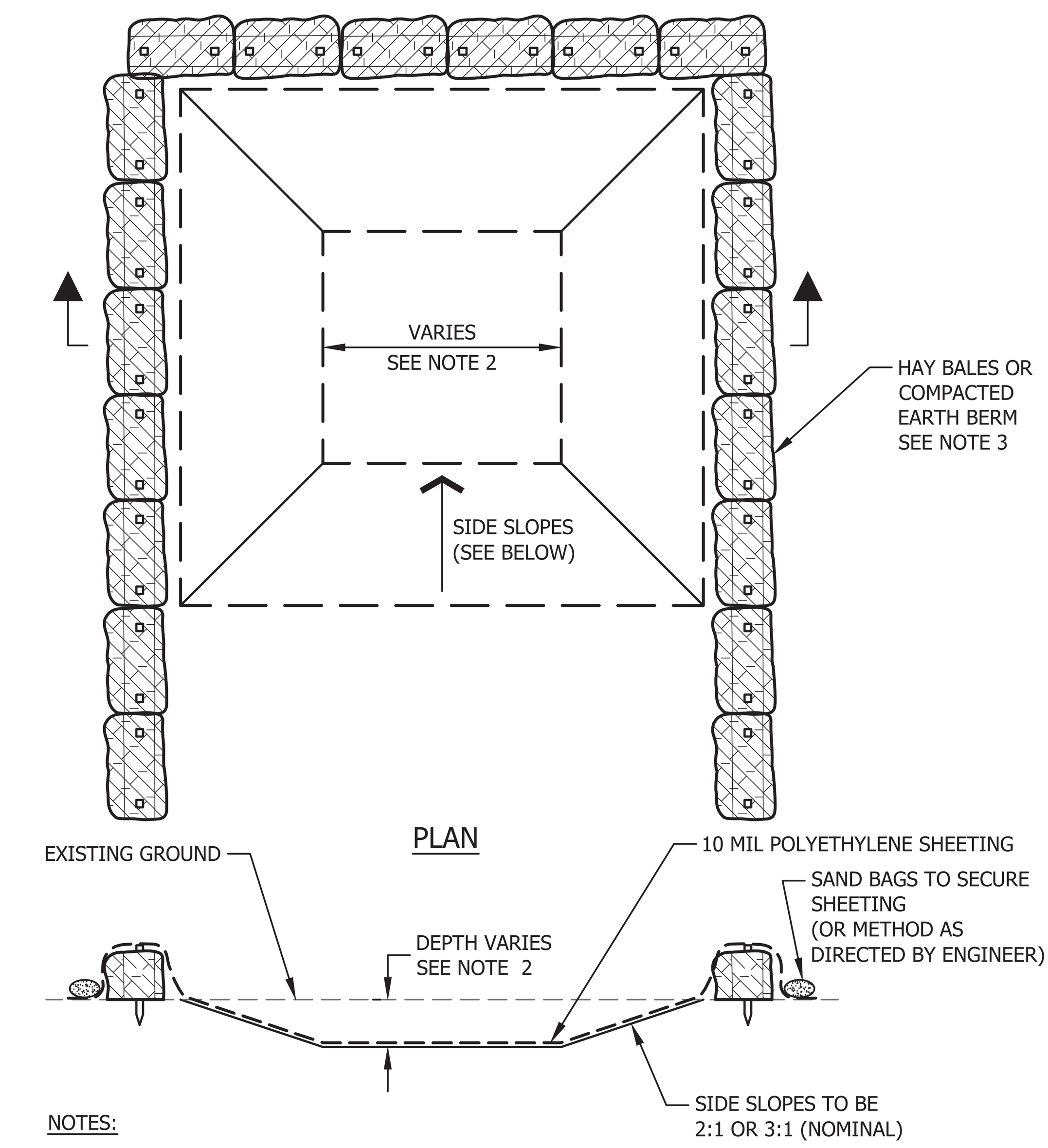
GRASS DITCH SECTION
NTS



NOTES:

