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June 17, 2019

Ms. Tanowa Troupe, Secretary
Ohio Power Siting Board
Docketing Division
180 East Broad Street, 11th Floor
Columbus, OH 43215

**Re: Case Nos. 09-479-EL-BGN, 11-3446-EL-BGA, 16-469-EL-BGA,
and 16-2404-EL-BGA**

In the Matter of the Application of Hardin Wind Energy LLC for a Certificate of
Environmental Compatibility and Public Need for the Hardin Wind Farm.

**Phase 3 – Compliance with Condition 23, Case No. 09-479-EL-BGN –
Turbine Foundation Design**

Dear Ms. Troupe:

Hardin Wind Energy LLC (“Applicant”) is certified to construct a wind-powered electric generation facility in Hardin County, Ohio, in accordance with the orders issued by the Ohio Power Siting Board (“OPSB”) in the above-referenced cases.

The Applicant is currently preparing to begin Phase 3 of the project, which will entail construction of the access roads and turbine foundations that were not included in Phases 1 and 2.

At this time, for purposes of complying with the certificate conditions for Phase 3, the Applicant is filing the attached Turbine Foundation Design. This document is being provided in compliance with Condition 23 of OPSB’s March 22, 2010 Order in Case No. 09-479-EL-BGN.

We are available, at your convenience, to answer any questions you may have.

Respectfully submitted,

/s/ Christine M.T. Pirik

Christine M.T. Pirik (0029759)

William V. Vorys (0093479)

Dickinson Wright PLLC

150 East Gay Street, Suite 2400

Columbus, Ohio 43215

Attorneys for Hardin Wind Energy LLC

cc: Ed Steele
Derek Collins

COLUMBUS 39579-20 117506v2

HARDIN WIND FARM PAD FOOTING FOUNDATION HARDIN COUNTY, OHIO

TURBINE ID	TYPE	X_Lon83	Y_Lat83
1	2.7-116	-83.8349148	40.7011553
2	2.7-116	-83.8376900	40.6982499
3	2.7-116	-83.8375013	40.6946427
4	2.7-116	-83.8335157	40.6913495
5	2.7-116	-83.8282559	40.7015332
6	2.7-116	-83.8272815	40.6989468
10	2.7-116	-83.8200031	40.6874428
11	2.7-116	-83.8189712	40.6842975
15	2.7-116	-83.8300300	40.6878366
16	2.7-116	-83.8298243	40.6846533
18	2.7-116	-83.8284913	40.6794349
19	2.7-116	-83.8273508	40.6788057
22	2.7-116	-83.8170591	40.6793543
55	2.7-116	-83.7965170	40.6436184
59	2.7-116	-83.7856078	40.6519797
60	2.7-116	-83.7850118	40.6493100
84	2.7-116	-83.7738059	40.6944985
85	2.7-116	-83.7690425	40.6932079
86	2.7-116	-83.7659439	40.6915348
88	2.7-116	-83.7600711	40.6946028
91	2.7-116	-83.7511557	40.6985177
92	2.7-116	-83.7492800	40.6949235
101	2.7-116	-83.7534005	40.6872232
104	2.7-116	-83.7432906	40.6845097
105	2.7-116	-83.7399274	40.6835178
106	2.7-116	-83.7365856	40.6825793
123	2.7-116	-83.7470458	40.6921035
127	2.7-116	-83.8188936	40.6816153
TOTAL:	28		

