

Technical Comments on the Utah DAQ's Proposed Approval of Granite Construction Company's I-80 South Quarry Project Number N161200001

by

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A. Introduction

Via this comment report, I am providing timely technical comments pertaining to Utah DAQ's proposed action noted in the Title. It concerns the approval of a large limestone mine to be located south of I-80 off Exit 132 in Parley's Canyon East of Salt Lake City in Salt Lake County.

In preparing these comments, I have carefully reviewed the record as provided in DAQ's website at <https://daqpermitting.utah.gov/DocViewer?IntDocID=137185&contentType=application/pdf>. This 410 page document contains DAQ's Engineer Review of the proposed air permit approval, various correspondence with the project applicant, Granite Construction, and its consultant Trinity. It also contains Trinity's initial permit application and air dispersion modeling review. I cite to and excerpt from this document and in these comments I will use pdf page numbers from this project file. In addition, I cite to various other documents, either via footnotes or via excerpts. In the interest of completeness, I provide copies of these other documents in Attachment B.

I have attempted to provide specific comments with particularity so that the DAQ should have no confusion or difficulty in understanding the specific comments being made. Therefore, I respectfully request that the DAQ provide similar particularity in its responses to these comments in the interest of the complete record.

¹ Resume provided in Attachment A.

B. Summary of My Comments and Opinions

B.1 Project Definition Is Not Clear

The project definition and description are not clear. In prior submittals to the Utah DOGM, there were references to “small” and “large” mine options. It is my understanding that only the small mine option is being permitted by this proposed action.² And, within that, the project consists of Phase I (which will involve an initial year of pioneering, bootstrapping, and other actions)³ followed by Phase 2, which will be the rest of the active life of the mine. In each Phase, particularly Phase 2, it appears that the disturbed area will be limited to 10 acres. However, it is not clear, as the operations move within the mine area, why disturbed areas will not grow in size as operations continue into future years due to the continued emissions from disturbed areas from prior years that cannot be revegetated properly. There is nothing in the record to indicate that a 10-acre disturbed area in Year N will stop ceasing to be a source of fugitive PM10/PM2.5 emissions in Years N+1, N+2, etc. until such time as natural vegetation growth may inhibit such emissions. I ask the DAQ to therefore explain, in detail, how the actual Phase 2 portion will not grow, at least as far as disturbed areas from prior years are concerned.

Similarly, I note that all of the air dispersion modeling for Phase 2 assumes a static configuration of the operations (i.e., the location of drilling/blasting, stockpiles, etc.). But, since operations will move around the mine area over time in Phase 2, what was the basis for the assumed static configuration assumed in the air dispersion modeling analysis? I ask the DAQ to please clarify.

The throughput assumed varies from 1,000,000 tons per year to 1,100,000 tons per year in some instances. The gap between these two values is not properly quantified in the record and it should be. A loss of 100,000 tons per year or, over 11 tons per hour of unexplained material is not trivial. I ask the DAQ to clarify the actual production rates. Related to this, and since Granite seems to presume that a 10% material loss is not consequential, I ask the DAQ to clearly identify the fate of this “lost” material.

B.2 Emissions Inventory Is Unsupported and Underestimates Emissions

(ii) A fundamental and inescapable part of any proper air permit analysis is a proper emissions inventory, in which the appropriate emissions (in this case, as in the case with every permitting exercise, the Potential-to-Emit, or PTE) is quantified across a range of time scales, such as hourly to annual for the various pollutants of interest from each source or activity that can produce that pollutant. For the reasons discussed in these comments, and in spite of DAQ staff’s recognition that the emissions inventory is a crucial aspect of its project evaluation,⁴ the PTE emission inventory for particulate matter (of two sizes, PM10 and PM2.5) are grossly unsupported, inaccurate and unreliable. I focus my comments on these two pollutants. For reasons that are

² See, pdf page 74. All references to pdf page numbers are for the single 410 page pdf document that is available in the public record at the DAQ’s website at

<https://daqpermitting.utah.gov/DocViewer?IntDocID=137185&contentType=application/pdf>.

³ See pdf page 319.

⁴ See, for example, the email of pdf page 307 where the permit engineer Mr. Persons states that the emissions inventory should be “...really solid...”

broadly similar, the PTE inventory for other pollutants including criteria (NO_x, VOC, CO, SO₂, etc.) and hazardous air pollutants or HAPs are also similarly deficient. In subsequent discussions, I provide more details about why the emissions inventory for PM₁₀/PM_{2.5} is unreliable and under predicts the PTE for these pollutants later in my comments.

B.3 Classification of the Mine As a Minor Source Is Unsupported

Following from (ii), any subsequent analysis or conclusion that relies on the emissions inventory is also unreliable and unsupported. Importantly, this includes DAQ's premature determination that the proposed mine will be a minor source of air pollutants and will therefore not be subject to the requirements of a major source of air emissions.

B.4 Air Dispersion Modeling Is Fatally Flawed

Also following from (ii), analyses such as the air dispersion modeling that has been conducted in this matter using the flawed emissions inventory as a critical input to the modeling, are also unsupported and unreliable and any results from the dispersion modeling should be set aside.

In addition to the flawed emissions input, the air dispersion modeling also suffers from additional fatal flaws. The first flaw is the use of surface meteorological data not collected at the proposed mine site with its complex topography but rather from the Salt Lake City airport, located some distance away with no showing or demonstration that this airport data, collected at a flat area (like all such data collected at any airport) is representative of the mine location, in a narrow canyon. Second, the modeling uses "background" concentration levels that are not shown to be representative of the mine location. I note that there has been sufficient time for the project proponent to have collected both on-site meteorological data and also background (i.e., current, pre-mining activity baseline) concentration data at the site. This, much more representative data, should have been collected and used in the modeling analysis. The excuse that this type of pre-construction monitoring was not required per regulations since the proposed mine is not a major source, fails due to the circularity of the argument. Besides, I am not aware of any constraint on DAQ to have required Granite to collect and then use on-site, representative, data for modeling conducted by its consultant. This is yet more reason to set aside all conclusions from the modeling that DAQ seems to have misrepresented to the public.

This issue is very critical because even with all of the flaws the modeling analysis shows that the predicted ambient impacts of PM₁₀ are very close (within a few percentage points) of exceeding the applicable National Ambient Air Quality Standard.⁵

B.5 There Is No Enforceability or Practical Ability to Verify Compliance

Turning now to verification, especially for PM₁₀/PM_{2.5} emissions from the various activities and sources, the vast majority of which are fugitive and cannot therefore be "stack" tested as a practical matter, the DAQ relies almost exclusively on opacity measurements. There are significant issues with this approach. First, while the permit requires opacity measurements and that they be conducted using the standard EPA Method 9, DAQ does not discuss the frequency of such

⁵ See pdf pages 83-84.

measurements for each activity. Since mining activities and sources will occur at all times, the lack of any consideration of frequency is a glaring deficiency.

Second, as DAQ is well aware, Method 9 is conducted by a certified opacity reader, during daytime hours only, and under significantly constrained requirements for where the observer needs to stand/be versus the source and the sun. This means that obtaining valid Method 9 measurements can be very challenging, even during daylight hours in the canyon. Of course, Method 9 cannot be used at night. Therefore, since mine operations are not limited to daytime hours, Method 9 opacity measurements, even if technically feasible at all, cannot suffice as a verification tool for ensuring that excessive PM10/PM2.5 emissions do not occur above the limits noted in the permit. DAQ should include other approaches including upwind/downwind monitoring of PM10/PM2.5 across the working area of the mine, along with locally collected meteorological data. I am also aware of a variant to Method 9 known as Method 9N, developed for nighttime operations and ask that the DAQ require its use.

More broadly, there are numerous permit conditions that simply do not contain any practical verification approaches. I discuss them later in these comments.

B.6 The BACT Analysis Is Unsupported And Cursory

The permit analysis includes a short discussion about Best Available Control Technology (BACT) for various activities. Specifically, for PM2.5, the area is non-attainment at present.⁶ So, the requirement should have been to include the Lowest Achievable Emission Rate (LAER) instead of BACT. LAER, as DAQ well knows, cannot reject a technically feasible option on economic or cost-effectiveness grounds. Yet, as part of its unsupported BACT analysis, Granite and DAQ have made conclusionary statements about certain options not being economic, with no cost analysis that I could find in the record.

B.7 There Are Additional Miscellaneous Deficiencies

In addition to these issues, I have a number of miscellaneous issues that I note in my comments. In the interest of ease of reference and readability, I have generally excerpted portions of the record when discussing a specific comment or a set of comments. Typically, I have emphasized areas that are not clear or supported or those that need more explanation by highlighting with red boxes or yellow highlights. While I have attempted to call these out in each instance, I ask the DAQ to specifically address and provide explanations (such as the support for an assumption or support for why an assumption should apply to this specific mine site, for example) for each such highlighted area.

⁶ The Engineer Report makes it clear that the project is located in the Northern Wasatch Front ozone Non-attainment Area, the Salt Lake City UT PM2.5 Non-attainment Area, and Salt Lake County SO2 Non-attainment Area.

C. The Emissions Estimates for PM10/PM2.5 Are Fatally Flawed and Underestimated

As I have noted prior, at the heart of the permitting analysis lies the emissions inventory. Getting this wrong automatically invalidates all of the other analyses, such as air dispersion modeling (for which the emissions are a critical important), BACT (since emissions are critical for an assessment of cost-effectiveness, even though this was not performed in the present instance), etc.

C1 The Emissions Estimates Are Not Potential Emissions, as Misrepresented

To start with the Engineer Report summarizes the “total potential emissions,” which I have previously notes as PTE as below. This is from Phase 2. Emissions from Phase 1 are very similar and only slightly smaller for PM10 and PM2.5.

Criteria Pollutant	Change (TPY)	Total (TPY)
CO ₂ Equivalent	403103.00	403103.00
Carbon Monoxide	16.68	16.68
Nitrogen Oxides	1.73	1.73
Particulate Matter - PM ₁₀ (Fugitives)	11.40	11.40
Particulate Matter - PM _{2.5}	2.44	2.44
Sulfur Dioxide	0.03	0.03
Volatile Organic Compounds	0.78	0.78

Hazardous Air Pollutant	Change (lbs/yr)	Total (lbs/yr)
Total HAPs (CAS #THAPS)	100	100
	Change (TPY)	Total (TPY)
Total HAPs	0.05	0.05

Note: Change in emissions indicates the difference between previous AO and proposed modification.

Since it is of utmost importance, I note that the term “potential” in the emissions inventory means the maximum possible emissions, subject to the design of the equipment, work activities, and any enforceable permit limits.⁷ As I will note later, the permit limits in this permit for PM10/PM2.5 are not enforceable in any sort of practical matter. Nor are the myriad, assumed, “control efficiency” values used in the permit calculations. In addition, as I will note and discuss below, the emissions calculation rely predominantly on EPA’s AP-42 document. At best, the emission factors from this document are average and not maximum values. Thus, using AP-42 emission factors, even if appropriate (and they are not, as will be discussed) cannot be used to estimate potential emissions.

C2 The Emissions Estimates Rely Predominantly on AP-42

⁷ See, for example, any EPA definition of PTE. “Potential to emit” is the maximum capacity of a stationary source to emit under its physical and operational design. Any physical or operational limitation on the source to emit an air pollutant, including air pollution control equipment and restrictions on hours of operation, or on the type or amount of material combusted, stored, or processed, shall be treated as part of its design if the limitation is enforceable by the (EPA) Administrator.” <https://www.epa.gov/sites/default/files/2015-07/documents/lowmarch.pdf>

This is readily confirmed by the following summary of the emissions estimates from the Engineer Report.

“There are various sources of emissions at this facility including emissions from crushing, screening, dozing, loading, drilling, blasting, disturbed land, fugitive road, engines, and tanks. The basis for these emission calculations is briefly listed below.

The emissions from crushing, screening and material handling were calculated using the emissions factors per "EPA Potential to Emit Calculator for Stone, Quarrying, Crushing, and Screening Plants" (November 2013) and from AP-42 11.19.2.

The emissions from the operation of bulldozers was calculated using emissions factors from AP-42 Section 1.9 (October 1998) Tables 11.9-1 and 11.9-3.

The drop emissions from loading aggregate onto crushers and haul trucks was calculated with uncontrolled emissions factors using the "drop equation" contained in AP-42 Section 13.2.4 (November 2006).

The emissions from the wind erosion of stockpiles was calculated using the stockpile wind erosion factor for active storage piles from AP-42 4th edition Table 8-19.1.1.

The emissions from drilling and blasting were calculated using emissions factors from AP-42 11.9.

The emissions from disturbed ground were calculated using emissions factors for "Wind Erosion of Exposed Areas" from AP-42 Table 11.9-4 and scaling factors based on bulldozing overburden from Table 11.9-1.

The emissions from paved and unpaved haul roads from the "UDAQ guidelines: Emissions Factors for Paved and Unpaved Haul Roads" (January 2015) and from AP-42 Section 13.2.2 (November 2006)....." (emphasis added)

It is clear that with the exception of the UDAQ guidelines noted in the last item above and also a few references in the Trinity permit application to a few NIOSH documents and a document from the WRAP organization, the emissions estimates rely on various chapters of AP-42. I first discuss the inappropriateness of using AP-42 and then address these other documents.

C3 AP-42 Is An Inappropriate Source for Developing Emissions Estimates

C3.1 AP-42 Is Designed, At Best, to Provide Estimates of Average Emissions and Not PTE

As the U.S. EPA itself explicitly acknowledges, there are many flaws and short-comings inherent to its use of AP-42; the EPA accordingly cautions users to take those flaws into account. These caveats, however, are neither recognized nor respected in the DAQ review or by Granite and its consultant. As a result, the PTE emissions estimates noted earlier – the critical foundation of the proposed permits -- are deeply flawed. The persistent bias introduced by this inappropriate reliance on the AP-42 is that resulting emissions projected are major underestimates.

The primary limitation on the use of AP-42 for PTE calculations is that its factors are designed only to approximate average emission rates, not the maximum emission rate necessary to appropriately calculate PTE for permitting purposes. As stated by U.S. EPA:

“In most cases, these factors are simply averages of all available data of acceptable quality, and are generally assumed to be representative of long-term averages for all facilities in the source category (i.e., a population average).”⁸ (emphasis added)

“Emission factor ratings in AP-42...provide indications of the robustness, or appropriateness, of emission factors for estimating average emissions for a source activity.”⁹ (emphasis added)

“Emission factors in AP-42 are neither EPA-recommended emission limits . . . nor standards. . . Use of these factors as source-specific permit limits and/or as emission regulation compliance determination is not recommended by EPA. Because emission factors essentially represent an average of a range of emission rates, approximately half of the subject sources will have emission rates greater than the emission factor and the other half will have emission rates less than the factor.”¹⁰

And, additionally:

“Average emissions differ significantly from source to source and, therefore, emission factors frequently may not provide adequate estimates of the average emissions for a specific source. The extent of between-source variability that exists, even among similar individual sources, can be large depending on process, control system, and pollutant. . . As a result, some emission factors are derived from tests that may vary by an order of magnitude or more. Even when the major process variables are accounted for, the emission factors developed may be the result of averaging source tests that differ by factors of five or more.”¹¹

Based on the above, it is clear that AP-42 emission factors are inappropriate for developing PTE estimates, since PTE, per the definition provided earlier, is supposed to represent the “potential”

⁸ AP-42 Introduction, p. 1. Available at <https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-compilation-air-emissions-factors>

⁹ *Ibid.*, p. 2.

¹⁰ *Ibid.*, p. 2 (emphasis added).

¹¹ *Ibid.*, p. 3.

or high-end emission estimate value. In contrast, AP-42 emission factors represent “average” and not maximum emission rates.

Thus, in each instance that the applicant’s PTE calculations rely on AP-42 emission factors the resultant PTE emissions (all other criticisms aside) are unquestionably underestimates – see later discussion on the significant underestimation of emissions using the drop equation, for example. In addition, using average emission factors underestimates PTE by definition. This has material consequences as previously discussed since the PTE estimates are a key input in the air dispersion modeling impacts analysis, for example. I therefore ask the DAQ to specifically address this shortcoming.

C3.2 The Reliability of AP-42 As Reflected in Rankings Should Be Considered

Even if it were proper to rely on the AP-42 factors to calculate PTE, which it is not, the present permit analysis makes no mention to the quality of emission factors used by Granite and accepted by DAQ. Quality of the emission factor directly reflects on the accuracy of the emissions estimates. As DAQ is undoubtedly well aware, AP-42 uses a rating system, quoted below, to provide the user with the accuracy of a particular emission factor:

“Each AP-42 emission factor is given a rating from A through E, with A being the best. A factor’s rating is a general indication of the reliability, or robustness, of that factor. This rating is assigned based on the estimated reliability of the tests used to develop the factor and on both the amount and the representative characteristics of those data. In general, factors based on many observations, or on more widely accepted test procedures, are assigned higher rankings. Conversely, a factor based on a single observation of questionable quality, or one extrapolated from another factor for a similar process, would probably be rated much lower....

The AP-42 emission factor rating is an overall assessment of how good a factor is, based on both the quality of the test(s) or information that is the source of the factor and on how well the factor represents the emission source. Higher ratings are for factors based on many unbiased observations, or on widely accepted test procedures. For example, ten or more source tests on different randomly selected plants would likely be assigned an "A" rating if all tests are conducted using a single valid reference measurement method. Likewise, a single observation based on questionable methods of testing would be assigned an "E", and a factor extrapolated from higher-rated factors for similar processes would be assigned a "D" or an "E".

AP-42 emission factor quality ratings are thus assigned:

A — Excellent. Factor is developed from A- and B-rated source test data taken from many randomly chosen facilities in the industry population. The source category population is sufficiently specific to minimize variability.

B — Above average. Factor is developed from A- or B-rated test data from a "reasonable number" of facilities. Although no specific bias is evident, it is not clear

if the facilities tested represent a random sample of the industry. As with an A rating, the source category population is sufficiently specific to minimize variability.

C — Average. Factor is developed from A-, B-, and/or C-rated test data from a reasonable number of facilities. Although no specific bias is evident, it is not clear if the facilities tested represent a random sample of the industry. As with the A rating, the source category population is sufficiently specific to minimize variability.

D — Below average. Factor is developed from A-, B- and/or C-rated test data from a small number of facilities, and there may be reason to suspect that these facilities do not represent a random sample of the industry. There also may be evidence of variability within the source population.

E — Poor. Factor is developed from C- and D-rated test data, and there may be reason to suspect that the facilities tested do not represent a random sample of the industry. There also may be evidence of variability within the source category population.”¹²

Note, in particular, the very poor reliabilities of “D” and “E” rated factors. As I will show in the examples below, the applicant and DAQ have used unreliable D and E rated factors in numerous instances to estimate the PTEs of many pollutants.

The record makes clear that DAQ was aware that AP-42 ratings can be poor. See the excerpt below from an email by Enqiang He of DEQ to the permit engineer, Mr. Persons.

Enqiang He <ehe@utah.gov>
To: John Persons <jpersons@utah.gov>, Alan Humpherys <ahumpherys@utah.gov>

Wed, Jan 25, 2023 at 11:59 AM

John,

AP-42 Section 13.2.4, Aggregate handling and storage piles, includes loading in/out and wind erosion emissions. This is what we have used to estimate fugitive dust emissions from storage piles.

As for other emissions, such as disturbed areas, loader operating areas, and haul road emissions, we have different ways to estimate emissions. For disturbed areas, we usually allow sources to use Table 11.9-4 in AP-42 Section 11.9. Western Surface Coal Mining. This method is quick but may be not very accurate (overestimated?) (C rating).

<https://mail.google.com/mail/u/0/?ik=6400efa1da&view=pt&search=all&permthid=thread-f:1755917286141044903&simpl=msg-f:17559172861410449...> 4/9

¹² *Ibid.*, pp. 8-10.

I reiterate that that agree that a C-rating is “not very accurate” and that lower ratings D and E are even less so.

C3.3 EPA Itself Has Alerted Users Against Using AP-42

In November 2020, i.e., prior to the submittal of the initial permit application for this mine, the EPA specifically alerted all users and practitioners against the use of AP-42.¹³ The excerpt of the red-fonted alert is excerpted below.



EPA Reminder About Inappropriate Use of AP-42 Emission Factors

I quote from the Enforcement Alert below:

“This purpose of this Enforcement Alert is to remind permitting agencies, consultants, and regulated entities that improperly using AP-42 emission factors can be costly to their businesses, inefficient, and in some circumstances, can subject regulated entities to enforcement and penalties. The Environmental Protection Agency (EPA) is concerned that some permitting agencies, consultants, and regulated entities may incorrectly be using AP-42 emission factors in place of more representative source-specific emission values for Clean Air Act permitting and compliance demonstration purposes.

....

Permitting agencies, consultants, and regulated entities should be aware that even emission factors with more highly rated AP-42 grades of “A” or “B” are only based on averages of data from multiple, albeit similar, sources (See the Attachment for an overview of the history of AP-42 emission factors and the AP-42 emission factor rating system). Accordingly, these factors are not likely to be accurate predictors of emissions from any one specific source, except in very limited scenarios. While emission factors are helpful in making emission estimates for area-wide inventories for specific source types, AP-42 provides the following warning:

¹³ <https://www.epa.gov/sites/default/files/2021-01/documents/ap42-enforcementalert.pdf>

“Use of these factors as source-specific permit limits and/or as emission regulation compliance determinations is not recommended by EPA. Because emission factors essentially represent an average of a range of emission rates, approximately half of the subject sources will have emission rates greater than the emission factor and the other half will have emission rates less than the factor. As such, a permit limit using an AP-42 emission factor would result in half of the sources being in noncompliance.” (citation omitted, emphasis in original)

With the advent of 1-hour and short-term National Ambient Air Quality Standards (NAAQS), permit limits must be able to account for short term fluctuations. AP-42 emission factors also do not account for short term variation in emissions as the emission factors are intended for use in developing area-wide annual or triannual inventories. In developing emission factors, test data are typically taken from normal operating conditions and generally avoid conditions that can cause short-term fluctuations in emissions. These short-term fluctuations in emissions can stem from variations in process conditions,

control device conditions, raw materials, ambient conditions, or other similar factors. This means that if facilities use AP-42 emission factors as permit limits, facilities increase their chances of violating their short-term permit limits. It also increases the likelihood of a geographic area’s non-compliance with the NAAQS.

