REQUEST FOR QUOTATION

Tanana Chiefs Conference
122 First Avenue
Fairbanks, AK 99701

Quotations will be received until **5 p.m. March 11th, 2024**

RFQ Title: **Solar Racking Badger Road**

Questions shall be emailed to Cortnie Doan at cortnie.doan@tananachiefs.org no later than 3:00 PM AST on **March 4st, 2024**. The final Addendum responding to questions shall be released no later than **March 7th, 2024.** Selection Date **March 18, 2024**

Page 1 of 52 Date February 28, 2024

VENDOR NOTICE (This is NOT a Purchase Order)

This is an informal quotation that will not be read at public opening. The information may be publicly reviewed after award. The terms and conditions should be reviewed and understood before preparing a quotation. The quotation shall be the best net price, FOB destination, to include all delivery charges, but exclude applicable taxes. Delivery schedule and discount for early payment shall be indicated in the spaces provided below. Return the quotation by the above time and date to the email address listed below. Please reference the RFQ Title on the subject line in your email.

Delivery Location:
2605 Badger Rd. North Pole, AK 99505

Quotes shall be returned to:
Cortnie Doan – cortnie.doan@tananachiefs.org

VENDOR QUOTATION

Item	Description of Supply or Service	Qty	Unit	Unit Price	Extended Price
	The system shall be a fixed tilt (35-40 degrees) ground mount racking, as opposed to single or dual-axis tracking. For foundation TCC prefers either driven posts (aka. Driven pile, driven beams, H-beams, or I-Beams), or helical piers for the solar foundation design. Refer to Geo-technical survey completed at site for data to determine embedment depths (provided in attachments). Selected racking company is expected to have an Alaskan PE on staff who is able to stamp the recommended design based off of the attached geotechnical analysis. TCC has a 95% design of the 1.183 MW Solar Array (provided in attachments). Solar Modules to be designed around are SEG 550 W, Yukon Series (provided in attachments). Engineered structural drawings of racking structures must be provided by racking manufacturer.			$	$
	Delivery Date: July 1st, 2024 Delivery POC: Ed Dellamary **Delivery Location:** Tanana Chiefs Conference 2605 Badger Rd. North Pole, AK 99505			$	$

THIS SECTION MUST BE COMPLETED BY VENDOR

Delivery shall be made ______________________ calendar days after receipt of order.

Company Name	Address	City	State	ZIP Code	Phone Number

Alaska Business License No.	Vendor Tax I.D. No.

Signature

Date

Typed Name and Title

INSTRUCTIONS TO BIDDERS
TERMS AND CONDITIONS

1. REQUEST FOR QUOTATION (RFQ) REVIEW: Offerors shall carefully review this RFQ for defects and questionable or objectionable material. Offerors' comments concerning defects and questionable or objectionable material in the RFQ must be made in writing and received by the purchasing authority before the date and time set for receipt of quotes. This will allow time for an amendment to be issued if one is required. It will also help prevent the opening of a defective quote, upon which award cannot be made, and the resultant exposure of offerors' prices. Offerors' original comments should be sent to the purchasing authority listed on the front of this RFQ.

2. QUOTATION FORMS: Offerors shall use this and attached forms in submitting quotes. A photocopied quote may be submitted.

3. SUBMISSION: Quotations shall be signed where applicable and received at the designated Purchasing Office no later than as indicated.

4. WAIVER OF MINOR INFORMALITIES: TCC expressly reserves the right to waive minor informalities, negotiate changes or reject any and all quotes and to not award the proposed contract, if in its best interest. “Minor Informalities” is defined as matters of form rather than substance which are evident from the submittal or are insignificant matters that have negligible effect on price, quantity, quality, delivery or contractual conditions and can be waived or corrected without prejudice to the other Proposers.

5. EXTENSION OF PRICES: In case of error in the extension of prices in the quote, the unit prices will govern; in a lot bid, the lot prices will govern. Negligence by the vendor in preparing the quotation confers no right for the withdrawal of the quotation after it has been opened.

6. PRICES: The offeror shall state prices in the units of issue on this RFQ. Prices quoted for commodities must be in U.S. funds and include applicable federal duty, brokerage fees, packaging, and transportation cost to the FOB point so that upon transfer of title the commodity can be utilized without further cost.

7. PAYMENT FOR PURCHASES: Payment for agreements under $500,000 for the undisputed purchase of goods or services provided, will be made within 30 days of the receipt of a proper billing and the delivery of the goods or services to the location(s) specified in the agreement, whichever is later. A late payment is subject to 1.5% interest per month on the unpaid balance. Interest will not be paid if there is a dispute or if there is an agreement which establishes a lower interest rate or precludes the charging of interest.

8. VENDOR TAX ID NUMBER: If goods or services procured through this RFQ are of a type that is required to be included on a Miscellaneous Tax Statement, as described in the Internal Revenue Code, a valid tax identification number must be provided to the TCC before payment will be made.

9. INDEMNIFICATION: The Contractor shall indemnify, hold harmless, and defend TCC from and against any claim of, or liability for error, omission or negligent act of the Contractor under this agreement. The Contractor shall not be required to indemnify TCC for a claim of, or liability for, the independent negligence of TCC. If there is a claim of, or liability for, the joint negligent error or omission of the Contractor and the independent negligence of TCC, the indemnification and hold harmless obligation shall be apportioned on a comparative fault basis. “Contractor” and “TCC”, as used within this and the following article, include the employees, agents and other contractors who are directly responsible, respectively, to each. The term “independent negligence” is negligence other than in TCC selection, administration, monitoring, or controlling of the Contractor and in approving or accepting the Contractor’s work.

10.INSURANCE: Before starting performance of Services, Contractor will provide to TCC proof of the following insurance obtained and maintained through the term of the Contract through an insurance carrier(s) licensed in the State of Alaska:

- Commercial general liability insurance with limits of no less than $1,000,000 per occurrence and $2,000,000 in the aggregate;

- Automobile insurance with limits of no less than $1,000,000.00 combined single limit coverage; and
- Worker's Compensation insurance as required by the State of Alaska.

11.SEVERABILITY: If any provision of this contract is declared by a court to be illegal or in conflict with any law, the validity of the remaining terms and provisions shall not be affected; and the rights and obligations of the parties shall be construed and enforced as if the contract did not contain the particular provision held to be invalid.

12.TITLE: Title passes to TCC for each item at FOB destination.

13.COMPLIANCE: In the performance of a contract that results from this RFQ, the contractor must comply with all applicable federal, state, and borough regulations, codes, and laws; and be liable for all required insurance, licenses, permits and bonds; and pay all applicable federal, state, and borough taxes.

14.SUITABLE MATERIALS, ETC.: Unless otherwise specified, all materials, supplies or equipment offered by an offeror shall be new, unused, and of the latest edition, version, model or crop and of recent manufacture.

15.SPECIFICATIONS: Unless otherwise specified in the RFQ, product brand names or model numbers are examples of the type and quality of product required, and are not statements of preference. If the specifications describing an item conflict with a brand name or model number describing the item, the specifications govern. Reference to brand name or number does not preclude an offer of a comparable or better product, if full specifications and descriptive literature are provided for the product. Failure to provide such specifications and descriptive literature may be cause for rejection of the offer.

16.FIRM OFFER: For the purpose of award, offers made in accordance with this RFQ must be good and firm for a period of ninety (90) days from the date of quote opening.

17.QUOTE PREPARATION COSTS: TCC is not liable for any costs incurred by the offeror in quote preparation.

18.CONTRACT FUNDING: Offerors are advised that funds are available for the initial purchase. Payment and performance obligations for succeeding purchases and/or additional terms of the contract are subject to the availability and appropriation of funds.

19.CONFLICT OF INTEREST: Before signing this contract, the Contractor agrees to disclose to the TCC contract manager any relationship that may be a potential conflict of interest related to the performance of the Services. A potential conflict of interest includes, but is not limited to, Contractor being related within the third degree of blood relationship to an employee of TCC, Contractor having an existing financial interest with TCC, or Contractor having an existing financial interest with any person involved in the signing of this contract. By signing this contract, Contractor represents and warrants that it has made all required disclosures to TCC. Any breach of this Section will be considered a material breach of this contract.

20.ASSIGNMENT(S): Assignment of rights, duties, or payments under a contract resulting from this RFQ is not permitted unless authorized in writing by the project manager of TCC. Quotes that are conditioned upon TCC approval of an assignment will be rejected as nonresponsive.

21.SUBCONTRACTOR(S): Within Seven (7) calendar days of notice from TCC, the apparent low bidder must submit a list of the subcontractors that will be used in the performance of the contract. The list must include the name of each subcontractor and the location of the place of business for each subcontractor and evidence of each subcontractor's valid Alaska business license. Contractor shall not contract with any subcontractor or supplier to whom Owner or Project Manager has made a timely and reasonable objection.

22.FORCE MAJEURE (Impossibility to perform): The parties to a contract resulting from this RFQ are not liable for the consequences of any failure to perform, or default in performing, any of its obligations under the contract, if that failure or default is caused by any unforeseeable Force Majeure, beyond the control of, and without the fault or negligence of, the respective party. For the purposes of this Agreement, Force Majeure will mean war (whether declared or not); revolution; invasion; insurrection; riot; civil commotion; sabotage; military or usurped power; lightning; explosion; fire; storm; drought; flood; earthquake; epidemic; quarantine; strikes; acts or restraints of governmental authorities affecting the project or directly or indirectly prohibiting or restricting the furnishing or use of materials or labor required; inability to secure materials, machinery, equipment or labor because of priority, allocation or other regulations of any governmental authorities.

23.LATE QUOTES: Late quotes are quotes received after the time and date set for receipt of the quotes. Late quotes will not be accepted.

24.DEFAULT: In case of default by the contractor, for any reason whatsoever, TCC may procure the goods or services from another source and hold the contractor responsible for any resulting excess cost and may seek other remedies under law or equity.

25.DISPUTES: If a contractor has a claim arising in connection with a contract resulting from this RFQ that it cannot resolve with TCC by mutual agreement, it shall pursue a claim, if at all,

26.GOVERNING LAW; FORUM SELECTION: A contract resulting from this RFQ is governed by the laws of the State of Alaska. To the extent not otherwise governed by section 29 of these Standard Terms and Conditions, any claim concerning the contract shall be brought only in the Superior Court of the State of Alaska and not elsewhere.

27. CONSUMER ELECTRICAL PRODUCT: AS 45.45.910 requires that "...a person may not sell, offer to sell, or otherwise transfer in the course of the person's business a consumer electrical product that is manufactured after August 14, 1990, unless the product is clearly marked as being listed by an approved third party certification program." Electrical consumer products manufactured before August 14, 1990, must either be clearly marked as being third party certified or be marked with a warning label that complies with AS 45.45.910(e). Even exempted electrical products must be marked with the warning label. By signature on this quote the offeror certifies that the product offered is in compliance with the law. A list of approved third party certifiers, warning labels and additional information is available from: Department of Labor, Labor Standards & Safety Division, Mechanical Inspection Section, P.O. Box 107020, Anchorage, Alaska 99510-7020, (907)269-4925, Mechanical Inspection (alaska.gov)

28. CONTINUING OBLIGATION OF CONTRACTOR: Notwithstanding the expiration date of a contract resulting from this RFQ, the contractor is obligated to fulfill its responsibilities until warranty, guarantee, maintenance and parts availability requirements have completely expired.

29. ORDER DOCUMENTS: Except as specifically allowed under this RFQ, an ordering department will not sign any vendor contract. TCC is not bound by a vendor contract signed by a person who is not specifically authorized to sign for TCC under this RFQ.

30. BILLING INSTRUCTIONS: Invoices must be billed to the address shown on the individual Purchase Order or TCC Service Agreement. TCC will make payment after it receives the merchandise or service and the invoice. Questions concerning payment must be addressed to the ordering department.

31. COMPLIANCE WITH ADA: By signature of their quote the bidder certifies that they comply with the Americans with Disabilities Act of 1990 and the regulations issued thereunder by the federal government. Services or activities furnished to the general public on behalf of the State must be fully accessible. This is intended to ensure that agencies are in accordance with 28 CFR Part 35 Section 35.130 and that services, programs or activities furnished to the public through a contract do not subject qualified individuals with a disability to discrimination based on the disability.

32.AN/AI (ALASKA NATIVE OR AMERICAN INDIAN) REQUIREMENTS: The Contractor and its subcontractors are required to employ AN/AI workers in sufficient numbers to equal, at a minimum, 25% of the firm’s workforce for this project. TCC recognizes that not all Contractor and subcontractor firms will be able to comply with the 25% AN\AI hire requirement. In this case, the Contractor will be required to demonstrate an effort of good faith.

BADGER RD SOLAR
GRID–TIE SOLAR ELECTRIC SYSTEM
2605 BADGER RD
NORTH POLE, AK 99705

SCOPE OF WORK

THE PROJECT SCOPE INCLUDES THE INSTALLATION OF A GRID–TIED SOLAR PHOTOVOLTAIC SYSTEM AT THE BADGER RD SOLAR PROPERTY IN NORTH POLE, AK.

THE INSTALLATION CONSISTS OF A GROUND MOUNT SOLAR ARRAY, 8 STRING–INVERTER(S), AND RELATED ELECTRICAL METERING AND SAFETY EQUIPMENT. ALL EQUIPMENT WILL BE INSTALLED AS REQUIRED BY APPLICABLE CODES AND THE LOCAL UTILITY COMPANY. DURING DAYLIGHT HOURS THIS PHOTOVOLTAIC SYSTEM (SOLAR ELECTRIC) WILL PROVIDE ELECTRICITY IN PARALLEL WITH THE LOCAL UTILITY SERVICE PROVIDER.

SYSTEM DESCRIPTION

FACILITY SERVICE VOLTAGE:
approx 2,150 SEG 550 watt modules - design being finalized DC, MONOCRYSTALLINE
(8) SMA, SHP 125–US–21, 125kVA, STRING–INVERTER(S), 480VAC, 3ϕ

1183.000kW DC
1000.000kW AC

GENERAL NOTES

ALL ELECTRICAL WORK TO BE INSTALLED BY A QUALIFIED AND LICENSED ELECTRICAL CONTRACTOR.

ALL SOLAR MODULES SHALL BE UL LISTED 61730 & CEC APPROVED. ALL INVERTERS SHALL BE UL LISTED 1741 CERTIFIED & CEC APPROVED. ALL ELECTRICAL COMPONENTS AND MATERIALS SHALL BE LISTED FOR IT'S PURPOSE AND AND INSTALLED IN A WORKMAN LIKE MANNER. ALL OUTDOOR EQUIPMENT SHALL MEET APPROPRIATE NEMA STANDARDS.

THE ELECTRICAL CONTRACTOR IS ADVISED THAT ALL DRAWINGS AND COMPONENT MANUALS ARE TO BE UNDERSTOOD PRIOR TO INSTALLATION. THE CONTRACTOR IS ADVISED TO HAVE ALL SWITCHES IN THE "OFF" POSITION AND FUSES REMOVED PRIOR TO INSTALLATION OF FUSE–BEARING COMPONENTS.