TURBINE ID	TYPE	X_Lon83	Y_Lat83
12	2.8-127	-83.01870891	60.69909083
17	2.8-127	-83.8296276	60.6819650
20	2.8-127	-83.8358768	60.6874648
21	2.8-127	-83.8369058	60.6853531
23	2.8-127	-83.8153281	60.6767395
33	2.8-127	-83.8454104	60.6713898
35	2.8-127	-83.8365280	60.6708700
37	2.8-127	-83.8447464	60.6549413
38	2.8-127	-83.8374532	60.6564269
52	2.8-127	-83.7911984	60.6521869
54	2.8-127	-83.7964893	60.6463988
56	2.8-127	-83.7955262	60.6405620
62	2.8-127	-83.7893980	60.6436794
64	2.8-127	-83.795128	60.6390573
65	2.8-127	-83.8058432	60.6316827
68	2.8-127	-83.8021929	60.6244035
80	2.8-127	-83.7682307	60.6813199
83	2.8-127	-83.7779391	60.6951467
84	2.8-127	-83.7418742	60.7001708
98	2.8-127	-83.7331991	60.6964045
103	2.8-127	-83.7466200	60.6854843
107	2.8-127	-83.7240834	60.6780293
108	2.8-127	-83.7575261	60.6819636
111	2.8-127	-83.7154346	60.7088936
122	2.8-127	-83.7058534	60.7139650
113	2.8-127	-83.7051527	60.7063610
114	2.8-127	-83.7052978	60.7205522
115	2.8-127	-83.6987556	60.7006562
116	2.8-127	-83.6969264	60.6943831
118	2.8-127	-83.7140955	60.6919556
125	2.8-127	-83.7661943	60.6729921
126	2.8-127	-83.7650734	60.6704880
TOTAL:	32		

PROJECT LOCATION

HARDIN COUNTY, OHIO

STATE MAP 

NOTES:

1. ANTICIPATED GROUNDWATER DEPTH BASED ON PROJECT GEOTECHNICAL REPORT. SEE DRAWING S-01 AND S-02 REFERENCE 2.
2. COORDINATES GEOGRAPHIC NAD83 AS PROVIDE BY INVENERGY LLC
3. TURBINE ID'S, COORDINATES AND PEDESTAL ELEVATIONS ARE TO BE VERIFIED BY CONTRACTOR WITH THE CIVIL DRAWINGS PRIOR TO CONSTRUCTION.

SECTION VIEW TITLE

LIMITS OF SECTION CUT
SECTION IDENTIFIER —

SECTION REFERENCES
(SHEET SECTION IS LOCATED ON)

