ECF-100KR2-23-0046
Revision 0

# Non-Radiological Emissions Calculations for 105 KW Demolition and Remediation AMP

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Contractor for the U.S. Department of Energy
under Contract 89303320DEM000030

CPCCo
Central Plateau
Cleanup Company

**P.O. Box 1464**
**Richland, Washington 99352**

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T. J. Rodovsky
Polestar Technical Services, Inc.

Date Published
June 2023

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APPROVED
By Julia Raymer at 3:08 pm, Jun 27, 2023

Release Approval | Date

# ENVIRONMENTAL CALCULATION COVER PAGE

| **SECTION 1 - Completed by the Responsible Manager** | |
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| Project:<br>105KW FSB D4 Project | **RELEASE / ISSUE**<br>DATE: Jun 27, 2023 HANFORD RELEASE |
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## ENVIRONMENTAL CALCULATION COVER PAGE (Continued)

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**SECTION 2 - Completed by Preparer**

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## ENVIRONMENTAL CALCULATION COVER PAGE (Continued)

**SECTION 5 - Applicable if Calculation is a Risk Assessment or Uses an Environmental Model**

**Prior to Initiating Modeling:**

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Integration Lead:

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|---|---|---|
| *Print First and Last Name* | *Signature* | *Date* |

Safety Software Approved:
Integration Lead:

| N/A | | |
|---|---|---|
| *Print First and Last Name* | *Signature* | *Date* |

**Calculation Approved:**
Risk/Modeling Integration Manager:

| N/A | | |
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| *Print First and Last Name* | *Signature* | *Date* |

*Non-Radiological Emissions Calculations for 105 KW Demolition and Remediation AMP*

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## Figures



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## Acronyms

| | |
|---|---|
| 105KW | 105 K West |
| AP-42 | Compilation of Air Pollutant Emissions Factors |
| APCD | Air Pollution Control District |
| ARAR | Applicable or Relevant and Appropriate Requirement |
| ASIL | Acceptable Source Impact Level |
| CARB | California Air Resources Board |
| CBP | Concrete Batch Plant |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| CFR | Code of Federal Regulations |
| DEEP | Diesel Engine Exhaust Particulate |
| DOE | U.S. Department of Energy |
| ECF | Environmental Calculation File |
| EPA | Environmental Protection Agency |
| ECRTS | Engineered Container Retrieval and Transfer System |
| FSB | Fuel Storage Basin |
| GWP | Global Warming Potential |
| HAP | Hazardous Air Pollutant |
| IDEQ | Idaho Department of Environmental Quality |
| ISR | In-Stack Ratio |
| NMHC | Non-Methane Hydrocarbon(s) |
| NOS | Not Otherwise Specified |
| NOx | Nitrogen Oxides |
| NSR | New Source Review |
| PM | Particulate Matter |
| PM10 | Particulate Matter <10 microns |
| PM2.5 | Particulate Matter <2.5 microns |
| PSD | Prevention of Significant Deterioration |
| PTE | Potential-to-Emit |
| RD/RAWP | Remedial Design/Remedial Action Work Plans |
| SER | Significant Emission Rate |
| SQER | Small Quantity Emission Rate |
| TAP | Toxic Air Pollutant |
| TSD | Technical Support Document |