It is also important to understand that there is a great deal of variability in the emissions data that are used to generate the emission factors. This variability is not necessarily reflected in the emission factor. AP-42 describes this as follows:

“The extent of between-source variability that exists, even among similar individual sources, can be large depending on process, control system, and pollutant. Although the causes of this variability are considered in emission factor development, this type of information is seldom included in emission test reports used to develop AP-42 factors. As a result, some emission factors are derived from tests that may vary by an order of magnitude or more. Even when the major process variables are accounted for, the emission factors developed may be the result of averaging source tests that differ by factors of five or more.” (citation omitted, emphasis in original)”

In addition, EPA provided a summary table below showing that of all the available approaches for developing emissions estimates, AP-42 is the “last resort.”

What Can Be Done?

Consultants and facility owners/operators should obtain and use the most representative emissions data, which in many cases may be source-specific emissions data, when determining applicability, applying for a permit, or demonstrating compliance with permit limits.

Various EPA publications (e.g., <https://www.epa.gov/emc>) describe the benefits and limitations of different ways to quantify source-specific emissions. These techniques in order of accuracy are:

- **Continuous Emissions Monitoring System (CEMS)** – CEMs offers a highly accurate source-specific method that continuously monitors the emissions coming out of a particular stack; however, although the accuracy of this method is high, the cost is also the highest at \$20,000-\$50,000 per year.
- **Stack Testing** – Like a CEMS, source-specific data are generated at a particular stack but emissions are only measured for a specific time, typically for a few hours during normal operations. Costs for stack testing typically run \$20,000, but testing may only be necessary every 2 to 5 years.
- **Vendor Guarantees and Stack Test Data from Similar Facilities** – If representative source-specific data cannot be obtained, emissions information from equipment vendors, particularly emission performance guarantees or actual test data from similar equipment, is a better source of information for permitting decisions than an AP-42 emission factor.
- **Material Balance Calculations** – While the material balance calculations are not generally considered as accurate as direct measurements, they may provide more reliable average emission estimates for certain sources where a high percentage of material is lost to the atmosphere (e.g., solvent VOC emissions). The costs for recordkeeping are approximately \$2,000-\$10,000 per year. This method works well for materials and processes that are well understood.
- **Optical Remote Sensing** – Measurement techniques involving differential absorption light detection and ranging (known as DIAL) and solar occultation flux or SOF can be used to measure emissions from sources such as coke ovens, storage tanks, wastewater treatment plants, and process units that are otherwise difficult to measure by other means. Measurement bias on the order of ± 30 percent is expected but the data can be more accurate than engineering estimates or emission factors.
- **Emission Factors** – When source-specific emissions or other more reliable approaches are unavailable, AP-42 emission factors may be the only way to estimate emissions. Again, the limitations of the factor in accurately representing the facility's emissions and the environmental/financial risk of using the emission factor for a particular situation should be carefully considered. **Remember, AP-42 emission factors should only be used as a last resort. Even then the facility assumes all risk associated with their use!**

Yet, in spite of this clear warning, as I have noted above, almost the entirety of the present emissions analysis for PM10/PM2.5 are based on AP-42.

I ask the DAQ to specifically address this issue and justify the use of AP-42. To the extent that DAQ is inclined to respond that AP-42 is widely used, that is specifically anticipated and address by EPA in the Alert. Widespread use of poor and inappropriate emission factors is not a proper basis for developing accurate and proper potential emissions estimates. This is especially problematic when DAQ and Granite continue to publicly state and imply that the permitting analysis was properly done.

C3.4 Examples of Poor Emission Factor Ratings

In the next several pages I simply excerpt the relevant tables from most of the AP-42 sections which were used in the emissions estimate development. I do this so that the record includes the ratings of the various emission factors. Most are C, D, or E rated and are very poor in terms of accuracy.

Table 11.19.2-2 (English Units). EMISSION FACTORS FOR CRUSHED STONE PROCESSING OPERATIONS (lb/Ton)^a

Source ^b	Total Particulate Matter ^{r,s}	EMISSION FACTOR RATING	Total PM-10	EMISSION FACTOR RATING	Total PM-2.5	EMISSION FACTOR RATING
Primary Crushing (SCC 3-05-020-01)	ND		ND ⁿ		ND ⁿ	
Primary Crushing (controlled) (SCC 3-05-020-01)	ND		ND ⁿ		ND ⁿ	
Secondary Crushing (SCC 3-05-020-02)	ND		ND ⁿ		ND ⁿ	
Secondary Crushing (controlled) (SCC 3-05-020-02)	ND		ND ⁿ		ND ⁿ	
Tertiary Crushing (SCC 3-050030-03)	0.0054 ^d	E	0.0024 ^o	C	ND ⁿ	
Tertiary Crushing (controlled) (SCC 3-05-020-03)	0.0012 ^d	E	0.00054 ^p	C	0.00010 ^q	E
Fines Crushing (SCC 3-05-020-05)	0.0390 ^e	E	0.0150 ^e	E	ND	
Fines Crushing (controlled) (SCC 3-05-020-05)	0.0030 ^f	E	0.0012 ^t	E	0.000070 ^q	E
Screening (SCC 3-05-020-02, 03)	0.025 ^c	E	0.0087 ^l	C	ND	
Screening (controlled) (SCC 3-05-020-02, 03)	0.0022 ^d	E	0.00074 ^m	C	0.000050 ^q	E
Fines Screening (SCC 3-05-020-21)	0.30 ^g	E	0.072 ^g	E	ND	
Fines Screening (controlled) (SCC 3-05-020-21)	0.0036 ^g	E	0.0022 ^g	E	ND	
Conveyor Transfer Point (SCC 3-05-020-06)	0.0030 ^h	E	0.00110 ^h	D	ND	
Conveyor Transfer Point (controlled) (SCC 3-05-020-06)	0.00014 ⁱ	E	4.6 x 10 ^{-5j}	D	1.3 x 10 ^{-5q}	E
Wet Drilling - Unfragmented Stone (SCC 3-05-020-10)	ND		8.0 x 10 ^{-5j}	E	ND	
Truck Unloading - Fragmented Stone (SCC 3-05-020-31)	ND		1.6 x 10 ^{-5j}	E	ND	
Truck Loading - Conveyor, crushed stone (SCC 3-05-020-32)	ND		0.00010 ^k	E	ND	

a. Emission factors represent uncontrolled emissions unless noted. Emission factors in lb/Ton of material of throughput. SCC = Source Classification Code. ND = No data.

Table 11.9-1 (English Units). EMISSION FACTOR EQUATIONS FOR UNCONTROLLED OPEN DUST SOURCES
AT WESTERN SURFACE COAL MINES^a

Operation	Material	Emissions By Particle Size Range (Aerodynamic Diameter) ^{b,c}				Units	EMISSION FACTOR RATING
		Emission Factor Equations		Scaling Factors			
		TSP ≤30 μm	≤15 μm	≤10 μm ^d	≤2.5 μm/TSP ^e		
Blasting ^f	Coal or overburden	$0.000014(A)^{1.5}$	ND	0.52^g	0.03	lb/blast	C_DD
Truck loading	Coal	$\frac{1.16}{(M)^{1.2}}$	$\frac{0.119}{(M)^{0.9}}$	0.75	0.019	lb/ton	BBCC
Bulldozing	Coal	$\frac{78.4 (s)^{1.2}}{(M)^{1.3}}$	$\frac{18.6 (s)^{1.5}}{(M)^{1.4}}$	0.75	0.022	lb/hr	CCDD
Dragline	Overburden	$\frac{5.7 (s)^{1.2}}{(M)^{1.3}}$	$\frac{1.0 (s)^{1.5}}{(M)^{1.4}}$	0.75	0.105	lb/hr	BCDD
	Overburden	$\frac{0.0021 (d)^{1.1}}{(M)^{0.3}}$	$\frac{0.0021 (d)^{0.7}}{(M)^{0.3}}$	0.75	0.017	lb/yd ³	BCDD
Vehicle traffic ^g							
Grading		$0.040 (S)^{2.5}$	$0.051 (S)^{2.0}$	0.60	0.031	lb/VMT	CCDD
Active storage pile ^h (wind erosion and maintenance)	Coal	0.72 u	ND	ND	ND	$\frac{\text{lb}}{(\text{acre})(\text{hr})}$	C_i_---

Table 11.9-3 (Metric And English Units). TYPICAL VALUES FOR CORRECTION FACTORS APPLICABLE TO THE PREDICTIVE EMISSION FACTOR EQUATIONS^a

Source	Correction Factor	Number Of Test Samples	Range	Geometric Mean	Units	
Blasting	Area blasted	17	100 - 6,800	1,590	m ²	
	Area blasted	17	1100 - 73,000	17,000	ft ²	
Coal loading	Moisture	7	6.6 - 38	17.8	%	
Bulldozers	Coal	Moisture	3	4.0 - 22.0	10.4	%
		Silt	3	6.0 - 11.3	8.6	%
Overburden	Moisture	8	2.2 - 16.8	7.9	%	
	Silt	8	3.8 - 15.1	6.9	%	
Dragline	Drop distance	19	1.5 - 30	8.6	m	
	Drop distance	19	5 - 100	28.1	ft	
	Moisture	7	0.2 - 16.3	3.2	%	
Scraper	Silt	10	7.2 - 25.2	16.4	%	
	Weight	15	33 - 64	48.8	Mg	
	Weight	15	36 - 70	53.8	ton	
Grader	Speed	7	8.0 - 19.0	11.4	kph	
	Speed		5.0 - 11.8	7.1	mph	
Haul truck	Silt content	61	1.2 - 19.2	4.3	%	
	Moisture	60	0.3 - 20.1	2.4	%	
	Weight	61	20.9 - 260	110	mg	
	Weight	61	23.0 - 290	120	ton	

^a Reference 1,6.

Table 11.9-4 (English And Metric Units). UNCONTROLLED PARTICULATE EMISSION FACTORS FOR OPEN DUST SOURCES AT WESTERN SURFACE COAL MINES

Source	Material	Mine Location ^a	TSP Emission Factor ^b	Units	EMISSION FACTOR RATING
Drilling	Overburden	Any	1.3	lb/hole	C
			0.59	kg/hole	C
	Coal	V	0.22	lb/hole	E
			0.10	kg/hole	E
Topsoil removal by scraper	Topsoil	Any	0.058	lb/ton	E
			0.029	kg/Mg	E
		IV	0.44	lb/ton	E
			0.22	kg/Mg	E
Overburden replacement	Overburden	Any	0.012	lb/ton	C
			0.0060	kg/Mg	C
Truck loading by power shovel (batch drop) ^c	Overburden	V	0.037	lb/ton	E
			0.018	kg/Mg	E
Train loading (batch or continuous drop) ^c	Coal	Any	0.028	lb/ton	E
			0.014	kg/Mg	E
		III	0.0002	lb/ton	E
			0.0001	kg/Mg	E
Bottom dump truck unloading (batch drop) ^c	Overburden	V	0.002	lb/ton	E
			0.001	kg/Mg	E
	Coal	IV	0.027	lb/ton	E
			0.014	kg/Mg	E
		III	0.005	lb/ton	E
			0.002	kg/Mg	E
		II	0.020	lb/ton	E
			0.010	kg/Mg	E
		I	0.014	lb/T	E
			0.0070	kg/Mg	E
		Any	0.066	lb/T	D
			0.033	kg/Mg	D

C3.5 Drop Equation Under-Predicts Emissions Significantly

In addition to the tables above, I want to specifically highlight the significant degree of underestimation when using AP-42's so-called drop equation, which, as the Engineer Report, confirms was used.¹⁴ At the mining site, there are numerous material transfer operations when materials are "dropped" from one operation to another below, and whose emissions are estimated by this approach.

In 2008, regulators in Florida conducted a series of assessments to determine the validity of the AP-42 drop equation and the results were astounding.¹⁵

Among the criticisms that were evident are:

- (a) Silt Content Missing From Continuous Drop Equation (although it supposedly is valid for a silt content range of 0.44 to 19%). Silt content is the material that is <75 um (200 mesh screen) using ASTM-C-136.
- (b) There is no correlation with PM emissions or EPA Method 5, a test method for determining PM emissions.
- (c) The Predictive emission factor in AP-42 is based upon dispersion modeling and ambient total suspended particulate (TSP) monitoring.

The Tampa study showed that measured versus AP-42 ratios (noted as "scale factors" in the document cited) ranged from a low of 8.3 to a high of 393 with values of 10.8, 28, 43, 92 for the tests reported.

As a result, the study concluded that "AP-42 Continuous Drop Equation Grossly Underestimates PM emissions up to Several Orders of Magnitude, and Previously Permitted Minor Sources May be Title V and/or PSD if throughputs are > 1,000,000 tpy." This conclusion is eerily relevant and appropriate for the I-80 mine, which is masquerading as a minor source with a similar throughput of 1,000,000 or 1,100,000 tons/year.

C3.6 Assumptions From Documents Besides AP-42 Are Also Problematic

In addition to AP-42, the Trinity application also mentions the Utah DAQ guidance, a WRAP document, and a couple of NIOSH documents in support of its emissions calculations. I address these in this sub-section.

- (i) on pdf page 341, the Trinity application states:

¹⁴ See pdf page 18.

¹⁵ "AP-42 Continuous Drop Equation vs Stack Testing," Material Handler's Workshop, Tampa, Florida, December 11, 2008 by Sterlin Woodard, P.E., EPC-Hillsborough County. Available at <https://slideplayer.com/slide/10450299/>

“Shroud Application to Drilling Equipment

Installing a shroud at the drilling location is one common method for controlling fugitive dust emissions from drilling operations. Shrouds can vary in shape (rectangular vs. circular) and complexity in order to adapt to mining operations. When installed and replaced correctly, shrouds can control 88% of fugitive dust emissions. (citing to NIOSH 2019, page 137)” (emphasis added).

This is misleading. The quote below from the cited NIOSH 2019, page 137 makes it clear.

This simple procedure of creating a dust collector dump shroud has been shown to be very effective in reducing the respirable dust. Respirable dust concentrations measured after installation of the dust collector shroud ranged from 0.16 to 0.24 mg/m³. Figure 4.16 shows the reduction of the respirable dust concentrations near the collector dump point with and without the dust collector shroud. It can be seen that the respirable dust generated by the dust collector dump point can be reduced by between 63 and 88 percent using the shroud [Reed et al. 2004]. It should be noted that this reduction is highly dependent upon wind direction and wind speed. Advantages to this method of respirable dust reduction are that the material is inexpensive and requires almost no maintenance. If the shroud becomes damaged, it can easily be replaced in 10–15 minutes, requiring little if any downtime for the drill.

Clearly, there is big difference between “...can be reduced by between 63 and 88 percent using the shroud...” and the misrepresentation by Trinity that the reduction would be 88%, especially where such numbers are “highly dependent upon wind direction and wind speed,” which is variable in the complex topographic setting of Parley’s canyon and the additional canyons on the mine site that lead to Parley’s canyon.

(ii) As another example, on pdf page 342, the Trinity application states:

“Dust control is often accomplished using a fan-powered dust-collection system. For drilling operations, these collection systems are mounted on the drill. If properly maintained, these systems can be up to 99% efficient. Citing to NIOSH 2019, p. 124

The quote below, shows that the 99% efficiency claimed by Trinity is conditioned on “...if properly maintained...” Yet, this important qualifier (and the lack of any permit conditions to ensure proper maintenance) makes the 99% misleading.

“Dry drilling is accomplished without the use of water for dust control. Dust control is accomplished using a fan-powered dust collection system mounted on the drill. These systems have the ability to operate in various climates, i.e., they are not subject to freezing at lower temperatures as with the use of water, and they can be up to 99 percent efficient if properly maintained [USBM 1987]. There are different

types of dust collector configurations used, dependent upon the size of the drill.”
(emphasis added)

(iii) The Trinity application cites to the Utah guidance¹⁶ for estimating road emissions. I quote various sections from the guidance, including the fact that it is now, self-admittedly, outdated and contains important qualifiers, omitted by Granite/Trinity and the DAQ.

The “s” factor above, the surface material silt content should be determined for each site for Option 1 and 2 below. For Options 3, 4, and 5, due to the nature of the control, the default value of 4.8% shall be used.

2. With these problems, sources have taken the task upon themselves to search out the best solution which at times has developed additional problems as they try to document and we try to validate their approach. We have also been concerned with consistency across industry. This memo is intended to provide some assistance on the issue for permit engineers and sources alike. Every Approval Order is a case-by-case determination and site specific with conditions unique to the site; implementation of this document will be likewise.

This Guideline shall be audited every two years by the Minor NSR Section Manager to determine the current status and relevance of the information.

¹⁶ Utah Emission Factors for Paved and Unpaved Roads, January 12, 2005.

(iv) Finally, the emissions calculations by Trinity also mention the WRAP Fugitive Dust Handbook.¹⁷

I merely want to point out that this document makes clear (like all emissions inventory guidance) that "...area specific factors should be used wherever they are available..." Of course, such data are not "available" unless the applicant is required to collect them in the first place.

This handbook is not intended to suggest any preferred method to be used by stakeholders in preparation of SIPs and/or Conformity analyses but rather to outline the most commonly adopted methodologies currently used in the US. The information contained in this handbook has been derived from a variety of sources each with its own accuracy and use limitations. Because many formulae and factors incorporate default values that have been derived for average US conditions, area specific factors should be used whenever they are available. Additionally, the

¹⁷ WRAP Fugitive Dust Handbook, September 7, 2006.

C4. In addition to the Misuse of AP-42, the Emissions Estimates Contain Numerous Assumptions That Are Not Supported

To best illustrate these deficiencies, I excerpt tables from the Engineer Report, which appear to be taken from Trinity’s spreadsheets. In the interest of brevity, I only use the examples from Phase 1 although the same deficiencies also apply to the Phase 2 tables.

(pdf page 24)

Table B-6. Drilling and Blasting

Parameter	Blasting	Units	Drilling	Units
Daily Maximum Frequency	1	(blast/day)	48	(holes/blast)
Annual Frequency	12	(blasts/yr)	480	(holes/yr)
Annual Area	94,675	(ft ² /yr)	--	--
Daily Area	7,890	(ft ² /day)	--	--
ANFO Usage	20,455	(lbs/blast)	--	--
Annual ANFO Usage	123	(tpy)	--	--
ANFO Heat Content	912	(cal/g)	--	--
Roads ¹	Silt	4.80	%	

There is a math error in the first red box. There is no data provided in the record supporting the silt content value used as being applicable at all times/locations at the mine site.

(pdf page 26)

Table B-8. Emission Factors for Crushing, Screening, & Material Handling (lb/ton)

Source ^{1,2}		PM ₁₀	PM _{2.5}
Primary Crushing	Controlled	5.40E-04	1.58E-04
Secondary Crushing	Controlled	5.40E-04	1.58E-04
Screening	Controlled	7.40E-04	5.00E-04
Conveyor Transfer	Controlled	4.60E-05	1.40E-05

Table B-8 Notes:

1. Emission factors per EPA Potential to Emit Calculator for Stone Quarrying, Crushing, and Screening Plants last updated November 2013 and AP-42 11.19.2, "controlled".
2. PM_{2.5} emission factors assumed to be 29.2% of PM₁₀ based on SCAQMD's Updated CEIDARS

It is not clear why the SCAQMD speciation factor should apply at the mine site. Please provide justification.

(pdf page 28)

Table B-11. Dozing Emissions

Vehicle Type	Annual Operating (hr/yr)	Quantity	Emission Factor ¹ (lb/hr)		Control Efficiency (%)	Daily Emissions (lb/day)		Annual Emissions (tpy)	
			PM ₁₀	PM _{2.5}		PM ₁₀	PM _{2.5}	PM ₁₀	PM _{2.5}
Bulldozers	3,000	1	1.13	0.65	0%	9.31	5.33	1.70	0.97
Total Dozing Emissions:						9.31	5.33	1.70	0.97

1. Emissions for the bulldozer were characterized using AP-42, Section 11.9 (October 1998), Table 11.9-1 and Table 11.9-3

where:

$$TSP = \frac{5.7(s)^{1.2}}{(M)^{1.3}}$$

$$PM_{15} = \frac{1.0(s)^{1.5}}{(M)^{1.4}}$$

Sil content s = 4.8 Percent (%) per AP-42 11.9.
 Moisture content M = 4 Material moisture content (%) per AP-42 11.9.
 Aerodynamic fa TSP = 0.74 PM₁₀ 0.36 PM_{2.5} 0.11
 Scaling factors use Mojave Desert AQMD

As noted previously, please provide justification for the silt content and also the moisture content and the PM speciation factors, as to how they apply to the mine site.

(pdf page 29)

Table B-12. Aggregate Handling and Storage Piles (stockpile erosion, loading and load out of aggregate)

Emission Activity	Total Annual Throughput (tpy)	Uncontrolled Emission Factor ¹		Control Efficiency (%)	Daily Emissions (lb/day)		Annual Emissions (tpy)	
		PM ₁₀	PM _{2.5}		PM ₁₀	PM _{2.5}	PM ₁₀	PM _{2.5}
Loader to Jaw Crusher 1	1,100,000	1.36E-03	3.98E-05	0%	4.11	0.12	0.75	0.02
Loader to Haul Trucks (Product)	1,000,000	1.36E-03	3.98E-05	0%	3.73	0.11	0.68	0.02
Stockpile Wind Erosion 2	1,000,000			0%	6.30		1.15	
Total Loading Emissions					14.14	0.23	2.58	0.04

1. Uncontrolled emission factors using the "drop equation" contained in U.S. EPA AP-42, Section 13.2.4 (Aggregate Handling and Storage Piles), November 2006:

$$E = k(0.0032) \left(\frac{U}{5} \right)^{1.3} \left(\frac{M}{2} \right)^{1.4}$$

E = Emission factor
 where:
 k = 0.74 PM 0.35 PM₁₀ 0.010 PM_{2.5} Particle size multiplier (dimensionless)
 U = 9.00 Mean wind speed (mph) is given per UDAQ's Average Annual Wind Speed map, November 2000.
 M = 3.00 Material moisture content (%) previously recommended by UDAQ.

2. Stockpile wind erosion emission factor from AP-42 4th Edition Table 8-19.1.1, which is 6.3lb/acre/day PM₁₀. Equation → Annual Stockpile Emissions (tpy) = Max. Pile Area (acre) X EF (lb/day*acre) X conversion (365 days x 1 ton / 1 year x 2,000 lb). Assumed 1 acre of stockpile area for phase 1.

Please see prior discussion on the vast underestimation of emissions using the AP-42 drop equation.