SECTION VIEW CALL OUT

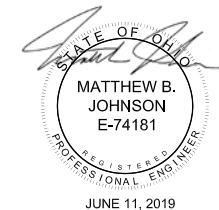
DRAWING INDEX

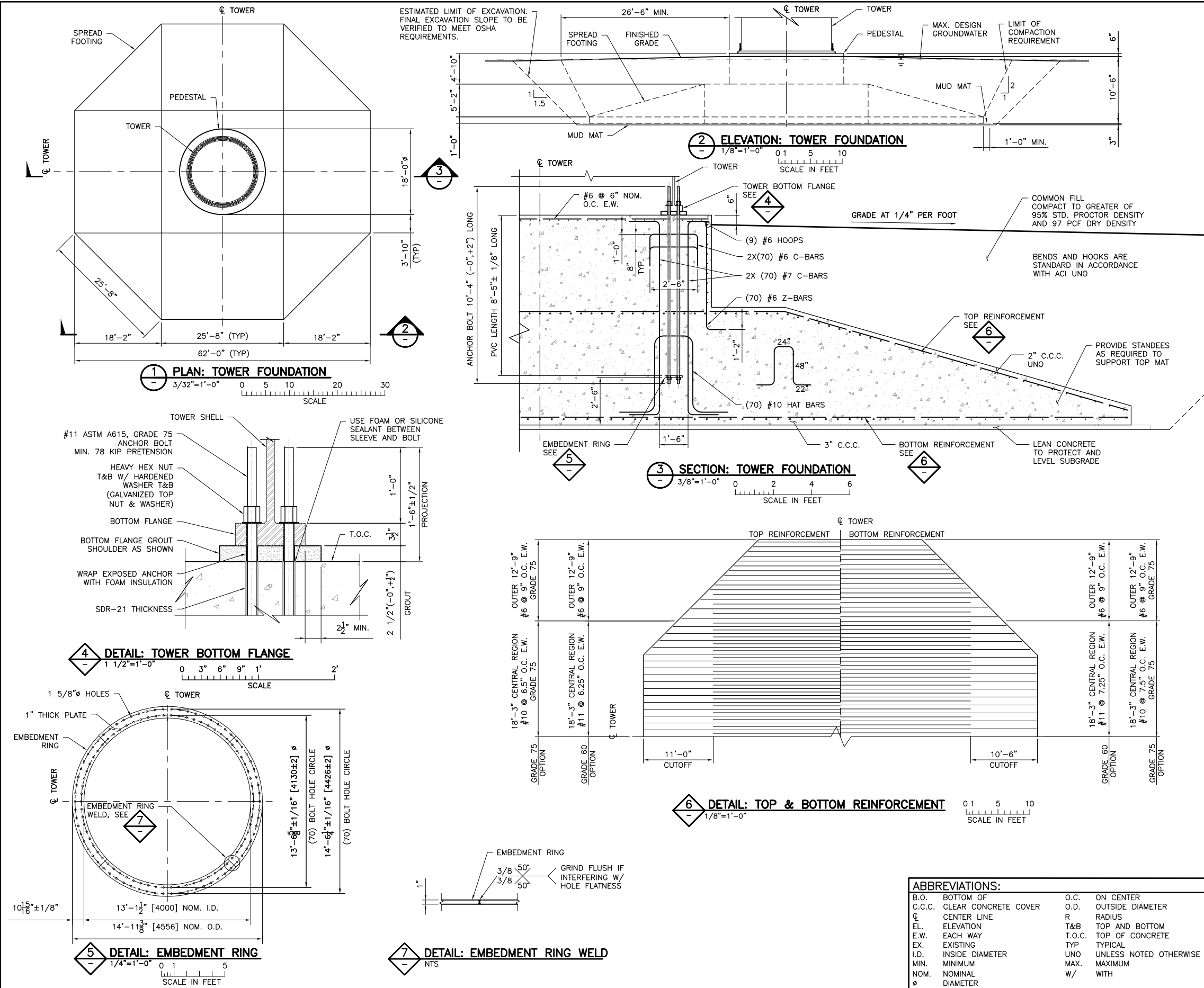
SHEET REV. TITLE

S-00	0	TITLE SHEET, DRAWING INDEX, AND SITE LOCATION MAP
S-01	0	GE 2.7-116 SPREAD FOOTING FOUNDATION PLAN, ELEVATION, SECTION, & DETAILS
S-02	0	GE 2.8-127 SPREAD FOOTING FOUNDATION PLAN, ELEVATION, SECTION, & DETAILS
S-03	0	SPREAD FOOTING FOUNDATION TECHNICAL SPECIFICATIONS AND SUBMITTALS
S-04	0	SPREAD FOOTING FOUNDATION SOIL CORRECTION SECTIONS AND SPECIFICATIONS

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[illegible]



BUILDING AND DESIGN CODES:
 2015 INTERNATIONAL BUILDING CODE, INTERNATIONAL CONFERENCE OF BUILDING OFFICIALS.
 BUILDING CODE REQUIREMENTS FOR STRUCTURAL CONCRETE, ACI 318, 2014, AMERICAN CONCRETE INSTITUTE.

WIND TURBINE AND TOWER:

MANUFACTURER: GE
 MODEL: 2.7-116
 POWER OUTPUT: 2.7 MW
 TURBINE HUB HEIGHT: 90m
 ROTOR DIAMETER: 116m

DESIGN SERVICE LOADS:

UNFACTORED SERVICE LOADS DUE TO EXTREME WIND CONDITION CLASS IEC S:
 (APPLY 1.35 LOAD FACTOR TO LOADS SHOWN BELOW TO OBTAIN FACTORED LOADS)
 OVERTURNING MOMENT, MXY = 49,218 KN-M = 36,301 FT-KIPS
 HORIZONTAL BASE SHEAR, HXY = 568 KN = 126 KIPS
 VERTICAL TOWER LOAD, WZ = 2,697 KN = 606 KIPS