THIS SYSTEM IS INTENDED TO BE OPERATED IN PARALLEL WITH THE UTILITY SERVICE PROVIDER. ANTI–ISLANDING PROTECTION IS A REQUIREMENT OF UL 1741 AND IS INTENDED TO PREVENT THE OPERATION OF THE PV SYSTEM WHEN THE UTILITY GRID IS NOT OPERATIONAL.

PERMISSION TO OPERATE THE SYSTEM IS NOT AUTHORIZED UNTIL FINAL INSPECTIONS AND APPROVALS ARE OBTAINED FROM THE LOCAL AUTHORITY HAVING JURISDICTION AND THE LOCAL UTILITY SERVICE PROVIDER.

THE METHOD OF ATTACHMENT CREATES A UNIFIED STRUCTURE TO MEET DEAD LOAD, WIND LOAD, AND SEISMIC REQUIREMENTS. SOLAR MODULES WILL BE SECURED AS SPECIFIED ON THE STRUCTURAL SHEETS. ALL STRUCTURAL DESIGN AND INSTALLATION COMPONENTS ARE THE RESPONSIBILITY OF OTHERS AND OUTSIDE THE SCOPE OF THIS DOCUMENT.

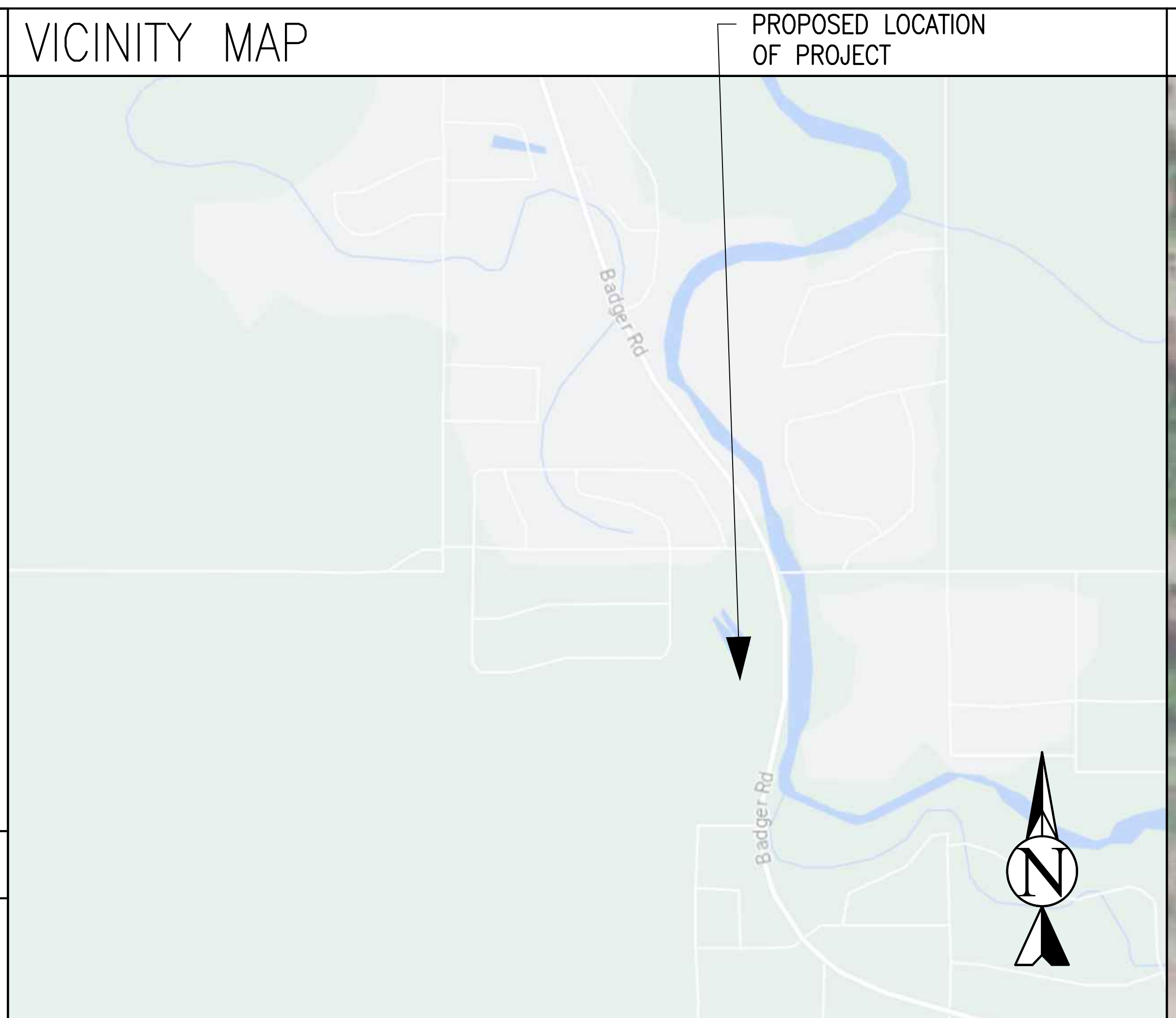
ALL FASTENERS SHALL BE CORROSION RESISTANT APPROPRIATE FOR SITE CONDITIONS. CONNECTORS SHALL BE TORQUED PER DEVICE LISTING OR ENGINEERING RECOMMENDATIONS.

ALL LAYOUT DIMENSIONS ARE SHOWN TO THE NEAREST 1 INCH U.O.N.

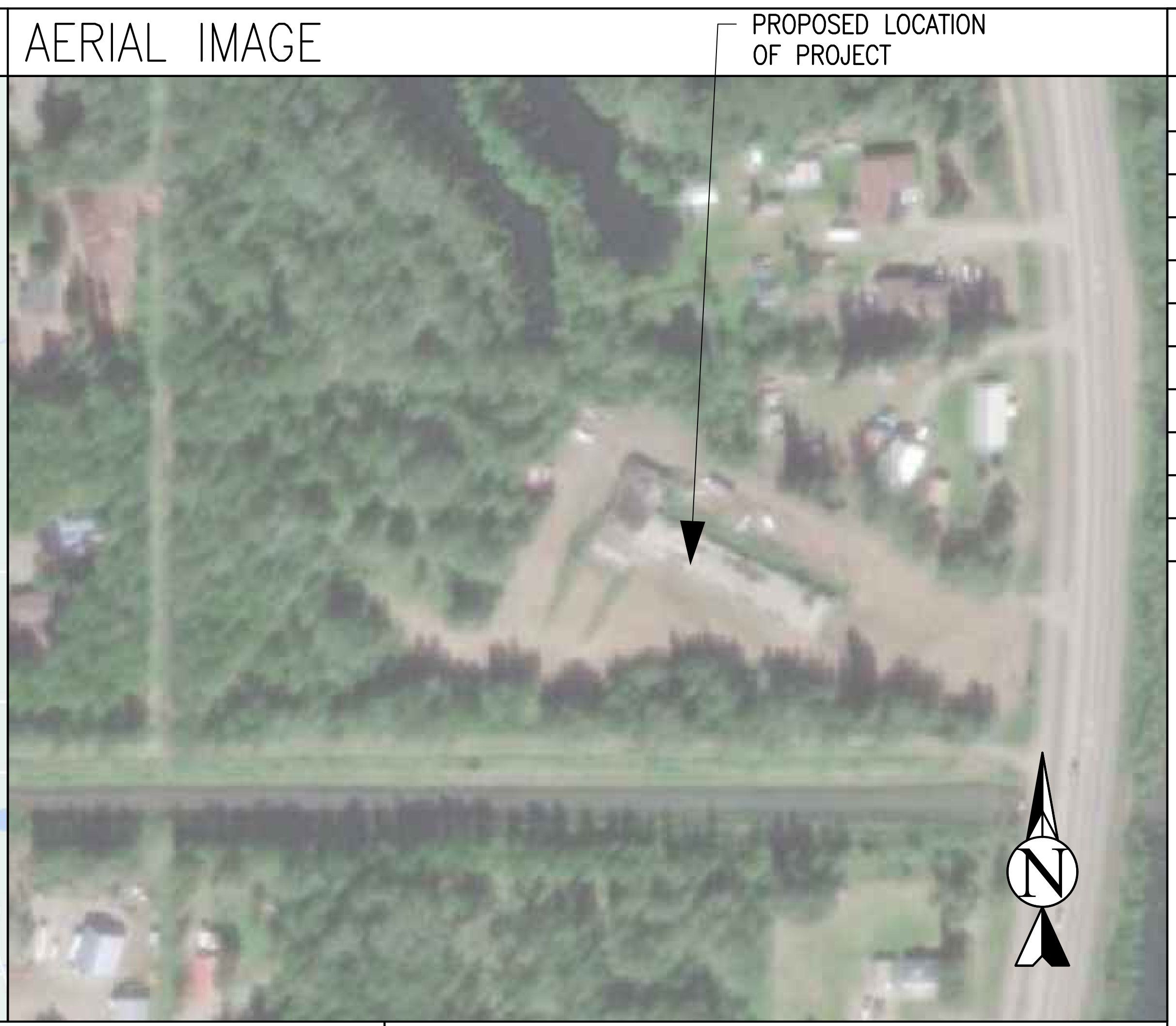
APPLICABLE CODES

INTERNATIONAL BUILDING CODE, 2021
NATIONAL ELECTRICAL CODE, 2020

VICINITY MAP



AERIAL IMAGE



GENERAL ABBREVIATIONS

(E)	EXISTING
AHJ	AUTHORITY HAVING JURISDICTION
AL	ALUMINUM
APPROX	APPROXIMATE
ARY	ARRAY
ASHRAE	AMERICAN SOCIETY OF HEATING REFRIGERATING AND AIR CONDITIONING ENGINEERS
BLDG	BUILDING
CL	CENTERLINE
DAS	DATA ACQUISITION SYSTEM
DIA	DIAMETER
DO	DITTO
EW	EAST–WEST
FBO	FURNISHED BY OTHERS
FF	FORWARD FACING
GALV	GALVANIZED
HDG	HOT DIP GALVANIZED
HVAC	HEATING VENTILATION AND AIR CONDITIONING
IBC	INTERNATIONAL BUILDING CODE
ID	INSIDE DIAMETER
IEEE	INSTITUTE OF ELECTRICAL AND ELECTRONIC ENGINEERS
MFR	MANUFACTURER
MOD	SOLAR MODULE
NEC	NATIONAL ELECTRICAL CODE
NS	NORTH–SOUTH
NTS	NOT TO SCALE
OAE	OR APPROVED EQUIVALENT
OC	ON CENTER
OD	OUTSIDE DIAMETER
OFCI	OWNER FURNISHED CONTRACTOR INSTALLED
PV	PHOTOVOLTAIC
PVC	POLY VINYL CHLORIDE
SCH	SCHEDULE
SS	STAINLESS STEEL
SSS	SOLAR SUPPORT STRUCTURE
STC	STANDARD TEST CONDITIONS
TBD	TO BE DETERMINED
TOF	TILT AND ORIENTATION FACTOR
TP	TAMPER PROOF
TSRF	TOTAL SOLAR RESOURCE FACTOR
TYP	TYPICAL
UL	UNDERWRITERS LABORATORIES
UON	UNLESS OTHERWISE NOTED
VIF	VERIFY IN FIELD
WP	WEATHER PROOF

PROJECT DIRECTORY

UTILITY
GOLDEN VALLEY ELECTRIC

PROJECT TEAM

CONTRACTOR
FIRM: TANANA CHIEFS CONFERENCE
CONTACT: DAVE MESSIER
PHONE: (907)–452–8251

SYSTEM DESIGNER
FIRM: MAYFIELD RENEWABLES
CONTACT: GREG KAMPS
PHONE: (541)–754–2001

SHEET INDEX

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E–1.0	ELECTRICAL SITEPLAN
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E–2.0	DC SINGLE LINE DIAGRAM
E–2.1	AC SINGLE LINE DIAGRAM
E–2.1	ELECTRICAL SPECIFICATIONS
E–3.0	LABELS & MARKINGS
E–5.0	DATA SHEETS

Mayfield Renewables
2210 NW Hayes Ave
Corvallis, OR 97333
541.754.2001

STAMP:

NOT FOR CONSTRUCTION

GRID–TIE SOLAR ELECTRIC SYSTEM
BADGER RD SOLAR
2605 BADGER RD
NORTH POLE, AK 99705

PROJECT NUMBER:
23–3688U

SCALE
NTS
ORIGINAL SIZE 24"X36"
SHEET SIZE ARCH "D"
0 ½" 1"

REV	ISSUED	BY	✓	DESCRIPTION
	11/14/23	GK	BB	UTILITY INTERCONNECTION SET
	11/30/23	GK	BB	CD IFR – ISSUED FOR REVIEW

SHEET NO. & NAME:
T–1
TITLE PAGE

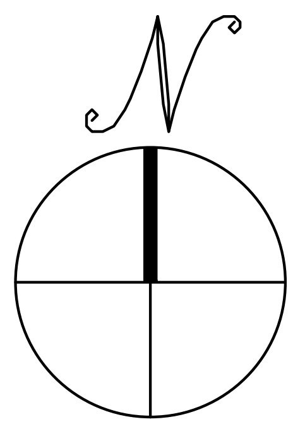
PRINT DATE: 11/30/2023 11:30 AM DWG LOCATION: g:\shared drives\Design\Projects\tanana chiefs conference\23-3688u – north pole\working set\T-1_TitlePage.dwg

PRINT DATE: 11/30/2023 11:30 AM DWG LOCATION: g:\shared drives\Design\Projects\tanana chiefs conference\23-3688u – north pole\working set\E-1.0 ELECTRICAL SITEPLAN.dwg

THIS PAGE FOR REFERENCE ONLY FINAL LAYOUT BEING FINALIZED

SHEET NOTES

1. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO HAVE ALL UNDERGROUND UTILITIES MARKED PRIOR TO CONSTRUCTION
2. CONNECTORS SHALL BE BY THE SAME MANUFACTURER AS THOSE ON THE MODULES.
3. CONTRACTOR SHALL ENSURE THE EXACT OUTER DIAMETER OF THE PROVIDED HOME RUN WIRING MEETS CONNECTOR SPECIFICATIONS.
4. ALL DIMENSIONS ARE FOR REFERENCE ONLY. PLEASE REFER TO MANUFACTURERS DRAWINGS TO CONFIRM ALL DIMENSIONS. ALL DIMENSIONS DISPLAYED ON THIS SHEET ARE ROUNDED TO THE NEAREST 1" U.O.N.