(pdf page 30)

Table B-13. Blasting and Drilling Area

Maximum Annual Blast Frequency (blasts/yr)	Maximum Annual Area Blasted (ft ² /yr)	Maximum Daily Blast Area (ft ² /blast)
12	94,675	7,890

Table B-14. Drilling, Blasting, and Disturbed Ground Emission Factors

Source Description	Source Activity	Throughput	Units	Emission Factors											
				PM		PM ₁₀		PM _{2.5}		SO ₂		NO _x		CO	
				Value	Units	Value	Units	Value	Units	Value	Units	Value	Units	Value	Units
Blasting	ANFO	123	(tpy)	9.81	(lb/blast)	5.10	(lb/blast)	0.29	(lb/blast)	0.0036	(lb/ton)	1.80	(lb/ton)	40.64	(lb/ton)
Drilling	Annual # of Drill Holes	48	holes/blast	1.30	(lb/hole)	0.68	(lb/hole)	3.90E-02	(lb/hole)	-	(lb/ton)	-	(lb/ton)	-	(lb/ton)
Disturbed Ground	Mine Area	10	Acres	0.38	(tons/acre yr)	0.75	(lb PM10/lb PM)	1.05E-01	(lb PM2.5/lb PM)	N/A	N/A	N/A	N/A	N/A	N/A

¹Blasting PM emission factors retrieved from AP-42 11.9, Table 11.9-1. Using the equation below the horizontal area blasted (A) is assumed to be the average daily Blast Area.
 $A = \text{horizontal area (ft}^2\text{), with blasting depth } \leq 70 \text{ ft}$
 $0.000014(A)^{1.5}$
 Scaling factors were applied to PM₁₀ and TSP emission factors to calculate PM₁₀ and PM_{2.5} emission factors respectively per Table 11.9-1:
 $PM_{10} = 0.52$
 $PM_{2.5} = 0.03$
 As there is not data for the PM₁₀ emission factor equation, PM₁₀ is conservatively assumed to be equal to TSP.
²Drilling PM emission factor is retrieved from AP-42 11.9, Table 11.9-4, where the drilling PM emission factor is for overburden material for conservatism. The coal PM emission factor is lower and may be appropriate for some drilling operations.
 Since no emission factors are provided for PM₁₀ and PM_{2.5} drilling operations, emission factors were calculated using the PM₁₀ and PM_{2.5} to TSP ratios for blasting overburden per AP-42 11.9, Table 11.9-1, where:
 $PM_{10} = PM_{2.5} * 0.52$
 $PM_{2.5} = TSP * 0.03$
³Blasting SO₂ emission factor developed using a mass balance assuming 6% fuel oil mixture with 500 ppm sulfur content, consistent with EPA non-road standards.
⁴Blasting NO_x and CO emission factors retrieved from ANFO blasting agent factor from AP-42 13.3-1.
⁵Blasting CO emission factor retrieved from ANFO blasting agent factor from AP-42 13.3-1.
⁶Blast and drilling quantities provided per design basis.
⁷Disturbed Ground Emissions Factor from "Wind Erosion of Exposed Areas" per AP-42 Table 11.9-4, with Scaling factors based on Bulldozing Overburden per Table 11.9-1

There are a number of specific speciation and additional assumptions in the notes highlighted above. They should be explained. How is the maximum blast area per day and year verified and enforced?

Table B-15. Drilling, Blasting, and Disturbed Ground Emissions

Source Description	Control Efficiency ¹ (%)	Max Daily Emissions (lbs/day) ^{2,3,6}						Annual Emissions (tpy) ^{5,6,7}					
		PM	PM ₁₀	PM _{2.5}	SO ₂	NO _x	CO	PM	PM ₁₀	PM _{2.5}	SO ₂	NO _x	CO
Blasting	0%	9.81	5.10	0.29	0.04	18.41	415.64	0.06	0.03	1.77E-03	2.21E-04	0.11	2.49
Drilling	88.8%	6.99	3.63	0.21	--	--	--	0.04	0.02	1.26E-03	--	--	--
Disturbed Ground	0%	20.82	15.62	2.19	--	--	--	3.80	2.85	3.99E-01	--	--	--
Total Emissions:		37.62	24.35	2.69	0.04	18.41	415.64	3.90	2.90	4.02E-01	0.00	0.11	2.49

¹Drilling operations will be controlled through wet-drilling. NIOSH reports 86-97% control efficiency for controlling fugitive emissions via wet-drilling (per NIOSH's Dust Control Handbook for Industrial Minerals Mining and Processing, 2012). Granite contracts a drilling company that implements wet-drilling control technologies to reduce fugitive drilling emissions but used the an average control factor of 88.8%.

- ²Daily Blasting PM Emissions (lb/day) = Emission Factor (lb/blast) as only one blast is allowed per day.
- ³SO₂, NO_x, & CO Daily Blasting Emissions (lb/day) = Emission Factor (lb/ton) * Annual ANFO Throughput (tpy) / Annual Blasts (blasts/yr)
- ⁴Daily PM Drilling Emissions (lb/day) = Emission Factor (lb/hole) * Drill Holes/yr / Expected Working Days/Year
- ⁵SO₂, NO_x, & CO Annual Blasting Emissions (tpy) = Emission Factor (lbs/ton) * Annual ANFO Throughput (tpy) * 1 ton/2000 lbs
- ⁶Annual Blasting PM Emissions (tpy) = Emission Factor (lb/blast) * blasts/yr * 1 ton/2000 lbs
- ⁷Annual PM Drilling Emissions (tpy) = Emission Factor (lb/hole) * Drill Holes/yr * 1 ton/2000 lb

Please see discussion on the apparent misuse of the quoted NIOSH control efficiency value used.

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Table B-16. Roads Emissions - PTE Emissions

Road Source	Controlled Emissions			
	Daily Emissions (lb/day) ¹		Annual Emissions (tpy) ¹	
	PM ₁₀	PM _{2.5}	PM ₁₀	PM _{2.5}
Unpaved, Chemical Application (Trucks)	19.80	4.20	1.68	0.36
Paved, Watered, Vacuum Swept (Trucks)	7.42	1.57	0.63	0.13
Total	27.22	5.77	2.31	0.49

¹ Daily and annual controlled emissions are calculated by applying the controlled emission factor (per UDAQ's control efficiencies) to the vehicular miles traveled per day (paved and unpaved).

Daily Emissions (lb/day) = Miles Travelled per Day (VMT/day) * Uncontrolled Emission Factor (lb/VMT) * (1 - η)

Annual Emissions (tpy) = Miles Travelled per Day (VMT/yr) * Uncontrolled Emission Factor (lb/VMT) * (1 - η)

Table B-17. Roads Emissions - Traveling Parameters (Supporting Operations)

Road Source	Product Throughput		Mean Vehicle Weights (tons) ¹		Average Vehicle Weight	Hauls/Year	Hauls/Day	Total Travel Distance per Haul (miles/haul)		Total Vehicle Miles Traveled			
			Empty Vehicle (tons)	Loaded Vehicle (tons)				Unpaved	Paved	Daily (VMT/day)		Annual (VMT/yr)	
	(tpy)	(ton/hr)	(tons)	(tons)	(tons/haul)	Unpaved	Paved			Unpaved	Paved	Unpaved	Paved
Haul Trucks	1,100,000	225	20.00	65.00	42.5	24,445	144	0.22	0.33	31.68	47.52	5,378	8,067

¹ Vehicle weights provided by Granite Construction.

Annual Days Vehicles Operate: 365

Six trips per hour x 24 hours per day = 144 trips per day

Please see previous discussion on why the outdated cited Utah guidance should not be relied upon. In addition, how will the number of trips be enforced and verified. Recordkeeping is not an appropriate method of ensuing compliance with activity levels.

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Table B-18. Roads Emissions - Emission Factors

Road Surface	Controls ¹	Control Efficiency (%)	Vehicle Emission Factors ^{1,2} (lb/VMT)	
			PM ₁₀	PM _{2.5}
Unpaved	Granite I-80 Specific Factor	80%	0.62	0.13
Paved	Granite I-80 Specific Factor	95%	0.1562	0.0331

¹ Emission controls for vehicular traffic on paved and unpaved roads per UDAQ guidelines: Emission Factors for Paved and Unpaved Haul Roads, January 2015, in conjunction with U.S. EPA AP-42 Section 13.2.2, November 2006.

$$E = k (s/12)^a (W/3)^b$$

where

E = Size-specific emission factor (lb/VMT)

k, a, b = Constants for equation 1a

	PM	PM ₁₀	PM _{2.5}
k =	1.8	1.5	0.15
a =	0.7	0.9	0.9
b =	0.45	0.45	0.45

s = surface material silt content (%)

s = 4.8 Per UDAQ guidance given in Emission Factors for Paved and Unpaved Haul Roads, January 2015.

W_{HT} = 42.5 Mean weight of all haul trucks (tons), per UDAQ guidance given in Emission Factors for Paved and Unpaved Haul Roads, January 2015.

² PM_{2.5} emissions are 21.2% of PM₁₀ for unpaved roads (SCAQMD Updated CEIDARS Table)

Please provide justification for site specific actions that will assure verification with the assumed control efficiencies. See prior comments on the lack of justification of the silt content and the unsupported use of the SCAQMD reference.

(pdf page 33)

Table B-19. Engine Parameters

Parameter	Jaw Crusher Generator	Screen Generator	Cone Crusher Generator
Engine Horsepower (hp)	260	175	440
Operating Hours per Day (hr/day)	24	24	24
Operating Hours per Year (hr/yr)	5631.4286	5631.4286	5631.4286
Annual Activity (hp-hr/yr)	1464171.4	985500	2477828.6
Max Hourly Fuel Use (gallon/hr)	14	9	23
Average Hourly Fuel Use (gallon/hr)	10	7	17
Max Annual Fuel Use (gallon/yr)	76220	51302	128988
Heating Value of Diesel (MMBtu/hr) ²	0.887	0.597	1.501
Fuel Type	Diesel	Diesel	Diesel
Fuel Sulfur Content (%) ³	0.0015	0.0015	0.0015

1. Per generator performance data sheets.
2. Per 40 CFR 98, Table C-1 to Subpart C for Distillate Fuel Oil No. 2
3. From EPA, "Diesel Fuel Standards and Rulemakings", <https://www.epa.gov/diesel-fuel-standards/diesel-fuel-standards-and-rulemakings>.

Assumes the following value for lb fuel/hp-hr: 0.367 per OFFROAD2011 Model

Assumes the following density for diesel in lb 7.05 per AP-42 Appendix A

Assumes the following engine load factor 0.74 per CalEEMod Appendix D Table 3.3

Please provide justification for the use of the factors from OFFROAD and CalEEMod, as they apply to equipment at the site. Similarly, how will the assumed heating values and operating hours (to the fourth place after decimal!) be verified?

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Table B-20. Criteria Pollutant and GHG Engine Emission Factors

Pollutant	Emission Factor	Emission Factor Units
CO ¹	5.76E-03	lb/hp-hr
NO _x ¹	6.58E-04	lb/hp-hr
PM ₁₀ ¹	3.29E-05	lb/hp-hr
PM _{2.5} ¹	1.76E-05	lb/hp-hr
VOC ¹	3.13E-04	lb/hp-hr
SO ₂ ²	1.21E-05	lb/hp-hr
CO ₂ ³	163.1	lb/MMBtu
CH ₄ ⁴	6.61E-03	lb/MMBtu
N ₂ O ⁴	1.32E-03	lb/MMBtu
CO ₂ e ⁵	1.64E+02	lb/MMBtu

1. EPA Tier 4 Final emission factors assuming NO_x = 0.4 g/kW-hr, CO = 3.5 g/Kw-hr, PM = 0.02 g/KW-hr, VOC = 0.19 g/Kw-hr

2. Per AP-42, Table 3.3-1, for Diesel Fuel 8.09E-3 x 0.0015% Sulfur

3. Per 40 CFR 98, Table C-1 to Subpart C for Distillate Fuel Oil No. 2

4. Per 40 CFR 98, Table C-2 to Subpart C for Petroleum Products CH₄ = 3.0E-3, NO₂ = 6.0E-4.

5. The CO₂ equivalent factor is the sum of the factors for CO₂, CH₄, and N₂O multiplied by their respective global warming potentials (GWPs), per 40 CFR 98,

Please provide how this assumed regulatory level will be verified at site conditions since EPA certification data are not valid under all site conditions (altitude, ambient pressure, etc.)

In addition to the red-boxed portions of each of the tables above, which require specific support that is currently missing in the record, I note that on pdf pages 37 – 72, the Engineer Report provides similar tables for Phase 2 (which is confusingly noted as Phase 1 at the top of each page, even though each footer makes clear that these tables are for Phase 2). I also note that DAQ seems to have haphazardly slapped together certain tables or portions of tables, making readability unnecessarily problematic. An example of this mislabeling is provided below.

(pdf page 38)

Table B-7. Annual Potential Emissions Increase Summary

Process	Annual Emission Rates (tpy)							
	PM ₁₀ (fugitive)	PM _{2.5}	NO _x	CO	SO ₂	VOC	Total HAP	CO _{2e}
Crushing and Screening Operations	1.00	0.44	--	--	--	--	--	--
Bulldozing & Loading Operations	4.85	1.01	--	--	--	--	--	--
Drillingd & Blasting	0.05	3.02E-03	0.11	2.49	2.21E-04	--	--	--
Disturbed Ground	2.85	0.40	--	--	--	--	--	--
Roads	2.56	0.54	--	--	--	--	--	--
Engines	0.08	0.04	1.62	14.19	0.03	0.77	5.32E-02	403,103
Tanks ¹	--	--	--	--	--	5.70E-03	--	--
Project Total	11.40	2.44	1.73	16.68	0.03	0.78	0.05	403,103
Modeling Limit ²	5	--	40	100	40	--	10/25	--
Modeling Required?	Yes	No	No	No	No	No	No	No
Major Source Thresholds ^{3,4,5}	250	70	70	250	70	70	10/25	100,000
Exceeding Major Source Thresholds?	No	No	No	No	No	No	No	No

- HAPs from the storage tank were considered, but are below the reasonable reporting threshold suggested by UDAQ (i.e., <1.00E-03 tpy), and are therefore considered negligible.
- Modeling Limit is stated in UDAQ Emissions Impact Assessment Guidelines under Table 1: Total Controlled Emission Rates for New Sources.
- Major source thresholds defined by 40 CFR section 51.165(a)(1)(iv)(A).
- Total HAP Threshold is stated in 40 CFR Section 63.2 under definition of a Major Source.
- 100,000 tons CO_{2e} threshold is for "anyways" sources that are already major source for another pollutant in this table.

D. The Air Dispersion Modeling Analysis is Fatally Flawed

As I have noted earlier, the emissions input into the dispersion modeling being grossly inaccurate/under-estimated invalidates the modeling all by itself.

It is worth pointing out that there are additional problematic issues with the modeling. I cite to pages pdf 77 and onward for this portion of my comments. I note that the DAQ recognizes that “[T]he Plant is at an elevation 5530 feet with terrain features that have an affect on concentration predictions.”¹⁸

(i) One way in which the terrain affects the predicted concentration is by the fact that the meteorology (i.e., wind speeds, directions, etc.) are affected by the terrain, i.e., the presence of the mine in a canyon. Yet, the modeling relied on “Five (5) years of off-site surface....[data] from the Salt Lake Airport, UT NWS.”¹⁹ This airport is 12 miles away and in completely different terrain.

Historical data from a wind speed monitor in Parleys Canyon, located less than 1 mile from the proposed mine site, indicates that wind gusts exceeded 25 mph over 8000 times in a 29 month period (Jan 2021-May 2023) and that the average wind speed for 10 minute increments exceeded 25 mph over 500 times in that same period.²⁰ Yet, the emissions analysis used an average wind speed of 5 mph.

There is literally no mention or even any attempt to justify how this airport meteorological data would remotely represent wind conditions in the mine site. Representativeness of meteorological data is a fundamental predicate that cannot be swept aside or glossed over. In fact this is rightly stressed in the DAQ’s own guidance:

“IX. Meteorological Data

The meteorological conditions under which a pollutant is released into the atmosphere is the controlling determinant of dispersion efficiency in the air quality models. In most dispersion modeling analyses, the user will attempt to define a realistic worst-case scenario for pollutant dispersion, thereby yielding the highest possible model predicted concentration.

a. Representative Meteorological Data

Ideally, a modeling analysis should attempt to simulate dispersion under conditions that would actually occur at a source. This data should be representative of transport

¹⁸ This is consistent with the DAQ’s Air Quality Emissions Impact Assessment Guidelines, available at <https://documents.deq.utah.gov/legacy/permits/air-quality/docs/2013/03Mar/EmissionsImpactAssessmentGuideline.pdf>

¹⁹ See pdf page 78.

²⁰ Examples of meteorological data from closer sites include:

Parleys Exit 132: <https://windalert.com/spot/187861>

Mouth of Parleys: <https://www.windalert.com/spot/8968>

Parleys Quarry: <https://windalert.com/spot/27567>

wind directions, speed, and turbulence at the elevation of final plume stabilization height, as prescribed by the GAQM. Therefore, the UDAQ requires that actual meteorological data be used in a refined modeling analysis. New or major modifications to PSD sources will be required to collect at least one year of continuous on-site meteorological data for use in their modeling analyses. If on-site data is not available for modeling, representative data collected from another meteorological site may be used, provided it is close enough and is within the same hydrological basin. Meteorological data used in modeling must be approved by the UDAQ for quality assurance and site representativeness prior to its use in a regulatory analysis.²¹ To demonstrate data representativeness, the applicant may provide an analysis comparing the physiographic and meteorological parameters of the data site using the minimum requirements that are detailed in Appendix II. In the case where the meteorological data is not determined to be representative, the applicant source may be required to collect on-site meteorological data. The UDAQ requires that at least one full year of representative meteorological data be used in all refined modeling analyses for the near field, where near field is defined to be within 50 kilometers of the source. If more than one year of data is available, the user shall run the model with all available years, up to a maximum of five years (R307-410-3). Sources that are required to gather on-site meteorological data are advised to Page 16 contact the UDAQ to establish a monitoring protocol for locating a representative meteorological site and gathering the necessary meteorological data. The UDAQ has compiled a set of AERMET data sets for most National Weather Service stations, as well as data from most UDAQ and PSD (major source) meteorological monitoring sites. A map showing the locations for this data can be found on the met data website. A link to show the data on Google earth is also provided so that the user can view topographic and other geographic features that may affect wind flow patterns. The web site also contains the links to download the data. The applicant can choose the AERMET data to be used in an analysis, but the applicant needs to confirm its representativeness with a modeler at the UDAQ in order to assure acceptance before it is submitted as part of modeling for a NOI.”²²

I therefore ask the DAQ to specifically how/why it accepted the modeling by Trinity, under these circumstances.

(ii) Similar to above, the modeling summary notes that background concentrations were “...based on concentrations measured in Salt Lake City, Utah.” This monitor was located 7 miles from the mine site and 5 miles from the mouth of the canyon. Again, it is not clear why this data should be representative of conditions at the mine site. I ask DAQ to provide a response.

(iii) The Trinity application shows how the Phase 2 sources were modeled – see Figure 3-2. Even though the mining activities are supposed to move around for the active life of the mine, the fixed specific locations for the various Phase 2 sources are not supported. For example, it is not clear

²¹ DAQ appears to have clearly approved the use of unrepresentative meteorological data, given conditions at the mine site/Parleys canyon versus the SLC airport.

²² *Ibid.*

that only this combination of locations would result in worst case Phase 2 impacts, etc. I ask the DAQ to provide a rationale for this fixed Phase 2 choice.

(iv) All of this is critical because DAQ’s analysis shows that the results of the modeling show that PM10 (the only pollutant that was modeled) concentrations are very close to exceeding the National Ambient Air Quality Standards (NAAQS), per the table below, from pdf 83, for Phase 1.

PHASE 1 RESULTS

Air Pollutant	Period	Prediction	Class II Significant Impact Level	Background	Nearby Sources*	Total	NAAQS	Percent
		($\mu\text{g}/\text{m}^3$)	($\mu\text{g}/\text{m}^3$)	($\mu\text{g}/\text{m}^3$)	($\mu\text{g}/\text{m}^3$)	($\mu\text{g}/\text{m}^3$)	($\mu\text{g}/\text{m}^3$)	NAAQS
PM ₁₀	24-Hour	77.20	5	66.6	0.6	144.4	150	96.3%

This table confirms that the current modeling is very close to exceeding the NAAQS for PM10 24-hour average for Phase 1. Similar results for Phase 2 shown on pdf pages 83 and 84 are also very close (at 93.9%) of the NAAQS.

E. The BACT Analysis is Conclusionary and is Unsupported

1. The DAQ Engineer Review of the BACT appears to be a simple regurgitation of the BACT analysis provided by Granite/Trinity. It does not appear to contain any additional research or verification by DAQ of the qualitative discussion presented by the consultant. I ask DAQ to confirm that no additional agency analysis was conducted beyond that presented by Granite's consultant.

2. A specific deficiency of the BACT analysis for various PM emitting activities is that often options are rejected based on economic grounds, with no accompanying economic analysis at all.