1. LOCATE SOIL STOCKPILES AS FAR FROM PROTECTED RESOURCES AS POSSIBLE (PONDS, RIVERS, STREAMS, BROOKS, & WETLANDS). LOCATE SOIL STOCKPILES AWAY FROM AREAS OF CONCENTRATED FLOW OR POTENTIAL FLOODING.
2. ERECT SEDIMENT BARRIER (SILT FENCE OR ECM BERM) DOWN SLOPE OF STOCKPILES
3. STABILIZE STOCKPILES THAT WILL NOT BE WORKED FOR 14 OR MORE DAYS IN THE GROWING SEASON OR WILL REMAIN UNWORKED OR PARTIALLY UNWORKED OVER THE WINTER (NOVEMBER 1 TO APRIL 15) WITH TEMPORARY SEED, MULCH AND MULCH ANCHORING OR EROSION CONTROL BLANKET OR MESH AS SPECIFIED IN THE EROSION CONTROL PLAN. IN WINTER APPLY HAY MULCH AT THE RATE OF AT LEAST 150 LBS/1000 SF AND THICK ENOUGH THAT THE GROUND SURFACE IS NOT VISIBLE AND ANCHOR IF STOCKPILE HAS NOT BEEN PERMANENTLY STABILIZED USING ANOTHER METHOD (TARPS, PERMANENT SEED (< 90% VEGETATED), EROSION CONTROL BLANKET OR EROSION CONTROL MIX. EROSION CONTROL MIX CAN BE MANUFACTURED ON OR OFF THE SITE. IT MUST CONSIST PRIMARILY OF ORGANIC MATERIAL SEPARATED AT THE POINT OF GENERATION, AND MAY INCLUDE: SHREDDED BARK, STUMP GRINDINGS, COMPOSTED BARK, OR FLUME GRIT AND FRAGMENTED WOOD GENERATED FROM WATER-FLUME LOG HANDLING SYSTEMS. WOOD CHIPS, GROUND CONSTRUCTION DEBRIS, REPROCESSED WOOD PRODUCTS OR BARK CHIPS WILL NOT BE ACCEPTABLE AS THE ORGANIC COMPONENT OF THE MIX. EROSION CONTROL MIX SHALL CONTAIN A WELL-GRADED MIXTURE OF PARTICLE SIZES AND MAY CONTAIN ROCKS LESS THAN 4" IN DIAMETER. EROSION CONTROL MIX MUST BE FREE OF REFUSE, PHYSICAL CONTAMINANTS, AND MATERIAL TOXIC TO PLANT GROWTH. THE MIX COMPOSITION SHALL MEET THE FOLLOWING STANDARDS:
   A. ORGANIC MATERIAL: BETWEEN 20% - 100% (DRY WEIGHT BASIS)
   B. PARTICLE SIZE: BY WEIGHT, 100% PASSING 6" SCREEN, 70-85% PASSING 0.75" SCREEN
   C. THE ORGANIC PORTION NEEDS TO BE FIBROUS AND ELONGATED.
   D. LARGE PORTIONS OF SILTS, CLAYS OR FINE SANDS ARE NOT ACCEPTABLE IN THE MIX.
   E. SOLUBLE SALTS CONTENT SHALL BE LESS THAN 4.0 MMHOS/CM.
   F. PH: 5.0 - 8.0
4. IF SLOPE OF LAND IS GREATER THAN 5%, CONSTRUCT A DIVERSION BERM UPHILL OF THE STOCKPILE TO DIVERT FLOW.