ELECTRICAL SITEPLAN

SCALE: 1/32" = 1'-0"
0 32' 64'

Mayfield Renewables

2210 NW Hayes Ave
Corvallis, OR 97333
541.754.2001

STAMP:

NOT FOR CONSTRUCTION

GRID-TIE SOLAR ELECTRIC SYSTEM
BADGER RD SOLAR
2605 BADGER RD
NORTH POLE, AK 99705

PROJECT NUMBER:
23-3688U

SCALE
AS SHOWN

ORIGINAL SIZE 24"X36"
SHEET SIZE ARCH "D"
0 ½" 1"

REV	ISSUED	BY	✓	DESCRIPTION
	11/14/23	GK	BB	UTILITY INTERCONNECTION SET
	11/30/23	GK	BB	CD IFR – ISSUED FOR REVIEW

SHEET NO. & NAME:

E-1.0
ELECTRICAL SITEPLAN

This Page Represents the actual expected layout

SEG SOLAR

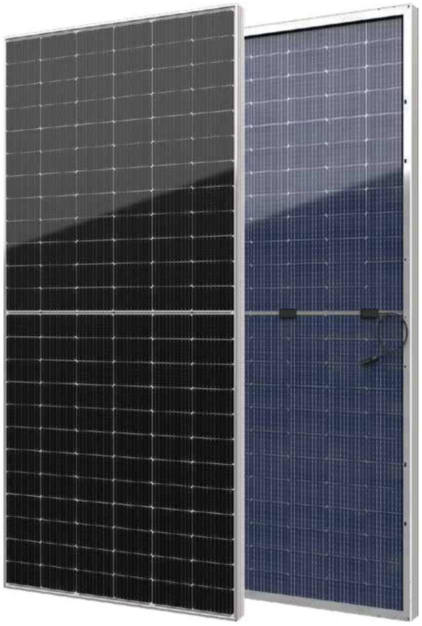
www.segsolar.com

YUKON Series

Half-Cell
Transparent Backsheet Module

540-555W
Module Power Output

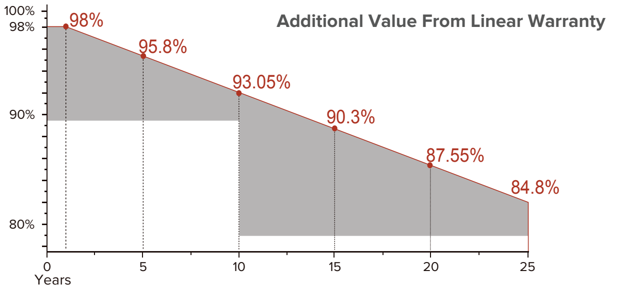
21.48%
Max Efficiency



Key Features

- High module conversion efficiency
- Better temperature coefficient
- Super multi busbar technology
- Low attenuation long warranty
- Superior load capacity
- Higher bifacially
- USA based liability insurance
- Houston, Texas based company

Warranty



15 <Years> Guarantee on product material and workmanship

25 <Years> Linear power output warranty

Product Certification

IEC61215:2016; IEC 61730:2016;	UL1703; UL61730/ETL/CEC
IEC62804	PID
IEC61701	Salt Mist
IEC62716	Ammonia Resistance
IEC60068	Dust and Sand
IEC61215	Hailstone
Fire Type (UL61730):Type1	
ISO14001:2015; ISO9001:2015; ISO45001:2018	

About SEG Solar

SEG Solar is a leading manufacturer of high-performance solar panels for residential, commercial, and utility applications. The company, headquartered in Houston,Texas, is committed to providing cost-effective and reliable solar solutions that help customers reduce their energy costs and carbon footprint.

Download Datasheet

SEG SOLAR

YUKON Series SEG-XXX-BMA-TB(144Cells)

Electrical Characteristics

Module Type	SEG-540-BMA-TB			SEG-545-BMA-TB			SEG-550-BMA-TB			SEG-555-BMA-TB		
	Front STC	Front NOCT	Back STC	Front STC	Front NOCT	Back STC	Front STC	Front NOCT	Back STC	Front STC	Front NOCT	Back STC
Maximum Power -Pmp(W)	540	406	378	545	409	382	550	414	385	555	418	389
Open Circuit Voltage -Voc(V)	49.50	46.18	49.48	49.60	46.32	49.58	49.70	46.40	49.68	49.80	46.47	49.78
Short Circuit Current -Isc(A)	13.81	11.16	9.74	13.90	11.23	9.80	14.00	11.32	9.87	14.10	11.40	9.94
Maximum Power Voltage -Vmp(V)	41.55	38.39	41.61	41.80	38.41	41.86	42.05	38.58	42.10	42.31	38.75	42.35
Maximum Power Current -Imp(A)	13.00	10.59	9.09	13.04	10.65	9.13	13.08	10.73	9.15	13.12	10.79	9.19
Module Efficiency STC-ηm(%)	20.90			21.10			21.29			21.48		
Power Tolerance(W)	(0, +3%)											
Maximum System Voltage	1500V DC											
Maximum Series Fuse Rating	25 A											

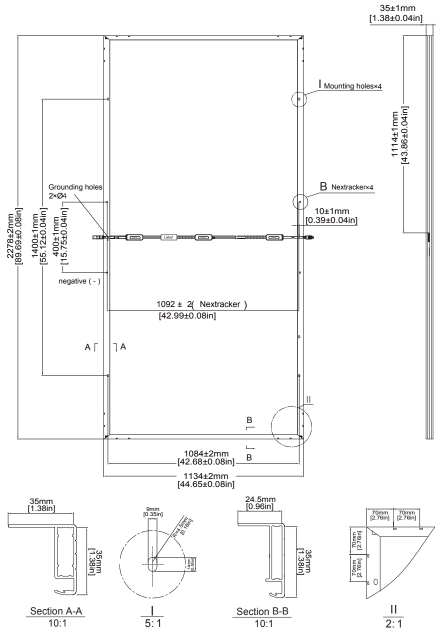
STC: Irradiance 1000 W/m^2 module temperature 25°C AM=1.5 NOCT: Irradiance 800W/m^2 ambient temperature 20°C module temperature 45°C wind speed: 1m/s Power measurement tolerance: +/-3%

Mechanical Specifications

External Dimension	2278 x 1134 x 35 mm
Weight	27.0 kg
Solar Cells	PERC Mono 182 x 91mm(144 pcs)
Front Glass	3.2 / mm AR coating tempered glass / low iron
Frame	Anodized aluminium alloy
Junction Box	IP68 / 3 diodes
Connector Type	QC4.10
Cable Type / Length	12 AWG PV Wire（UL）/1200 mm
Mechanical Load(Front)	5400 Pa / 113 psf*
Mechanical Load(Rear)	3600 Pa / 75 psf*

*Refer to SEG installation Manual for details

Technical Drawing



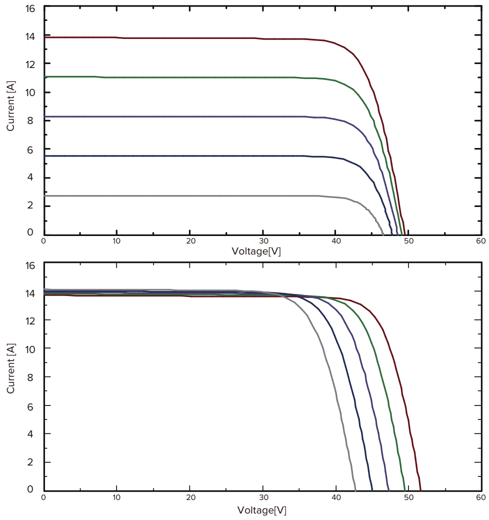
*Refer to SEG installation Manual for details

Packing Configuration

Container	20'GP	40'HQ
Pieces per Pallet	31	31
Pallets per Container	4	20
Pieces per Container	124	620

341kw/container

I-V Curve



Temperature Characteristics

Pmax Temperature Coefficient	-0.35 %/°C
Voc Temperature Coefficient	-0.27 %/°C
Isc Temperature Coefficient	+0.05 %/°C
Operating Temperature	-40~+85 °C
Nominal Operating Cell Temperature (NOCT)	45±2 °C

www.segsolar.com

GEOTECHNICAL FOUNDATION ENGINEERING EVALUATION REPORT REVISION 0

PROPOSED GROUND MOUNT SOLAR ARRAY

A Portion of
Tax Lot 3212, Section 032,
Township 1-South, Range 2-East
(2605 Badger Road),
Fairbanks Meridian, Alaska

Prepared for:

Tanana Chiefs Conference
122 First Avenue
Fairbanks, Alaska 99701

by:

SYNGEN Consulting Services
2112 Alyeska Drive
Fairbanks, Alaska 99709

SYNGEN Project No. 2022-G020

THOMAS JOHN BERGLIN
24 NOV 2023
No. C 11911

November 24, 2023

SYNGEN
CONSULTING SERVICES
Your Alaskan Permafrost Specialist

TABLE OF CONTENTS

FIGURES

TABLES (in text)

APPENDICES

EXECUTIVE SUMMARY

SYNGEN Consulting Services has developed and directed the authorized subsurface investigation program and has completed a geotechnical engineering evaluation of the gathered information for application to the planning, design, and construction of foundations that will support ground-mount solar PV panel racking planned for construction on the portion of the property explored at 2605 Badger Road in Fairbanks, Alaska. As of the time of the preparation of this report, a racking system had not been selected and rack loads were not available.

Subsurface conditions across the property were explored by drilling three boreholes. The boreholes were drilled using hollow-stem augers with a continuous flight to a depth of approximately 31 feet below ground surface. In general, beneath a frozen crust and approximately 2 to 4 feet of material visually classified as silt and interpreted as loess or alluvium, material visually classified as sandy gravel was encountered to the termination depth of each borehole. A 4-inch band of peaty material was encountered near the bottom of borehole B-3. Perennially frozen soil (permafrost) was not detected in the boreholes. A summary of the subsurface conditions encountered in the boreholes is tabulated below.

BOREHOLE ID	TOTAL DEPTH	APPROXIMATE DEPTH TO GROUNDWATER	DEPTH TO SAND AND GRAVEL
B-1	31 ft.	9.5 ft.	2 ft.
B-2	31 ft.	9 ft.	3 ft.
B-3	31 ft.	10 ft.	4 ft.

Driven steel foundations are anticipated for the support of ground mount solar panel racking. Options generally include driven steel wide flange beams (W shapes), hollow structural sections (HSS), and helical piers. Surface mounted ballasted systems are also an option. However, if ballasted systems are considered, flexibility will be required in the racking system for relative movement due to frost heave (fixed tilt systems are generally adaptable to ballasts). The tables below summarize the geotechnical parameters recommended for use in the axial and lateral design of driven steel W, HP, or HSS shapes. These are intended for use with low displacement steel sections driven directly into the native materials.

Geotechnical Parameters for use in Axial Foundation Design

PARAMETER	RECOMMENDATION	
Foundation Type	Driven (Impact or Torque) Wide Flange Steel Beam or HSS	
Allowable* Unit Side Resistance (psf)	0 – 6.5 ft.	Neglect
	6.5 – 15 ft.	250 psf
	> 15 ft.	220 psf.
Allowable** Tip Bearing Capacity	< 10 ft.	Neglect
	10 – 15 ft.	20 ksf
	> 15 ft.	15 ksf

Incorporates a Safety Factor of 3.0* to 5.0**

Geotechnical Parameters (LPILE) for use in Lateral Pile Design

Layer	**Depth (ft.)**	**p-y Relationship**	**P-Mult**	**Unit Weight** (γ, $^{lb.}/_{ft.^3}$)	**Cohesion (C, psf)**	**Angle of Shearing Resistance** (ϕ, **degrees**)	**Strain Factor** (ε_{50})	**Subgrade Modulus (k, pci)**
1	0 – 5 ft.	Silt (c-ϕ)	3	105	50	26	Default	Default
2	5 - 7 ft.	API Sand	2	120	N/A	32	Default	Default
3	>7 ft.	API Sand	1	74	N/A	34	Default	Default

A frost action (frost heave/jacking and thaw weakening) hazard is identified by SYNGEN as a risk at this site. Frost action can lift upward on slender embedded foundations penetrating the zone of seasonal ground freezing such as posts and piles, displacing and eventually ejecting them from the ground. The magnitude of the uplift forces imposed on the sides of slender foundation elements from the development and growth of segregated ground ice (lens ice), generally far exceed ASCE 7 (e.g., wind, snow, etc.) axial loads on solar panels. Given the subsurface materials and the depth to free groundwater (average, annual), a high, but manageable frost jacking hazard is perceived.

If driven (impact or torque) wide-flange beams or hollow structural sections (round or rectangular), are selected, consideration should be given to predrilling each location and encasing each foundation in clean pea gravel (no sand or fines) as an adfreeze bond breaker/reducer to a depth of at least 5 feet below finished grade, extending out at least 8 inches beyond the perimeter of each foundation. A heavy Sonotube or other barrier material should be considered between the native silt and the pea gravel. Consideration can also be given to the use of a plastic or PVC sleeve as a bond breaker. However, sleeves will also jack out of the ground, eventually damaging them and/or rendering them ineffective. Alternatively, an HSS helical pier could be considered. If a helical pier is selected, a sleeve would have the same effect, but a properly designed helical pier (with sufficient anchorage) will generally reduce frost jacking related displacement to tolerable amounts.

General site development-related considerations are summarized in the table below.

General Site Considerations

Consideration	**Comment**
Moisture-Sensitive Silt Soils	• Avoid earthwork during wet weather.
Corrosion	• Corrosion will reduce the bending capacity of buried steel over time, resulting in a reduced service life. A moderate corrosion hazard is estimated by the NRCS. Laboratory testing is required to evaluate the corrosivity of the subsurface materials and to estimate metal loss rates over time.

Frost Heave/Jacking	• Frost jacking of slender embedded foundations (piles or posts) is identified as a hazard. • An adfreeze bond breaker/reducer should be considered to help safeguard against possible frost jacking on embedded foundations. • Helical piers are recommended if a bond breaker/reducer will not be applied.

If a straight (no anchor) wide flange beam or a hollow structural section embedded in 5 feet of pea gravel is considered, the design should consider the application of an averaged tangential frost bond of 15 psi to the subsurface material (conservatively assumed to be deep silt) in contact with the steel from 5 to 6.5 feet below ground surface. If a helical pier is considered with no fost bond-breaker within the zone of ground freezing, an averaged tangential frost bond of 35 psi should be applied from the surface to 5 feet below ground surface and the contribution to axial resistance from the material from 5 to 6.5 feet below grade should be neglected. A torque factor of 7/ft. should be assumed if helical piers are considered. SYNGEN should be retained to design the foundations.

This Executive Summary does not contain all the information that is found in the full report. The report should be read in its entirety to obtain a more complete understanding of the information provided and to aid in any decisions made or actions taken based on this information. SYNGEN should be contacted for guidance in the interpretation and application of this information.

1.0 INTRODUCTION

SYNGEN Consulting Services (SYNGEN) has completed the authorized geotechnical engineering evaluation for the proposed solar array planned for construction at 2605 Badger Road in North Pole, Alaska. The location of the project site is shown on the Property Location Map included at the end of this report as Figure 1. Site investigation efforts were directed towards the location selected by the Client. Deviation from this site is not recommended without further exploration. This work was authorized by Dave Messier of Tanana Chiefs Conference (TCC, hereinafter referred to as "Client").

This report has been prepared based on information provided by the Client, familiarity with geologic and physiographic conditions in the vicinity of the project site, previous experience on similar projects, and on information gathered during a site and subsurface investigation program developed and directed by SYNGEN. The report details the methods used to evaluate the portions of the property under consideration for foundation construction and provides recommendations for use in foundation subgrade preparation and geotechnical parameters for use in foundation design.

