Memorandum

To:	Korina Cassidy, Sand Hill Wind, LLC
From:	Laura Yoon, ICF
Cc:	Brad Schafer, ICF
Date:	June 19, 2018
Re:	**Sand Hill Air Quality and Greenhouse Gas Analysis**

Introduction

Air quality and greenhouse gas (GHG) impacts from repowering the Alameda County portion of the Altamont Pass Wind Resource Area (APWRA) were previously assessed in the *Altamont Pass Wind Resource Area Repowering Final Program Environmental Impact Report* (program EIR). The program EIR evaluated impacts associated with development of up to 450 megawatts (MW) in combined nameplate capacity within the program area. Sand Hill Wind, LLC (Sand Hill) is proposing to develop the 144.5 MW Sand Hill project (proposed project), which is in the program area and was included in the development capacity evaluated in the program EIR. This memorandum quantifies criteria pollutant and GHG emissions that would be generated by construction and operation of the proposed project.

Analysis Methods

Consistent with federal, state, and local guidance, the emissions analysis focuses on the following three types of pollutants that are of greatest concern for the proposed project.

- **Criteria pollutants—**Pollutants for which the U.S. Environmental Protection Agency (EPA) and California Air Resources Board (ARB) have set ambient air quality standards or that are chemical precursors to compounds for which ambient standards have been set. The criteria pollutants associated with the proposed project are ozone, particulate matter (PM) (PM10 is PM smaller than or equal to 10 microns in diameter and PM2.5 is PM smaller than or equal to 2.5 microns in diameter), carbon monoxide (CO), nitrogen dioxide (NO_2), and sulfur dioxide (SO_2).

- **Toxic air containments (TACs)—**The TAC of primary concern for construction and operation of the proposed project is diesel particulate matter (DPM). This pollutant is known or suspected to cause cancer and other serious health and environmental effects.
- **GHGs—**GHGs are gaseous compounds that limit the transmission of Earth's radiated heat out to space. GHGs include ozone, water vapor, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and fluorinated gases (e.g., chlorofluorocarbons, hydrofluorocarbons [HFC], and sulfur hexafluoride [SF_6]). The GHGs of concern for construction and operation of the proposed project are CO_2, CH_4, N_2O, and SF_6

Analysts estimated combustion exhaust and fugitive dust based on project-specific construction data (e.g., schedule, equipment, truck volumes) provided by the project engineer and a combination of emission factors and methodologies from CalEEMod, version 2016.3.2; ARB's EMFAC2017 model; EPA's AP-42 Compilation of Air Pollutant Emission Factors, and several other industry-accepted tools. Fugitive reactive organic gas emissions from architectural coating of the 6,000-square-foot operations and maintenance (O&M) building were also estimated using CalEEMod. All major design components of the project (e.g., road construction, turbine delivery) were quantitatively analyzed and included in the emissions modeling to ensure that emissions from construction and air quality impacts associated with the completed project were accurately assessed.

Project construction would take place in the Bay Area Air Quality Management District (BAAQMD). However, some equipment and materials would originate from the Port of Stockton and the city of Tracy, both of which are in the San Joaquin Valley Air Pollution Control District (SJVAPCD). Accordingly, consistent with the program EIR, heavy-duty truck trip exhaust emissions that would be generated in the SJVAPCD have been quantified and included in the construction analysis.

Operational criteria pollutant and GHG emissions were estimated for routine maintenance activities, worker commutes, and vehicle trips. The GHG analysis also considers emissions from minor electricity consumption and SF_6 circuit breaker leakage, as well as emission reductions that would occur from offsetting grid electricity, which includes fossil fuel-based resources, with wind-generated electricity, which is a renewable resource that does not generate any emissions.

Refer to Attachment A for the detailed modeling assumptions.