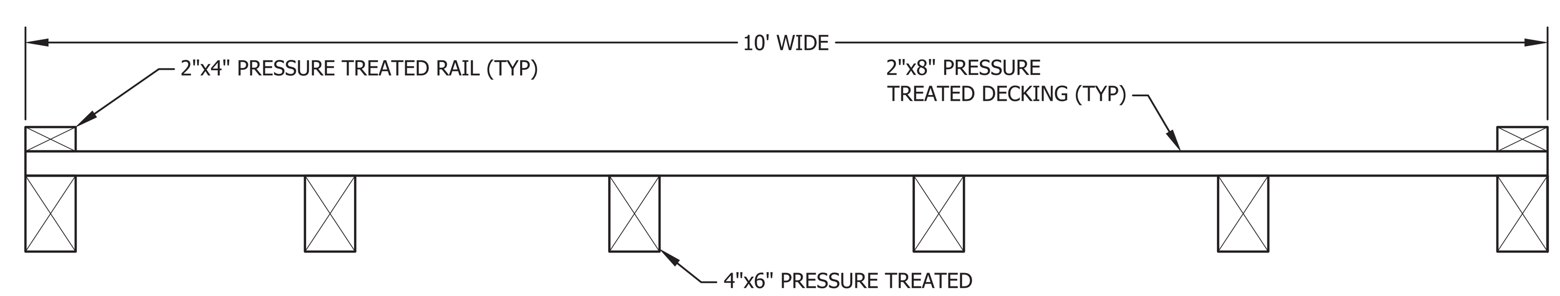
SOILS STOCKPILE DETAIL
NTS



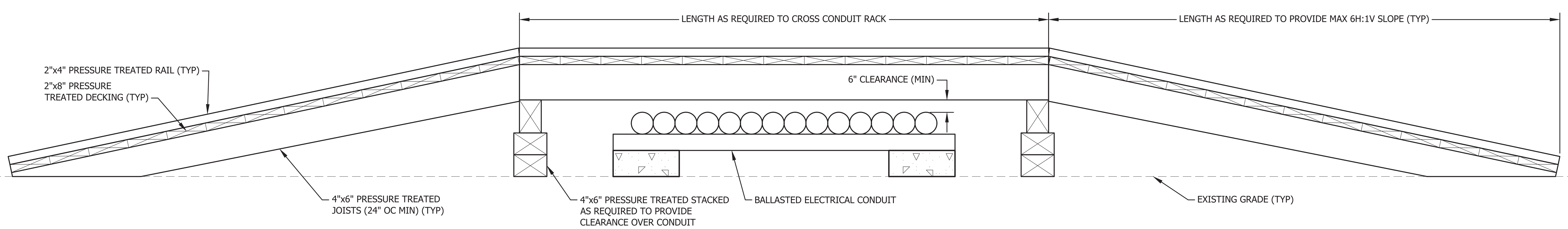
NOTES:

1. CONCRETE WASHOUT AREA(S) SHALL BE INSTALLED PRIOR TO CONCRETE PLACEMENT ON SITE. THE CONCRETE WASHOUT AREA SHALL BE ENTIRELY SELF-CONTAINED.
2. LOCATION: WASHOUT AREA(S) ARE TO BE LOCATED AT LEAST 50 FEET FROM ANY STREAM, WETLAND, STORM DRAINS, OR OTHER SENSITIVE RESOURCE.
3. SIZE: THE WASHOUT MUST HAVE SUFFICIENT VOLUME TO CONTAIN ALL LIQUID AND CONCRETE WASTE GENERATED BY WASHOUT OPERATIONS INCLUDING, BUT NOT LIMITED TO, OPERATIONS ASSOCIATED WITH GROUT AND MORTAR.
4. SURFACE DISCHARGE IS UNACCEPTABLE. THEREFORE, HAY BALES OR OTHER CONTROL MEASURES AS APPROVED BY THE ENGINEER, SHOULD BE USED AROUND THE PERIMETER OF THE CONCRETE WASHOUT AREA FOR CONTAINMENT.
5. SIGNS SHOULD BE PLACED AT THE CONSTRUCTION ENTRANCE, AT THE CONCRETE AREA(S), AND ELSEWHERE AS NECESSARY TO CLEARLY INDICATE THE LOCATION OF THE CONCRETE WASHOUT TO OPERATORS OF CONCRETE TRUCKS AND PUMP RIGS. WASHOUT AREA(S) SHOULD BE FLAGGED WITH SAFETY FENCING OR OTHER APPROVED METHOD.
6. WASHOUT AREA(S) ARE TO BE INSPECTED AT LEAST ONCE A WEEK FOR STRUCTURAL INTEGRITY, ADEQUATE HOLDING CAPACITY AND CHECKED FOR LEAKS, TEARS, OR OVERFLOWS. (AS REQUIRED BY THE CONSTRUCTION SITE ENVIRONMENTAL INSPECTION REPORT) WASHOUT AREA(S) SHOULD BE CHECKED AFTER HEAVY RAINS.
7. HARDENED CONCRETE WASTE SHOULD BE REMOVED AND DISPOSED OF WHEN THE WASTE HAS ACCUMULATED TO HALF OF THE CONCRETE WASHOUT'S HEIGHT. THE WASTE CAN BE STORED AT AN UPLAND LOCATION, AS APPROVED BY THE ENGINEER. ALL CONCRETE WASTE SHALL BE DISPOSED OF IN A MANNER CONSISTENT WITH ALL APPLICABLE LAWS, REGULATIONS, AND GUIDELINES.