2.0 PROJECT UNDERSTANDING

It is understood that the site will be developed with a ground-mount solar power generating facility with a capacity of less than 5 megawatts (MW) DC. Impact (or torque) driven foundations consisting of wide flange beams or hollow structural sections (round or rectangular) are anticipated. As of the time of the preparation of this report, a racking vendor and module had not been selected and foundation loading was not available. If any of this information is incorrect or has changed, SYNGEN should be notified.

3.0 SCOPE OF WORK

To complete this geotechnical foundation engineering evaluation report, SYNGEN accomplished the following scope of work:

1. Review available soil and geologic mapping information for the project site and develop the authorized subsurface investigation program.
2. Review provided project information including preliminary array layout and available aerial imagery showing the property, vegetation, drainage, erosion, and other features.
3. Direct the authorized subsurface investigation program which included three boreholes drilled using hollow stem augers with a continuous flight. Standard penetration testing was conducted with sampling at regular intervals.
4. Direct water content measurement for samples of materials collected from the boreholes.
5. Review other relevant project information including site photos and other imagery taken during the fieldwork.
6. Interpret and classify the subsurface materials reported on field borehole logs and prepare and publish logs of the subsurface conditions encountered in each borehole.
7. Review the results of the subsurface investigation program with regard to the proposed construction.
8. Perform engineering analyses and formulate conclusions and opinions about the subsurface conditions encountered relative to the proposed construction.
9. Prepare this Revision 0 report.

4.0 AVAILABLE INFORMATION

Project information was provided by the Client and consisted mainly of verbal discussions surrounding the proposed construction and documentation showing the general array layout. Rack structural loads were not provided. Drilling was performed by The Drilling Company Corp. (TDC) under the terms of a separate agreement with the Client. Handwritten field logs of the subsurface conditions encountered in the boreholes, penetration resistance data, borehole location data, and sample water content data from the boreholes along with site photos were transmitted to SYNGEN by TDC on the Client's behalf.

4.1 Climate

The climate of the area is sub-arctic with an average annual air temperature that is slightly below freezing. The 50-year air freezing index of the area is estimated by the National Oceanic and Atmospheric Administration (NOAA) to be up to approximately 6,900 ˚F-days. However, it is noted that since the onset of the Holocene (approximately 11,000 years ago) an overall warming trend continues, which is magnified in the circumpolar north. Hence, this historic freezing index may not be representative of events within the service life of the structure. The average annual precipitation in the area is reported by the United States Department of Agriculture Natural Resources Conservation Service (NRCS) to be on the order of 10 to 14 inches. Like the air freezing index, the reported annual precipitation may also be expected to change over the design life of the structure.

4.2 General Site Description and Physiographic Setting

The area of development consists of an approximately 6.28-acre lot located between Fairbanks and North Pole, Alaska in an area of known sporadic permafrost. The terrain is generally flat and level but has some mounded areas (probably built during previous development) and is partly cleared of large trees. Low brush and scrub covered much of the cleared areas and mature stands of birch and spruce remained. The parcel is partly improved with an approximate 12,000 square foot building. The condition of the building is not known. However, development is expected to require demolition and removal of the building and its foundation system. According to available topographic mapping, the average elevation of the site is approximately 460 feet above mean sea level (AMSL). The nearest mapped natural drainage is the active channel of Chena Slough, located approximately 150 feet to the east of the property, across Badger Road. The active channel of the Tanana River is located approximately 3 miles to the southwest and that of the Chena River is approximately the same distance to the northeast. Numerous active and inactive slough channels incise the surrounding terrain. Shallow groundwater is exposed in numerous active and inactive gravel borrow sites. At the time of the subsurface investigation, the site was snow-covered, with a crust of seasonal frost.

4.3 General Soil Conditions

The NRCS has mapped the soils in the area in the Soil Survey of the Greater Fairbanks Area, Alaska. The NRCS soil mapping was originally intended mainly for agricultural planning purposes and is generally limited to the upper approximately 70 inches of the subsurface profile. This mapping has expanded to include other useful information including general construction related considerations and basic soil engineering properties. Most of the soil in the general area has been altered by previous development and is mapped by the NRCS as Typic Cryorthrents-Urban Land. Jarvis-Salchaket complex soils are mapped adjacent to these, and a reasonable extrapolation of this complex may be extended to the site of interest. Permafrost is not associated by the NRCS with either soil type. An excerpt from the NRCS mapping showing the subject property and its surroundings is shown in Figure 2.

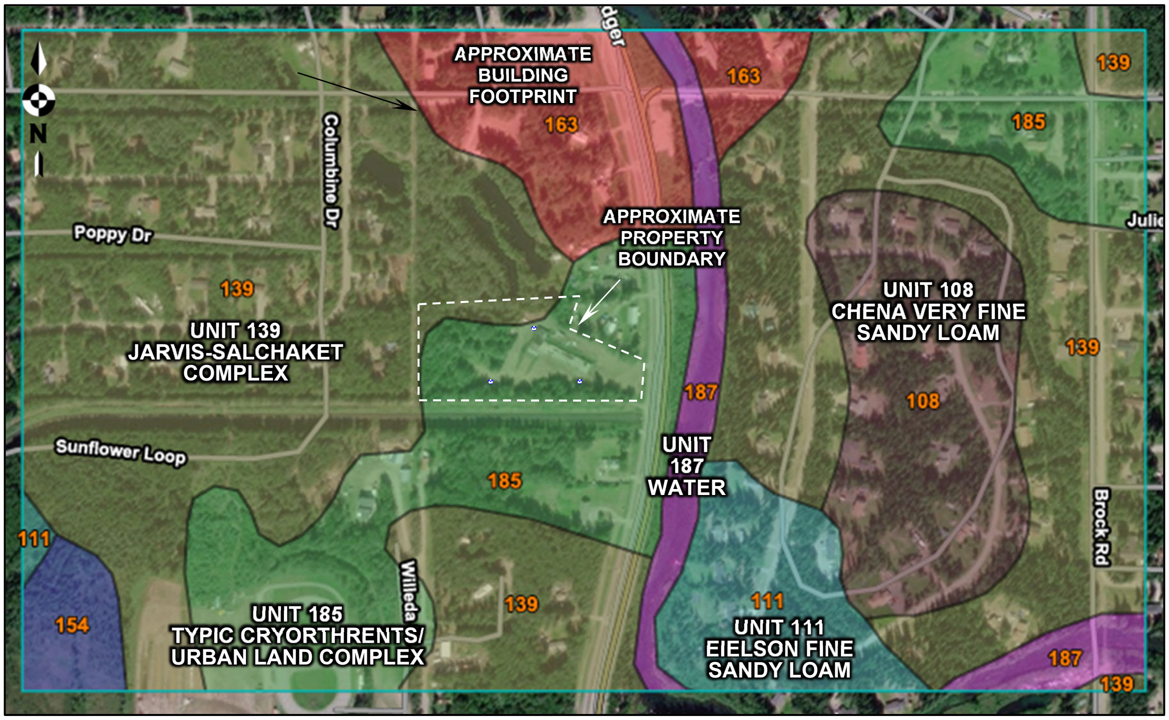


Figure 2: Excerpt from the USDA NRCS Soil Map and annotated by SYNGEN. The property is mapped mainly as Typic Cryorthrents-Urban Land complex (Unit 185, mine spoils and/or fill). Jarvis-Salchaket complex is also mapped.

Typic Cryorthrents-Urban Land Complex is generally interpreted by the NRCS geologically as mine spoil or earthy fill over alluvium. The Urban land component of the complex is land which has been altered by development to the extent that its original soil taxonomy is no longer discernible. It is not described in detail by the NRCS but is likely to be consistent with neighboring undisturbed soil (Jarvis-Salchaket complex).

The landform and landform position associated with the Typic-Cryorthrents component of the complex are described as terraces/floodplains and rise, respectively. The downslope shape is described as linear, generally indicating that a steady-state (neither depositional nor erosional) geomorphic environment may be present. It is reported to be well drained with rare to no flooding and no ponding. Groundwater is reported to be greater than 80 inches. The saturated hydraulic conductivity is reported to be moderately high to high (100 to 30 min/in.). The Typic Cryorthrent component of the complex is estimated to be moderately corrosive to buried concrete and steel. A typical profile of this component of the complex is reproduced below:

- 0 to 30 inches: stratified gravelly loamy sand to gravelly fine sandy loam to gravelly silt loam
- 30 to 63 inches: stratified fine sand to silt loam
- 63 to 72 inches: very gravelly sand

Jarvis-Salchaket complex is generally interpreted geologically by the NRCS as alluvium (stream deposits). The complex is estimated to contain up to 88 percent sand, 9 percent silt, and less than 3 percent clay with a liquid limit of up to 7 and a plasticity index of less than 5. A bulk dry density of up to approximately 90 pounds per cubic foot is reported. Permafrost is not reported by the NRCS to be associated with Jarvis-Salchaket Complex.

The landform associated with the Jarvis component of the complex is described as flood plains. The down-slope shape is described as linear, generally indicating that a steady-state (neither erosional nor depositional) environment may be present. It is reported to be well drained with rare to no flooding and occasional ponding. Shallow groundwater is reported. The saturated hydraulic conductivity is reported to be moderately high to high (100 to 30 minutes per inch). The unit is reported to be moderately corrosive to buried concrete and steel. A typical profile of the Jarvis component of the complex is reproduced below:

- 0 to 3 inches: moderately decomposed plant material
- 3 to 6 inches: very fine sandy loam
- 6 to 24 inches: stratified sand to fine sand to very fine sandy loam
- 24 to 72 inches: very gravelly sand

The landform associated with the Salchaket component of the complex is described as floodplains. The down-slope shape is described as linear, generally indicating that a steady-state (neither erosional nor depositional) environment may be present. It is reported to be well drained with rare to no flooding and occasional ponding. Shallow groundwater is reported. The saturated hydraulic conductivity is reported to be moderately high to high (100 to 30 minutes per inch). The unit is reported to be moderately corrosive to buried concrete and steel. A typical profile of the Salchaket component of the complex is reproduced below:

- 0 to 3 inches: slightly decomposed plant material
- 3 to 24 inches: very fine sandy loam
- 24 to 45 inches: stratified silt loam to fine sand
- 45 to 72 inches: very gravelly sand

Eielson fine sandy loam (mapped nearby) is generally interpreted geologically by the NRCS as alluvium (stream deposits). The complex is estimated to contain up to 65 percent sand, 30 percent silt, and up to 5 percent clay with a liquid limit of up to 26 and a plasticity index of less than 5. A bulk dry density of up to approximately 70 pounds per cubic foot is reported. Permafrost is not reported by the NRCS to be associated with Eielson fine sandy loam.

The landform and landform position associated with Eielson fine sandy loam are described as flood plains and tread, respectively. The down-slope shape is described as linear, generally indicating that a steady-state (neither erosional nor depositional) environment may be present. It is reported to be moderately well drained with occasional flooding and frequent ponding. Shallow groundwater is reported. The saturated hydraulic conductivity is reported to be moderately high to high (100 to 30 minutes per inch). The unit is reported to be moderately corrosive to buried concrete and steel. A typical profile of Eielson fine sandy loam is reproduced below:

0 to 2 inches:	slightly decomposed plant material
2 to 49 inches:	very fine sandy loam
49 to 71 inches:	stratified silt loam to fine sand
71 to 72 inches:	very gravelly sand

4.4 Quaternary Geologic Setting

The Quaternary geology of the area was mapped by the United States Geological Survey (USGS) on the Geology of the Fairbanks D-2 Quadrangle, Alaska. The Quaternary Ice Age began some 2 to 3 million years ago and includes several major lobal glacial advances and retreats which span the Pleistocene epoch, each of which helped to shape much of North America's present-day surficial features. The period extends to include the present interglacial period (the Holocene), which is estimated to have begun with the retreat of the continental ice sheets around 11,000 years ago.

The property is mapped by the USGS mainly as floodplain alluvium (river sand and gravel). The alluvium infills a deep basin between the Alaska Range and the Yukon Tanana Uplands to the north of the site and extends several hundred feet in depth. The deposit is described as well-stratified stream-laid layers and lenses of unconsolidated silt, sand, and rounded river gravel. The unit is overlain in most locations by a mantle of silt that can range in depth from a few inches to over 20 feet. Some of the silt is likely alluvium overlain by loess. Its grains are mostly garnet quartz-mica schist. River gravel clasts consist mainly of quartz and gneiss and range in size from ¼ inch to 3 inches in diameter. Larger rocks are uncommon.

The material is locally perennially frozen (permafrost) and where frozen, grains are cemented by interstitial ice. The ice content is usually low to medium. The unit is incised by swale and slough deposits which generally contain poorly stratified layers of unconsolidated stream-laid grey to blue-grey silt and silty very fine sand, which is fairly well-sorted and can contain up to 30 percent clay. The grains are angular and sub-rounded and consist mainly of quartz, mica, and feldspar.

Organic material is encountered both in and out of the swale and slough deposits and sometimes includes buried logs which may be individual or may be portions of buried logjams. Organic material is more frequently encountered within the swales and slough deposits. Where swale and slough deposits are frozen (either seasonally or perennially), the ice content is usually high, and lenses and seams of segregated ice are common. Larger ground ice deposits such as wedge ice are uncommon.

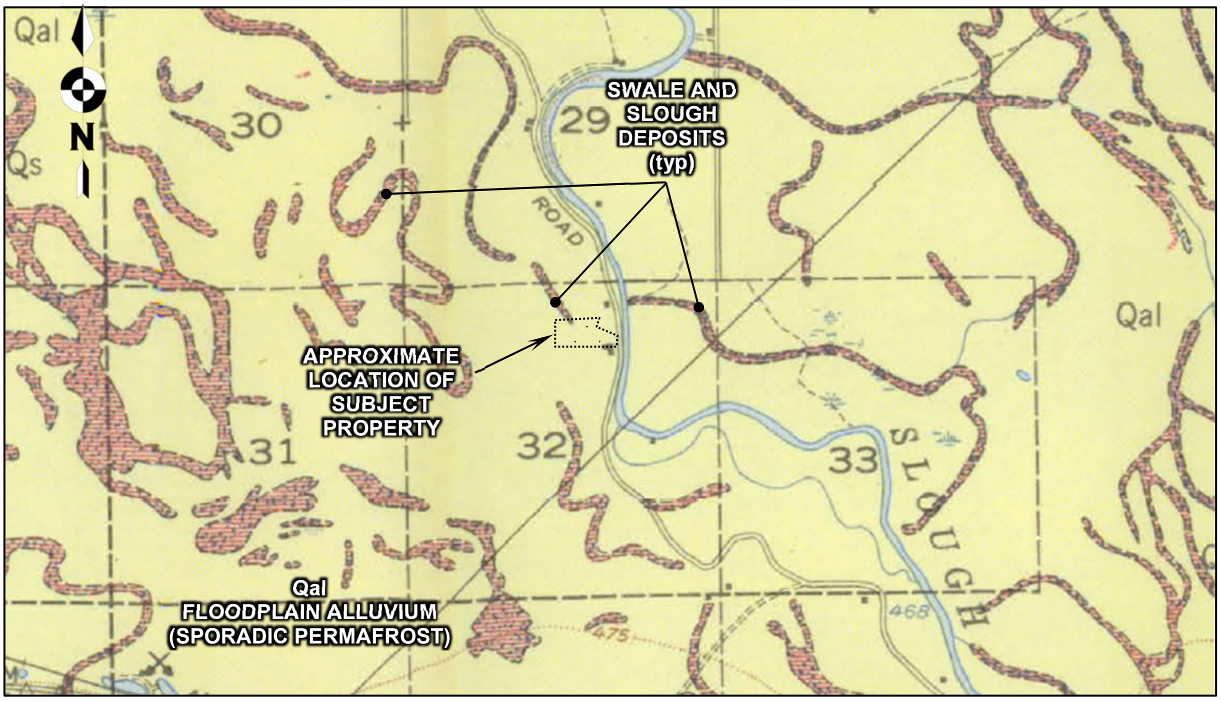


Figure 3: Excerpt reproduced from the Geology of the Fairbanks D-1 Quadrangle, Alaska, and annotated by SYNGEN showing the approximate location of the subject property.