First, for the processing of aggregate, the BACT analysis states that “[T]he use of baghouses/fabric filters, cyclones, ESPs, and wet scrubbers all rely on an enclosure to capture the PM emissions so that the emissions can be routed to them. Because the source operates this equipment outside and has to routinely move the equipment around the site, the use of constantly constructing and deconstructing a full enclosure is not economically feasible. Because enclosures are infeasible, all of these options are infeasible as well.” - *I ask DAQ specifically address this lack of economic analysis for processing of aggregates.*

Second, a similar, non-specific economic argument is made to eliminate the use of water to manage dust emissions from disturbed areas: “[T]he use of water sprayers is not economically feasible because of the large volume of water that would be needed to keep the entire area wet during operation....” - *Again, since no cost analysis is provided, I ask the DAQ for the basis of this “not economically feasible” determination.*

Third, for storage pile emissions, the DAQ, without any supporting analysis, simply accepts that “[T]he use of enclosures (full or partial) is also technically feasible. However, the use of enclosures is not economically feasible. The cost of enclosing the acres of storage piles is not economically feasible due to the large size of the piles.” - *I ask the DAQ to provide the basis upon which it accepted the economic infeasibility of storage piles, with no supporting analysis.*

3. The BACT analysis makes various claims about control efficiency, with no enforcement or verification provisions at all. Not only are some of the quoted control efficiency values unsupported or dubious (or even mis-represented from source documents as I have previously discussed in my critique of the emissions estimates – since those estimates rely on the same dubious and unsupported claims), neither the BACT analysis nor the permit contains verification or testing requirements that can validate the claims made. For example, for the processing of aggregate, the Engineer Report states that “[T]he use of watering and best management practices is feasible. Watering is between 50-90% effective at controlling PM emissions from the processing of aggregate.” This conclusionary statement is not enforceable because there is literally no requirement to validate this claim. The Engineer Report notes that “[B]est management practices consist of minimizing drop heights and regular inspection and maintenance.” What does “minimizing” mean? And, what are “regular” inspection and maintenance practices? These and similar statements abound in the BACT analysis. None are enforceable. I ask the DAQ to specifically address each of the following statements/conclusions of the BACT analysis as to enforceability. I quote DAQ text followed by my questions in *italics*:

(A) BACT review regarding PM Emissions from the Processing of Aggregate

“The source will operate water sprayers to apply water on all crushers, screens, and conveyor transfer points throughout the facility.” – *where will these sprayers be located and what water flow rates will be used. How does the selected water flow rate ensure that control efficiencies in the desired range will be maintained?*

“The source will operate all crushers, screens, and conveyors using best management practices.” – *what are best management practices and where are they defined?*

“The source will minimize conveyor drop heights where possible to ensure that opacity limits are not breached.” – *what does “minimize” mean? And, what does “where possible” mean since this appears to allow opacity limits to be breached where it is “not possible” to minimize drop heights?*

“The use of water sprayers will be used to meet the visible emission limitations outlined in Utah's Administrative Code. The source will not allow visible emissions from all screens and conveyor transfer points to exceed 7% opacity. The source will not allow visible emissions from all crushers to exceed 12% opacity.” – *please see my previous comments about how Method 9 cannot be implemented under all operating conditions and provide a technical response as to how these opacity limits will then be assessed continuously. In addition, please address how even meeting these stated opacity limits ensure that the desired control efficiencies will be maintained and, more importantly, the claimed emissions levels for PM10/PM2.5 will be attained and maintained under all conditions.*

(B) BACT review regarding Fugitive PM Emissions from Haul Roads

For this activity, the Engineer Report states that:

“[T]he control options are listed below [in order of effectiveness (1 - most effective): Road Paving with Vacuum Sweeping and Watering (95% effective); Chemical Suppressants and Watering (85% effective); Basic Watering and Silt Reduction (75% effective); Basic Watering (70% effective) – *none of these claimed control efficiencies are required to be verified under actual conditions. I ask the DAQ to provide the technical basis for each of these claimed effectiveness or efficiency values. To the extent they are based on any test data, I ask the DAQ to provide such data in the public record so that the public can assess if test conditions are comparable to conditions that will exist at this proposed mine.*

The Engineer Report states that the Selected BACT for this activity include, among other items:

“The source will pave the entrance road to the quarry.” – *how will this pavement be maintained?*

“The source will use road sweeping and watering to minimize fugitive dust on all paved haul roads.” – *what is the frequency of road sweeping and watering? What quantities of water will be used?*

“The source will use chemical suppressants, watering, and road base to minimize fugitive dust on all unpaved roads.” – *what quantities of chemical suppressants and water be used? How will the road base be maintained?*

“The source will not allow visible emissions from haul roads to exceed 20% opacity on-site and 10% at the property boundary.” – *please see prior comments on inadequacy of opacity measurement, even if feasible using Method 9, to be a proper surrogate for control efficiency and/or emission rates of PM10/PM2.5.*

(C) BACT review regarding PM Emissions from Drilling and Blasting

The DAQ Review Reports accepts, without verification unsupported or misleading claims about drilling and blasting controls, that I have previously addressed. For example, the Engineer Report states that “[T]he use of a dust collection system is up to 99% effective at controlling PM emissions from drilling. The use of wet drilling or drilling shrouds is around 88% effective at controlling PM emissions.” *I ask the DAQ to substantiate this statement.*

The Engineer Report states:

“For controlling the PM emissions from drilling the control options are listed below in order of effectiveness (1 - most effective): Dust Collection Systems (95 - 99% effective); Wet drilling (88% effective); Drilling Shrouds (88% effective).” – *I ask the DAQ to substantiate each of these claims and, to the extent they rely on test data, to provide such data so the public can assess test conditions with conditions at the proposed mine site.*

For the selected BACT, the Engineer Report notes:

“The source shall use a dust collection system to control all emissions from drilling. The source will apply water to any drilling or blasting area before blasting or drilling when the area is not already naturally wet.” – *there is no design information provided in the record for the referenced dust collection system. Therefore, simply presuming its effectiveness is not supportable. As to wet drilling, how much water is expected to be applied in what manner? Please provide and clarify.*

“The source will not allow visible emissions from any fugitive dust source to exceed 20% opacity on-site and 10% at the property boundary.” – *please see prior comments on inadequacy of opacity measurement, even if feasible using Method 9, to be a proper surrogate for control efficiency and/or emission rates of PM10/PM2.5.*

(D) BACT review regarding PM Emissions from Disturbed and Exposed Areas

The BACT for addressing PM10/PM2.5 emissions from disturbed and exposed areas, which the DAQ admits can “...generate fugitive emissions by wind and continued activity on the disturbed soil...” is stated to be “minimum disturbance,” after the elimination of water, given the DAQ’s determination that “[T]he use of water sprayers is not economically feasible because of the large volume of water that would be needed to keep the entire area wet during operation. This is also not an environmentally friendly option due to the large amount of water consumption in an already

drought-stricken area.” – *I have previously noted the lack of any support for the determination that water use would not be economic. If this is true, however, then that simply means that this site, due to lack of water for dust control (as has been repeatedly suggested for use in the prior BACT determinations above) may not be suitable for mining activities. I therefore ask the DAQ to address this incongruity.*

After eliminating water application, the DAQ states that, for BACT, “[T]he source will operate using a minimal disturbance strategy. This will include leaving natural vegetation in for as long as possible and allowing natural vegetation to grow back as soon as possible. The source will not allow visible emissions from disturbed and exposed areas to exceed 20% opacity on-site and 10% at the property boundary.” – *what is meant by “minimal disturbance strategy” and how will it reduce the propensity for dust generation during the extensive dry season in this area, especially to the tune of 50% as imagined in the emissions calculations? Since DAQ did not provide any details in the record, I ask that it do so now. I especially ask the DAQ to provide enough detail to support its determination that there will be less than 20% opacity from disturbed areas, as measured by Method 9, and how this will be implemented. In addition, I ask the DAQ to support its presumption that natural vegetation will grow back at a sufficient rate (with no water in the dry season) so as to be effective as a dust control mechanism for previously-disturbed areas, when the mine continues to progress to additional 10-acre areas in Phase 2. It is my opinion that this is not biologically feasible. Once the topsoil has been removed and the water retention properties of the soil altered, the ability to revegetate the disturbed area quickly is severely limited.*

(E) Storage Piles

Having eliminated, with no support, the option of enclosing the piles, the DAQ states that BACT for storage piles is the application of water “...via water trucks, spray bars, and water cannons to control PM emissions from the storage piles.” – *however, no details of how many trucks, volume of water, design of the water cannons, or any other aspect of storage pile dust control are provided, and certainly nothing is provided to ensure that these options will be enough to maintain the stated emissions levels used in the analysis. I therefore ask the DAQ to provide all design and operational details so that there is a proper basis to conclude that these options will be as effective as intended in the control efficiency assumptions made in the estimated emissions.*

In summary, the entirety of the PM10/PM2.5 BACT analysis is unsupported and full of assumptions and conclusionary statements that do not require any verification and lack any valid or reliable enforcement mechanism. I therefore ask the DAQ to completely revisit the totality of the BACT analysis for all particulate matter.

F. The Special Provisions in the Permit Contain Numerous Unverifiable Assumptions

In this section, I excerpt various pages from the Special Conditions. In these excerpts I have highlighted by red boxes where specific conditions are not enforceable as written. In each instance I note that the permit conditions that ensure verifiability either rely on: (i) recordkeeping by the operator, with no audit of the values being recorded (ii) Method 9 for opacity measurements which, I have noted previously is significantly limited in its application (daytime hours only, need to meet strict observer/source/sun relationships for valid readings/lack of continuous measurements, etc.); (iii) simple qualitative statements about water use for control with no quantification at all; or (iv) similarly vague statements that are, on their face, qualitative or not required to be verified.

SECTION II: SPECIAL PROVISIONS

The intent is to issue an air quality AO authorizing the project with the following recommended conditions and that failure to comply with any of the conditions may constitute a violation of the AO. (New or Modified conditions are indicated as “New” in the Outline Label):

II.B REQUIREMENTS AND LIMITATIONS

II.B.1.a NEW	Unless otherwise specified in this AO, the owner/operator shall not allow visible emissions from any source on site to exceed 20% opacity. [R307-305-3]
II.B.1.a.1 NEW	Unless otherwise specified in this AO, opacity observations of emissions from stationary sources shall be conducted according to 40 CFR 60, Appendix A, Method 9. [R307-305-3]
II.B.1.b NEW	The owner/operator shall not produce more than 1,100,000 tons of aggregate per rolling 12-month period with no more than 1,000,000 tons of aggregate being processed in the aggregate equipment. [R307-401-8]
II.B.1.b.1 NEW	The owner/operator shall: <ul style="list-style-type: none"> A. Determine production and bank run by belt scale records or scale house records B. Record production and bank run on a daily basis C. Use this data to calculate a new rolling 12-month total by the 20th day of each month using data from the previous 12 months D. Keep these records for all periods the plant is in operation. [R307-401-8]
II.B.1.c NEW	The owner/operator shall not operate the crushers, screens, conveyors, feeder, and generator engines at the I-80 South Quarry for more than 12 hours per day from January 1st through the last of February. [R307-401-8]
II.B.1.c.1 NEW	The owner/operator shall: <ul style="list-style-type: none"> A. Determine the hours of operation for the above-listed equipment using hours of operation records/logs B. Record hours of operation on a daily basis C. Keep the hours of operation records onsite for all periods the plant is in operation. [R307-401-8]
II.B.1.d NEW	The owner/operator shall not conduct drilling or blasting operations at the I-80 South Quarry before 9:00 am or after 2:00 pm. [R307-401-8]

II.B.1.d.1 NEW	The owner/operator shall: A. Determine the hours drilling and blasting occur by keeping a records log B. Record the time drilling and/or blasting start and end on a daily basis C. Keep the hourly records onsite for all periods the facility is in operation. [R307-401-8]
II.B.1.e NEW	The owner/operator shall not operate more than One (1) bulldozer onsite. [R307-401-8]
II.B.1.f NEW	The owner/operator shall not operate the bulldozer on site for more than 2,903 hours per rolling 12-month period. [R307-401-8]
II.B.1.f.1 NEW	The owner/operator shall: A. Determine hours of operation by keeping an operational hours log B. Record hours of operation on a daily basis C. Use the hours of operation data to calculate a new rolling 12-month total by the 20th day of each month using data from the previous 12 months D. Keep the production records for all periods the plant is in operation. [R307-401-8]
II.B.1.g NEW	The owner/operator shall only fill the diesel storage tanks using submerged filling. [R307-401-8]
II.B.2 NEW	Aggregate Processing Equipment Requirements
II.B.2.a NEW	The owner/operator shall install water sprays on each crusher, screen, conveyor transfer point, and conveyor drop point on site to control emissions. Water sprays shall operate as necessary to prevent visible emissions from exceeding the opacity limits listed in this AO. [R307-401-8]
II.B.2.b NEW	The owner/operator shall perform monthly periodic inspections to check that water is flowing to water sprays associated with each crusher, screen, and conveyor. If the owner/operator finds that water is not flowing properly during an inspection of the water sprays, the owner/operator shall initiate corrective action within 24 hours and complete corrective action as expediently as practical. [R307-401-8]
II.B.2.b.1 NEW	Records of the water spray inspections shall be maintained in a logbook for all periods when the plant is in operation. The records shall include the following items: A. Date the inspections were made B. Any corrective actions taken C. Control mechanism used if sprays are not operating. [R307-401-8]

II.B.2.c NEW	The owner/operator shall not exceed the following opacity limits for the indicated emission units. A. Crushers - 12% Opacity B. Screens - 7% Opacity C. Conveyor Transfer Points - 7% Opacity D. Conveyor Drop Points - 20% Opacity. [R307-312-4, R307-401-8]
II.B.3 NEW	All NSPS Subpart OOO Equipment on Site Shall be Subject to the Following:
II.B.3.a NEW	The owner/operator shall conduct an initial performance test for all crushers, screens, and conveyor transfer points. Performance tests shall meet the limitations specified in Table 3 to Subpart OOO. Records of initial performance tests shall be kept and maintained on-site for the life of the equipment. [40 CFR 60 Subpart OOO]
II.B.3.b NEW	Initial performance tests for fugitive emissions limits shall be conducted according to 40 CFR 60.675(c). The owner or operator may use methods and procedures specified in 40 CFR 60.675(e) as alternatives to the reference methods and procedures specified in 40 CFR 60.675(c). [40 CFR 60 Subpart OOO]
II.B.3.c NEW	The owner/operator shall submit written reports to the Director of the results of all performance tests conducted to demonstrate compliance with the standards set forth in 40 CFR 60.672. [40 CFR 60 Subpart OOO]
II.B.4 NEW	Paved Haul Road Requirements
II.B.4.a NEW	The owner/operator shall pave the entrance road to the quarry with concrete or asphalt. The total length of all paved haul roads on-site shall not be less than 0.46 miles combined. [R307-401-8]
II.B.4.a.1 NEW	The owner/operator shall: A. Record the length of all paved haul roads using satellite imagery or measurement equipment, or other methods acceptable to the Director B. Keep a record of the total paved haul road length on site at all times the facility is in operation. [R307-401-8]
II.B.4.b NEW	The owner/operator shall vacuum sweep and use water to flush all paved haul roads on-site to maintain the opacity limits listed in the AO. If the temperature is below freezing, the owner/operator shall continue to vacuum sweep the road but may stop flushing the paved haul roads with water. If the haul roads are covered in snow and ice, the owner/operator may stop vacuum sweeping and flushing the paved haul roads. [R307-401-8]

II.B.4.b.1 NEW	Records of vacuum sweeping and water application shall be kept for all periods when the plant is in operation. The records shall include the following items: A. Date and time treatments were made B. Number of treatments made and quantity of water applied C. Rainfall amount received, if any D. Records of temperature, if the temperature is below freezing E. Records shall note if the paved haul roads are covered with snow or ice. [R307-401-8]
II.B.5 NEW	Unpaved Roads and Surfaces
II.B.5.a NEW	The owner/operator shall cover all unpaved haul roads with road base material to reduce fugitive dust emissions from unpaved haul roads. [R307-401-8]
II.B.5.b NEW	The owner/operator shall use a chemical suppressant, water application, or other control options contained in R307-309 to minimize emissions from fugitive dust and fugitive emissions sources, including haul roads, storage piles, and unpaved areas. Controls shall be applied as needed to ensure the opacity limits in this AO are not exceeded. [R307-401-8]
II.B.5.b.1 NEW	Records of water and chemical treatment shall be kept for all periods when the plant is in operation. The records shall include the following items: A. Date of treatment B. Number of treatments made, dilution ratio, and quantity C. Rainfall received, if any, and approximate amount D. Time of day treatments were made E. Records of temperature if the temperature is below freezing. [R307-401-8]
II.B.6 NEW	Fugitive Dust Source Requirements
II.B.6.a NEW	The owner/operator shall not conduct more than 12 blasts per rolling 12-month period. [R307-401-8]
II.B.6.a.1 NEW	The owner/operator shall: A. Record the time and date of each blast on an operations log B. Use the blast data to calculate a new rolling 12-month total by the 20th day of each month using the blasting data from the previous 12-months. C. Keep blasting records onsite at all times the facility is in operation. [R307-401-8]

II.B.6.b NEW	The owner/operator shall not allow visible emissions from haul roads and fugitive dust sources on-site to exceed 20% opacity on site and 10% opacity at the property boundary. [R307-401-8]
II.B.6.b.1 NEW	Opacity observations of fugitive dust from intermittent sources shall be conducted according to 40 CFR 60, Appendix A, Method 9; however, the requirement for observations to be made at 15-second intervals over a six-minute period shall not apply. The number of observations and the time period shall be determined by the length of the intermittent source. For fugitive dust generated by mobile sources, visible emissions shall be measured at the densest point of the plume but at a point not less than one-half vehicle length behind the vehicle and not less than one-half the height of the vehicle. [R307-401-8]
II.B.6.c NEW	The owner/operator shall control particulate emissions from storage piles using water trucks and/or water cannons. The water trucks and/or water cannons shall operate as required to ensure the opacity limits in this AO are not exceeded. [R307-401-8]
II.B.6.c.1 NEW	Records of water application to the storage piles kept for all periods when the plant is in operation. The records shall include the following items: A. The date, time, and location of applications B. The volume of water applied. [R307-401-8]
II.B.6.d NEW	The owner/operator shall install and operate a dust collection system on all drills to control emissions from drilling. [R307-401-8]
II.B.6.d.1 NEW	The owner/operator shall keep records of dust-control systems installed on all drills on-site at all times the facility is in operation. [R307-401-8]
II.B.6.e NEW	The owner/operator shall apply water to any drilling or blasting area before blasting or drilling when the area is not already naturally wet. [R307-401-8]
II.B.6.e.1 NEW	Records of water application shall be kept for all periods that the plant is in operation. The records should include the following: A. Date and time treatments were made B. Number of treatments made and quantity of water applied C. Rainfall amount received, if any. [R307-401-8]
II.B.6.f NEW	Within 30 days of the date of this AO, the owner/operator shall submit a FDCP in electronic or written format. An electronic FDCP can be completed through the Utah DEQ Fugitive Dust Plan Permit Application Website. If a written FDCP is completed, it shall be submitted to the Director, attention: Compliance Branch, for approval. The owner/operator shall comply with the FDCP for control of all fugitive dust sources associated with the I-80 South Quarry. [R307-309-6]
II.B.6.g NEW	The owner/operator shall not allow the disturbed and exposed area to exceed 10 acres in size. [R307-401-8]

II.B.6.g.1 NEW	The owner/operator shall measure the size of the disturbed and exposed area using aerial photographs, land surveys, on-site measurements, or other methods acceptable to the Director at least once per calendar year. [R307-401-8]
II.B.6.h NEW	The owner/operator shall not allow the total storage pile area to exceed 1.5 acres in size. [R307-401-8]
II.B.6.h.1 NEW	The owner/operator shall measure the total storage pile area using aerial photographs, land surveys, on-site measurements, or other methods acceptable to the Director at least once per calendar year. [R307-401-8]
II.B.7 NEW	Diesel Engine Requirements
II.B.7.a NEW	The owner/operator shall not operate any engine on-site for more than 2,200 hours per rolling 12-month period. [R307-401-8]
II.B.7.a.1 NEW	The owner/operator shall: <ul style="list-style-type: none"> A. Determine hours of operation by supervisor monitoring and maintaining an operations log B. Records hours of operation each day C. Use the hours of operation to calculate a new rolling 12-month total by the 20th day of each month using data from the previous 12 months D. Keep hours of operation records for all periods the plant is in operation. [R307-401-8]
II.B.7.b NEW	The owner/operator shall install diesel-fired generator engines that are certified to meet a NO _x emission rate of 0.30 g/hp-hr or less. [R307-401-8]
II.B.7.b.1 NEW	To demonstrate compliance with the emission rate, the owner/operator shall keep a record of the manufacturer's certification of the emission rate. The record shall be kept for the life of the equipment. [R307-401-8]
II.B.7.c NEW	The owner/operator shall not allow visible emissions from the stationary diesel generator engine on-site to exceed 20% opacity. [R307-401-8]
II.B.7.d NEW	The owner/operator shall only combust diesel fuel that meets the definition of ultra-low sulfur diesel (ULSD), which has a sulfur content of 15 ppm or less. [R307-401-8]
II.B.7.d.1 NEW	To demonstrate compliance with the ULSD fuel requirement, the owner/operator shall maintain records of diesel fuel purchase invoices or obtain certification of sulfur content from the diesel fuel supplier. The diesel fuel purchase invoices shall indicate that the diesel fuel meets the ULSD requirements. [R307-401-8]
II.B.7.e NEW	The owner/operator shall operate the diesel-fired generator engines according to the manufacturer's operational and maintenance guidelines. [R307-401-8]

G. Miscellaneous Comments

(i) The Fugitive Dust Control Plan, which is not part of the permit record, should be made available for public review and comment before being accepted by DAQ. In particular, it should contain enforceable provisions of the various commitments that Granite is likely to make in the Plan.

(ii) I excerpt the drilling and blasting assumptions as provided on pdf page 24. Note the incorrect arithmetic. If there are 48 holes per blast, there are 48×12 or 576 holes/year and not 480 as noted in the table. Please revise.

Table B-6. Drilling and Blasting

Parameter	Blasting	Units	Drilling	Units
Daily Maximum Frequency	1	(blast/day)	48	(holes/blast)
Annual Frequency	12	(blasts/yr)	480	(holes/yr)
Annual Area	94,675	(ft ² /yr)	--	--
Daily Area	7,890	(ft ² /day)	--	--
ANFO Usage	20,455	(lbs/blast)	--	--
Annual ANFO Usage	123	(tpy)	--	--
ANFO Heat Content	912	(cal/g)	--	--
Roads ¹	Silt	4.80	%	

Attachment A

Resume

RANAJIT (RON) SAHU, PH.D, CEM (NEVADA)

CONSULTANT, ENVIRONMENTAL AND ENERGY ISSUES

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EXPERIENCE SUMMARY

Dr. Sahu has over thirty two years of experience in the fields of environmental, mechanical, and chemical engineering including: program and project management services; design and specification of pollution control equipment for a wide range of emissions sources including stationary and mobile sources; soils and groundwater remediation including landfills as remedy; combustion engineering evaluations; energy studies; multimedia environmental regulatory compliance (involving statutes and regulations such as the Federal CAA and its Amendments, Clean Water Act, TSCA, RCRA, CERCLA, SARA, OSHA, NEPA as well as various related state statutes); transportation air quality impact analysis; multimedia compliance audits; multimedia permitting (including air quality NSR/PSD permitting, Title V permitting, NPDES permitting for industrial and storm water discharges, RCRA permitting, etc.), multimedia/multi-pathway human health risk assessments for toxics; air dispersion modeling; and regulatory strategy development and support including negotiation of consent agreements and orders.