Analysis Results

Construction-Generated Criteria Pollutant Emissions

Table 1 summarizes estimated unmitigated emissions in SJVAPCD from construction of the proposed project. Emissions are presented in terms of tons per year and average pounds per day for comparison to SJVAPCD's (2015) thresholds. Table 2 summarizes unmitigated emissions in the BAAQMD in terms of pounds per day. The total amount, duration, and intensity of construction activity could have a substantial effect on the amount of construction emissions, their concentrations, and the resulting impacts occurring at any one time. Consequently, the emission forecasts provided in this analysis reflect a specific set of conservative assumptions based on the expected construction scenario wherein a relatively large amount of construction takes place in a

relatively intensive and overlapped schedule. Because of this conservative assumption, actual emissions could be less than those forecasted.

Table 1. Unmitigated Criteria Pollutants from Construction of the Sand Hill Project in SJVAPCD

	Average Pounds per Day[a]						Tons per Year					
Activity	ROG	NO_X	CO	SO_2	PM10	PM2.5	ROG	NO_X	CO	SO_2	PM10	PM2.5
Offsite truck trips	1	23	3	<1	4	1	<1	1	<1	<1	<1	<1
SJVAPCD threshold[b]	100	100	100	100	100	100	10	10	100	27	15	15
Significant Impact?	No	No	No	No	No	No	No	No	No	No	No	No

ROG = reactive organic gases.
NO_X = nitrogen oxide.
CO = carbon monoxide.
PM10 = particulate matter that is 10 microns in diameter and smaller.
PM2.5 = particulate matter that is 2.5 microns in diameter and smaller.
SO_2 = sulfur dioxide.

[a] Presents average emissions during a single day of construction in each year, consistent with guidance for correct application of SJVAPCD's ambient air quality analysis screening criteria.

[b] The 100-pound-per-day threshold is a screening-level threshold to help determine whether increased emissions from a project will cause or contribute to a violation of the ambient air quality standards.

Table 2. Unmitigated Criteria Pollutants from Construction of the Sand Hill Project in BAAQMD

					PM10		PM2.5	
Activity	ROG	NO_X	CO	SO_2	Exhaust	Dust	Exhaust	Dust
Laydown, substations and switch yards	4	39	22	<1	1	24	1	12
Road construction	9	***81***	47	<1	3	34	3	23
Turbine foundations	14	***131***	74	<1	5	57	4	35
Turbine delivery and installation	3	38	23	<1	1	7	1	1
Utility collector line installation	2	19	11	<1	1	10	1	6
O&M building construction	19	29	22	<1	2	7	2	6
Restoration and cleanup	4	37	19	<1	1	11	1	16
Offsite truck trips	2	41	9	<1	1	7	1	2
Offsite worker trips	<1	<1	4	<1	<1	3	<1	1
Maximum Daily[a]	50	***341***	188	1	12	142	12	84
BAAQMD (2017) threshold	54	54	-	-	82	BMPs	54	BMPs
Significant Impact?	No	***Yes***	No	No	No	***Yes***	No	***Yes***

ROG = reactive organic gases.
NO_X = nitrogen oxide.
CO = carbon monoxide.
PM10 = particulate matter that is 10 microns in diameter and smaller.
PM2.5 = particulate matter that is 2.5 microns in diameter and smaller.
SO_2 = sulfur dioxide.

[a] Includes all construction activities except *turbine delivery and installation* and *restoration and cleanup*, which would not occur during the period of maximum daily emissions (June 2019).

As shown in Table 1, material hauling activity in SJVAPCD would not exceed any of the air district's thresholds of significance.

As shown in Table 2, NO_x emissions generated by *road construction* and *turbine foundations* would independently exceed BAAQMD's threshold of significance. Maximum daily emissions from concurrent construction overlapping activities would also exceed the threshold. Consistent with BAAQMD guidance, fugitive dust emission would also be potentially significant without implementation of BMPs.

Mitigation Measures AQ-2a and AQ-2b from the program EIR are required to reduce NO_x and fugitive dust emissions from project construction. Table 3 summarizes mitigated emissions in the BAAQMD. As shown in Table 3, Mitigation Measures AQ-2a and AQ-2b would reduce fugitive dust emissions to a less-than-significant level, but NO_X emissions would still exceed BAAQMD's threshold and would therefore be significant and unavoidable.