4.5 General Hydrologic and Hydrogeologic Conditions

As indicated in the Climate section of this report, based on historical records, between 10 and 14 inches of annual precipitation are reported by the NRCS. This historic annual precipitation may not be representative of future precipitation over the design life of the facility.

The surface hydrology of Interior Alaska is largely immobilized during the freezing season from October through May. The freezing season typically ends with a rapid release of stored water from the melting snowpack. When spring thaw is very rapid and the snowpack is high, the persistence of seasonally frozen soil during breakup impedes infiltration and the resulting surface water storage can result in shallow but widespread ponding and flooding.

In the General Soil Conditions section of this report, the immediate vicinity of the property is reported to have been altered by development. However, from results of the subsurface investigation program and SYNGEN's extrapolation of nearby mapping of unaltered soil deposits, the site is interpreted by SYNGEN as Jarvis-Salchaket complex. Permafrost is not reported to be associated with this complex.

The NRCS reports this complex to be well drained with rare flooding and occasional ponding. A moderately high to high saturated hydraulic conductivity is estimated.

The nearest mapped natural drainage is the active channel of Chena Slough, approximately 150 feet to the east of the project site. The active channel of the Tanana River is located approximately 3 miles southwest of the site and the active channel of the Chena River is located approximately the same distance to the northeast. The level of groundwater at the site of interest lags, but generally follows the average level of water in these streams. Flood events from these streams are managed by a levee system on the Tanana River and by a dam and diversion channel upstream of Fairbanks at Moose Creek. Numerous slough channels and swales incise the area and shallow groundwater is exposed in many active and former gravel borrow pits.

A detailed hydrogeologic study is beyond the purpose and scope of this report. Groundwater within the Chena-Tanana floodplain is generally found at shallow depth and shallow groundwater is common of the area. Shallow groundwater is exposed in the many gravel borrow sites scattered around the area. Permafrost, where present, can act as an aquitard by preventing infiltration, and accordingly groundwater in permafrost areas may be encountered in a perched condition atop impervious frozen soil. Permafrost can also act as an aquiclude by locally depressing and confining groundwater as sub-permafrost groundwater. Experience and the information contained in logs of USGS boreholes mapped in the Chena-Tanana floodplain indicate that permafrost, where present, may extend to depths exceeding 150 feet. Sub-permafrost groundwater (in alluvial and/or in schist bedrock aquifers) is usually present below this frozen material.

5.0 GEOHAZARDS

The following section is intended to provide a brief overview of the major geohazards known to adversely impact construction in the general area. This overview is not intended to be all-inclusive. Other geohazards that are not readily apparent may be identified during construction or over the operational life of this construction.

5.1 Permafrost

Perennially frozen ground (“permafrost”) is any soil or rock that remains at or below the freezing point of pure water (32.0 ˚F) for at least two consecutive winters and the intervening summer. However, as evidenced by the preserved remains of extinct Ice Age animals it is sometimes found to contain, most permafrost has persisted for at least tens of thousands of years. It is identified as a geohazard anywhere where the average annual air temperature is below freezing. Most of the State of Alaska, including Fairbanks and the Interior, is underlain by some form of permafrost.

Permafrost is often described in terms of its continuity. It is generally described as continuous (or nearly continuous), discontinuous, or sporadic in nature. Exposure of terrain to direct solar radiation can play a prominent role in the presence of (and depth to) permafrost at a given site. In hilly terrain, permafrost is often present and nearly continuous on north-facing slopes and in valley bottoms adjacent to north facing slopes. Permafrost may be nearly continuous to sporadic on lower, south-facing slopes and often becomes absent on mid-to-upper-level south-facing slopes. On west or east facing slopes permafrost is often patchy or sporadic at lower elevations and may persist at mid-level elevations where it is absent at comparable mid-level elevations on south-facing slopes. On flat terrain, permafrost can be nearly continuous or patchy. Many factors contribute to the presence or absence of permafrost and none by itself is a reliable indicator. The presence of permafrost, especially on westerly or easterly facing slopes or in boundary areas but also on flat terrain can require several boreholes and downhole instrumentation (temperature sensing instruments) to detect. In such areas it can be present as lobes or isolated masses.

Since the beginning of the Holocene interglacial period approximately 11,000 years ago, permafrost has been in a general state of retreat worldwide. Heat introduced into the ground by development including heat lost from a warm building floor, heat from wastewater disposal systems, and solar radiation (especially on cleared land) can locally accelerate the thaw of permafrost. For engineering purposes, permafrost is generally characterized by its stability upon thaw (thaw stability). Fine-grained frozen soils (silts) are often rich in ground ice and generally have the greatest potential for thaw related settlement. Coarse-grained soils (sand and gravel) often contain less ice and generally settle less upon thaw but still may settle appreciably and adversely impact foundations. Structures founded upon non-thaw-stable permafrost can be severely damaged due to thaw related settlement whereas structures founded on thaw stable permafrost may experience little or no damage upon thaw. Subsidence, where present, typically continues until consolidation of the thawed soil is complete and a new thermal balance is reached in response to the added heat.

Permafrost was not encountered in the authorized boreholes. However, permafrost is mapped in the area of interest by the USGS, and the site of interest is otherwise located in an area of known sporadic permafrost. Deep seasonal frost (also a form of permafrost) may have accumulated beneath the building located on the property if the building remained unheated for several years. Where present, permafrost in the area generally consists of frozen sand and gravel of low to medium ice content which, upon thaw, can adversely impact the stability of foundations. Frozen silt deposits which may contain high ice content, and can more seriously damage foundations, are also present. These materials are usually localized in sloughs or swales, but also may be present beneath the building.

5.2 Frost Action

The combined effects of ground freezing and thawing on a soil mass are commonly known collectively as frost action. As a soil body freezes, water present in the voids will expand. When there is sufficient pore space to accommodate the expansion, there is little or no impact on the soil from freezing (e.g., freezing dry soil). Conversely, if the void spaces are partly or completely filled with water, the net expansion can force the soil particles apart and the soil mass as a whole can expand. The amount of expansion is dependent on the degree of saturation. This expansive phenomenon is commonly known as frost heave. Frost heave can lift unprotected shallow foundations and floor slabs unevenly and cause building distress. It can also lift pavements unevenly, resulting in an uneven driving surface. The severity of frost heave at a given site is proportional to the availability of water (throughout the freezing season), the hydraulic properties of the soil, and the climate. Frost heave is most intense in cold climates or during very cold winters in temperate climates.

When the soil mass thaws, the frozen water contained within it returns to liquid and contracts to its original volume, leaving the soil structure in a loosened, weakened state which is easily deformed under load. This phenomenon is commonly called thaw weakening. During thaw, structures lifted by the frozen soil will settle at least partly under the building’s weight. Pavement sub-bases, which given their albedo tend to thaw rapidly from the surface down, can be temporarily weakened by liberated water that is trapped within them by impermeable seasonally frozen soil below which leads to rutting and pavement distress.

5.2.1 Frost Jacking

Slender foundation elements such as embedded posts or piles can also be lifted by ground freezing. Soil frozen to the surface of the element creates a bond which can be mobilized by the vertical expansion of the surrounding ground freezing. The process is commonly called frost jacking. The tangential bond between the frozen soil and the foundation material is commonly known as the adfreeze bond. Its mechanism is similar in fashion to its non-frozen namesake, adhesion (in cohesive soils) except its strength is highly temperature dependent. Frost jacking is most common where slender foundation elements (piles or posts) penetrate stratified alluvial fine-grained soils that are present with a continuous groundwater source within or within close proximity to the zone of ground freezing.

Unlike spread footings displaced by freezing ground, which upon thaw generally settle and at least partly return to their original position; when the frozen soil in contact with slender embedded foundation elements thaws, the surface soil relaxes (under its own weight and after being wetted) but the displaced element is restrained by side resistance along its embedded length and may also be obstructed by slough-in below its tip. Consequently, the displacement is not usually recoverable, and the foundation remains displaced until the next freezing season adds more irrecoverable displacement. Over many freezing seasons, the cumulative displacements acting on a slender embedded foundation element can unevenly stress connections and damage structures.

The primary mechanism responsible for causing heave and mobilizing the adfreeze bond in fine grained soils is the growth and development of segregated ground ice. In a homogenous fine-grained deposit such as silt (loess or outwash of loess) ground ice tends to grow in lens-shaped sheets oriented parallel to the direction of the freezing front. Lens ice formed in the ground will tend to parallel the ground surface while lens ice growth behind retaining walls will tend to parallel the wall surface. It is the expansion of the surface which mobilizes the adfreeze bond and exerts a jacking force. Without saturated ground conditions and a continuous supply of water to feed lens ice throughout the freezing season, lens ice is malformed, and jacking will be weak or will not occur. The adfreeze bond may be disrupted or broken by replacing the fine-grained subsurface materials within the zone of ground freezing with free draining material such as pea-sized gravel (no sand or fines).

The shallow earth materials encountered in the building footprint consist mainly of fine-grained soils that are highly susceptible to frost action. These materials and the depth to groundwater indicate that a frost action hazard is present at the site.

5.3 Seismicity

Interior Alaska is a seismically active region. Many recent and historic large (Richter magnitude 8.0) earthquakes have their epicenters near the Denali Fault within 100 miles of Fairbanks. Other faults (extensional from the Denali Fault) located closer to Fairbanks can produce Richter magnitude 5.0 events. Knowledge of past seismicity in the area indicates that all structures should be designed to withstand a major seismic shock without collapse.

5.3.1 Ground Motions

Ground motions produced during an earthquake are the result of shear and compressional waves propagating outward from the epicenter of the event, through the earth's crust, to the site under consideration. The shock waves attenuate (spread out) with increasing distance from the epicenter. The intensity of ground motions at a given site is dependent on the magnitude of the event, the distance between the epicenter and the site, and the physical properties of the subsurface materials present beneath the site itself. Damage to a building can arise from the response to the shaking of the subsurface soils, which can amplify the shaking. Where soils are not present (e.g., rock is shallow), damage can also arise from the response of the building to the sudden and sharp acceleration of the bedrock mass at the ground surface. However, damage to buildings where shallow rock is present is often reduced.

5.3.2 Site Response

The subsurface materials at a site can respond to a seismic shock by rupturing and/or by softening (liquefying). Rupture usually occurs where bedrock is relatively shallow and relative motion of the bedrock surface on either side of an active fault results in a fissure which propagates to the surface. Ground softening (liquefaction) occurs when seismic waves cause loose, water-bearing or saturated soils near the ground surface to lose their strength and consolidate and settle under their own weight. As the soil particles settle and move into a tighter configuration, the porewater contained in the spaces between them is expelled. In liquefiable soils, during the shaking, the water in the pore spaces may become trapped by fines, which can plug pore spaces and inhibit the passage of water. For a brief period during and immediately following the shaking, undrained conditions in the soil develop and result in the foundation shear forces being temporarily transferred from the soil particles to the water trapped between them, which cannot support shear. For a foundation, the loss in shear strength usually results in shear failure and soil rupture and the resulting foundation movement can result in severe damage to the building. Liquefaction may also be accompanied by lateral ground spreading in flatter terrain and deep slope failure and mass movement (landslides) in steeper terrain.

The presence of permafrost complicates the ground response to shear and compressional waves. Deep bodies of solidly frozen soil can behave as soft bedrock and locally affect ground motions, while ground motions in non-frozen soils between or adjacent to frozen soil bodies may be amplified.

5.3.3 Structure Response

Buildings and other structures respond to ground motions by swaying. The amount of time (in seconds) elapsed as the top of the structure completes one full sway back and forth is called the fundamental period. As the height of the structure increases, the time required for its top to complete one full sway generally increases and hence, the fundamental period increases. As the structure becomes increasingly rigid (e.g., shorter or stiffer), its period decreases. A perfectly rigid structure has a period of zero (seconds). The magnitude of the forces imposed on a structure by ground motions acting at its base is related to its fundamental period. Most buildings less than three stories in height generally have a short period (around 0.2 second). Taller structures usually have longer periods. The steel racking supporting solar panels is commonly aligned to maximize solar exposure. In the direction the module is facing, the structure usually behaves as an inverted pendulum. Ninety degrees to this, the module behaves as a braced frame. The fundamental period of the structure in either direction is a function of the mass of the panel and the stiffness of the foundation element supporting it.

5.3.4 Seismic Design

The 2018 International Building Code (IBC) includes probabilistic earthquake-induced loading parameters for use in the design of structural elements. These parameters are intended to reduce the risk of catastrophic structural failure and collapse, and loss of life during the maximum considered earthquake (MCE). The maximum considered earthquake should not be confused with the maximum credible earthquake, which is a larger (and rarer) event. The maximum credible earthquake is considered in the design of critical structures such as dams, major power generation facilities, and emergency responder facilities, which must remain intact and operational during and following the largest earthquake. Design of a structure to resist the maximum credible earthquake without damage is generally cost-prohibitive whereas design of a structure to resist the maximum considered earthquake involves a less costly risk-targeted approach that is intended mainly to prevent loss of life. Structures that are designed using the risk-targeted approach may sustain considerable damage during a major earthquake but will usually remain intact enough to permit egress of the building occupants.

Per the 2018 IBC, the MCE spectral response acceleration specified for use in the design of non-critical structures is characterized by an event with a 2 percent probability of exceedance in 50 years. This approximates an event that occurs once in approximately 2,500 years. The spectral response acceleration for the site was estimated by SYNGEN using seismic hazard maps developed by the National Earthquake Hazard Reduction Program (NEHRP) and the USGS. These maps delineate contours of spectral acceleration expressed as a percent of gravity (%g) at 5 percent critical damping for Site Class B, (defined as rock). The Site Class is a function of the geotechnical properties of the upper 100 feet of subsurface material and ranges from A (hard rock) to F (very soft soil). Where solidly frozen permafrost is present and extends from the surface down to at least 100 feet, a designation of Site Class C (soft rock) may be appropriate in the short term. However, in the long term, heat transfer from development and/or continued interglacial warming promote localized thaw and overall permafrost retreat, and non-frozen conditions may eventually dominate, and thereafter consideration of a Site Class of D or softer may be appropriate.