UNFACTORED SERVICE LOADS DUE TO ABNORMAL EXTREME WIND CONDITION CLASS IEC S:
 (APPLY 1.10 LOAD FACTOR TO LOADS SHOWN BELOW TO OBTAIN FACTORED LOADS)
 OVERTURNING MOMENT, MXY = 55,997 KN-M = 41,301 FT-KIPS
 HORIZONTAL BASE SHEAR, HXY = 668 KN = 150 KIPS
 VERTICAL TOWER LOAD, WZ = 2,692 KN = 594 KIPS

DESIGN FATIGUE LIFE: 30 YEARS

FOUNDATION DESIGN DATA:

FACTOR OF SAFETY AGAINST OVERTURNING: >1.5
 MIN FACTOR OF SAFETY AGAINST SLIDING: >1.5
 MIN FACTOR OF SAFETY AGAINST BEARING CAPACITY FAILURE: >2.26 ON EXTREME

REFERENCE DOCUMENTS:

- GE RENEWABLE ENERGY, "FOUNDATION LOAD SPECIFICATION FOR WIND TURBINE GENERATOR SYSTEMS, HARDIN, OHIO (GE PROJECT 267241) 2.7-116, 60HZ, 90m NOMINAL HUB HEIGHT, COLD WEATHER EXTREME, IEC CLASS S," REV. 02 DATED 2019-04-17.
- BARR ENGINEERING COMPANY, "GEOTECHNICAL ENGINEERING REPORT, HARDIN WIND PROJECT, HARDIN COUNTY, OHIO," JANUARY 2012.

MIN 28-DAY COMPRESSIVE STRENGTH CONCRETE:
5,000 PSI

MIN YIELD POINT STRENGTH OF REINFORCING BAR:
60 KSI UNO

MIN STRENGTH OF ANCHOR BOLTS:
 TENSILE STRENGTH **100 KSI** YIELD STRENGTH **75 KSI**

MIN 28-DAY COMPRESSIVE STRENGTH OF NON-SHRINK GROUT:
10,500 PSI

MIN YIELD POINT STRENGTH OF EMBEDMENT PLATE:
36 KSI

VOLUME OF FOUNDATION AS DIMENSIONED:
504 CUBIC YARDS

ESTIMATED WEIGHT OF STEEL REINFORCING:
 GRADE 60 REINFORCEMENT OPTION:
45.0 TONS GRADE 60
 GRADE 75 REINFORCEMENT OPTION:
31.2 TONS GRADE 75
5.8 TONS GRADE 60

COARSE AGGREGATE GRADATION:
ASTM C33 (SIZE 6 OR 67) W/ MIN 2% RETAINED BY MASS ON THE 3/4-INCH SIEVE.

GROUNDWATER LEVEL: **0'-6" BELOW GRADE**

MIN REQUIRED GROSS SOIL BEARING CAPACITY:
1,750 PSF (NORMAL LOADING)
2,100 PSF (NORMAL EXTREME LOADING)
2,400 PSF (ABNORMAL EXTREME LOADING)



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JUNE 11, 2019

**HARDIN WIND PROJECT
 HARDIN COUNTY, OHIO**

**GE 2.7-116 SPREAD FOOTING FOUNDATION
 PLAN, ELEVATION, SECTION & DETAILS**

BARR PROJECT No.
35331001.01
 CLIENT PROJECT No.