He has over thirty years of project management experience and has successfully managed and executed hundreds of projects in this time period. This includes basic and applied research projects, design projects, regulatory compliance projects, permitting projects, energy studies, risk assessment projects, and projects involving the communication of environmental data and information to the public.

He has provided consulting services to numerous private sector, public sector and public interest group clients. His major clients over the past three decades include various trade associations as well as individual companies such as steel mills, petroleum refineries, chemical plants, cement manufacturers, aerospace companies, power generation facilities, lawn and garden equipment manufacturers, spa manufacturers, chemical distribution facilities, land development companies, and various entities in the public sector including EPA, the US Dept. of Justice, several states (including New York, New Jersey, Connecticut, Kansas, Oregon, New Mexico, Pennsylvania, and others), various agencies such as the California DTSC, and various cities and municipalities. Dr. Sahu has executed projects in all 50 US states, numerous local jurisdictions and internationally.

In addition to consulting, for approximately two decades, Dr. Sahu taught numerous courses in several Southern California universities as adjunct faculty, including UCLA (air pollution), UC Riverside (air pollution, process hazard analysis), and Loyola Marymount University (air pollution, risk assessment, hazardous waste management). He also taught at Caltech, his alma mater (various engineering courses), at the University of Southern California (air pollution controls) and at California State University, Fullerton (transportation and air quality).

Dr. Sahu has and continues to provide expert witness services in a number of environmental and engineering areas discussed above in both state and Federal courts as well as before administrative bodies (please see Annex A).

EXPERIENCE RECORD

2000-present **Independent Consultant.** Providing a variety of private sector (industrial companies, land development companies, law firms, etc.), public sector (such as the US Department of Justice), and

public interest group clients with project management, environmental consulting, project management, as well as regulatory and engineering support consulting services.

- 1995-2000 Parsons ES, **Associate, Senior Project Manager and Department Manager for Air Quality/Geosciences/Hazardous Waste Groups**, Pasadena, CA.
Parsons ES, **Manager for Air Source Testing Services**. Responsible for the management of 8 individuals in the area of air source testing and air regulatory permitting projects located in Bakersfield, California.
- 1992-1995 Engineering-Science, Inc. **Principal Engineer and Senior Project Manager** in the air quality department.
- 1990-1992 Engineering-Science, Inc. **Principal Engineer and Project Manager** in the air quality department.
- 1989-1990 Kinetics Technology International, Corp. **Development Engineer**. Involved in thermal engineering R&D and project work related to low-NO_x ceramic radiant burners, fired heater NO_x reduction, SCR design, and fired heater retrofitting.
- 1988-1989 Heat Transfer Research, Inc. **Research Engineer**. Involved in the design of fired heaters, heat exchangers, air coolers, and other non-fired equipment. Also did research in the area of heat exchanger tube vibrations.

EDUCATION

- 1984-1988 Ph.D., Mechanical Engineering, California Institute of Technology (Caltech), Pasadena, CA.
- 1984 M. S., Mechanical Engineering, California Institute of Technology (Caltech), Pasadena, CA.
- 1978-1983 B. Tech (Honors), Mechanical Engineering, Indian Institute of Technology (IIT) Kharagpur, India

TEACHING EXPERIENCE

Caltech

- "Thermodynamics," Teaching Assistant, California Institute of Technology, 1983, 1987.
- "Air Pollution Control," Teaching Assistant, California Institute of Technology, 1985.
- "Caltech Secondary and High School Saturday Program," - taught various mathematics (algebra through calculus) and science (physics and chemistry) courses to high school students, 1983-1989.
- "Heat Transfer," - taught this course in the Fall and Winter terms of 1994-1995 in the Division of Engineering and Applied Science.
- "Thermodynamics and Heat Transfer," Fall and Winter Terms of 1996-1997.

U.C. Riverside, Extension

- "Toxic and Hazardous Air Contaminants," University of California Extension Program, Riverside, California. Various years since 1992.
- "Prevention and Management of Accidental Air Emissions," University of California Extension Program, Riverside, California. Various years since 1992.
- "Air Pollution Control Systems and Strategies," University of California Extension Program, Riverside, California, Summer 1992-93, Summer 1993-1994.
- "Air Pollution Calculations," University of California Extension Program, Riverside, California, Fall 1993-94, Winter 1993-94, Fall 1994-95.
- "Process Safety Management," University of California Extension Program, Riverside, California. Various years since 1992-2010.

"Process Safety Management," University of California Extension Program, Riverside, California, at SCAQMD, Spring 1993-94.

"Advanced Hazard Analysis - A Special Course for LEPCs," University of California Extension Program, Riverside, California, taught at San Diego, California, Spring 1993-1994.

"Advanced Hazardous Waste Management" University of California Extension Program, Riverside, California, 2005.

Loyola Marymount University

"Fundamentals of Air Pollution - Regulations, Controls and Engineering," Loyola Marymount University, Dept. of Civil Engineering. Various years beginning 1993.

"Air Pollution Control," Loyola Marymount University, Dept. of Civil Engineering, Fall 1994.

"Environmental Risk Assessment," Loyola Marymount University, Dept. of Civil Engineering. Various years beginning 1998.

"Hazardous Waste Remediation" Loyola Marymount University, Dept. of Civil Engineering. Various years beginning 2006.

University of Southern California

"Air Pollution Controls," University of Southern California, Dept. of Civil Engineering, Fall 1993, Fall 1994.

"Air Pollution Fundamentals," University of Southern California, Dept. of Civil Engineering, Winter 1994.

University of California, Los Angeles

"Air Pollution Fundamentals," University of California, Los Angeles, Dept. of Civil and Environmental Engineering, Spring 1994, Spring 1999, Spring 2000, Spring 2003, Spring 2006, Spring 2007, Spring 2008, Spring 2009.

International Programs

"Environmental Planning and Management," 5 week program for visiting Chinese delegation, 1994.

"Environmental Planning and Management," 1 day program for visiting Russian delegation, 1995.

"Air Pollution Planning and Management," IEP, UCR, Spring 1996.

"Environmental Issues and Air Pollution," IEP, UCR, October 1996.

PROFESSIONAL AFFILIATIONS AND HONORS

President of India Gold Medal, IIT Kharagpur, India, 1983.

Member of the Alternatives Assessment Committee of the Grand Canyon Visibility Transport Commission, established by the Clean Air Act Amendments of 1990, 1992.

American Society of Mechanical Engineers: Los Angeles Section Executive Committee, Heat Transfer Division, and Fuels and Combustion Technology Division, 1987-mid-1990s.

Air and Waste Management Association, West Coast Section, 1989-mid-2000s.

PROFESSIONAL CERTIFICATIONS

EIT, California (#XE088305), 1993.

REA I, California (#07438), 2000.

Certified Permitting Professional, South Coast AQMD (#C8320), since 1993.

QEP, Institute of Professional Environmental Practice, 2000 - 2021.

CEM, State of Nevada (#EM-1699).

PUBLICATIONS (PARTIAL LIST)

"Physical Properties and Oxidation Rates of Chars from Bituminous Coals," with Y.A. Levendis, R.C. Flagan and G.R. Gavalas, *Fuel*, **67**, 275-283 (1988).

"Char Combustion: Measurement and Analysis of Particle Temperature Histories," with R.C. Flagan, G.R. Gavalas and P.S. Northrop, *Comb. Sci. Tech.* **60**, 215-230 (1988).

"On the Combustion of Bituminous Coal Chars," PhD Thesis, California Institute of Technology (1988).

"Optical Pyrometry: A Powerful Tool for Coal Combustion Diagnostics," *J. Coal Quality*, **8**, 17-22 (1989).

"Post-Ignition Transients in the Combustion of Single Char Particles," with Y.A. Levendis, R.C. Flagan and G.R. Gavalas, *Fuel*, **68**, 849-855 (1989).

"A Model for Single Particle Combustion of Bituminous Coal Char." Proc. ASME National Heat Transfer Conference, Philadelphia, **HTD-Vol. 106**, 505-513 (1989).

"Discrete Simulation of Cenospheric Coal-Char Combustion," with R.C. Flagan and G.R. Gavalas, *Combust. Flame*, **77**, 337-346 (1989).

"Particle Measurements in Coal Combustion," with R.C. Flagan, in "**Combustion Measurements**" (ed. N. Chigier), Hemisphere Publishing Corp. (1991).

"Cross Linking in Pore Structures and Its Effect on Reactivity," with G.R. Gavalas in preparation.

"Natural Frequencies and Mode Shapes of Straight Tubes," Proprietary Report for Heat Transfer Research Institute, Alhambra, CA (1990).

"Optimal Tube Layouts for Kamui SL-Series Exchangers," with K. Ishihara, Proprietary Report for Kamui Company Limited, Tokyo, Japan (1990).

"HTRI Process Heater Conceptual Design," Proprietary Report for Heat Transfer Research Institute, Alhambra, CA (1990).

"Asymptotic Theory of Transonic Wind Tunnel Wall Interference," with N.D. Malmuth and others, Arnold Engineering Development Center, Air Force Systems Command, USAF (1990).

"Gas Radiation in a Fired Heater Convection Section," Proprietary Report for Heat Transfer Research Institute, College Station, TX (1990).

"Heat Transfer and Pressure Drop in NTIW Heat Exchangers," Proprietary Report for Heat Transfer Research Institute, College Station, TX (1991).

"NO_x Control and Thermal Design," Thermal Engineering Tech Briefs, (1994).

"From Purchase of Landmark Environmental Insurance to Remediation: Case Study in Henderson, Nevada," with Robin E. Bain and Jill Quillin, presented at the AQMA Annual Meeting, Florida, 2001.

"The Jones Act Contribution to Global Warming, Acid Rain and Toxic Air Contaminants," with Charles W. Botsford, presented at the AQMA Annual Meeting, Florida, 2001.

PRESENTATIONS (PARTIAL LIST)

"Pore Structure and Combustion Kinetics - Interpretation of Single Particle Temperature-Time Histories," with P.S. Northrop, R.C. Flagan and G.R. Gavalas, presented at the AIChE Annual Meeting, New York (1987).

"Measurement of Temperature-Time Histories of Burning Single Coal Char Particles," with R.C. Flagan, presented at the American Flame Research Committee Fall International Symposium, Pittsburgh, (1988).

"Physical Characterization of a Cenospheric Coal Char Burned at High Temperatures," with R.C. Flagan and G.R. Gavalas, presented at the Fall Meeting of the Western States Section of the Combustion Institute, Laguna Beach, California (1988).

"Control of Nitrogen Oxide Emissions in Gas Fired Heaters - The Retrofit Experience," with G. P. Croce and R. Patel, presented at the International Conference on Environmental Control of Combustion Processes (Jointly sponsored by the American Flame Research Committee and the Japan Flame Research Committee), Honolulu, Hawaii (1991).

"Air Toxics - Past, Present and the Future," presented at the Joint AIChE/AAEE Breakfast Meeting at the AIChE 1991 Annual Meeting, Los Angeles, California, November 17-22 (1991).

"Air Toxics Emissions and Risk Impacts from Automobiles Using Reformulated Gasolines," presented at the Third Annual Current Issues in Air Toxics Conference, Sacramento, California, November 9-10 (1992).

"Air Toxics from Mobile Sources," presented at the Environmental Health Sciences (ESE) Seminar Series, UCLA, Los Angeles, California, November 12, (1992).

"Kilns, Ovens, and Dryers - Present and Future," presented at the Gas Company Air Quality Permit Assistance Seminar, Industry Hills Sheraton, California, November 20, (1992).

"The Design and Implementation of Vehicle Scrapping Programs," presented at the 86th Annual Meeting of the Air and Waste Management Association, Denver, Colorado, June 12, 1993.

"Air Quality Planning and Control in Beijing, China," presented at the 87th Annual Meeting of the Air and Waste Management Association, Cincinnati, Ohio, June 19-24, 1994.

Annex A

Expert Litigation Support

A. Occasions where Dr. Sahu has provided Written or Oral testimony before Congress:

1. In July 2012, provided expert written and oral testimony to the House Subcommittee on Energy and the Environment, Committee on Science, Space, and Technology at a Hearing entitled “Hitting the Ethanol Blend Wall – Examining the Science on E15.”

B. Matters for which Dr. Sahu has provided affidavits and expert reports include:

2. Affidavit for Rocky Mountain Steel Mills, Inc. located in Pueblo Colorado – dealing with the technical uncertainties associated with night-time opacity measurements in general and at this steel mini-mill.
3. Expert reports and depositions (2/28/2002 and 3/1/2002; 12/2/2003 and 12/3/2003; 5/24/2004) on behalf of the United States in connection with the Ohio Edison NSR Cases. *United States, et al. v. Ohio Edison Co., et al.*, C2-99-1181 (Southern District of Ohio).
4. Expert reports and depositions (5/23/2002 and 5/24/2002) on behalf of the United States in connection with the Illinois Power NSR Case. *United States v. Illinois Power Co., et al.*, 99-833-MJR (Southern District of Illinois).
5. Expert reports and depositions (11/25/2002 and 11/26/2002) on behalf of the United States in connection with the Duke Power NSR Case. *United States, et al. v. Duke Energy Corp.*, 1:00-CV-1262 (Middle District of North Carolina).
6. Expert reports and depositions (10/6/2004 and 10/7/2004; 7/10/2006) on behalf of the United States in connection with the American Electric Power NSR Cases. *United States, et al. v. American Electric Power Service Corp., et al.*, C2-99-1182, C2-99-1250 (Southern District of Ohio).
7. Affidavit (March 2005) on behalf of the Minnesota Center for Environmental Advocacy and others in the matter of the Application of Heron Lake BioEnergy LLC to construct and operate an ethanol production facility – submitted to the Minnesota Pollution Control Agency.
8. Expert Report and Deposition (10/31/2005 and 11/1/2005) on behalf of the United States in connection with the East Kentucky Power Cooperative NSR Case. *United States v. East Kentucky Power Cooperative, Inc.*, 5:04-cv-00034-KSF (Eastern District of Kentucky).
9. Affidavits and deposition on behalf of Basic Management Inc. (BMI) Companies in connection with the BMI vs. USA remediation cost recovery Case.
10. Expert Report on behalf of Penn Future and others in the Cambria Coke plant permit challenge in Pennsylvania.
11. Expert Report on behalf of the Appalachian Center for the Economy and the Environment and others in the Western Greenbrier permit challenge in West Virginia.
12. Expert Report, deposition (via telephone on January 26, 2007) on behalf of various Montana petitioners (Citizens Awareness Network (CAN), Women’s Voices for the Earth (WVE) and the Clark Fork Coalition (CFC)) in the Thompson River Cogeneration LLC Permit No. 3175-04 challenge.
13. Expert Report and deposition (2/2/07) on behalf of the Texas Clean Air Cities Coalition at the Texas State Office of Administrative Hearings (SOAH) in the matter of the permit challenges to TXU Project Apollo’s eight new proposed PRB-fired PC boilers located at seven TX sites.
14. Expert Testimony (July 2007) on behalf of the Izaak Walton League of America and others in connection with the acquisition of power by Xcel Energy from the proposed Gascoyne Power Plant – at the State of

- Minnesota, Office of Administrative Hearings for the Minnesota PUC (MPUC No. E002/CN-06-1518; OAH No. 12-2500-17857-2).
15. Affidavit (July 2007) Comments on the Big Cajun I Draft Permit on behalf of the Sierra Club – submitted to the Louisiana DEQ.
 16. Expert Report and Deposition (12/13/2007) on behalf of Commonwealth of Pennsylvania – Dept. of Environmental Protection, State of Connecticut, State of New York, and State of New Jersey (Plaintiffs) in connection with the Allegheny Energy NSR Case. *Plaintiffs v. Allegheny Energy Inc., et al.*, 2:05cv0885 (Western District of Pennsylvania).
 17. Expert Reports and Pre-filed Testimony before the Utah Air Quality Board on behalf of Sierra Club in the Sevier Power Plant permit challenge.
 18. Expert Report and Deposition (October 2007) on behalf of MTD Products Inc., in connection with *General Power Products, LLC v MTD Products Inc.*, 1:06 CVA 0143 (Southern District of Ohio, Western Division) .
 19. Expert Report and Deposition (June 2008) on behalf of Sierra Club and others in the matter of permit challenges (Title V: 28.0801-29 and PSD: 28.0803-PSD) for the Big Stone II unit, proposed to be located near Milbank, South Dakota.
 20. Expert Reports, Affidavit, and Deposition (August 15, 2008) on behalf of Earthjustice in the matter of air permit challenge (CT-4631) for the Basin Electric Dry Fork station, under construction near Gillette, Wyoming before the Environmental Quality Council of the State of Wyoming.
 21. Affidavits (May 2010/June 2010 in the Office of Administrative Hearings)/Declaration and Expert Report (November 2009 in the Office of Administrative Hearings) on behalf of NRDC and the Southern Environmental Law Center in the matter of the air permit challenge for Duke Cliffside Unit 6. Office of Administrative Hearing Matters 08 EHR 0771, 0835 and 0836 and 09 HER 3102, 3174, and 3176 (consolidated).
 22. Declaration (August 2008), Expert Report (January 2009), and Declaration (May 2009) on behalf of Southern Alliance for Clean Energy in the matter of the air permit challenge for Duke Cliffside Unit 6. *Southern Alliance for Clean Energy et al., v. Duke Energy Carolinas, LLC*, Case No. 1:08-cv-00318-LHT-DLH (Western District of North Carolina, Asheville Division).
 23. Declaration (August 2008) on behalf of the Sierra Club in the matter of Dominion Wise County plant MACT.us
 24. Expert Report (June 2008) on behalf of Sierra Club for the Green Energy Resource Recovery Project, MACT Analysis.
 25. Expert Report (February 2009) on behalf of Sierra Club and the Environmental Integrity Project in the matter of the air permit challenge for NRG Limestone’s proposed Unit 3 in Texas.
 26. Expert Report (June 2009) on behalf of MTD Products, Inc., in the matter of *Alice Holmes and Vernon Holmes v. Home Depot USA, Inc., et al.*
 27. Expert Report (August 2009) on behalf of Sierra Club and the Southern Environmental Law Center in the matter of the air permit challenge for Santee Cooper’s proposed Pee Dee plant in South Carolina).
 28. Statements (May 2008 and September 2009) on behalf of the Minnesota Center for Environmental Advocacy to the Minnesota Pollution Control Agency in the matter of the Minnesota Haze State Implementation Plans.
 29. Expert Report (August 2009) on behalf of Environmental Defense, in the matter of permit challenges to the proposed Las Brisas coal fired power plant project at the Texas State Office of Administrative Hearings (SOAH).
 30. Expert Report and Rebuttal Report (September 2009) on behalf of the Sierra Club, in the matter of challenges to the proposed Medicine Bow Fuel and Power IGL plant in Cheyenne, Wyoming.
 31. Expert Report (December 2009) and Rebuttal reports (May 2010 and June 2010) on behalf of the United States in connection with the Alabama Power Company NSR Case. *United States v. Alabama Power Company*, CV-01-HS-152-S (Northern District of Alabama, Southern Division).

32. Pre-filed Testimony (October 2009) on behalf of Environmental Defense and others, in the matter of challenges to the proposed White Stallion Energy Center coal fired power plant project at the Texas State Office of Administrative Hearings (SOAH).
33. Pre-filed Testimony (July 2010) and Written Rebuttal Testimony (August 2010) on behalf of the State of New Mexico Environment Department in the matter of Proposed Regulation 20.2.350 NMAC – *Greenhouse Gas Cap and Trade Provisions*, No. EIB 10-04 (R), to the State of New Mexico, Environmental Improvement Board.
34. Expert Report (August 2010) and Rebuttal Expert Report (October 2010) on behalf of the United States in connection with the Louisiana Generating NSR Case. *United States v. Louisiana Generating, LLC*, 09-CV100-RET-CN (Middle District of Louisiana) – Liability Phase.
35. Declaration (August 2010), Reply Declaration (November 2010), Expert Report (April 2011), Supplemental and Rebuttal Expert Report (July 2011) on behalf of the United States in the matter of DTE Energy Company and Detroit Edison Company (Monroe Unit 2). *United States of America v. DTE Energy Company and Detroit Edison Company*, Civil Action No. 2:10-cv-13101-BAF-RSW (Eastern District of Michigan).
36. Expert Report and Deposition (August 2010) as well as Affidavit (September 2010) on behalf of Kentucky Waterways Alliance, Sierra Club, and Valley Watch in the matter of challenges to the NPDES permit issued for the Trimble County power plant by the Kentucky Energy and Environment Cabinet to Louisville Gas and Electric, File No. DOW-41106-047.
37. Expert Report (August 2010), Rebuttal Expert Report (September 2010), Supplemental Expert Report (September 2011), and Declaration (November 2011) on behalf of Wild Earth Guardians in the matter of opacity exceedances and monitor downtime at the Public Service Company of Colorado (Xcel)'s Cherokee power plant. No. 09-cv-1862 (District of Colorado).
38. Written Direct Expert Testimony (August 2010) and Affidavit (February 2012) on behalf of Fall-Line Alliance for a Clean Environment and others in the matter of the PSD Air Permit for Plant Washington issued by Georgia DNR at the Office of State Administrative Hearing, State of Georgia (OSAH-BNR-AQ-1031707-98-WALKER).
39. Deposition (August 2010) on behalf of Environmental Defense, in the matter of the remanded permit challenge to the proposed Las Brisas coal fired power plant project at the Texas State Office of Administrative Hearings (SOAH).
40. Expert Report, Supplemental/Rebuttal Expert Report, and Declarations (October 2010, November 2010, September 2012) on behalf of New Mexico Environment Department (Plaintiff-Intervenor), Grand Canyon Trust and Sierra Club (Plaintiffs) in the matter of *Plaintiffs v. Public Service Company of New Mexico* (PNM), Civil No. 1:02-CV-0552 BB/ATC (ACE) (District of New Mexico).
41. Expert Report (October 2010) and Rebuttal Expert Report (November 2010) (BART Determinations for PSCo Hayden and CSU Martin Drake units) to the Colorado Air Quality Commission on behalf of Coalition of Environmental Organizations.
42. Expert Report (November 2010) (BART Determinations for TriState Craig Units, CSU Nixon Unit, and PRPA Rawhide Unit) to the Colorado Air Quality Commission on behalf of Coalition of Environmental Organizations.
43. Declaration (November 2010) on behalf of the Sierra Club in connection with the Martin Lake Station Units 1, 2, and 3. *Sierra Club v. Energy Future Holdings Corporation and Luminant Generation Company LLC*, Case No. 5:10-cv-00156-DF-CMC (Eastern District of Texas, Texarkana Division).
44. Pre-Filed Testimony (January 2011) and Declaration (February 2011) to the Georgia Office of State Administrative Hearings (OSAH) in the matter of Minor Source HAPs status for the proposed Longleaf Energy Associates power plant (OSAH-BNR-AQ-1115157-60-HOWELLS) on behalf of the Friends of the Chattahoochee and the Sierra Club).
45. Declaration (February 2011) in the matter of the Draft Title V Permit for RRI Energy MidAtlantic Power Holdings LLC Shawville Generating Station (Pennsylvania), ID No. 17-00001 on behalf of the Sierra Club.