CONCRETE WASHOUT AREA
NTS



DECK AND RAMP SECTION



WOODEN CONDUIT (TIMBER MAT) BRIDGE
NTS

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1	DPD	2/2024	REISSUED FOR NHDES REVIEW
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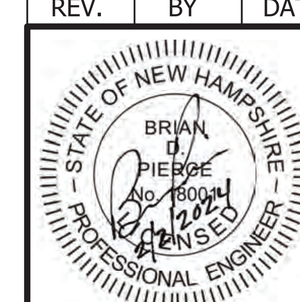

1.5 MW AC SOLAR ARRAY
REVISION ENERGY
9 CROSS ROAD
EXETER, NEW HAMPSHIRE

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DATE:	9/2023
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LMN:	NONE
CTB:	SME-STD

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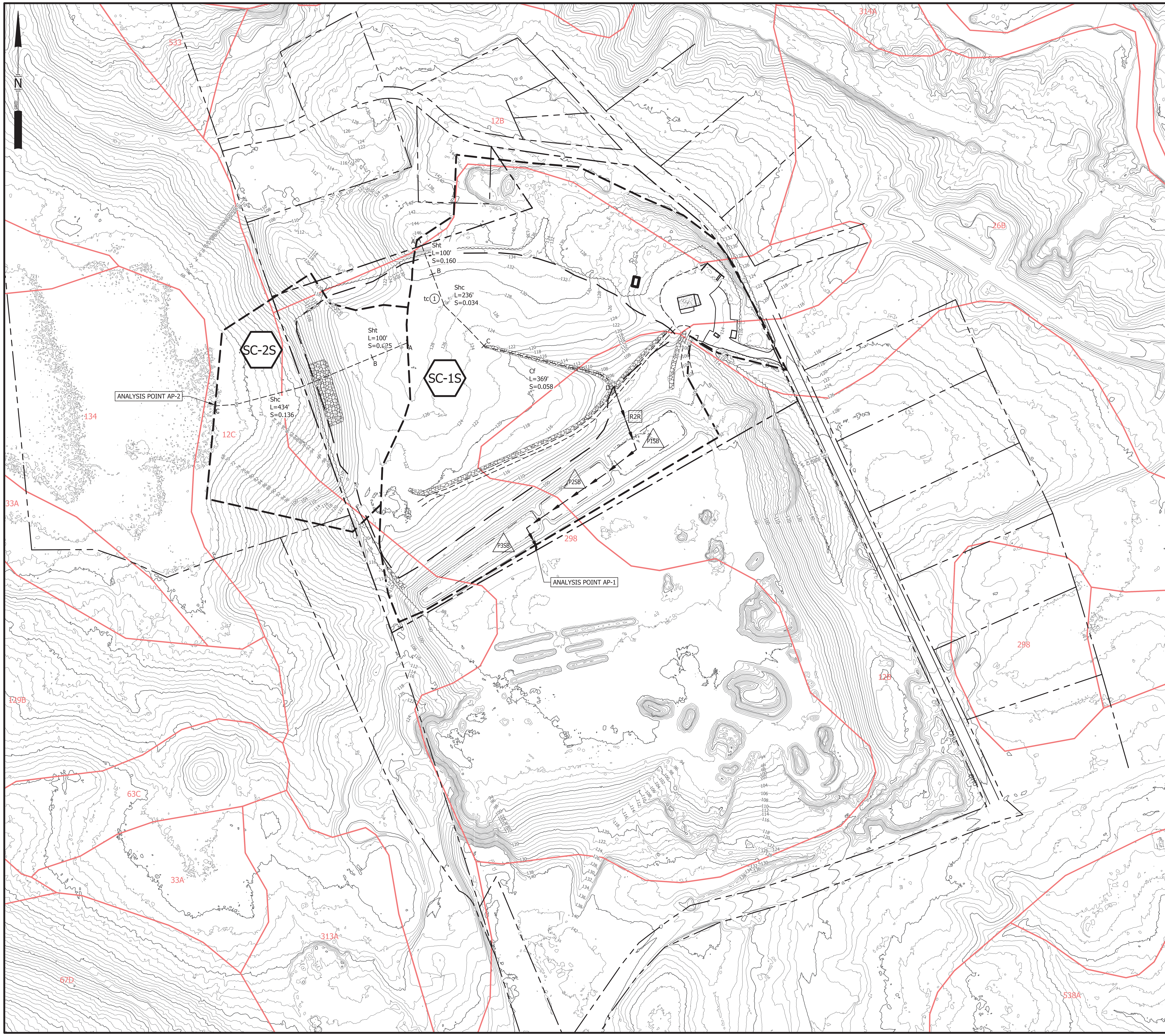
C-302