Table 3. Mitigated Criteria Pollutants from Construction of the Sand Hill Project in BAAQMD

Activity	ROG	NO_X	CO	SO_2	PM10		PM2.5	
					Exhaust	Dust	Exhaust	Dust
Laydown, substations and switch yards	4	33	22	<1	1	12	1	6
Road construction	9	***66***	47	<1	2	17	2	11
Turbine foundations	14	***109***	74	<1	3	30	3	16
Turbine delivery and installation	3	31	23	<1	1	4	1	0
Utility collector line installation	2	15	11	<1	<1	5	<1	3
O&M building construction	19	23	22	<1	1	5	1	3
Restoration and cleanup	4	30	19	<1	1	5	1	7
Offsite truck trips	2	41	9	<1	1	7	1	2
Offsite worker trips	<1	<1	4	<1	<1	3	<1	1
Maximum Daily[a]	50	***288***	188	1	8	80	7	41
BAAQMD (2017) threshold	54	54	-	-	82	BMPs	54	BMPs
Significant Impact?	No	***Yes***	No	No	No	No	No	No

ROG = reactive organic gases.
NO_X = nitrogen oxide.
CO = carbon monoxide.
PM10 = particulate matter that is 10 microns in diameter and smaller.
PM2.5 = particulate matter that is 2.5 microns in diameter and smaller.
SO_2 = sulfur dioxide.

[a] Includes all construction activities except *turbine delivery and installation* and *restoration and cleanup*, which would not occur during the period producing the maximum daily emissions (June 2019.

Operational Criteria Pollutant Emissions

Table 4 presents estimated emissions from O&M of the proposed project. These emissions would occur exclusively in the BAAQMD and would begin following completion of project construction (i.e., the first operational year would be 2020). As shown in Table 4, O&M emissions would not exceed BAAQMD's thresholds of significance.

Table 4. Criteria Pollutants from Operation of the Sand Hill Project in BAAQMD (pounds per day)[a]

Activity	ROG	NO_X	CO	SO_2	PM10	PM2.5
Offsite worker trips	<1	<1	<1	<1	<1	<1
Maintenance/operation	2	21	13	<1	9	6
Total	2	21	14	<1	9	7
BAAQMD (2017) threshold	54	54	-	-	82	54
Significant Impact?	No	No	No	No	No	No

ROG = reactive organic gases.
NO_X = nitrogen oxide.
CO = carbon monoxide.
PM10 = particulate matter that is 10 microns in diameter and smaller.
PM2.5 = particulate matter that is 2.5 microns in diameter and smaller.
SO_2 = sulfur dioxide.

[a] Wind energy generated by the proposed project will displace a comparable quantity of conventional grid energy. Power plants located throughout the state supply the grid with power; some of these generate criteria pollutants. Because these power plants are located throughout the state, criteria pollutant reductions achieved by the proposed project cannot be fully ascribed to the BAAQMD and are therefore not reported in the table.

Greenhouse Gas Emissions

Table 5 summarizes estimated construction and operational GHG emissions associated with the proposed project. GHG emissions are inherently cumulative and do not ascribe to air district boundaries, like most regional and local criteria pollutants. Accordingly, GHG emissions generated in BAAQMD and SJVAPCD during construction are summed together in Table 5. Emission reductions that would occur from offsetting grid electricity with wind-generated electricity are also presented.