46. Expert Report (March 2011), Rebuttal Expert Report (June 2011) on behalf of the United States in *United States of America v. Cemex, Inc.*, Civil Action No. 09-cv-00019-MSK-MEH (District of Colorado).
47. Declaration (April 2011) and Expert Report (July 16, 2012) in the matter of the Lower Colorado River Authority (LCRA)'s Fayette (Sam Seymour) Power Plant on behalf of the Texas Campaign for the Environment. *Texas Campaign for the Environment v. Lower Colorado River Authority*, Civil Action No. 4:11-cv-00791 (Southern District of Texas, Houston Division).
48. Declaration (June 2011) on behalf of the Plaintiffs MYTAPN in the matter of Microsoft-Yes, Toxic Air Pollution-No (MYTAPN) v. State of Washington, Department of Ecology and Microsoft Corporation Columbia Data Center to the Pollution Control Hearings Board, State of Washington, Matter No. PCHB No. 10-162.
49. Expert Report (June 2011) on behalf of the New Hampshire Sierra Club at the State of New Hampshire Public Utilities Commission, Docket No. 10-261 – the 2010 Least Cost Integrated Resource Plan (LCIRP) submitted by the Public Service Company of New Hampshire (re. Merrimack Station Units 1 and 2).
50. Declaration (August 2011) in the matter of the Sandy Creek Energy Associates L.P. Sandy Creek Power Plant on behalf of Sierra Club and Public Citizen. *Sierra Club, Inc. and Public Citizen, Inc. v. Sandy Creek Energy Associates, L.P.*, Civil Action No. A-08-CA-648-LY (Western District of Texas, Austin Division).
51. Expert Report (October 2011) on behalf of the Defendants in the matter of *John Quiles and Jeanette Quiles et al. v. Bradford-White Corporation, MTD Products, Inc., Kohler Co., et al.*, Case No. 3:10-cv-747 (TJM/DEP) (Northern District of New York).
52. Declaration (October 2011) on behalf of the Plaintiffs in the matter of *American Nurses Association et al. (Plaintiffs), v. US EPA (Defendant)*, Case No. 1:08-cv-02198-RMC (US District Court for the District of Columbia).
53. Declaration (February 2012) and Second Declaration (February 2012) in the matter of *Washington Environmental Council and Sierra Club Washington State Chapter v. Washington State Department of Ecology and Western States Petroleum Association*, Case No. 11-417-MJP (Western District of Washington).
54. Expert Report (March 2012) and Supplemental Expert Report (November 2013) in the matter of *Environment Texas Citizen Lobby, Inc and Sierra Club v. ExxonMobil Corporation et al.*, Civil Action No. 4:10-cv-4969 (Southern District of Texas, Houston Division).
55. Declaration (March 2012) in the matter of *Center for Biological Diversity, et al. v. United States Environmental Protection Agency*, Case No. 11-1101 (consolidated with 11-1285, 11-1328 and 11-1336) (US Court of Appeals for the District of Columbia Circuit).
56. Declaration (March 2012) in the matter of *Sierra Club v. The Kansas Department of Health and Environment*, Case No. 11-105,493-AS (Holcomb power plant) (Supreme Court of the State of Kansas).
57. Declaration (March 2012) in the matter of the Las Brisas Energy Center *Environmental Defense Fund et al., v. Texas Commission on Environmental Quality*, Cause No. D-1-GN-11-001364 (District Court of Travis County, Texas, 261st Judicial District).
58. Expert Report (April 2012), Supplemental and Rebuttal Expert Report (July 2012), and Supplemental Rebuttal Expert Report (August 2012) on behalf of the states of New Jersey and Connecticut in the matter of the Portland Power plant *State of New Jersey and State of Connecticut (Intervenor-Plaintiff) v. RRI Energy Mid-Atlantic Power Holdings et al.*, Civil Action No. 07-CV-5298 (JKG) (Eastern District of Pennsylvania).
59. Declaration (April 2012) in the matter of the EPA's EGU MATS Rule, on behalf of the Environmental Integrity Project.
60. Expert Report (August 2012) on behalf of the United States in connection with the Louisiana Generating NSR Case. *United States v. Louisiana Generating, LLC*, 09-CV100-RET-CN (Middle District of Louisiana) – Harm Phase.
61. Declaration (September 2012) in the Matter of the Application of *Energy Answers Incinerator, Inc.* for a Certificate of Public Convenience and Necessity to Construct a 120 MW Generating Facility in Baltimore City, Maryland, before the Public Service Commission of Maryland, Case No. 9199.

62. Expert Report (October 2012) on behalf of the Appellants (Robert Concilus and Leah Humes) in the matter of Robert Concilus and Leah Humes v. Commonwealth of Pennsylvania Department of Environmental Protection and Crawford Renewable Energy, before the Commonwealth of Pennsylvania Environmental Hearing Board, Docket No. 2011-167-R.
63. Expert Report (October 2012), Supplemental Expert Report (January 2013), and Affidavit (June 2013) in the matter of various Environmental Petitioners v. North Carolina DENR/DAQ and Carolinas Cement Company, before the Office of Administrative Hearings, State of North Carolina.
64. Pre-filed Testimony (October 2012) on behalf of No-Sag in the matter of the North Springfield Sustainable Energy Project before the State of Vermont, Public Service Board.
65. Pre-filed Testimony (November 2012) on behalf of Clean Wisconsin in the matter of Application of Wisconsin Public Service Corporation for Authority to Construct and Place in Operation a New Multi-Pollutant Control Technology System (ReACT) for Unit 3 of the Weston Generating Station, before the Public Service Commission of Wisconsin, Docket No. 6690-CE-197.
66. Expert Report (February 2013) on behalf of Petitioners in the matter of Credence Crematory, Cause No. 12-A-J-4538 before the Indiana Office of Environmental Adjudication.
67. Expert Report (April 2013), Rebuttal report (July 2013), and Declarations (October 2013, November 2013) on behalf of the Sierra Club in connection with the Luminant Big Brown Case. *Sierra Club v. Energy Future Holdings Corporation and Luminant Generation Company LLC*, Civil Action No. 6:12-cv-00108-WSS (Western District of Texas, Waco Division).
68. Declaration (April 2013) on behalf of Petitioners in the matter of *Sierra Club, et al., (Petitioners) v. Environmental Protection Agency et al. (Respondents)*, Case No., 13-1112, (Court of Appeals, District of Columbia Circuit).
69. Expert Report (May 2013) and Rebuttal Expert Report (July 2013) on behalf of the Sierra Club in connection with the Luminant Martin Lake Case. *Sierra Club v. Energy Future Holdings Corporation and Luminant Generation Company LLC*, Civil Action No. 5:10-cv-0156-MHS-CMC (Eastern District of Texas, Texarkana Division).
70. Declaration (August 2013) on behalf of A. J. Acosta Company, Inc., in the matter of *A. J. Acosta Company, Inc., v. County of San Bernardino*, Case No. CIVSS803651.
71. Comments (October 2013) on behalf of the Washington Environmental Council and the Sierra Club in the matter of the Washington State Oil Refinery RACT (for Greenhouse Gases), submitted to the Washington State Department of Ecology, the Northwest Clean Air Agency, and the Puget Sound Clean Air Agency.
72. Statement (November 2013) on behalf of various Environmental Organizations in the matter of the Boswell Energy Center (BEC) Unit 4 Environmental Retrofit Project, to the Minnesota Public Utilities Commission, Docket No. E-015/M-12-920.
73. Expert Report (December 2013) on behalf of the United States in *United States of America v. Ameren Missouri*, Civil Action No. 4:11-cv-00077-RWS (Eastern District of Missouri, Eastern Division).
74. Expert Testimony (December 2013) on behalf of the Sierra Club in the matter of Public Service Company of New Hampshire Merrimack Station Scrubber Project and Cost Recovery, Docket No. DE 11-250, to the State of New Hampshire Public Utilities Commission.
75. Expert Report (January 2014) on behalf of Baja, Inc., in *Baja, Inc., v. Automotive Testing and Development Services, Inc. et al.*, Civil Action No. 8:13-CV-02057-GRA (District of South Carolina, Anderson/Greenwood Division).
76. Declaration (March 2014) on behalf of the Center for International Environmental Law, Chesapeake Climate Action Network, Friends of the Earth, Pacific Environment, and the Sierra Club (Plaintiffs) in the matter of *Plaintiffs v. the Export-Import Bank (Ex-Im Bank) of the United States*, Civil Action No. 13-1820 RC (District Court for the District of Columbia).

77. Declaration (April 2014) on behalf of Respondent-Intervenors in the matter of *Mexichem Specialty Resins Inc., et al., (Petitioners) v Environmental Protection Agency et al.*, Case No., 12-1260 (and Consolidated Case Nos. 12-1263, 12-1265, 12-1266, and 12-1267), (Court of Appeals, District of Columbia Circuit).
78. Direct Prefiled Testimony (June 2014) on behalf of the Michigan Environmental Council and the Sierra Club in the matter of the Application of DTE Electric Company for Authority to Implement a Power Supply Cost Recovery (PSCR) Plan in its Rate Schedules for 2014 Metered Jurisdictional Sales of Electricity, Case No. U-17319 (Michigan Public Service Commission).
79. Expert Report (June 2014) on behalf of ECM Biofilms in the matter of the US Federal Trade Commission (FTC) v. ECM Biofilms (FTC Docket #9358).
80. Direct Prefiled Testimony (August 2014) on behalf of the Michigan Environmental Council and the Sierra Club in the matter of the Application of Consumers Energy Company for Authority to Implement a Power Supply Cost Recovery (PSCR) Plan in its Rate Schedules for 2014 Metered Jurisdictional Sales of Electricity, Case No. U-17317 (Michigan Public Service Commission).
81. Declaration (July 2014) on behalf of Public Health Intervenors in the matter of *EME Homer City Generation v. US EPA* (Case No. 11-1302 and consolidated cases) relating to the lifting of the stay entered by the Court on December 30, 2011 (US Court of Appeals for the District of Columbia).
82. Expert Report (September 2014), Rebuttal Expert Report (December 2014) and Supplemental Expert Report (March 2015) on behalf of Plaintiffs in the matter of *Sierra Club and Montana Environmental Information Center (Plaintiffs) v. PPL Montana LLC, Avista Corporation, Puget Sound Energy, Portland General Electric Company, Northwestern Corporation, and PacifiCorp (Defendants)*, Civil Action No. CV 13-32-BLG-DLC-JCL (US District Court for the District of Montana, Billings Division).
83. Expert Report (November 2014) on behalf of Niagara County, the Town of Lewiston, and the Villages of Lewiston and Youngstown in the matter of CWM Chemical Services, LLC New York State Department of Environmental Conservation (NYSDEC) Permit Application Nos.: 9-2934-00022/00225, 9-2934-00022/00231, 9-2934-00022/00232, and 9-2934-00022/00249 (pending).
84. *Declaration (January 2015) relating to Startup/Shutdown in the MATS Rule (EPA Docket ID No. EPA-HQ-OAR-2009-0234) on behalf of the Environmental Integrity Project.*
85. Pre-filed Direct Testimony (March 2015), Supplemental Testimony (May 2015), and Surrebuttal Testimony (December 2015) on behalf of Friends of the Columbia Gorge in the matter of the Application for a Site Certificate for the Troutdale Energy Center before the Oregon Energy Facility Siting Council.
86. Brief of Amici Curiae Experts in Air Pollution Control and Air Quality Regulation in Support of the Respondents, On Writs of Certiorari to the US Court of Appeals for the District of Columbia, No. 14-46, 47, 48. *Michigan et al., (Petitioners) v. EPA et al., Utility Air Regulatory Group (Petitioners) v. EPA et al., National Mining Association et al., (Petitioner) v. EPA et al.*, (Supreme Court of the United States).
87. Expert Report (March 2015) and Rebuttal Expert Report (January 2016) on behalf of Plaintiffs in the matter of *Conservation Law Foundation v. Broadrock Gas Services LLC, Rhode Island LFG GENCO LLC, and Rhode Island Resource Recovery Corporation (Defendants)*, Civil Action No. 1:13-cv-00777-M-PAS (US District Court for the District of Rhode Island).
88. Declaration (April 2015) relating to various Technical Corrections for the MATS Rule (EPA Docket ID No. EPA-HQ-OAR-2009-0234) on behalf of the Environmental Integrity Project.
89. Direct Prefiled Testimony (May 2015) on behalf of the Michigan Environmental Council, the Natural Resources Defense Council, and the Sierra Club in the matter of the Application of DTE Electric Company for Authority to Increase its Rates, Amend its Rate Schedules and Rules Governing the Distribution and Supply of Electric Energy and for Miscellaneous Accounting Authority, Case No. U-17767 (Michigan Public Service Commission).
90. Expert Report (July 2015) and Rebuttal Expert Report (July 2015) on behalf of Plaintiffs in the matter of *Northwest Environmental Defense Center et al., v. Cascade Kelly Holdings LLC, d/b/a Columbia Pacific Bio-Refinery, and Global Partners LP (Defendants)*, Civil Action No. 3:14-cv-01059-SI (US District Court for the District of Oregon, Portland Division).

91. Declaration (August 2015, Docket No. 1570376) in support of “Opposition of Respondent-Intervenors American Lung Association, et. al., to Tri-State Generation’s Emergency Motion;” Declaration (September 2015, Docket No. 1574820) in support of “Joint Motion of the State, Local Government, and Public Health Respondent-Intervenors for Remand Without Vacatur;” Declaration (October 2015) in support of “Joint Motion of the State, Local Government, and Public Health Respondent-Intervenors to State and Certain Industry Petitioners’ Motion to Govern, *White Stallion Energy Center, LLC v. US EPA*, Case No. 12-1100 (US Court of Appeals for the District of Columbia).
92. Declaration (September 2015) in support of the Draft Title V Permit for Dickerson Generating Station (Proposed Permit No 24-031-0019) on behalf of the Environmental Integrity Project.
93. Expert Report (Liability Phase) (December 2015) and Rebuttal Expert Report (February 2016) on behalf of Plaintiffs in the matter of *Natural Resources Defense Council, Inc., Sierra Club, Inc., Environmental Law and Policy Center, and Respiratory Health Association v. Illinois Power Resources LLC, and Illinois Power Resources Generating LLC (Defendants)*, Civil Action No. 1:13-cv-01181 (US District Court for the Central District of Illinois, Peoria Division).
94. Declaration (December 2015) in support of the Petition to Object to the Title V Permit for Morgantown Generating Station (Proposed Permit No 24-017-0014) on behalf of the Environmental Integrity Project.
95. Expert Report (November 2015) on behalf of Appellants in the matter of *Sierra Club, et al. v. Craig W. Butler, Director of Ohio Environmental Protection Agency et al.*, ERAC Case No. 14-256814.
96. Affidavit (January 2016) on behalf of Bridgewatch Detroit in the matter of *Bridgewatch Detroit v. Waterfront Petroleum Terminal Co., and Waterfront Terminal Holdings, LLC.*, in the Circuit Court for the County of Wayne, State of Michigan.
97. Expert Report (February 2016) and Rebuttal Expert Report (July 2016) on behalf of the challengers in the matter of the Delaware Riverkeeper Network, Clean Air Council, et. al., vs. Commonwealth of Pennsylvania Department of Environmental Protection and R. E. Gas Development LLC regarding the Geyer well site before the Pennsylvania Environmental Hearing Board.
98. Direct Testimony (May 2016) in the matter of Tesoro Savage LLC Vancouver Energy Distribution Terminal, Case No. 15-001 before the State of Washington Energy Facility Site Evaluation Council.
99. Declaration (June 2016) relating to deficiencies in air quality analysis for the proposed Millenium Bulk Terminal, Port of Longview, Washington.
100. Declaration (December 2016) relating to EPA’s refusal to set limits on PM emissions from coal-fired power plants that reflect pollution reductions achievable with fabric filters on behalf of Environmental Integrity Project, Clean Air Council, Chesapeake Climate Action Network, Downwinders at Risk represented by Earthjustice in the matter of *ARIPPA v EPA, Case No. 15-1180*. (D.C. Circuit Court of Appeals).
101. Expert Report (January 2017) on the Environmental Impacts Analysis associated with the Huntley and Huntley Poseidon Well Pad on behalf citizens in the matter of the special exception use Zoning Hearing Board of Penn Township, Westmoreland County, Pennsylvania.
102. Expert Report (January 2017) on the Environmental Impacts Analysis associated with the Apex Energy Backus Well Pad on behalf citizens in the matter of the special exception use Zoning Hearing Board of Penn Township, Westmoreland County, Pennsylvania.
103. Expert Report (January 2017) on the Environmental Impacts Analysis associated with the Apex Energy Drakulic Well Pad on behalf citizens in the matter of the special exception use Zoning Hearing Board of Penn Township, Westmoreland County, Pennsylvania.
104. Expert Report (January 2017) on the Environmental Impacts Analysis associated with the Apex Energy Deutsch Well Pad on behalf citizens in the matter of the special exception use Zoning Hearing Board of Penn Township, Westmoreland County, Pennsylvania.
105. Affidavit (February 2017) pertaining to deficiencies water discharge compliance issues at the Wood River Refinery in the matter of *People of the State of Illinois (Plaintiff) v. Phillips 66 Company, ConocoPhillips Company, WRB Refining LP (Defendants)*, Case No. 16-CH-656, (Circuit Court for the Third Judicial Circuit, Madison County, Illinois).

106. Expert Report (March 2017) on behalf of the Plaintiff pertaining to non-degradation analysis for waste water discharges from a power plant in the matter of *Sierra Club (Plaintiff) v. Pennsylvania Department of Environmental Protection (PADEP) and Lackawanna Energy Center*, Docket No. 2016-047-L (consolidated), (Pennsylvania Environmental Hearing Board).
107. Expert Report (March 2017) on behalf of the Plaintiff pertaining to air emissions from the Heritage incinerator in East Liverpool, Ohio in the matter of *Save our County (Plaintiff) v. Heritage Thermal Services, Inc. (Defendant)*, Case No. 4:16-CV-1544-BYP, (US District Court for the Northern District of Ohio, Eastern Division).
108. Rebuttal Expert Report (June 2017) on behalf of Plaintiffs in the matter of *Casey Voight and Julie Voight (Plaintiffs) v Coyote Creek Mining Company LLC (Defendant)*, Civil Action No. 1:15-CV-00109 (US District Court for the District of North Dakota, Western Division).
109. Expert Affidavit (August 2017) and Penalty/Remedy Expert Affidavit (October 2017) on behalf of Plaintiff in the matter of *Wildearth Guardians (Plaintiff) v Colorado Springs Utility Board (Defendant,)* Civil Action No. 1:15-cv-00357-CMA-CBS (US District Court for the District of Colorado).
110. Expert Report (August 2017) on behalf of Appellant in the matter of *Patricia Ann Troiano (Appellant) v. Upper Burrell Township Zoning Hearing Board (Appellee)*, Court of Common Pleas of Westmoreland County, Pennsylvania, Civil Division.
111. Expert Report (October 2017), Supplemental Expert Report (October 2017), and Rebuttal Expert Report (November 2017) on behalf of Defendant in the matter of *Oakland Bulk and Oversized Terminal (Plaintiff) v City of Oakland (Defendant,)* Civil Action No. 3:16-cv-07014-VC (US District Court for the Northern District of California, San Francisco Division).
112. Declaration (December 2017) on behalf of the Environmental Integrity Project in the matter of permit issuance for ATI Flat Rolled Products Holdings, Breckenridge, PA to the Allegheny County Health Department.
113. Expert Report (Harm Phase) (January 2018), Rebuttal Expert Report (Harm Phase) (May 2018) and Supplemental Expert Report (Harm Phase) (April 2019) on behalf of Plaintiffs in the matter of *Natural Resources Defense Council, Inc., Sierra Club, Inc., and Respiratory Health Association v. Illinois Power Resources LLC, and Illinois Power Resources Generating LLC (Defendants)*, Civil Action No. 1:13-cv-01181 (US District Court for the Central District of Illinois, Peoria Division).
114. Declaration (February 2018) on behalf of the Chesapeake Bay Foundation, et. al., in the matter of the Section 126 Petition filed by the state of Maryland in *State of Maryland v. Pruitt (Defendant)*, Civil Action No. JKB-17-2939 (Consolidated with No. JKB-17-2873) (US District Court for the District of Maryland).
115. Direct Pre-filed Testimony (March 2018) on behalf of the National Parks Conservation Association (NPCA) in the matter of *NPCA v State of Washington, Department of Ecology and BP West Coast Products, LLC*, PCHB No. 17-055 (Pollution Control Hearings Board for the State of Washington).
116. Expert Affidavit (April 2018) and Second Expert Affidavit (May 2018) on behalf of Petitioners in the matter of *Coosa River Basin Initiative and Sierra Club (Petitioners) v State of Georgia Environmental Protection Division, Georgia Department of Natural Resources (Respondent) and Georgia Power Company (Intervenor/Respondent)*, Docket Nos: 1825406-BNR-WW-57-Howells and 1826761-BNR-WW-57-Howells, Office of State Administrative Hearings, State of Georgia.
117. Direct Pre-filed Testimony and Affidavit (December 2018) on behalf of Sierra Club and Texas Campaign for the Environment (Appellants) in the contested case hearing before the Texas State Office of Administrative Hearings in Docket Nos. 582-18-4846, 582-18-4847 (Application of GCGV Asset Holding, LLC for Air Quality Permit Nos. 146425/PSDTX1518 and 146459/PSDTX1520 in San Patricio County, Texas).
118. Expert Report (February 2019) on behalf of Sierra Club in the State of Florida, Division of Administrative Hearings, Case No. 18-2124EPP, Tampa Electric Company Big Bend Unit 1 Modernization Project Power Plant Siting Application No. PA79-12-A2.
119. Declaration (March 2019) on behalf of Earthjustice in the matter of comments on the renewal of the Title V Federal Operating Permit for Valero Houston refinery.