STORMWATER MANAGEMENT LEGEND

1	SUBCATCHMENT DESIGNATION
— — — —	SUBCATCHMENT BOUNDARY
A B C	TIME OF CONCENTRATION SEGMENT DESIGNATION TIME OF CONCENTRATION PATH
Sht L=50' S=0.005	TIME OF CONCENTRATION TYPE, LENGTH AND SLOPE. (75% TEXT HT)
Sht	SHEET FLOW
Shc	SHALLOW CONCENTRATED FLOW
Cf	CHANNEL FLOW
——►——►	DRAINAGE REACH
R1	REACH DESIGNATION (HYDROCAD)
P1	POND/STRUCTURE DESIGNATION (HYDROCAD)
tc 1	TIME OF CONCENTRATION WITH SUBCATCHMENT DESIGNATION
	SOIL TYPE BOUNDARY
Sn	SOIL TYPE DESIGNATION

Soils Table		
12B	Hinckley loamy sand	A
12C	Hinckley loamy sand	A
26B	Windsor loamy sand	A
134	Maybid silt loam	D
298	Pits, sand and gravel	A

NOTES:
1. SEE DRAWING C-100 FOR GENERAL SITE NOTES AND PLAN REFERENCES.
2. DAMAGE TO THE LANDFILL COVER SYSTEM AND EXISTING LANDFILL GAS VENTS SHALL BE REPAIRED TO TOWN AND MEDEP SPECIFICATIONS.

60 0 120 240 FEET

REV.	BY	DATE	STATUS
1	DPD	2/2024	REISSUED FOR NHDES REVIEW
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STATE OF NEW HAMPSHIRE – BRIAN D. PIERCE No. 1800?? LICENSED – PROFESSIONAL ENGINEER