The longitude and latitude of the site were obtained and were used with the USGS seismic hazard maps (ASCE 7 Hazard Tool) to estimate the spectral response accelerations during the MCE. ASCE 7-16 parameters were considered. The short (0.2 s) period spectral response acceleration is $S_S = 0.981g$ and the 1 second period is 0.376g (Site Class D and 5 percent critical damping). The site-adjusted MCE short period ground acceleration is $S_{MS} = 1.086g$. Accordingly, the design spectral response acceleration (2/3 of the site adjusted MCE) is $S_{DS} = 0.724g$. Following ASCE 7-16, buildings located on Site Class D (and E) soils, whose fundamental period exceeds 0.2 second and is up to 1.5 seconds, and whose 1-second spectral response acceleration (S_1) is greater than 0.2g require a site-specific ground motion analysis or computation of an appropriate long-period design spectral response acceleration (S_{DL}) using more conservative means (ASCE 7-16 Eq. 12.8-2). As described previously in this section, most braced frame structures up to two stories (above grade) in height have fundamental periods approximating 0.2 second. As described earlier in this section, a solar racking system is expected to have a comparable period to that of a building in the direction normal to the panel face and an inverted pendulum in the direction of the panel. A modal analysis would help to better define the frequency of the rack, once selected. For preliminary design, short periods are usually conservatively assumed for solar racking.

The conditions observed at the site and the subsurface conditions encountered in the boreholes indicate a low risk of liquefaction-induced settlement and/or lateral spreading during a major earthquake.

Previous experience in the area following strong seismic events supports this assessment.

5.4 Buried Peat

As described in the Quaternary Geologic Setting section of this report, swales and abandoned slough channels are mapped in the area, each of which can contain deposits of peat and other organic material. Peat materials decompose with time and are highly compressible under building loads and construction on these materials can result in compression and settlement of these materials and building distress. Peaty soils were not encountered in the authorized boreholes. However, swales and sloughs containing peat are mapped in the area. Compressible peat soils are identified by SYNGEN as a geohazard in the area.

5.5 Flooding

Flooding is reported by the NRCS to be rare to occasional. The site is mapped by FEMA as Flood Zone X (moderate- to low-risk). Experience indicates that flooding is most frequent in areas where high groundwater can intersect swales, abandoned slough channels, oxbows, or other areas of low relief. Peak flows in the Chena River three miles to the north are controlled by a dam and diversion channel that are located upstream of Fairbanks near Moose Creek. The dam is managed by the US Army Corps of Engineers and excess water is diverted to the Tanana River. Flooding from the larger Tanana River is controlled by a levee system. Owing to these flood control measures river flood events are generally rare. However, as indicated in the General Hydrology section of this report, the surface hydrology of the area is largely immobilized during the freezing season and generally ends with a rapid release of stored water from the melting snowpack during the spring thaw. When the snowpack is high and the spring thaw is rapid, the persistence of seasonally frozen soil prevents infiltration of meltwater and promotes ponding, and this can lead to shallow but widespread flooding. Despite the control of flows in the Chena and Tanana Rivers, localized flooding in the area remains a hazard, especially from the Little Chena River, which is not controlled. A flood elevation survey of the property should be conducted to establish module clearance and for electrical equipment pads.

6.0 SUBSURFACE EXPLORATION PROGRAM

The following section details the authorized site investigation program developed and used to explore the subsurface conditions at the project site and describes the methods used to conduct this program.

6.1 Drilling Program

SYNGEN developed and directed the authorized subsurface investigation program. Subsurface conditions at the site of interest were explored by drilling three boreholes. The boreholes were drilled using a top-drive rotary drill rig 5-¼ inch inside diameter hollow stem augers with a continuous flight. In each borehole, Standard penetration testing was conducted at regular intervals. Upon completion, each borehole was backfilled with auger cuttings. The drilling was performed by The Drilling Company Corp. under the terms of a separate Agreement with the Client.

The latitude and longitude of each borehole were measured using a handheld GPS receiver and these coordinates were plotted using Google Earth imagery and Fairbanks North Star Borough Geographic Information System (GIS) software as shown on the Borehole Location Diagram in Figure 4. Ground surface elevations at the site of each exploration were not available and were not measured by SYNGEN. Field logs of the subsurface conditions encountered were transmitted to SYNGEN for review. SYNGEN interpreted and classified the subsurface conditions and materials reported on the field logs and prepared the final published borehole logs which are attached to this report, along with a summary of the soil classification symbols used on the logs, as Appendix A. Photos taken during the fieldwork are included as Appendix B.

6.2 Sampling

Samples were obtained from the split barrel sampler at approximate five-foot depth intervals. The subsurface materials were monitored and logged by experienced personnel, and all samples collected were sealed in airtight containers for further examination and analysis.

7.0 GEOTECHNICAL MATERIALS CHARACTERIZATION

Geotechnical materials characterization for this investigation was limited to measurement of the water content of the samples obtained from the boreholes and measurements of Standard penetration resistance. Other geotechnical material properties were estimated from previous experience or were obtained from published literature.

7.1 Water Content

The as-collected water content of each sample was measured in general accordance with ASTM D2216. The water content of each sample is reported on the Log of Borehole reports at the corresponding depth.

7.2 Geotechnical Index Properties

Typical geotechnical index properties for the materials encountered in the boreholes such as the liquid limit (LL), plasticity index (PI), bulk dry density, particle size distribution, saturated hydraulic conductivity, and other properties were measured in similar soils and were published by the NRCS in the Soil Survey of the project area and these values are reported in the General Soil Conditions section of this report.

7.3 Standard Penetration Testing

Standard penetration testing was conducted in the boreholes at regular intervals using a 24-inch ASTM split-barrel sampler driven with a 140-pound safety hammer free-falling (rope and cathead) 30 inches in accordance with ASTM D-1586. After driving the barrel (spoon) the first 6 inches to set the sampler, the number of hammer strikes (blows) required to advance the sampler the middle 12 inches of the 24-inch barrel length is the blow count. This number is a measure of the relative density of non-frozen cohesionless soils and the relative stiffness of non-frozen cohesive soils and can be correlated to soil shear strength and other properties. Measured penetration resistances are shown with depth on the Log of Borehole report for the corresponding borehole in Appendix A.

8.0 SUBSURFACE CONDITIONS

8.1 Subsurface Materials

In general, beneath 2 to 4 feet of material visually classified as silt and interpreted as alluvium or loess, material visually classified as sandy gravel was encountered and continued to the bottom of each borehole. Perennially frozen soil (permafrost) was not detected. A summary of the subsurface conditions encountered in the boreholes is provided below in Table 1.

Table 1: Summary of Subsurface Conditions in Authorized Boreholes

BOREHOLE ID	TOTAL DEPTH	APPROXIMATE DEPTH TO GROUNDWATER	DEPTH TO SAND AND GRAVEL
B-1	31 ft.	9.5 ft.	2 ft.
B-2	31 ft.	10 ft.	3 ft.
B-3	31 ft.	7.5 ft.	4 ft.

Detailed descriptions of the subsurface materials and conditions encountered in each borehole are presented on the Log of Borehole reports in Appendix A of this report. The logs show the specific subsurface conditions encountered at each borehole location. Subsurface conditions may vary beneath other portions of the property. The subject of variations in subsurface conditions is discussed in greater detail in the Limitations section of this report.

8.2 Groundwater

Free groundwater (e.g., the water table) was encountered while drilling at depths ranging from approximately 7.5 feet to 10 feet in the boreholes. Open standpipe piezometers would be required to precisely measure the level of groundwater at the site. The level of groundwater at this location generally lags the level of water in the Chena and Tanana rivers, and typically fluctuates a few feet seasonally, with the lowest average occurring late in the freezing season. Shallower groundwater can also be found perched atop seasonally frozen soil during breakup. Changes in the level of groundwater at this site can be expected seasonally.

9.0 CONCLUSIONS AND RECOMMENDATIONS

The following section identifies an appropriate foundation type for the proposed structure given the subsurface conditions encountered in the boreholes and provides subgrade preparation recommendations and geotechnical parameters for use in foundation design.

9.1 General Discussion

Experience indicates that the subsurface conditions encountered in the boreholes will support properly designed and constructed frost-protected ground mount solar PV foundations. The existing building will require demolition and deep seasonal frost/permafrost may be present where the building stood and this could impact development. Additional exploration is recommended to assess subsurface conditions where the building was located.

PV module foundation options generally include driven steel wide flange beams and/or hollow structural sections (HSS, round, square, or rectangular). Steel channels are also sometimes used, and surface mounted ballasted systems are also an option. If ballasted systems are considered, flexibility will be required in the racking system for relative movement due to frost heave (fixed tilt systems are generally adaptable to ballasts). SYNGEN is available to provide design guidance for ballasted systems in more detail for an additional fee. Design parameters for driven (impact or torque) piers (wide flange beams (W) or hollow structural sections (HSS) are provided in the following subsections.

9.2 Axial Design Parameters

PV (and related) foundations must be designed to resist axial (vertical) uplift and compressive forces. These forces are generally imposed by wind, snow, and seismic excitations. Uplift forces may also be imparted to foundations from pressures imposed on the sides of foundations by swell, and or frost heave. Axial compressive loads can be resisted using a combination of tip resistance and side resistance. Using a straight-sided W shape or an HSS (i.e., no anchor attached), uplift forces can be resisted by side resistance. To mobilize tip resistance in the resistance of uplift forces, an anchor is required.

Allowable unit side resistances for the subsurface materials encountered in the boreholes were estimated by SYNGEN using experience and empirical relationships correlating Standard penetration resistance to unit side frictional resistance (granular materials) developed by Meyerof and Briaud (from research conducted on load tests on driven piles). Tip resistance was estimated from correlations developed by Kulhawy. Using these relationships, a multilayer model was developed by SYNGEN. Axial design parameters are tabulated below.

Table 2: Axial Design Parameters

PARAMETER	RECOMMENDATION	
Foundation Type	Driven (Impact or Torque) Wide Flange Steel Beam or HSS	
Allowable* Unit Side Resistance (psf) (tension or compression)	0 – 6.5 ft.	Neglect
	6.5 – 15 ft.	250 psf
	> 15 ft.	220 psf.
Allowable** Tip Bearing Capacity (tension (anchor) or compression)	< 10 ft.	Neglect
	10 – 15 ft.	20 ksf
	> 15 ft.	15 ksf

*Incorporates a Safety Factor of 3.0

**Incorporates a Safety Factor of 5.0

In the computation of axial capacity, the upper 6.5 feet of subsurface material should be neglected. These factors should be applied to the box perimeter of the section of interest. For a wide flange or hollow structural section, a fully plugged tip may be assumed in the calculation of tip resistance. A minimum 10-foot embedment is recommended. To avoid group effects, driven foundations should be spaced no closer than 4 section diameters apart. Closer spacings are not expected for solar projects. If foundations must be spaced closer than 4 section diameters, SYNGEN should be consulted to provide capacity reduction factors to account for group effects.

9.3 Frost Protection

As described in the geohazards section of this report, frost action is identified as a hazard at the site. SYNGEN developed a site-specific frost action hazard evaluation for use in guidance in foundation design. In the evaluation of the frost action hazard at the site, the following information was considered.

- Calculated frost depth (10-year recurrence interval)
- Location of groundwater table in the boreholes.
- Subsurface materials in the boreholes.
- Known frost action hazard (also mapped by the NRCS).
- Classification of the site by the NRCS as well drained with moderately high to high saturated hydraulic conductivity.

From this information and previous experience, a frost jacking hazard is identified by SYNGEN for ground mount solar foundations at the project site. In the estimation of frost jacking forces, a 50-year air freezing index of 6,900 °F-days was considered with the Modified Berggren equation to calculate a frost depth of approximately 6.5 feet in silt. Experience indicates this depth is conservative for silt overlain by turf and snow that remains partly snow-covered throughout a typical winter. A deeper frost depth would apply where sand and gravel is encountered shallower than 6.5 feet. However, Fairbanks sand gravel is generally deficient of fines and may be considered non frost susceptible provided it is not underlain by fine grained soils (not common except where granular fill is placed).

To resist the anticipated governing axial uplift (frost jacking) with a straight steel wide flange or HSS (no anchor), excessive embedments are expected. Hence, if a straight wide flange or HSS is considered, the application of a tangential frost bond (adfreeze bond) breaker or reducer should be considered. This could consist of a nonstick coating (e.g., polymer-based corrosion protection) applied to each steel section within the zone of ground freezing or a predrilled hole to 5 feet at each foundation location that is backfilled with free-draining pea-sized gravel (no sand or fines) extending at least 8 inches beyond perimeter of the foundation element, once the element is installed. If employed, a separator material (such as a heavy Sonotube) should be considered to help prevent native fines from washing into the pea gravel over time.

To further help reduce the risk of jacking, consideration should be given to designing anchorless foundations to resist up to 18 inches of frost extending below the bottom of the 5-foot bond breaker/reducer (6.5-foot total frost depth, 1.5-foot effective frost depth) and the contribution to axial resistance from the subsurface materials within the entire 6.5-foot zone should be neglected. Design within this zone should consider late (freezing) season lens ice growth in silt conservatively assumed to extend up to 30 inches below the deepest silt measured in the boreholes to mobilize a tangential bond of up to 15 psi over the 18-inch depth where no bond breaker/reducer is applied. This value should be applied to the entire perimeter of the section of interest. SYNGEN should be retained to assist with this design, and in the development of a remedial action plan if any frost jacking becomes apparent over the life of the development. The site should be kept well drained.

As an alternative to a bond breaker/reducer, subject to the results of load testing, an anchor plate may be welded to the base of a round HSS and the section may be screwed into the ground. An anchor usually consists of a circular steel plate at least ½ inch thick bent into a helix attached (welded) just above the tip of a round HSS. A plate diameter of at least 18 inches, and a torque factor (k_t) of 7/ft. are recommended for preliminary planning purposes. The tip of the round HSS is usually cut at 45 degrees to provide a tapping point. However, wobble results from the tip geometry as installation begins, and care is required to restrain the anchor and to install it within common racking tolerance (often up to 1 inch in any direction). Obstructions to driving are not expected.

Alternatives to round structural steel sections include square and rectangular structural steel sections fashioned with top-drive rotating screws (self-driving). SYNGEN should be retained to provide guidance on the selection and application of specialized foundation products/solutions and approaches during later stages of project development.

9.3.1 Axial Capacity Validation (Proof Testing)

The above axial design values are estimates which were derived from experience using analytical methods. Axial capacity can be validated using standard American Society for Testing of Materials (ASTM) static load tests (appropriately modified for PV foundations). For helical piers, torque factors (k_t) can be derived using torque-probing and load testing. If sufficient axial capacity is not apparent from the results of validation load testing (proof tests), additional embedment (i.e., welding on additional length) or additional anchorage plates may be required. SYNGEN should be retained to provide axial design services, and to assist with development of a load testing program for predesign, and/or for later stages of project development.

9.4 Lateral Design Parameters

PV foundations must be designed to resist lateral loads imposed by wind, sloping dead, and seismic forces. The following values are provided for the lateral design of driven foundations. These values are intended for use with LPILE 2018 or later.