Table 5. GHG Emissions from Construction and Operation of the Sand Hill Project in BAAQMD (metric tons)

Source	CO_2	CH_4	N_2O	SF_6	CO_2e
Construction					
Laydown, substations and switch yards	57	<1	<1	0	58
Road construction	185	<1	<1	0	188
Turbine foundations	263	<1	<1	0	269
Turbine delivery and installation	128	<1	<1	0	131
Utility collector line installation	61	<1	<1	0	63
O&M building construction	21	<1	<1	0	21
Restoration and cleanup	88	<1	<1	0	89
Offsite truck trips	743	<1	<1	0	777
Offsite worker trips	93	<1	<1	0	94
Electricity use	1	<1	<1	0	1
Total	1,640	<1	<1	0	1,691
Amortized (per year for 30 years)					56
Operation					
Offsite worker trips	19	<1	<1	0	19

Source	CO_2	CH_4	N_2O	SF_6	CO_2e
Maintenance/operation	46	<1	<1	0	47
Electricity use	1	<1	<1	0	1
Circuit breaker leakage	0	0	0	<1	22
Total	66	<1	<1	<1	89
Total annual construction and operation emissions					145
Annual GHG reductions from offsetting grid electricity					-50,274
Annual net GHG emissions					-50,128

CO_2 = carbon dioxide.
CH_4 = methane.
N_2O = nitrous oxide.
SF_6 = sulfur hexafluoride.
CO_2e = carbon dioxide equivalent.
GHG = greenhouse gas.

As shown in Table 5, wind energy generated by the proposed project would reduce GHG emissions by approximately 50,000 metric tons carbon dioxide equivalent per year. This would more than offset emissions generated by project construction and O&M.

References Cited

Bay Area Air Quality Management District. 2017. *Air Quality Guidelines*. May.

San Joaquin Valley Air Pollution Control District. 2015. *Guidance for Assessing and Mitigating Air Quality Impacts*. March.