DWG. No.
S-01
 REV. No.
0

NO.	BY	CHK.	APP.	DATE	REVISION DESCRIPTION
0	JMW	AST	MBJ	06/11/19	ISSUED FOR CONSTRUCTION
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

CLIENT	BID	CONSTRUCTION	RELEASED TO/FOR	DATE RELEASED

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Scale	AS SHOWN
Date	7/29/2016
Drawn	JMW
Checked	MBJ
Designed	JAD
Approved	MBJ

**INVENERGY, LLC
 CHICAGO, ILLINOIS**

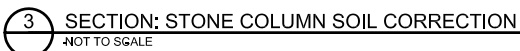
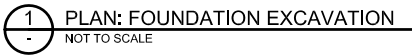


TABLE 1 NOTES:

1. PROJECT CONTRACTOR/SPECIALTY DESIGN-BUILD CONTRACTOR TO DETERMINE FINAL SOIL CORRECTION METHOD(S). SUGGESTED GROUND REMEDIATION OPTIONS INCLUDE:
 <4 FT - ENGINEERED FILL
 >4 FT - STONE COLUMNS
2. APPROXIMATE SOIL CORRECTION DEPTHS PER GEOTECHNICAL ENGINEERING REPORT. SEE REFERENCE ON DRAWING S-01 AND S-02.
3. D'VALUE ASSUMES A DISTANCE BELOW EXISTING GRADE TO BOTTOM OF MUDMAT AS SHOWN IN TABLE 1. ACTUAL DISTANCE BELOW EXISTING GRADE TO BOTTOM OF MUDMAT MAY VARY TO ACCOUNT FOR SITE SPECIFIC CONDITIONS, TO ALLOW FOR PROPER GRADING AWAY FROM THE FOUNDATION PEDESTAL, OR FOR CONFORMANCE TO THE CIVIL DRAWINGS. ADJUST 'D' VALUES ACCORDINGLY IF DISTANCE BELOW EXISTING GRADE TO BOTTOM OF MUDMAT VARIES FROM WHAT IS SHOWN IN TABLE 1.
4. TURBINE IDS, COORDINATES, AND FINISHED GRADE ELEVATIONS ARE TO BE VERIFIED BY CONTRACTOR WITH THE CIVIL DRAWINGS PRIOR TO CONSTRUCTION.

A. GENERAL

1. ENSURE FOUNDATION SITE IS EXCAVATED, BACKFILLED AND GRADED IN ACCORDANCE WITH THIS DRAWING AND DRAWINGS S-01 AND S-02.
2. PROJECT CONTRACTOR/SPECIALTY DESIGN-BUILD CONTRACTOR TO DETERMINE FINAL SOIL CORRECTION METHOD(S), SUGGESTED GROUND REMEDIATION OPTIONS INCLUDE ENGINEERED FILL, SURFACE COMPACTION, AND STONE COLUMNS.
3. THE MAXIMUM AND MINIMUM INDEX DENSITIES OF SOILS TO BE USED AS ENGINEERED FILL SHALL BE MEASURED ACCORDING TO ASTM D4253 AND D4254 OR A STANDARD PROCTOR DENSITY TO ASTM D698 PRIOR TO THE MATERIALS BEING PLACED.
4. ANTICIPATED CORRECTION DEPTHS AND SITE COORDINATES ARE REPRODUCED FROM THE PROJECT GEOTECHNICAL REPORT REFERENCED ON DRAWING S-01 AND S-02. BARR TAKES NO RESPONSIBILITY FOR THE SITE COORDINATES, DETERMINATION THAT SOIL CORRECTION IS REQUIRED, OR FOR THE METHOD OR DEPTH OF SOIL CORRECTION.