Table 3: Lateral (LPILE) Design Parameters

LAYER	**DEPTH (ft.)**	**p-y RELATIONSHIP**	**P-MULT**	**UNIT WEIGHT (γ, $^{lb.}/_{ft.}{}^3$)**	**COHESION (C, psf)**	**ANGLE OF SHEARING RESISTANCE (ϕ, DEGREES)**	**STRAIN FACTOR (ε_{50})**	**SUBGRADE MODULUS (k, pci)**
1	0 – 5 ft.	Silt (c-ϕ)	3	105	50	26	Default	Default
2	5 - 7 ft.	API Sand	2	120	N/A	32	Default	Default
3	>7 ft.	API Sand	1	74	N/A	34	Default	Default

In the calculation of lateral capacity, the contribution to lateral resistance from the upper 12 inches of subsurface material should be neglected. Similar to axial design, a foundation spacing of less than 4 section diameters is not anticipated for this project, and group reduction factors are not required. If foundations are placed closer than 4 diameters, SYNGEN should be consulted to provide group reduction factors as appropriate.

9.1 Lateral Capacity Validation (Proof Testing)

Similar to the axial design values provided above, the above lateral design values are estimates which were derived from experience using analytical methods. Lateral capacity can also be validated using standard American Society for Testing of Materials (ASTM) static load tests (appropriately modified for PV foundations). If sufficient lateral capacity is not apparent from validation load testing (proof tests), stiffer section, deeper embedments, or both may be required. Lateral load testing should be conducted to inform the design prior to material procurement and construction. SYNGEN should be retained to provide lateral design services and to assist with development of a load testing program for detailed design, prior to material procurement and construction.

10.0 ADDITIONAL SERVICES RECOMMENDED

SYNGEN should be retained to provide design services for the foundations and to review the final plans and specifications for the proposed foundation prior to construction. The footprint of the existing building should be explored following demolition to verify the subsurface materials and conditions there. SYNGEN should be retained to monitor installation and validation load testing to ensure capacity is achieved. SYNGEN should be consulted with any questions about the proper interpretation of the information contained in this report. If SYNGEN is not retained to provide guidance during foundation construction, SYNGEN cannot be available to assist with the proper interpretation and application of the recommendations provided in this report.

11.0 REPORT LIMITATIONS

SYNGEN Consulting Services (SYNGEN) has prepared this report for the exclusive use of Tanana Chiefs Conference (Client). No other party may rely upon the information contained in this report without the express written consent of SYNGEN. This report is intended to provide the Client with an opinion on the suitability of the subsurface conditions encountered in the boreholes for foundation support.

This report (in its entirety) may be included with applicable contract documents for informational purposes. However, it may not contain sufficient information to prepare detailed construction bids and should not be exclusively relied upon by contractors preparing bids. Contractors preparing bids are advised to gather additional, independent information.

The recommendations contained in this report are based in part upon the information obtained from the boreholes performed at the locations explored as indicated on the Borehole Location Diagram in Figure 4. The explorations performed for this evaluation revealed subsurface conditions only at the specific locations explored. Subsurface conditions may vary beneath other portions of the subject property and between boreholes and this is especially true in permafrost areas. Like all geotechnical reports, this report should not be construed as a guaranty of subsurface conditions or foundation performance across the site but is intended to provide an evaluation of the specific subsurface conditions encountered in the boreholes and an opinion on their suitability for foundation support. This evaluation was based upon a reasonable effort to characterize subsurface conditions across the building site and to identify hazards and variations in subsurface conditions. A more exhaustive effort to identify subsurface hazards and variations (and reduce risk) could include additional boreholes and these could be performed at the Client's request, for an additional fee.

The nature and extent of variations in subsurface conditions between boreholes, if any, may not become evident until after construction activities have begun. If variations are observed during construction or if the effects of undetected variations become apparent during the operational life of this construction, additional analyses and revisions to this report may be required. The recommendations contained in this report should be considered provisional and are subject to the availability of new or additional information.

This report was prepared pursuant to a verbal agreement between the Client and SYNGEN. SYNGEN agreed to gather and provide to the Client, geotechnical information that is unique to the portion of the property under consideration. This evaluation did not include environmental contaminant screening. SYNGEN directed field exploration efforts toward the portion of property selected by the Client, as indicated on the Borehole Location Diagram in Figure 4. Deviation from the specific location explored is not recommended without additional exploration.

This report has been prepared for specific application to the proposed foundations planned at the locations explored at 2605 Badger Road near North Pole, Alaska. SYNGEN's services consisted of providing professional opinions and recommendations made in accordance with generally accepted cold regions geotechnical foundation engineering principles and practices. This acknowledgement alone is provided. No form of warranty expressed or implied is offered with this report. Use of this information requires the Client’s acceptance of these limitations, terms, and conditions.

The following figures, tables, and appendices accompany or complete this report:

FIGURES

Figure 1	Property Location Map
Figure 2 (in text)	Excerpt from the USDA NRCS Soil Map Showing Subject Property.
Figure 3 (in text)	Excerpt from the Geology of the Fairbanks (D-1) Quadrangle Showing Subject Property.
Figure 4	Borehole Location Diagram

TABLES (in text)

Table 1	Summary of Subsurface Conditions in Authorized Boreholes
Table 2	Axial Design Parameters
Table 3	Lateral (LPILE) Design Parameters

APPENDICES

Appendix A	Log of Borehole Reports, Unified Soil Classification System (USCS) Summary
Appendix B	Photoset

12.0 REFERENCES

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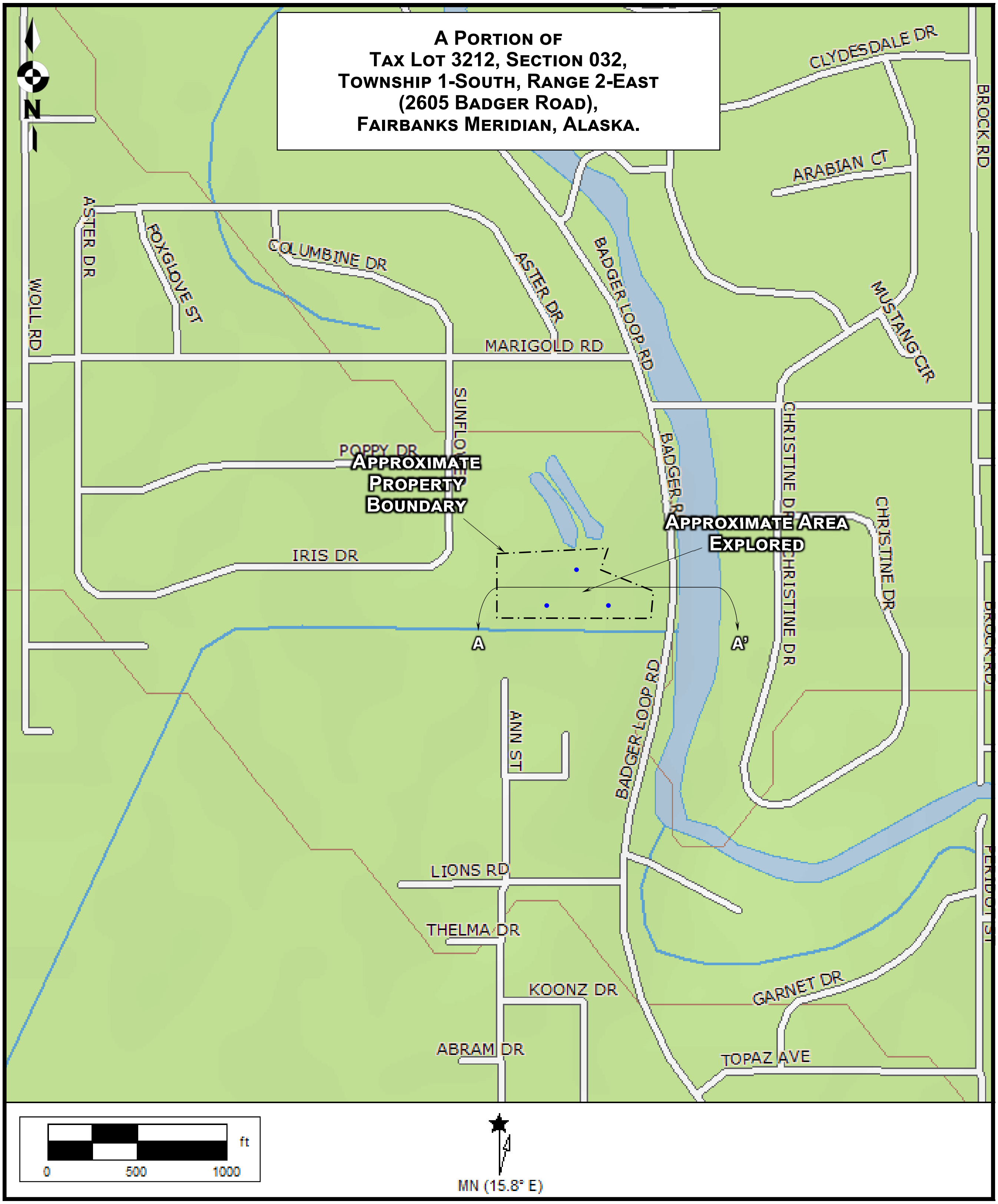
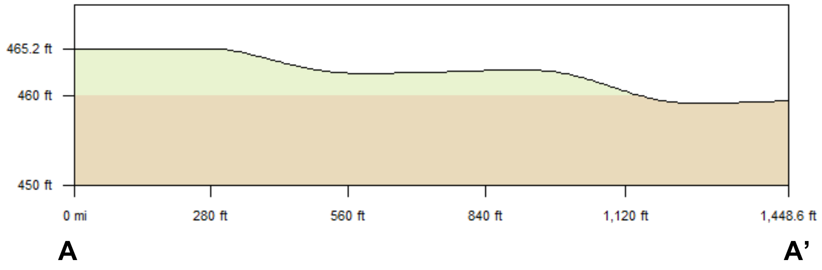
FIGURES

A Portion of
Tax Lot 3212, Section 032,
Township 1-South, Range 2-East
(2605 Badger Road),
Fairbanks Meridian, Alaska.



NOTES:
1. IMAGE REPRODUCED FROM DE LORME TOPO USA AND ANNOTATED BY SYNGEN.
2. LOCATIONS OF FEATURES SHOWN ARE APPROXIMATE AND DO NOT CONSTITUTE A LEGAL BOUNDARY SURVEY.
3. STREETMAP SHOWN IS APPROXIMATE AND MAY NOT REFLECT ACTUAL STREET LOCATION



PROJECT
PROPOSED GROUND MOUNT SOLAR ARRAY

TITLE
PROPERTY LOCATION MAP

CLIENT
TANANA CHIEFS CONFERENCE

SYNGEN
CONSULTING SERVICES
Your Alaskan Permafrost Specialist

DESIGNED BY	T. BERGLIN	LOCATION	PROJECT NUMBER	FIGURE NUMBER	REVISION
DRAWN BY	T. BERGLIN	2023	G020	1	0
ACTIVITY CODE	N/A	XREF NUMBER	N/A		

**A Portion of
Tax Lot 3212, Section 032,
Township 1-South, Range 2-East
(2605 Badger Road),
Fairbanks Meridian, Alaska**

NOTES:

1. IMAGES REPRODUCED FROM GOOGLE EARTH AND FAIRBANKS NORTH STAR BOROUGH GEOGRAPHIC INFORMATION SYSTEM (GIS) AND ANNOTATED BY SYNGEN.
2. ACCURACY OF GPS COORDINATES USED TO GENERATE DIAGRAM IS +/- 20 FT.
3. FEATURES SHOWN ARE APPROXIMATE AND DO NOT CONSTITUTE A LEGAL BOUNDARY SURVEY

PROJECT
PROPOSED GROUND MOUNT SOLAR ARRAY

TITLE
BOREHOLE LOCATION DIAGRAM

CLIENT
TANANA CHIEFS CONFERENCE

SYNGEN
CONSULTING SERVICES
Your Alaskan Permafrost Specialist

DESIGNED BY	T. BERGLIN	LOCATION	PROJECT NUMBER	FIGURE NUMBER	REVISION
DRAWN BY	T. BERGLIN	2023	G020	4	0
ACTIVITY CODE	N/A	XREF NUMBER	N/A		

APPENDIX A

Log of Borehole Reports
Unified Soil Classification System (USCS) Summary

SYNGEN CONSULTING SERVICES
Your Alaskan Permafrost Specialist

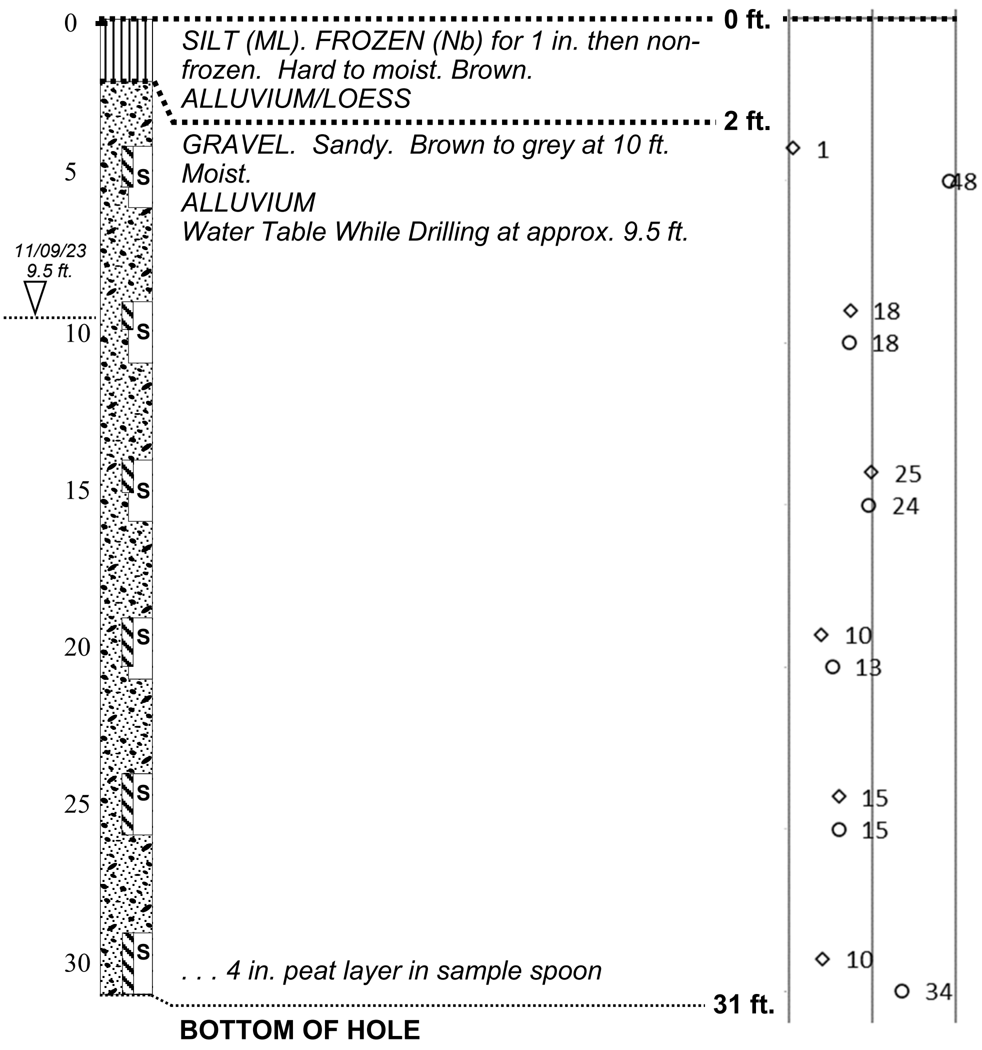
LOG OF BOREHOLE B-1
Geotechnical Engineering Evaluation Report Revision 0

Proposed Ground Mount Solar Array

A Portion of
TAX LOT 3212, SECTION 032,
TOWNSHIP 1-SOUTH, RANGE 2-EAST
(2605 BADGER ROAD),
FAIRBANKS MERIDIAN, ALASKA

HOLE COMPLETED: November 9, 2023
FOR: Tanana Chiefs Conference

DEPTH (ft.)	GRAPHIC	DESCRIPTION	Gravimetric Water Content (% by weight) ◇ Standard Penetration Test Blow Count (blows/ft.) ○
		Terrain and Vegetation: Flat. Mostly cleared. Low brush and scrub. Primary successors (willow and immature spruce). ***Borehole Location:*** See Borehole Location Diagram. N64.78830°, E-147.389310° ***Equipment:*** *Truck-mounted top-drive rotary drill with 5-1/4 in. ID hollow stem augers.* ***Weather:*** *Partly cloudy. 32°F* ***Driller:*** R. Drumhiller ***Engineer:*** *T. Berglin*	



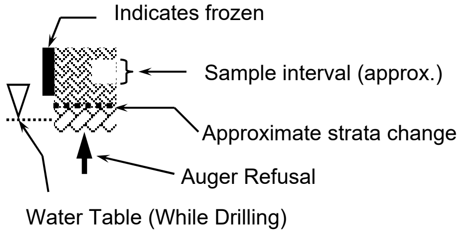
SILT (ML). FROZEN (Nb) for 1 in. then non-frozen. Hard to moist. Brown.
ALLUVIUM/LOESS

GRAVEL. Sandy. Brown to grey at 10 ft.
Moist.
ALLUVIUM
Water Table While Drilling at approx. 9.5 ft.