120. Expert Report (March 2019) on behalf of Plaintiffs for Class Certification in the matter of *Resendez et al v Precision Castparts Corporation* in the Circuit Court for the State of Oregon, County of Multnomah, Case No. 16cv16164.
121. Expert Report (June 2019), Affidavit (July 2019) and Rebuttal Expert Report (September 2019) on behalf of Appellants relating to the NPDES permit for the Cheswick power plant in the matter of *Three Rivers Waterkeeper and Sierra Club (Appellants) v. State of Pennsylvania Department of Environmental Protection (Appellee) and NRG Power Midwest (Permittee)*, before the Commonwealth of Pennsylvania Environmental Hearing Board, EHB Docket No. 2018-088-R.
122. Affidavit/Expert Report (August 2019) relating to the appeal of air permits issued to PTTGCA on behalf of Appellants in the matter of *Sierra Club (Appellants) v. Craig Butler, Director, et. al., Ohio EPA (Appellees)* before the State of Ohio Environmental Review Appeals Commission (ERAC), Case Nos. ERAC-19-6988 through -6991.
123. Expert Report (October 2019) relating to the appeal of air permit (Plan Approval) on behalf of Appellants in the matter of *Clean Air Council and Environmental Integrity Project (Appellants) v. Commonwealth of Pennsylvania Department of Environmental Protection and Sunoco Partners Marketing and Terminals L.P.*, before the Commonwealth of Pennsylvania Environmental Hearing Board, EHB Docket No. 2018-057-L.
124. Expert Report (December 2019), Affidavit (March 2020), Supplemental Expert Report (July 2020), and Declaration (February 2021) on behalf of Earthjustice in the matter of *Objection to the Issuance of PSD/NSR and Title V permits for Riverview Energy Corporation*, Dale, Indiana, before the Indiana Office of Environmental Adjudication, Cause No. 19-A-J-5073.
125. Affidavit (December 2019) on behalf of Plaintiff-Intervenor (Surfrider Foundation) in the matter of *United States and the State of Indiana (Plaintiffs), Surfrider Foundation (Plaintiff-Intervenor), and City of Chicago (Plaintiff-Intervenor) v. United States Steel Corporation (Defendant)*, Civil Action No. 2:18-cv-00127 (US District Court for the Northern District of Indiana, Hammond Division).
126. Declarations (January 2020, February 2020, May 2020, July 2020, and August 2020) and Pre-filed Testimony (April 2021) in support of Petitioner's Motion for Stay of PSCAA NOC Order of Approval No. 11386 in the matter of the *Puyallup Tribe of Indians v. Puget Sound Clean Air Agency (PSCAA) and Puget Sound Energy (PSE)*, before the State of Washington Pollution Control Hearings Board, PCHB No. P19-088.
127. Expert Report (April 2020) on behalf of the plaintiff in the matter of Orion Engineered Carbons, GmbH (Plaintiff) vs. Evonik Operations, GmbH (formerly Evonik Degussa GmbH) (Respondent), before the German Arbitration Institute, Case No. DIS-SV-2019-00216.
128. Expert Independent Evaluation Report (June 2020) for *PacifiCorp's Decommissioning Costs Study Reports dated January 15, 2020 and March 13, 2020 relating to the closures of the Hunter, Huntington, Dave Johnston, Jim Bridger, Naughton, Wyodak, Hayden, and Colstrip (Units 3&4) plants*, prepared for the Oregon Public Utility Commission (Oregon PUC).
129. Direct Pre-filed Testimony (July 2020) on behalf of the Sierra Club in the matter of *the Application of the Ohio State University for a certificate of Environmental Compatibility and Public Need to Construct a Combined Heat and Power Facility in Franklin County, Ohio*, before the Ohio Power Siting Board, Case No. 19-1641-EL-BGN.
130. Expert Report (August 2020) and Rebuttal Expert Report (September 2020) on behalf of WildEarth Guardians (petitioners) in the matter of *the Appeals of the Air Quality Permit No. 7482-M1 Issued to 3 Bear Delaware Operating – NM LLC (EIB No. 20-21(A) and Registrations Nos. 8729, 8730, and 8733 under General Construction Permit for Oil and Gas Facilities (EIB No. 20-33 (A))*, before the State of New Mexico, Environmental Improvement Board.
131. Expert Report (July 2020) on the *Initial Economic Impact Analysis (EIA) for A Proposal To Regulate NOx Emissions from Natural Gas Fired Rich-Burn Natural Gas Reciprocating Internal Combustion Engines (RICE) Greater Than 100 Horsepower* prepared on behalf of Earthjustice and the National Parks Conservation Association in the matter of Regulation Number 7, Alternate Rules before the Colorado Air Quality Control Commission.

132. Expert Report (August 2020) and Supplemental Expert Report (February 2021) on the Potential Remedies to Avoid Adverse Thermal Impacts from the Merrimack Station on behalf of Plaintiffs in the matter of *Sierra Club Inc. and the Conservation Law Foundation (Plaintiffs) v. Granite Shore Power, LLC et. al., (Defendants)*, Civil Action No. 19-cv-216-JL (US District Court for the District of New Hampshire.)
133. Expert Report (August 2020) and Supplemental Expert Report (December 2020) on behalf of Plaintiffs in the matter of *PennEnvironment Inc., and Clean Air Council (Plaintiffs) and Allegheny County Health Department (Plaintiff-Intervenor) v. United States Steel Corporation (Defendant)*, Civil Action No. 2-19-cv-00484-MJH (US District Court for the Western District of Pennsylvania.)
134. Pre-filed Direct Testimony (October 2020) and Sur-rebuttal Testimony (November 2020) on behalf of petitioners (Ten Persons Group, including citizens, the Town of Braintree, the Town of Hingham, and the City of Quincy) in the matter of Algonquin Gas Transmission LLC, Weymouth MA, No. X266786 Air Quality Plan Approval, before the Commonwealth of Massachusetts, Department of Environmental Protection, the Office of Appeals and Dispute Resolution, OADR Docket Nos. 2019-008, 2019-009, 2019010, 2019-011, 2019-012 and 2019-013.
135. Expert Report (November 2020) on behalf of Protect PT in the matter of *Protect PT v. Commonwealth of Pennsylvania Department of Environmental Protection and Apex Energy (PA) LLC*, before the Commonwealth of Pennsylvania Environmental Hearing Board, Docket No. 2018-080-R (consolidated with 2019-101-R)(the “Drakulic Appeal”).
136. Expert Report (December 2020) on behalf of Plaintiffs in the matter of *Sierra Club Inc. (Plaintiff) v. GenOn Power Midwest LP (Defendants)*, Civil Action No. 2-19-cv-01284-WSS (US District Court for the Western District of Pennsylvania.)
137. Pre-filed Testimony (January 2021) on behalf of the Plaintiffs (Shrimpers and Fishermen of the Rio Grande Valley represented by Texas RioGrande Legal Aid, Inc.) in the matter of the Appeal of Texas Commission on Environmental Quality (TCEQ) Permit Nos. 147681, PSDTX1522, GHGPSDTX172 for the Jupiter Brownsville Heavy Condensate Upgrader Facility, Cameron County, before the Texas State Office of Administrative Hearings, SOAH Docket No. 582-21-0111, TCEQ Docket No. 2020-1080-AIR.
138. Expert Reports (March 2021 and May 2021) regarding the Aries Newark LLC Sludge Processing Facility, Application No. CPB 20-74, Central Planning Board, City of Newark, New Jersey.
139. Expert Report (April 2021) for *Charles Johnson Jr. (Plaintiff) v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 2:20-CV-01329 (Related to 12-968 BELO in MDL No. 2179). (US District Court for the Eastern District of Louisiana, New Orleans Division).
140. Expert Report (April 2021) for *Floyd Ruffin (Plaintiff), v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 2:20-cv-00334-CJB-JCW (US District Court for the Eastern District of Louisiana, New Orleans Division).
141. Expert Report (April 2021) and Sur-Rebuttal Report (June 2021) on behalf of the Plaintiffs in the matter of *Modern Holdings, LLC, et al. (Plaintiffs) v. Corning Inc., et al. (Defendants)*, Civil Action No. 5:13-cv-00405-GFVT, (US District Court for the Eastern District of Kentucky, Central Division at Lexington).
142. Expert Report (May 2021) for *Clifford Osmer (Plaintiff) v. BP Exploration and Production Inc., et. al., (Defendants)* related to No. 18-CV-12557 (US District Court for the Eastern District of Louisiana).
143. Expert Report (May 2021) and Rebuttal Expert Report (January 2022) for *James Noel (Plaintiff) v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 1:19-CV-00694-JB-MU-C (US District Court for the Southern District of Alabama, Southern Division).
144. Expert Report (June 2021) and Declarations (May 2021 and June 2021) on behalf of Plaintiffs in the matter of *Sierra Club (Plaintiff) v. Woodville Pellets, LLC (Defendant)*, Civil Action No. 9:20-cv-00178-MJT (US District Court for the Eastern District of Texas, Lufkin Division.)
145. Expert Witness Disclosure (June 2021) on behalf of the Plaintiffs in the matter of *Jay Burdick, et. al., (Plaintiffs) v. Tanoga Inc. (d/b/a Taconic) (Defendant)*, Index No. 253835, (State of New York Supreme Court, County of Rensselaer).

146. Expert Report (June 2021) on behalf of Appellants in the matter of *PennEnvironment and Earthworks (Appellants) v. Commonwealth of Pennsylvania Department of Environmental Protection (Appellee) and MarkWest Liberty Midstream and resource, LLC (Permittee)*, before the Commonwealth of Pennsylvania Environmental Hearing Board, EHB Docket No. 2020-002-R.
147. Expert Report (June 2021) for *Antonia Saavedra-Vargas (Plaintiff) v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 2:18-CV-11461 (US District Court for the Eastern District of Louisiana, New Orleans Division).
148. Affidavit (June 2021) for Lourdes Rubi in the matter of *Lourdes Rubi (Plaintiff) v. BP Exploration and Production Inc., et. al., (Defendants)*, related to 12-968 BELO in MDL No. 2179 (US District Court for the Eastern District of Louisiana, New Orleans Division).
149. Expert Report (June 2021) for *Wallace Smith (Plaintiff) v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 2:19-CV-12880 (US District Court for the Eastern District of Louisiana, New Orleans Division).
150. Declaration (July 2021) on behalf of Plaintiffs in the matter of *Stephanie Mackey and Nick Migliore, on behalf of themselves and all others similarly situated (Plaintiffs) v. Chemtool Inc. and Lubrizol Corporation (Defendants)*, Case No. 2021-L-0000165, State of Illinois, Circuit Court of the 17th Judicial Circuit, Winnebago County.
151. Declaration (July 2021, August 2021) on behalf of Petitioners in the matter of the Petition for a Hearing on the Merits Regarding Air Quality Permit No. 3340-RMD issued to New Mexico Terminal Services, LLC by *Mountain View Neighborhood Association et. al., (Petitioners) v. City of Albuquerque Environmental Health Department, AQCB Petition No. 2020-1* before the Albuquerque-Bernalillo County Air Quality Control Board.
152. Expert Disclosure (September 2021) on behalf of the Plaintiffs in the matter of *State of New York, Town of Hempstead, Town of Brookhaven, Incorporated Village of Garden City and Long Island Power Authority et. al., (Plaintiffs) v. Covanta Hempstead Company et. al., (Defendants)*, Index No. 7549/2013 before the Supreme Court of the State of New York, County of Nassau.
153. Expert Report (October 2021) for *John A. Battiste (Plaintiff) v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 1:21-CV-00118 (US District Court for the Southern District of Alabama, Mobile Division)
154. Declaration/Expert Report (October 2021) for *Charles K. Grasley et. al., (Plaintiffs) v. Chemtool Incorporated (Defendant)*, Case No. 2021-L-0000162 (State of Illinois, In the Circuit Court of the 17th Judicial Circuit, Winnebago County).
155. Declaration (October 2021) and Expert Report (November 2021) on behalf of the Plaintiffs in the matter of Toll Brothers, Inc., and Porter Ranch Development Company (Plaintiffs) v. Sempra Energy, Southern California Gas Company et. al., (Defendants), Southern California [Aliso Canyon] Gas Leak Cases, JCCP No.: 4861, Lead Case No.: BC674622, Superior Court of the State of California for the County of Los Angeles.
156. Expert Report (November 2021) and Declaration (September 2022) on behalf of Plaintiffs in Re: Deepwater Horizon BELO Cases, Case No. 3:19cv963-MCR-GRJ (US District Court for the Northern District of Florida, Pensacola Division).
157. Declaration (November 2021) for the *United States of America and the State of Kansas, Department of Health and Environment (Plaintiffs) v. Coffeyville Resources Refining & Marketing, LLC (Defendant)*, Civ. No. 6:04-cv-01064-JAR-KGG (US District Court for the District of Kansas).
158. Expert Report/Affidavit (December 2021) on behalf of the City of Detroit in the matter of Marathon Petroleum Company (Claimant) v. City of Detroit Building Safety Engineering and Environmental Department, BSEED Case No. MCR 2018-2525, DAH Appeal No. 21-SWA-01, before the State of Michigan, City of Detroit Department of Appeals and Hearings.
159. Expert Report (December 2021) for *John Pabst (Plaintiff) v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 21-CV-00290 (US District Court for the Eastern District of Louisiana).

160. Expert Report (December 2021) for *Audrey Annette Tillery-Perdue individually and as person representative of the estate of Eddie Lewis Perdue (Plaintiff) v. BP Exploration and Production Inc., et. al., (Defendant)*, Civil Action No. 5:19-cv-00052-MCR-GRJ (US District Court for the Northern District of Florida, Pensacola Division).
161. Expert Report (February 2022) for *Richard Dufour (Plaintiff) v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 19-cv-00591 (US District Court for the Southern District of Mississippi).
162. Expert Report (February 2022) and Rebuttal Expert Report (June 2022, in preparation) for *Kamuda (Plaintiff) v. Sterigenics U.S., LLC, et. al., (Defendant)*, Case No. 2018-L-010475 (Circuit Court of Cook County, Illinois).
163. Expert Report (February 2022) in the matter of the *Appeal Petition for Hearing on Air Quality Permit No. 8585 on behalf of Earth Care New Mexico et. al., (Petitioners) v. New Mexico Environment Department and Associated Asphalt and Materials, LLC (Applicant)*, No. EIB 21-48 before the State of New Mexico Environmental Improvement Board.
164. Expert Report (March 2022) and Affidavit (June 2022) in the matter of *Clean Air Council et. al., (Appellants) v. Commonwealth of Pennsylvania, Department of Environmental Protection (Appellee) and Renovo Energy Center (Permittee) EHB Docket No. 2021-055-R* before the Commonwealth of Pennsylvania Environmental Hearing Board.
165. Declaration (March 2022) in the matter of *Max Midstream Texas LLC Air Quality Permit No. 162941 for the Seahawk Crude Condensate Terminal in Calhoun County Texas, TCEQ Docket No. 2022-0157-AIR*, before the Texas Commission on Environmental Quality.
166. Expert Pre-filed Testimony (April 2022) in the matter of *Application of TPC Group LLC for New State and PSD Air Quality Permits (various), TCEQ Docket No. 2021-1422-AIR, SOAH Docket No. 582-22-0799*, Before the Texas State Office of Administrative Hearings.
167. Expert Report (April 2022) and Rebuttal Report (August 2022) for *Teresa Fornek (Plaintiff) v. Sterigenics U.S., LLC, et. al., (Defendant)*, Case No. 2018-L-010744 (Circuit Court of Cook County, Illinois).
168. Rule 26 Disclosure (May 2022) in the matter of the *Water Works and Sewer Board of the City of Gadsden (Plaintiff) v. 3M Company, et. al., (Defendants)*, Civil Action No.: 31 CV-2016-900676.00 (Circuit County of Etowah County, Alabama)
169. Expert Report (June 2022) for *Heather Schumacher (Plaintiff) v. Sterigenics U.S., LLC, et. al., (Defendant)*, Case No. 2018-L-011939 (Circuit Court of Cook County, Illinois.)
170. Expert Report (June 2022), Rebuttal Reports (August 2022, September 2022) for Plaintiffs in *Phylliss Grayson et. al. (Plaintiffs), v Lockheed Martin Corporation (Defendant)*, Case No. 6:20-cv-01770. (US District Court for the Middle District of Florida – Orlando Division.)
171. Expert Affidavit (July 2022) for Center for Environmental Rights in connection with the 2019 South Africa Integrated Resource Plan in *African Climate Alliance et. al. v. The Minister of Mineral Resources and Energy et. al.*, in the High Court of South Africa, Gauteng Division, Pretoria.
172. Expert Affidavit (July 2022) for Center for Environmental Rights in connection with the Limpopo Mine (Lephalale Coal Mines Ltd.) in *Earthlife Africa v. The Minister of Forestry, Fisheries and Environment et. al.*, in the High Court of South Africa, Gauteng Division, Pretoria, Case No. 9149/2022.
173. Pre-filed Testimony (July 2022) and Rebuttal Testimony (September 2020) on behalf of the Puyallup Tribe of Indians in the matter of *Washington Utilities and Transportation Commission (Complainant) v. Puget Sound Energy (Respondent)* before the Washington Utilities and Transportation Commission, Docket UE-220066 and UG-220067 (Consolidated).
174. Expert Affidavit (October 2022) for *Concerned Citizens of Cook County GA (Petitioner) v. Georgia Department of Natural Resources (Respondent) and Spectrum Energy Georgia, LLC (Respondent Intervenor)* before the Office of State Administrative Hearings, State of Georgia, Docket No: 2303405-OAH-BNR-AQ-37-Barnes.

C. Occasions where Dr. Sahu has provided oral testimony in depositions, at trial or in similar proceedings include the following:

175. Deposition on behalf of Rocky Mountain Steel Mills, Inc. located in Pueblo, Colorado – dealing with the manufacture of steel in mini-mills including methods of air pollution control and BACT in steel mini-mills and opacity issues at this steel mini-mill.
176. Trial Testimony (February 2002) on behalf of Rocky Mountain Steel Mills, Inc. in Denver District Court.
177. Trial Testimony (February 2003) on behalf of the United States in the Ohio Edison NSR Cases, *United States, et al. v. Ohio Edison Co., et al.*, C2-99-1181 (Southern District of Ohio).
178. Trial Testimony (June 2003) on behalf of the United States in the Illinois Power NSR Case, *United States v. Illinois Power Co., et al.*, 99-833-MJR (Southern District of Illinois).
179. Deposition (10/20/2005) on behalf of the United States in connection with the Cinergy NSR Case. *United States, et al. v. Cinergy Corp., et al.*, IP 99-1693-C-M/S (Southern District of Indiana).
180. Oral Testimony (August 2006) on behalf of the Appalachian Center for the Economy and the Environment re. the Western Greenbrier plant, WV before the West Virginia DEP.
181. Oral Testimony (May 2007) on behalf of various Montana petitioners (Citizens Awareness Network (CAN), Women’s Voices for the Earth (WVE) and the Clark Fork Coalition (CFC)) re. the Thompson River Cogeneration plant before the Montana Board of Environmental Review.
182. Oral Testimony (October 2007) on behalf of the Sierra Club re. the Sevier Power Plant before the Utah Air Quality Board.
183. Oral Testimony (August 2008) on behalf of the Sierra Club and Clean Water re. Big Stone Unit II before the South Dakota Board of Minerals and the Environment.
184. Oral Testimony (February 2009) on behalf of the Sierra Club and the Southern Environmental Law Center re. Santee Cooper Pee Dee units before the South Carolina Board of Health and Environmental Control.
185. Oral Testimony (February 2009) on behalf of the Sierra Club and the Environmental Integrity Project re. NRG Limestone Unit 3 before the Texas State Office of Administrative Hearings (SOAH) Administrative Law Judges.
186. Deposition (July 2009) on behalf of MTD Products, Inc., in the matter of *Alice Holmes and Vernon Holmes v. Home Depot USA, Inc., et al.*
187. Deposition (October 2009) on behalf of Environmental Defense and others, in the matter of challenges to the proposed Coletto Creek coal fired power plant project at the Texas State Office of Administrative Hearings (SOAH).
188. Deposition (October 2009) on behalf of Environmental Defense, in the matter of permit challenges to the proposed Las Brisas coal fired power plant project at the Texas State Office of Administrative Hearings (SOAH).
189. Deposition (October 2009) on behalf of the Sierra Club, in the matter of challenges to the proposed Medicine Bow Fuel and Power IGL plant in Cheyenne, Wyoming.
190. Deposition (October 2009) on behalf of Environmental Defense and others, in the matter of challenges to the proposed Tenaska coal fired power plant project at the Texas State Office of Administrative Hearings (SOAH). (April 2010).
191. Oral Testimony (November 2009) on behalf of the Environmental Defense Fund re. the Las Brisas Energy Center before the Texas State Office of Administrative Hearings (SOAH) Administrative Law Judges.
192. Deposition (December 2009) on behalf of Environmental Defense and others, in the matter of challenges to the proposed White Stallion Energy Center coal fired power plant project at the Texas State Office of Administrative Hearings (SOAH).