B. SUBMITTALS

1. PRIOR TO THE MATERIALS BEING PLACED SUBMIT GRAIN SIZE ANALYSIS (ASTM D422), NATURAL MOISTURE CONTENT (ASTM D2216), AND EITHER STANDARD PROCTOR (ASTM D698) OR MAXIMUM (ASTM D4253) AND MINIMUM (ASTM D4254) INDEX DENSITY TEST RESULTS FOR SOILS TO BE USED AS ENGINEERED FILL.
2. SUBMIT COMPACTION TEST RESULTS FOR ENGINEERED FILL PLACED BENEATH THE FOUNDATION INDICATING LOCATION OF TEST, DRY DENSITY, AND MOISTURE CONTENT OF PLACED ENGINEERED FILL.
3. SUBMIT A STONE COLUMN DESIGN REPORT, DRAWINGS, AND SPECIFICATIONS STAMPED BY AN OHIO PROFESSIONAL ENGINEER.
4. SUBMIT STONE COLUMN TESTING AND INSPECTION REPORTS.
5. THE SUBGRADE FOR EACH FOUNDATION SHALL BE INSPECTED BY A GEOTECHNICAL ENGINEER WITHIN 24 HOURS PRIOR TO PLACEMENT OF ENGINEERED FILL OR LEAN CONCRETE, AND WITHIN 24 HOURS AFTER SURFACE COMPACTION. SUBMIT SUBGRADE INSPECTION REPORT IN ACCORDANCE WITH DRAWING S-03 FOR EACH FOUNDATION COMPLETED BY A GEOTECHNICAL ENGINEER.

C. PRODUCTS

1. ENGINEERED FILL: PER OHIO DOT (ODOT) 703.17, A WELL GRADED GRANULAR SOIL CONSISTING OF GRAVEL, SAND OR CRUSHED STONE WITH A MAXIMUM SIZE OF 1 1/2", A MINIMUM OF 70% PASSING THE 3/4" SIEVE AND A MAXIMUM OF 10% PASSING THE NO. 200 SIEVE.
2. STONE COLUMNS: TO STONE COLUMN CONTRACTOR REQUIREMENTS.
3. LEAN CONCRETE AND COMMON FILL: SEE DRAWING S-03.

D. EXECUTION

1. WHERE NOTED IN TABLE 1, PERFORM SUBGRADE SOIL CORRECTION EITHER BY SURFACE COMPACTION, SUBCUTTING DEFICIENT SOILS AND REPLACING WITH COMPACTED ENGINEERED FILL OR LEAN CONCRETE, OR INSTALLING STONE COLUMNS TO THE DEPTHS INDICATED IN ACCORDANCE WITH THE APPLICABLE SOIL CORRECTION METHOD REQUIREMENTS.
2. HAVE THE PROJECT GEOTECHNICAL ENGINEER VERIFY THE SURFACE COMPACTION, DEPTH OF SUITABLE BEARING CONDITIONS AND REQUIRED SUBCUT AT THE TIME OF EXCAVATION, OR THE STONE COLUMN DEPTH AT THE TIME OF INSTALLATION AND INCLUDE THAT INFORMATION WITH THE SUBGRADE INSPECTION REPORT.
3. CONTROL SURFACE WATER OR GROUNDWATER FLOWS INTO THE EXCAVATION USING MEANS DETERMINED BY THE CONTRACTOR. IF SUCH MEANS ARE EMPLOYED, RECORD THE MEANS UNDERTAKEN, SOURCE OF WATER (GROUND OR SURFACE), AND VOLUME OF WATER CONTROLLED. SUBMIT A DEWATERING RECORD TO THE FOUNDATION ENGINEER.
4. SURFACE COMPACTION: SURFACE COMPACT BY USING A SMOOTH DRUM VIBRATORY COMPACTOR OR OTHER EQUIPMENT TO A MINIMUM OF 98% OF STANDARD PROCTOR MAXIMUM DRY DENSITY.
5. ENGINEERED FILL PLACEMENT AND COMPACTION: PLACE AND COMPACT ENGINEERED FILL TO THE LIMITS, DEPTH AND RELATIVE DENSITY OR STANDARD PROCTOR DENSITY INDICATED IN SECTION 1. PLACE AN INITIAL LIFT OF ENGINEERED FILL IMMEDIATELY AFTER COMPLETION OF THE EXCAVATION AND APPROVAL BY THE GEOTECHNICAL ENGINEER. MOISTURE CONDITION THE MATERIAL TO WITHIN 3% OF OPTIMUM (PER ASTM D698). PLACE ENGINEERED FILL IN LOOSE LIFTS OF 9 INCHES OR LESS TO ACHIEVE THE SPECIFIED DENSITY.
6. PLACE LEAN CONCRETE IN ACCORDANCE WITH DRAWING S-03.
7. PLACE COMMON FILL AND GRADE THE SITE IN ACCORDANCE WITH DRAWING S-03.