. . . 4 in. peat layer in sample spoon

BOTTOM OF HOLE

EXPLANATION



FROZEN SOIL CLASSIFICATION

N	No visibly segregated ice	V	Visible segregated ice (<1" thick)
b	Well bonded	r	Randomly oriented ice
f	Poorly bonded	s	Stratified ice seams
e	Excess pore ice	c	Ice coating on particles
n	No excess pore ice	x	Individual Ice inclusions

Visible segregated ice (>1" thick)

ICE + (soil type)	Ice with soil inclusions
ICE	Clear ice

KEY TO GRAPHIC SYMBOLS

▥ SILT
▨ SAND with gravel

OTHER SYMBOLS

◇ WATER CONTENT
○ SPT BLOW COUNT

SAMPLE TYPES

S SPLIT SPOON WITH RECOVERY

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SYNGEN CONSULTING SERVICES

Your Alaskan Permafrost Specialist

LOG OF BOREHOLE B-2

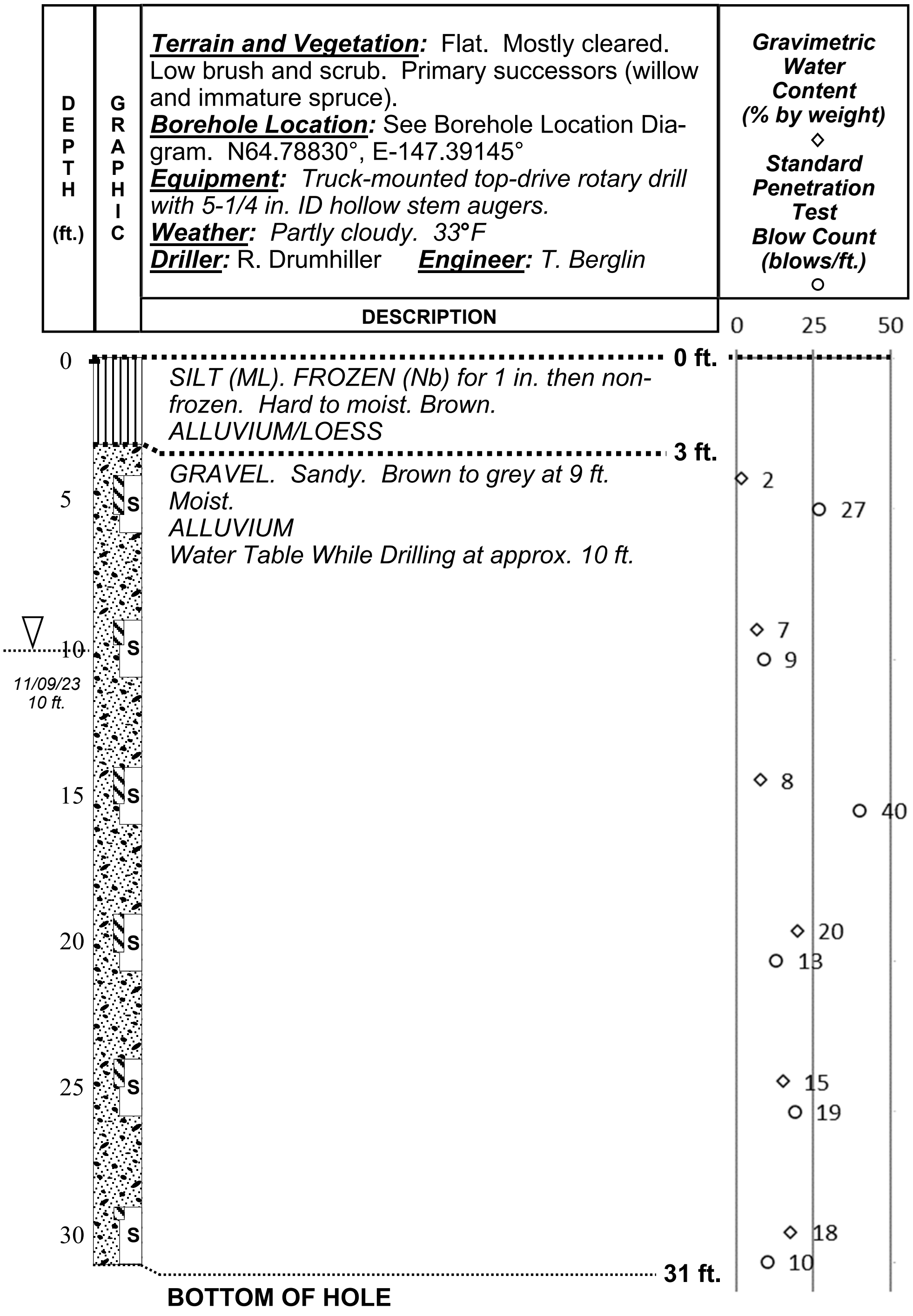
Geotechnical Engineering Evaluation Report Revision 0

Proposed Ground Mount Solar Array

A Portion of
TAX LOT 3212, SECTION 032,
TOWNSHIP 1-SOUTH, RANGE 2-EAST
(2605 BADGER ROAD),
FAIRBANKS MERIDIAN, ALASKA

HOLE COMPLETED: November 9, 2023
FOR: Tanana Chiefs Conference

Terrain and Vegetation: Flat. Mostly cleared. Low brush and scrub. Primary successors (willow and immature spruce).
Borehole Location: See Borehole Location Diagram. N64.78830°, E-147.39145°
Equipment: *Truck-mounted top-drive rotary drill with 5-1/4 in. ID hollow stem augers.*
Weather: *Partly cloudy. 33°F*
Driller: R. Drumhiller ***Engineer:*** *T. Berglin*

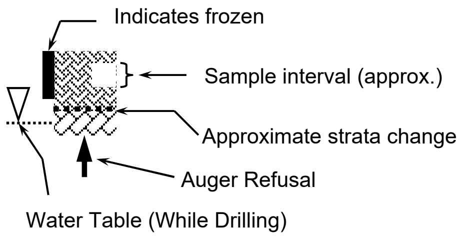


SILT (ML). FROZEN (Nb) for 1 in. then non-frozen. Hard to moist. Brown.
ALLUVIUM/LOESS

GRAVEL. Sandy. Brown to grey at 9 ft.
Moist.
ALLUVIUM
Water Table While Drilling at approx. 10 ft.

BOTTOM OF HOLE

EXPLANATION



FROZEN SOIL CLASSIFICATION

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SAMPLE TYPES

S SPLIT SPOON WITH RECOVERY

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SYNGEN
CONSULTING SERVICES
Your Alaskan Permafrost Specialist

LOG OF BOREHOLE B-3
Geotechnical Engineering Evaluation Report Revision 0

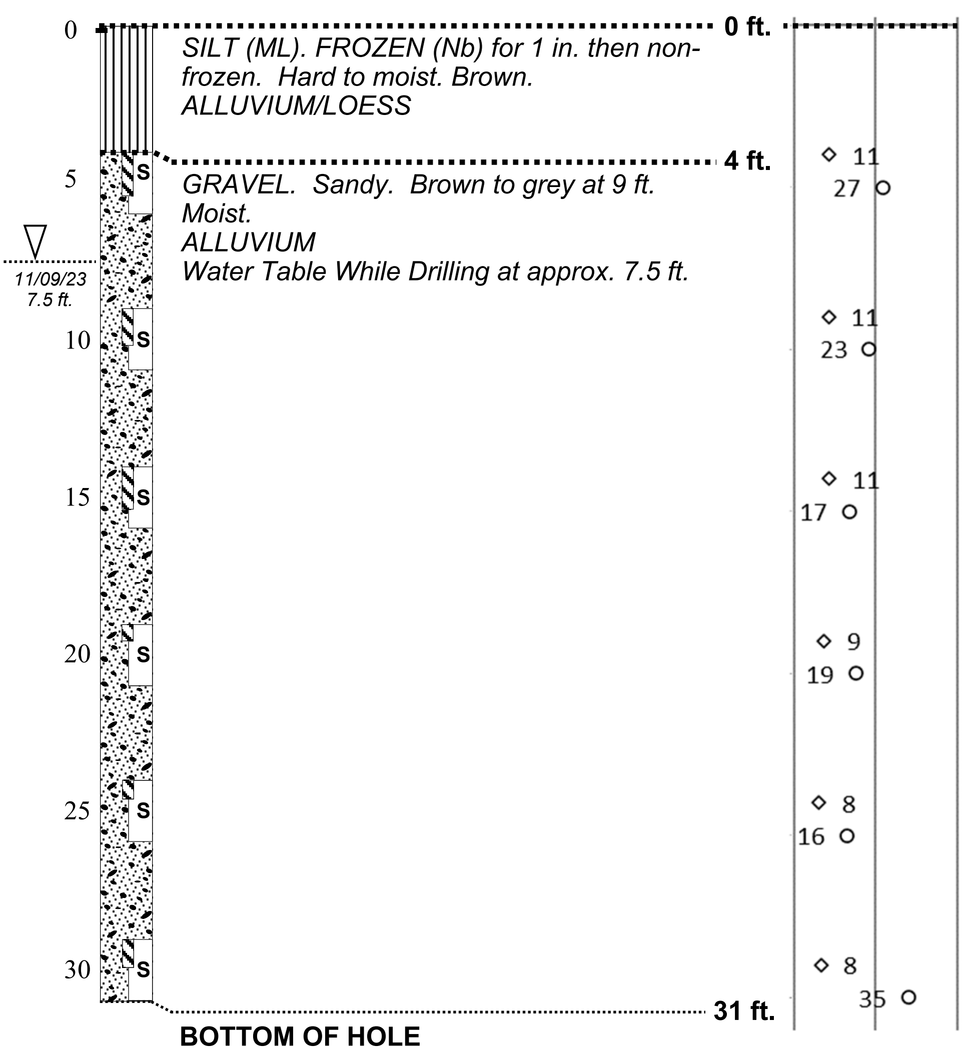
Proposed Ground Mount Solar Array

A Portion of
TAX LOT 3212, SECTION 032,
TOWNSHIP 1-SOUTH, RANGE 2-EAST
(2605 BADGER ROAD),
FAIRBANKS MERIDIAN, ALASKA

HOLE COMPLETED: November 9, 2023
FOR: Tanana Chiefs Conference

DEPTH (ft.) | **GRAPHIC** | **DESCRIPTION** | ***Gravimetric Water Content (% by weight)* ◇ *Standard Penetration Test Blow Count (blows/ft.)* ○**

Terrain and Vegetation: Flat. Mostly cleared. Low brush and scrub. Primary successors (willow and immature spruce).
Borehole Location: See Borehole Location Diagram. N64.78885°, E-147.39042°
Equipment: *Truck-mounted top-drive rotary drill with 5-1/4 in. ID hollow stem augers.*
Weather: *Partly cloudy. 24°F*
Driller: R. Drumhiller ***Engineer:*** *T. Berglin*

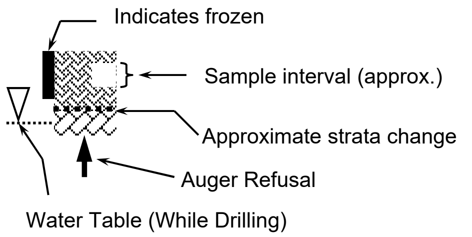


SILT (ML). FROZEN (Nb) for 1 in. then non-frozen. Hard to moist. Brown.
ALLUVIUM/LOESS

GRAVEL. Sandy. Brown to grey at 9 ft.
Moist.
ALLUVIUM
Water Table While Drilling at approx. 7.5 ft.

BOTTOM OF HOLE

EXPLANATION



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SAMPLE TYPES

S SPLIT SPOON WITH RECOVERY

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Unified Soil Classification System

First and/or second letters

Symbol	Definition
G	gravel
S	sand
M	silt
C	clay
O	organic

Second letter

Letter	Definition
P	poorly graded (uniform particle sizes)
W	well graded (diversified particle sizes)
H	high plasticity
L	low plasticity

Symbol chart

Major divisions			**Group symbol**	**Group name**
Coarse grained soils more than 50% retained on No. 200 (0.075 mm) sieve	gravel > 50% of coarse fraction retained on No. 4 (4.75 mm) sieve	clean gravel <5% smaller than #200 Sieve	**GW**	well graded gravel, fine to coarse gravel
			GP	poorly graded gravel
		gravel with >12% fines	**GM**	silty gravel
			GC	clayey gravel
	sand ≥ 50% of coarse fraction passes No.4 sieve	clean sand	**SW**	well graded sand, fine to coarse sand
			SP	poorly-graded sand
		sand with >12% fines	**SM**	silty sand
			SC	clayey sand
Fine grained soils more than 50% passes No.200 sieve	silt and clay liquid limit < 50	inorganic	**ML**	silt
			CL	clay
		organic	**OL**	organic silt, organic clay
	silt and clay liquid limit ≥ 50	inorganic	**MH**	silt of high plasticity, elastic silt
			CH	clay of high plasticity, fat clay
		organic	**OH**	organic clay, organic silt
Highly organic soils			**Pt**	peat

APPENDIX B

Photoset

Photo 1: View looking north from the area explored.

Photo 2: View looking east from the area explored.

Photo 3: View looking south from the area explored.

Photo 4: View looking west from the area explored.