1.5 MW AC SOLAR ARRAY
REVISION ENERGY
9 CROSS ROAD
EXETER, NEW HAMPSHIRE

STORMWATER MANAGEMENT PLAN
PRE-DEVELOPMENT CONDITIONS

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DRAWN BY:	JRL
DATE:	9/2023
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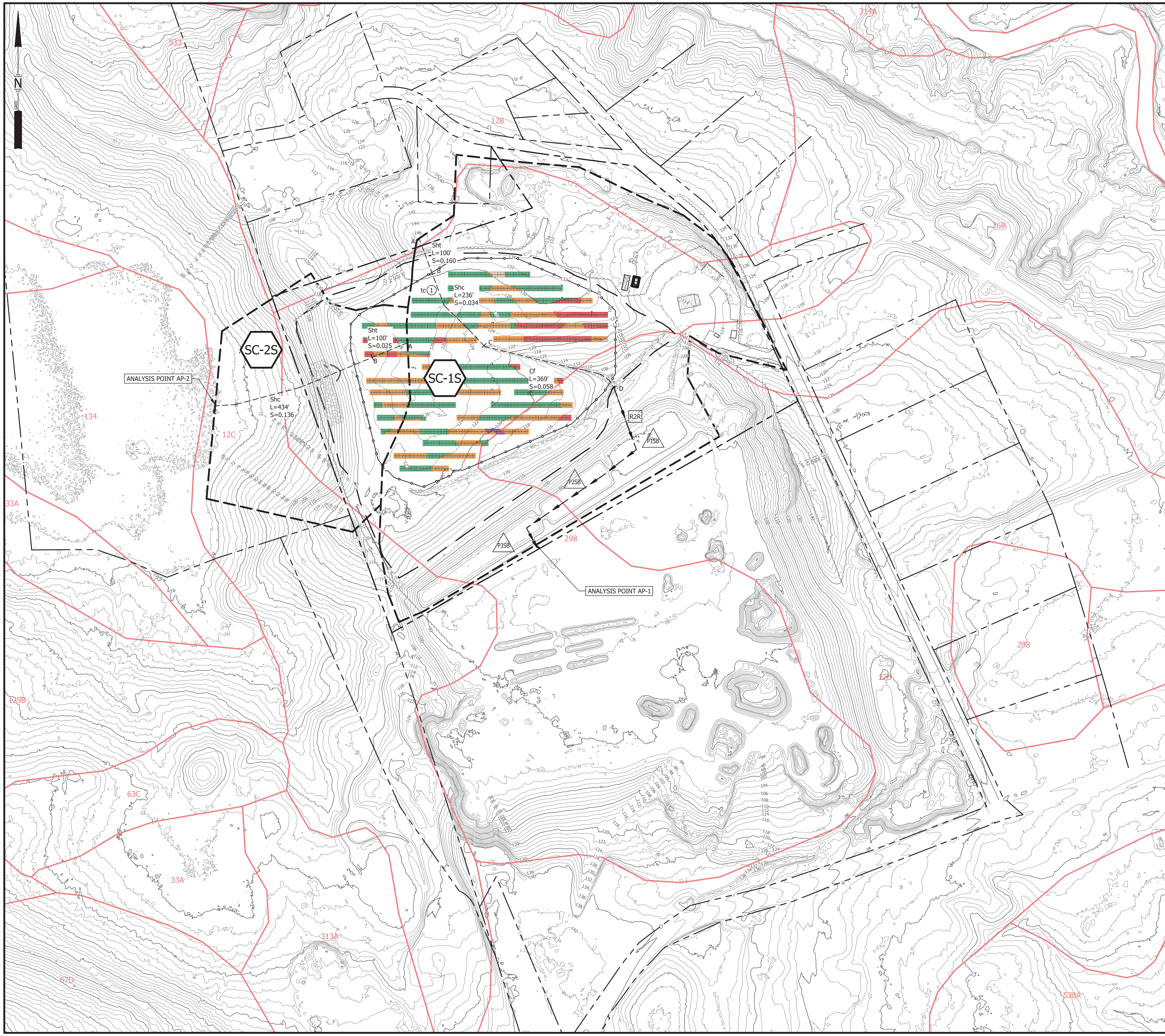
LMN:	SMP-E
CTB:	SME-STD

JOB NO. 220241.00 DWG FILE BASE

D-100



STORMWATER MANAGEMENT LEGEND

2	SUBCATCHMENT DESIGNATION
	SUBCATCHMENT BOUNDARY
A B C	TIME OF CONCENTRATION SEGMENT DESIGNATION TIME OF CONCENTRATION PATH
Sht L=100' S=0.035	TIME OF CONCENTRATION TYPE, LENGTH AND SLOPE. (75% TEXT HT)
Sht	SHEET FLOW
Shc	SHALLOW CONCENTRATED FLOW
Cf	CHANNEL FLOW
	DRAINAGE REACH
R1	REACH DESIGNATION (HYDROCAD)
P1	POND/STRUCTURE DESIGNATION (HYDROCAD)
tc 1	TIME OF CONCENTRATION WITH SUBCATCHMENT DESIGNATION
	SOIL TYPE BOUNDARY
Sn	SOIL TYPE DESIGNATION
	NOT IMPERVIOUS
	IMPERVIOUS WITH ADJUSTMENT FROM TABLE 1
	COMPLETELY IMPERVIOUS
	???

Soils Table

12B	Hinckley loamy sand	A
12C	Hinckley loamy sand	A
26B	Windsor loamy sand	A
134	Maybid silt loam	D
298	Pits, sand and gravel	A

NOTES:
1. SEE DRAWING C-100 FOR GENERAL SITE NOTES AND PLAN REFERENCES.
2. DAMAGE TO THE LANDFILL COVER SYSTEM AND EXISTING LANDFILL GAS VENTS SHALL BE REPAIRED TO TOWN AND MEDEP SPECIFICATIONS.

60 0 120 240 FEET

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STATE OF NEW HAMPSHIRE – BRIAN D. PIERCE No. 8001 LICENSED – PROFESSIONAL ENGINEER

1.5 MW AC SOLAR ARRAY
REVISION ENERGY
9 CROSS ROAD
EXETER, NEW HAMPSHIRE

STORMWATER MANAGEMENT PLAN
POST-DEVELOPMENT CONDITIONS

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CTB: SME-STD

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D-101