Attachment A

Detailed Modeling Assumptions

Table 1. Onsite Construction Equipment

Phase	County	Equipment Name	Number/Day	Hours/day	Fuel Type	HP	Start	End	Working Days
Laydown, substations and switch yards	Alameda	1-ton crew cab 4x4	2	8	Diesel	300	5/1/2019	6/30/2019	37
Laydown, substations and switch yards	Alameda	Road grader	1	8	Diesel	350	5/1/2019	6/30/2019	37
Laydown, substations and switch yards	Alameda	Track type dozer	1	8	Diesel	350	5/1/2019	6/30/2019	37
Laydown, substations and switch yards	Alameda	Drum type compactor	1	8	Diesel	250	5/1/2019	6/30/2019	37
Laydown, substations and switch yards	Alameda	Water truck	1	6	Diesel	350	5/1/2019	6/30/2019	37
Laydown, substations and switch yards	Alameda	Lowboy/truck/trailer	2	8	Diesel	500	5/1/2019	6/30/2019	37
Laydown, substations and switch yards	Alameda	Backhoe/front loader	1	8	Diesel	350	5/1/2019	6/30/2019	37
Road construction	Alameda	1-ton crew cab 4x4	2	8	Diesel	300	5/8/2019	7/31/2019	56
Road construction	Alameda	Road grader	2	8	Diesel	350	5/8/2019	7/31/2019	56
Road construction	Alameda	Track type dozer	2	8	Diesel	350	5/8/2019	7/31/2019	56
Road construction	Alameda	Drum type compactor	2	8	Diesel	250	5/8/2019	7/31/2019	56
Road construction	Alameda	Water truck	2	6	Diesel	350	5/8/2019	7/31/2019	56
Road construction	Alameda	Lowboy/truck/trailer	2	8	Diesel	500	5/8/2019	7/31/2019	56
Road construction	Alameda	Backhoe/front loader	1	8	Diesel	350	5/8/2019	7/31/2019	56
Road construction	Alameda	Excavator	1	8	Diesel	350	5/8/2019	7/31/2019	56
Road construction	Alameda	Rock crusher	1	8	Diesel	350	5/8/2019	7/31/2019	56
Turbine foundations	Alameda	1-ton crew cab 4x4	2	8	Diesel	300	6/3/2019	8/31/2019	49
Turbine foundations	Alameda	Road grader	3	8	Diesel	350	6/3/2019	8/31/2019	49
Turbine foundations	Alameda	Track type dozer	3	8	Diesel	350	6/3/2019	8/31/2019	49
Turbine foundations	Alameda	Drum type compactor	3	8	Diesel	250	6/3/2019	8/31/2019	49
Turbine foundations	Alameda	Water truck	3	6	Diesel	350	6/3/2019	8/31/2019	49
Turbine foundations	Alameda	Lowboy/truck/trailer	3	8	Diesel	500	6/3/2019	8/31/2019	49
Turbine foundations	Alameda	Backhoe/front loader	3	8	Diesel	350	6/3/2019	8/31/2019	49
Turbine foundations	Alameda	Excavator	2	8	Diesel	350	6/3/2019	8/31/2019	49
Turbine foundations	Alameda	Rock crusher	1	8	Diesel	350	6/3/2019	8/31/2019	49
Turbine foundations	Alameda	Cement trucks	3	8	Diesel	335	6/3/2019	8/31/2019	49
Turbine delivery and installation	Alameda	Crane	2	8	Diesel	500	7/1/2019	10/31/2019	88
Turbine delivery and installation	Alameda	Lowboy/truck/trailer	2	8	Diesel	500	7/1/2019	10/31/2019	88
Turbine delivery and installation	Alameda	Excavator	2	8	Diesel	400	7/1/2019	10/31/2019	88
Utility collector line installation	Alameda	1-ton crew cab 4x4	1	8	Diesel	300	6/15/2019	9/15/2019	76
Utility collector line installation	Alameda	Water truck	1	6	Diesel	350	6/15/2019	9/15/2019	76
Utility collector line installation	Alameda	Backhoe/front loader	1	8	Diesel	350	6/15/2019	9/15/2019	76
Utility collector line installation	Alameda	Trencher	1	8	Diesel	350	6/15/2019	9/15/2019	76
Utility collector line installation	Alameda	HDD bore machine	1	8	Diesel	350	6/15/2019	8/1/2019	37
O&M building construction	Alameda	Grader	1	8	Diesel	187	6/1/2019	6/4/2019	2
O&M building construction	Alameda	Tractors/loaders/backhoe	1	8	Diesel	97	6/1/2019	6/4/2019	2
O&M building construction	Alameda	Concrete/industrial saw	1	8	Diesel	81	6/5/2019	6/6/2019	2
O&M building construction	Alameda	Rubber-tired dozer	1	1	Diesel	247	6/5/2019	6/6/2019	2

Phase	County	Equipment Name	Number/Day	Hours/day	Fuel Type	HP	Start	End	Working Days
O&M building construction	Alameda	Tractors/loaders/backhoe	2	6	Diesel	97	6/5/2019	6/6/2019	2
O&M building construction	Alameda	Crane	1	4	Diesel	231	6/7/2019	8/27/2019	58
O&M building construction	Alameda	Forklift	2	6	Diesel	89	6/7/2019	8/27/2019	58
O&M building construction	Alameda	Tractors/loaders/backhoe	2	8	Diesel	97	6/7/2019	8/27/2019	58
O&M building construction	Alameda	Vendor truck	1	8	Diesel	300	6/7/2019	8/27/2019	58
O&M building construction	Alameda	Air compressor	1	6	Diesel	78	8/28/2019	8/31/2019	4
Restoration and cleanup	Alameda	Road grader	3	8	Diesel	350	8/1/2019	11/30/2019	55
Restoration and cleanup	Alameda	Excavator	3	8	Diesel	350	8/1/2019	11/30/2019	55