193. Oral Testimony (February 2010) on behalf of the Environmental Defense Fund re. the White Stallion Energy Center before the Texas State Office of Administrative Hearings (SOAH) Administrative Law Judges.
194. Deposition (June 2010) on behalf of the United States in connection with the Alabama Power Company NSR Case. *United States v. Alabama Power Company*, CV-01-HS-152-S (Northern District of Alabama, Southern Division).
195. Trial Testimony (September 2010) on behalf of Commonwealth of Pennsylvania – Dept. of Environmental Protection, State of Connecticut, State of New York, State of Maryland, and State of New Jersey (Plaintiffs) in connection with the Allegheny Energy NSR Case in US District Court in the Western District of Pennsylvania. *Plaintiffs v. Allegheny Energy Inc., et al.*, 2:05cv0885 (Western District of Pennsylvania).
196. Oral Direct and Rebuttal Testimony (September 2010) on behalf of Fall-Line Alliance for a Clean Environment and others in the matter of the PSD Air Permit for Plant Washington issued by Georgia DNR at the Office of State Administrative Hearing, State of Georgia (OSAH-BNR-AQ-1031707-98-WALKER).
197. Oral Testimony (September 2010) on behalf of the State of New Mexico Environment Department in the matter of Proposed Regulation 20.2.350 NMAC – *Greenhouse Gas Cap and Trade Provisions*, No. EIB 10-04 (R), to the State of New Mexico, Environmental Improvement Board.
198. Oral Testimony (October 2010) on behalf of the Environmental Defense Fund re. the Las Brisas Energy Center before the Texas State Office of Administrative Hearings (SOAH) Administrative Law Judges.
199. Oral Testimony (November 2010) regarding BART for PSCo Hayden, CSU Martin Drake units before the Colorado Air Quality Commission on behalf of the Coalition of Environmental Organizations.
200. Oral Testimony (December 2010) regarding BART for TriState Craig Units, CSU Nixon Unit, and PRPA Rawhide Unit) before the Colorado Air Quality Commission on behalf of the Coalition of Environmental Organizations.
201. Deposition (December 2010) on behalf of the United States in connection with the Louisiana Generating NSR Case. *United States v. Louisiana Generating, LLC*, 09-CV100-RET-CN (Middle District of Louisiana).
202. Deposition (February 2011 and January 2012) on behalf of Wild Earth Guardians in the matter of opacity exceedances and monitor downtime at the Public Service Company of Colorado (Xcel)’s Cherokee power plant. No. 09-cv-1862 (D. Colo.).
203. Oral Testimony (February 2011) to the Georgia Office of State Administrative Hearings (OSAH) in the matter of Minor Source HAPs status for the proposed Longleaf Energy Associates power plant (OSAH-BNR-AQ-1115157-60-HOWELLS) on behalf of the Friends of the Chattahoochee and the Sierra Club).
204. Deposition (August 2011) on behalf of the United States in *United States of America v. Cemex, Inc.*, Civil Action No. 09-cv-00019-MSK-MEH (District of Colorado).
205. Deposition (July 2011) and Oral Testimony at Hearing (February 2012) on behalf of the Plaintiffs MYTAPN in the matter of Microsoft-Yes, Toxic Air Pollution-No (MYTAPN) v. State of Washington, Department of Ecology and Microsoft Corporation Columbia Data Center to the Pollution Control Hearings Board, State of Washington, Matter No. PCHB No. 10-162.
206. Oral Testimony at Hearing (March 2012) on behalf of the United States in connection with the Louisiana Generating NSR Case. *United States v. Louisiana Generating, LLC*, 09-CV100-RET-CN (Middle District of Louisiana).
207. Oral Testimony at Hearing (April 2012) on behalf of the New Hampshire Sierra Club at the State of New Hampshire Public Utilities Commission, Docket No. 10-261 – the 2010 Least Cost Integrated Resource Plan (LCIRP) submitted by the Public Service Company of New Hampshire (re. Merrimack Station Units 1 and 2).
208. Oral Testimony at Hearing (November 2012) on behalf of Clean Wisconsin in the matter of Application of Wisconsin Public Service Corporation for Authority to Construct and Place in Operation a New Multi-Pollutant Control Technology System (ReACT) for Unit 3 of the Weston Generating Station, before the Public Service Commission of Wisconsin, Docket No. 6690-CE-197.

209. Deposition (March 2013) in the matter of various Environmental Petitioners v. North Carolina DENR/DAQ and Carolinas Cement Company, before the Office of Administrative Hearings, State of North Carolina.
210. Deposition (August 2013) on behalf of the Sierra Club in connection with the Luminant Big Brown Case. *Sierra Club v. Energy Future Holdings Corporation and Luminant Generation Company LLC*, Civil Action No. 6:12-cv-00108-WSS (Western District of Texas, Waco Division).
211. Deposition (August 2013) on behalf of the Sierra Club in connection with the Luminant Martin Lake Case. *Sierra Club v. Energy Future Holdings Corporation and Luminant Generation Company LLC*, Civil Action No. 5:10-cv-0156-MHS-CMC (Eastern District of Texas, Texarkana Division).
212. Deposition (February 2014) on behalf of the United States in *United States of America v. Ameren Missouri*, Civil Action No. 4:11-cv-00077-RWS (Eastern District of Missouri, Eastern Division).
213. Trial Testimony (February 2014) in the matter of *Environment Texas Citizen Lobby, Inc and Sierra Club v. ExxonMobil Corporation et al.*, Civil Action No. 4:10-cv-4969 (Southern District of Texas, Houston Division).
214. Trial Testimony (February 2014) on behalf of the Sierra Club in connection with the Luminant Big Brown Case. *Sierra Club v. Energy Future Holdings Corporation and Luminant Generation Company LLC*, Civil Action No. 6:12-cv-00108-WSS (Western District of Texas, Waco Division).
215. Deposition (June 2014) and Trial (August 2014) on behalf of ECM Biofilms in the matter of the *US Federal Trade Commission (FTC) v. ECM Biofilms* (FTC Docket #9358).
216. Deposition (February 2015) on behalf of Plaintiffs in the matter of *Sierra Club and Montana Environmental Information Center (Plaintiffs) v. PPL Montana LLC, Avista Corporation, Puget Sound Energy, Portland General Electric Company, Northwestern Corporation, and PacifiCorp (Defendants)*, Civil Action No. CV 13-32-BLG-DLC-JCL (US District Court for the District of Montana, Billings Division).
217. Oral Testimony at Hearing (April 2015) on behalf of Niagara County, the Town of Lewiston, and the Villages of Lewiston and Youngstown in the matter of CWM Chemical Services, LLC New York State Department of Environmental Conservation (NYSDEC) Permit Application Nos.: 9-2934-00022/00225, 9-2934-00022/00231, 9-2934-00022/00232, and 9-2934-00022/00249 (pending).
218. Deposition (August 2015) on behalf of Plaintiff in the matter of *Conservation Law Foundation (Plaintiff) v. Broadrock Gas Services LLC, Rhode Island LFG GENCO LLC, and Rhode Island Resource Recovery Corporation (Defendants)*, Civil Action No. 1:13-cv-00777-M-PAS (US District Court for the District of Rhode Island).
219. Testimony at Hearing (August 2015) on behalf of the Sierra Club in the matter of *Amendments to 35 Illinois Administrative Code Parts 214, 217, and 225* before the Illinois Pollution Control Board, R15-21.
220. Deposition (May 2015) on behalf of Plaintiffs in the matter of *Northwest Environmental Defense Center et. al., (Plaintiffs) v. Cascade Kelly Holdings LLC, d/b/a Columbia Pacific Bio-Refinery, and Global Partners LP (Defendants)*, Civil Action No. 3:14-cv-01059-SI (US District Court for the District of Oregon, Portland Division).
221. Trial Testimony (October 2015) on behalf of Plaintiffs in the matter of *Northwest Environmental Defense Center et. al., (Plaintiffs) v. Cascade Kelly Holdings LLC, d/b/a Columbia Pacific Bio-Refinery, and Global Partners LP (Defendants)*, Civil Action No. 3:14-cv-01059-SI (US District Court for the District of Oregon, Portland Division).
222. Deposition (April 2016) on behalf of the Plaintiffs in *UNatural Resources Defense Council, Respiratory Health Association, and Sierra Club (Plaintiffs) v. Illinois Power Resources LLC and Illinois Power Resources Generation LLC (Defendants)*, Civil Action No. 1:13-cv-01181 (Central District of Illinois, Peoria Division).
223. Trial Testimony at Hearing (July 2016) in the matter of Tesoro Savage LLC Vancouver Energy Distribution Terminal, Case No. 15-001 before the State of Washington Energy Facility Site Evaluation Council.
224. Trial Testimony (December 2016) on behalf of the challengers in the matter of the Delaware Riverkeeper Network, Clean Air Council, et. al., vs. Commonwealth of Pennsylvania Department of Environmental

- Protection and R. E. Gas Development LLC regarding the Geyer well site before the Pennsylvania Environmental Hearing Board.
225. Trial Testimony (July-August 2016) on behalf of the United States in *United States of America v. Ameren Missouri*, Civil Action No. 4:11-cv-00077-RWS (Eastern District of Missouri, Eastern Division).
 226. Trial Testimony (January 2017) on the Environmental Impacts Analysis associated with the Huntley and Huntley Poseidon Well Pad Hearing on behalf citizens in the matter of the special exception use Zoning Hearing Board of Penn Township, Westmoreland County, Pennsylvania.
 227. Trial Testimony (January 2017) on the Environmental Impacts Analysis associated with the Apex energy Backus Well Pad Hearing on behalf citizens in the matter of the special exception use Zoning Hearing Board of Penn Township, Westmoreland County, Pennsylvania.
 228. Trial Testimony (January 2017) on the Environmental Impacts Analysis associated with the Apex energy Drakulic Well Pad Hearing on behalf citizens in the matter of the special exception use Zoning Hearing Board of Penn Township, Westmoreland County, Pennsylvania.
 229. Trial Testimony (January 2017) on the Environmental Impacts Analysis associated with the Apex energy Deutsch Well Pad Hearing on behalf citizens in the matter of the special exception use Zoning Hearing Board of Penn Township, Westmoreland County, Pennsylvania.
 230. Deposition Testimony (July 2017) on behalf of Plaintiffs in the matter of *Casey Voight and Julie Voight v Coyote Creek Mining Company LLC (Defendant)* Civil Action No. 1:15-CV-00109 (US District Court for the District of North Dakota, Western Division).
 231. Deposition Testimony (November 2017) on behalf of Defendant in the matter of *Oakland Bulk and Oversized Terminal (Plaintiff) v City of Oakland (Defendant,)* Civil Action No. 3:16-cv-07014-VC (US District Court for the Northern District of California, San Francisco Division).
 232. Deposition Testimony (December 2017) on behalf of Plaintiff in the matter of *Wildearth Guardians (Plaintiff) v Colorado Springs Utility Board (Defendant)* Civil Action No. 1:15-cv-00357-CMA-CBS (US District Court for the District of Colorado).
 233. Deposition Testimony (January 2018) in the matter of National Parks Conservation Association (NPCA) v. State of Washington Department of Ecology and British Petroleum (BP) before the Washington Pollution Control Hearing Board, Case No. 17-055.
 234. Trial Testimony (January 2018) on behalf of Defendant in the matter of *Oakland Bulk and Oversized Terminal (Plaintiff) v City of Oakland (Defendant,)* Civil Action No. 3:16-cv-07014-VC (US District Court for the Northern District of California, San Francisco Division).
 235. Trial Testimony (April 2018) on behalf of the National Parks Conservation Association (NPCA) in the matter of NPCA v State of Washington, Department of Ecology and BP West Coast Products, LLC, PCHB No. 17-055 (Pollution Control Hearings Board for the State of Washington).
 236. Deposition (June 2018) (harm Phase) on behalf of Plaintiffs in the matter of *Natural Resources Defense Council, Inc., Sierra Club, Inc., and Respiratory Health Association v. Illinois Power Resources LLC, and Illinois Power Resources Generating LLC (Defendants)*, Civil Action No. 1:13-cv-01181 (US District Court for the Central District of Illinois, Peoria Division).
 237. Trial Testimony (July 2018) on behalf of Petitioners in the matter of *Coosa River Basin Initiative and Sierra Club (Petitioners) v State of Georgia Environmental Protection Division, Georgia Department of Natural Resources (Respondent) and Georgia Power Company (Intervenor/Respondent)*, Docket Nos: 1825406-BNR-WW-57-Howells and 1826761-BNR-WW-57-Howells, Office of State Administrative Hearings, State of Georgia.
 238. Deposition (January 2019) and Trial Testimony (January 2019) on behalf of Sierra Club and Texas Campaign for the Environment (Appellants) in the contested case hearing before the Texas State Office of Administrative Hearings in Docket Nos. 582-18-4846, 582-18-4847 (Application of GCGV Asset Holding, LLC for Air Quality Permit Nos. 146425/PSDTX1518 and 146459/PSDTX1520 in San Patricio County, Texas).

239. Deposition (February 2019) and Trial Testimony (March 2019) on behalf of Sierra Club in the State of Florida, Division of Administrative Hearings, Case No. 18-2124EPP, Tampa Electric Company Big Bend Unit 1 Modernization Project Power Plant Siting Application No. PA79-12-A2.
240. Deposition (June 2019) relating to the appeal of air permits issued to PTTGCA on behalf of Appellants in the matter of *Sierra Club (Appellants) v. Craig Butler, Director, et. al., Ohio EPA (Appellees)* before the State of Ohio Environmental Review Appeals Commission (ERAC), Case Nos. ERAC-19-6988 through -6991.
241. Deposition (September 2019) on behalf of Appellants relating to the NPDES permit for the Cheswick power plant in the matter of *Three Rivers Waterkeeper and Sierra Club (Appellants) v. State of Pennsylvania Department of Environmental Protection (Appellee) and NRG Power Midwest (Permittee)*, before the Commonwealth of Pennsylvania Environmental Hearing Board, EHB Docket No. 2018-088-R.
242. Deposition (December 2019) on behalf of the Plaintiffs in the matter of David Kovac, individually and on behalf of wrongful death class of Irene Kovac v. BP Corporation North America Inc., Circuit Court of Jackson County, Missouri (Independence), Case No. 1816-CV12417.
243. Deposition (February 2020, virtual) and testimony at Hearing (August 2020, virtual) on behalf of Earthjustice in the matter of *Objection to the Issuance of PSD/NSR and Title V permits for Riverview Energy Corporation, Dale, Indiana*, before the Indiana Office of Environmental Adjudication, Cause No. 19-A-J-5073.
244. Hearing (July 14-15, 2020, virtual) on behalf of the Sierra Club in the matter of *the Application of the Ohio State University for a certificate of Environmental Compatibility and Public Need to Construct a Combined Heat and Power Facility in Franklin County, Ohio*, before the Ohio Power Siting Board, Case No. 19-1641-EL-BGN.
245. Hearing (September 2020, virtual) on behalf of WildEarth Guardians (petitioners) in the matter of *the Appeals of the Air Quality Permit No. 7482-M1 Issued to 3 Bear Delaware Operating – NM LLC (EIB No. 20-21(A) and Registrations Nos. 8729, 8730, and 8733 under General Construction Permit for Oil and Gas Facilities (EIB No. 20-33 (A))*, before the State of New Mexico, Environmental Improvement Board.
246. Deposition (December 2020, March 4-5, 2021, all virtual) and Hearing (April 2021, virtual) in support of Petitioner’s Motion for Stay of PSCAA NOC Order of Approval No. 11386 in the matter of the *Puyallup Tribe of Indians v. Puget Sound Clean Air Agency (PSCAA) and Puget Sound Energy (PSE)*, before the State of Washington Pollution Control Hearings Board, PCHB No. P19-088.
247. Hearing (September 2020, virtual) on the *Initial Economic Impact Analysis (EIA) for A Proposal To Regulate NOx Emissions from Natural Gas Fired Rich-Burn Natural Gas Reciprocating Internal Combustion Engines (RICE) Greater Than 100 Horsepower* prepared on behalf of Earthjustice and the National Parks Conservation Association in the matter of Regulation Number 7, Alternate Rules before the Colorado Air Quality Control Commission.
248. Deposition (December 2020, virtual and Hearing February 2021, virtual) on behalf of the Plaintiffs (Shrimpers and Fishermen of the Rio Grande Valley represented by Texas RioGrande Legal Aid, Inc.) in the matter of the Appeal of Texas Commission on Environmental Quality (TCEQ) Permit Nos. 147681, PSDTX1522, GHGPSDTX172 for the Jupiter Brownsville Heavy Condensate Upgrader Facility, Cameron County, before the Texas State Office of Administrative Hearings, SOAH Docket No. 582-21-0111, TCEQ Docket No. 2020-1080-AIR.
249. Deposition (January 2021, virtual) on behalf of Plaintiffs in the matter of *PennEnvironment Inc., and Clean Air Council (Plaintiffs) and Allegheny County Health Department (Plaintiff-Intervenor) v. United States Steel Corporation (Defendant)*, Civil Action No. 2-19-cv-00484-MJH (US District Court for the Western District of Pennsylvania.)
250. Deposition (February 2021, virtual) on behalf of Plaintiffs in the matter of *Sierra Club Inc. (Plaintiff) v. GenOn Power Midwest LP (Defendants)*, Civil Action No. 2-19-cv-01284-WSS (US District Court for the Western District of Pennsylvania.)
251. Deposition (April 2021, virtual) on the Potential Remedies to Avoid Adverse Thermal Impacts from the Merrimack Station on behalf of Plaintiffs in the matter of *Sierra Club Inc. and the Conservation Law*

- Foundation (Plaintiffs) v. Granite Shore Power, LLC et. al., (Defendants)*, Civil Action No. 19-cv-216-JL (US District Court for the District of New Hampshire.)
252. Deposition (June 2021, virtual) on behalf of Plaintiffs in the matter of *Sierra Club (Plaintiff) v. Woodville Pellets, LLC (Defendant)*, Civil Action No. 9:20-cv-00178-MJT (US District Court for the Eastern District of Texas, Lufkin Division).
253. Deposition (June 2021, virtual) on behalf of the Plaintiffs in the matter of *Modern Holdings, LLC, et al. (Plaintiffs) v. Corning Inc., et al. (Defendants)*, Civil Action No. 5:13-cv-00405-GFVT, (US District Court for the Eastern District of Kentucky, Central Division at Lexington).
254. Testimony (June 2021, virtual) regarding the Aries Newark LLC Sludge Processing Facility, Application No. CPB 20-74, (Central Planning Board, City of Newark, New Jersey).
255. Testimony at Hearing (October 2021) on behalf of Evraz Rocky Mountain Steel in the matter of Colorado's Proposed Revisions to Regulation 22, the Greenhouse Gas Emissions and Energy Management for the Manufacturing Sector in Colorado (GEMM Rule), before the Colorado Air Quality Control Commission.
256. Deposition (November 2021) for *Charles Johnson Jr. (Plaintiff) v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 2:20-CV-01329 (Related to 12-968 BELO in MDL No. 2179). (US District Court for the Eastern District of Louisiana).
257. Testimony at Hearing (November 2021) on behalf of *National Parks Conservation Association, et. al.*, in the matter of the Proposed Revisions to Colorado's Regional Haze State Implementation Plan (SIP) and Colorado Regulation 23, before the Colorado Air Quality Control Commission.
258. Deposition (December 2021) on behalf of Plaintiffs in Re: Deepwater Horizon BELO Cases, Case No. 3:19cv963-MCR-GRJ (US District Court for the Northern District of Florida, Pensacola Division).
259. Deposition (December 2021) for *James Noel (Plaintiff) v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 1:19-CV-00694-JB-MU-C (US District Court for the Southern District of Alabama, Southern Division).
260. Testimony at Hearing (February 2022, virtual) in the matter of the *Appeal Petition for Hearing on Air Quality Permit No. 8585 on behalf of Earth Care New Mexico et. al., (Petitioners) v. New Mexico Environment Department and Associated Asphalt and Materials, LLC (Applicant)*, No. EIB 21-48 before the State of New Mexico Environmental Improvement Board.
261. Deposition (March 2022) and Rebuttal Deposition (July 2022) for *Kamuda (Plaintiff) v. Sterigenics U.S., LLC, et. al., (Defendant)*, Case No. 2018-L-010475 (Circuit Court of Cook County, Illinois.)
262. Deposition (April 2022, virtual) in the matter of Application of TPC Group LLC for New State and PSD Air Quality Permits (various), TCEQ Docket No. 2021-1422-AIR, SOAH Docket No. 582-22-0799, Before the Texas State Office of Administrative Hearings.
263. Deposition (May 2022, virtual) in the matter of the *Water Works and Sewer Board of the City of Gadsden (Plaintiff) v. 3M Company, et. al., (Defendants)*, Civil Action No.: 31 CV-2016-900676.00 (Circuit County of Etowah County, Alabama)
264. Deposition (June 2022 and September 2022, both virtual) for *Teresa Fornek (Plaintiff) v. Sterigenics U.S., LLC, et. al., (Defendant)*, Case No. 2018-L-010744 (Circuit Court of Cook County, Illinois.)
265. Deposition (June 2022, virtual) on behalf of the Plaintiffs in the matter of Toll Brothers, Inc., and Porter Ranch Development Company (Plaintiffs) v. Sempra Energy, Southern California Gas Company et. al., (Defendants), Southern California [Aliso Canyon] Gas Leak Cases, JCCP No.: 4861, Lead Case No.: BC674622, Superior Court of the State of California for the County of Los Angeles.
266. Deposition (July 2022) for *Richard Dufour (Plaintiff) v. BP Exploration and Production Inc., et. al. (Defendant)*, Civil Action No. 19-cv-00591 (US District Court for the Southern District of Mississippi).
267. Trial (August 2022) on behalf of the Plaintiffs in the matter of *Modern Holdings, LLC, et al. (Plaintiffs) v. Phillips (Defendants)*, Civil Action No. 5:13-cv-00405-GFVT, (US District Court for the Eastern District of Kentucky, Central Division at Lexington).

268. Trial (August 2022, in person) for *Susan Kamuda (Plaintiff) v. Sterigenics U.S., LLC, et. al., (Defendant)*, Case No. 2018-L-010475 (Circuit Court of Cook County, Illinois).
269. Deposition (September 2022, virtual) for *Heather Schumacher (Plaintiff) v. Sterigenics U.S., LLC, et. al., (Defendant)*, Case No. 2018-L-010744 (Circuit Court of Cook County, Illinois.)
270. Deposition (September 2022) on behalf of Plaintiffs in *Phylliss Grayson et. al. (Plaintiffs), v Lockheed Martin Corporation (Defendant)*, Case No. 6:20-cv-01770. (US District Court for the Middle District of Florida – Orlando Division.)
271. Hearing (October 2022) on behalf of the Puyallup Tribe of Indians in the matter of *Washington Utilities and Transportation Commission (Complainant) v. Puget Sound Energy (Respondent)* before the Washington Utilities and Transportation Commission, Docket UE-220066 and UG-220067 (Consolidated).
272. Deposition (September 2022) for *Teresa Fornek (Plaintiff) v. Sterigenics U.S., LLC, et. al., (Defendant)*, Case No. 2018-L-010475 (Circuit Court of Cook County, Illinois).
273. Trial (October 2022, in person) for *Teresa Fornek (Plaintiff) v. Sterigenics U.S., LLC, et. al., (Defendant)*, Case No. 2018-L-010475 (Circuit Court of Cook County, Illinois).

Attachment B

Documents Referenced

1. Citations to all AP-42 Sections are available on EPA's website at <https://www.epa.gov/air-emissions-factors-and-quantification/ap-42-compilation-air-emissions-factors>

Since these are publicly available, they are not being reproduced and attached.

2. The DAQ record document (410 pdf pages) are cited as respective pdf pages. Since this is a public document produced by the Agency, it is also not being separately reproduced.

3. Citations to other webpages etc. are provided as links throughout the document and/or footnotes. These were all accessed within the prior 2 weeks of submittal of these comments.