E. TESTING AND INSPECTION

1. FOR EVERY 1000 CUBIC YARDS OF PLACED ENGINEERED FILL: OBTAIN SAMPLES OF ENGINEERED FILL MATERIALS AND PERFORM GRAIN SIZE ANALYSIS, MOISTURE CONTENT, AND RELATIVE DENSITY OR PROCTOR TESTS.
2. FOR PLACED AND COMPACTED ENGINEERED FILL PROVIDE TWO DENSITY TESTS PER LIFT INDICATING TEST LOCATION, DRY DENSITY, MOISTURE CONTENT AND RELATIVE COMPACTION. IN THE EVENT THAT THE SPECIFIED COMPACTION REQUIREMENT IS NOT ACHIEVED, RECOMPACT AND RETEST THE ENGINEERED FILL.
3. FOR SURFACE COMPACTION PROVIDE FIVE DENSITY TESTS INDICATING TEST LOCATION (CENTER AND FOUR QUADRANTS), DRY DENSITY, MOISTURE CONTENT, AND RELATIVE COMPACTION. IN THE EVENT THAT THE SPECIFIED COMPACTION REQUIREMENT IS NOT ACHIEVED, RECOMPACT AND RETEST.
4. PERFORM STONE COLUMN TESTING AND INSPECTION IN ACCORDANCE WITH STONE COLUMN REQUIREMENTS. MINIMUM ONE TEST PER SOIL TYPE ENCOUNTERED.
5. PROVIDE A SUBGRADE INSPECTION REPORT TO BE COMPLETED BY A GEOTECHNICAL ENGINEER,

A circular professional engineer seal for the State of Ohio. The outer ring contains the text "STATE OF OHIO" at the top and "REGISTERED PROFESSIONAL ENGINEER" at the bottom. The inner circle contains the name "MATTHEW B. JOHNSON" and the license number "E-74181". A handwritten signature is written across the top of the seal.

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JUNE 11, 2019

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HARDIN WIND PROJECT
HARDIN COUNTY, OHIO

SPREAD FOOTING FOUNDATION
SOIL CORRECTION SECTIONS AND SPECIFICATIONS

BARR PROJECT No. _____

35331001 01

CLIENT PROJECT NO.

DWG. No.

S-04	0
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CADD USER: Matt B. Johnson FILE: M:\ADEPTWORK\MATT JOHNSON\35331001.01_S-03_SOIL CORRECTION.DWG PLOT SCALE: 1:2 PLOT DATE: 6/11/2019 9:44 PM

0	JWM	AST	MBJ	06/10/19	ISSUED FOR CONSTRUCTION	
NO.	BY	CHK.	APP.	DATE	REVISION DESCRIPTION	

CLIENT				6/10/19				
BID								
CONSTRUCTION				6/10/19				
PERMITTING								
RELEASED TO/FOR	A	B	C	0	1	2	3	
	DATE RELEASED							

BARR

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Scale	AS SHOWN
Date	4/17/2019
Drawn	SWO
Checked	AST
Designed	JMW
Approved	MBJ

INVENERGY, LLC
CHICAGO, ILLINOIS

This foregoing document was electronically filed with the Public Utilities

Commission of Ohio Docketing Information System on

6/17/2019 4:25:38 PM

in

Case No(s). 09-0479-EL-BGN, 11-3446-EL-BGA, 16-0469-EL-BGA, 16-2404-EL-BGA

Summary: Notification of Phase 3 – Compliance with Condition 23,
Turbine Foundation Design electronically filed by Christine M.T. Pirik on behalf of Hardin Wind
Energy LLC