Table 2. Offsite Construction Vehicles

Phase	County	Vehicle Type	Number/Day	Fuel Type	Miles/Trip	Total Trips	Start	End
WTG machines, pads and substation materials	Alameda	Light duty	3	Gasoline	1	360	5/1/2019	10/31/2019
WTG machines, pads and substation materials	Alameda	Light duty	3	Gasoline	1	360	5/1/2019	10/31/2019
WTG machines, pads and substation materials	Alameda	Light duty	3	Gasoline	23	360	5/1/2019	10/31/2019
WTG machines, pads and substation materials	Alameda	Heavy duty	4	Diesel	5	590	5/1/2019	10/31/2019
WTG machines, pads and substation materials	Alameda	Heavy duty	4	Diesel	1	590	5/1/2019	10/31/2019
WTG machines, pads and substation materials	Alameda	Heavy duty	4	Diesel	29	590	5/1/2019	10/31/2019
WTG machines, pads and substation materials	Alameda	Heavy duty	11	Diesel	6	1,430	5/1/2019	10/31/2019
WTG machines, pads and substation materials	Alameda	Heavy duty	11	Diesel	1	1,430	5/1/2019	10/31/2019
WTG machines, pads and substation materials	Alameda	Heavy duty	11	Diesel	19	1,430	5/1/2019	10/31/2019
Roads, WTG foundations and aggregate	Alameda	Light duty	37	Gasoline	1	3,240	5/1/2019	8/31/2019
Roads, WTG foundations and aggregate	Alameda	Light duty	37	Gasoline	1	3,240	5/1/2019	8/31/2019
Roads, WTG foundations and aggregate	Alameda	Light duty	37	Gasoline	23	3,240	5/1/2019	8/31/2019
Roads, WTG foundations and aggregate	Alameda	Heavy duty	57	Diesel	5	5,000	5/1/2019	8/31/2019
Roads, WTG foundations and aggregate	Alameda	Heavy duty	57	Diesel	1	5,000	5/1/2019	8/31/2019
Roads, WTG foundations and aggregate	Alameda	Heavy duty	57	Diesel	29	5,000	5/1/2019	8/31/2019
Roads, WTG foundations and aggregate	Alameda	Heavy duty	8	Diesel	6	707	5/1/2019	8/31/2019
Roads, WTG foundations and aggregate	Alameda	Heavy duty	8	Diesel	1	707	5/1/2019	8/31/2019
Roads, WTG foundations and aggregate	Alameda	Heavy duty	8	Diesel	19	707	5/1/2019	8/31/2019
WTG machines, pads and substation materials	San Joaquin	Heavy duty	3	Diesel	56	357	5/1/2019	10/31/2019
WTG machines, pads and substation materials	San Joaquin	Heavy duty	2	Diesel	16	233	5/1/2019	10/31/2019
Roads, WTG foundations and aggregate	San Joaquin	Heavy duty	34	Diesel	56	3,028	5/1/2019	8/31/2019
Roads, WTG foundations and aggregate	San Joaquin	Heavy duty	22	Diesel	16	1,972	5/1/2019	8/31/2019
Worker trips	Alameda	Light duty	69	Gasoline	25	10,575	5/1/2019	11/30/2019

Table 3. Construction Site Disturbance

Phase	Total Acres
Laydown, substations and switch yards	35
Road Construction	53
Turbine foundations	110
Utility collector line installation	47
O&M building construction	3
Restoration and cleanup	224

Table 4. Operations and Maintenance

Phase	County	Equipment Name	Number/Day	Hours/day	Fuel Type	HP	Start	End	Working Days	Daily Miles	Total Acres
Maintenance/operation	Alameda	1 ton crew cab 4x4	2	4	Diesel	300	1/1/2020	12/31/2020	262	120	-
Maintenance/operation	Alameda	Road grader	1	8	Diesel	350	1/1/2020	1/7/2020	5	-	1.00
Maintenance/operation	Alameda	Crane	1	8	Diesel	500	1/1/2020	1/7/2020	5	-	-
Maintenance/operation	Alameda	Lowboy/truck/trailer	1	2	Diesel	500	1/1/2020	1/14/2020	10	30	-
Maintenance/operation	Alameda	Generator	2	2	Diesel	100	1/1/2020	12/31/2020	262	-	-
Worker trips	Alameda	Light duty	2	-	Gasoline	-	1/1/2020	12/31/2020	262	213	-