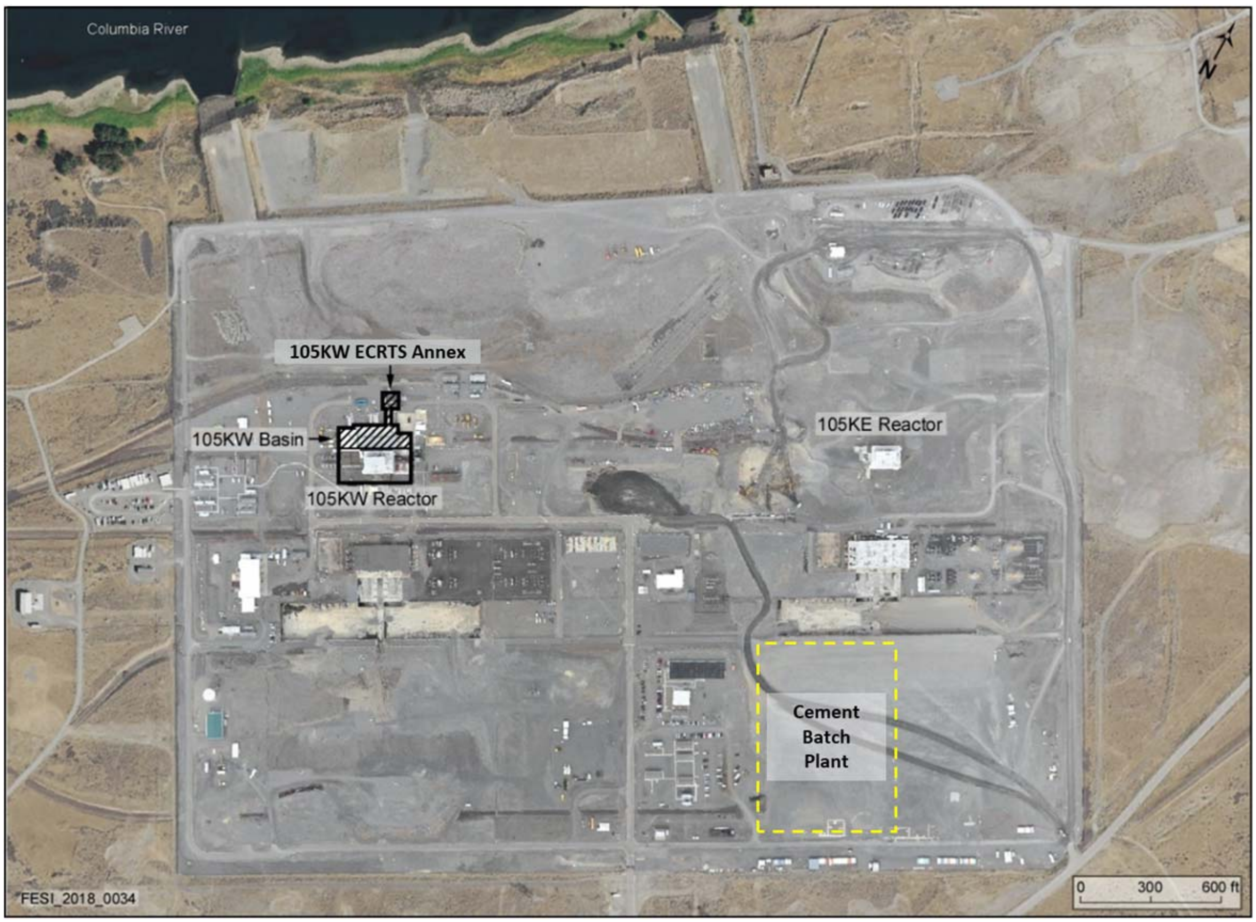
| | |
|---|---|
| TSP | Total Suspended Particulate |
| VMT | Vehicle Miles Traveled |
| VOC | Volatile Organic Compound |
| WAC | Washington Administrative Code |

# 1 Introduction

This Environmental Calculation File (ECF) provides information necessary to conduct an air quality impact assessment pertaining to remediation of the K Area waste sites, demolition of the K West (105KW) Fuel Storage Basin (FSB) and Engineered Container Retrieval and Transfer System (ECRTS) Annex structure, and placement of the 105KW reactor into interim safe storage. Work is being performed under the Compensation and Liability Act of 1980 (CERCLA) and the remedial design/remedial action work plans (RD/RAWP).

This ECF summarizes the assumptions, inputs, and methodology used to assess non-radioactive air emissions against the potential need to fulfill the requirements of WAC 173-400-110 through -113, WAC 173-460, and Chapter 40 of the US Code of Federal Regulations (40 CFR) (Section 52.21). The sources being evaluated include diesel fuel-fired engines, a Concrete Batch Plant (CBP) for grout production, and vehicle traffic.

**Figure 1. 105KW Site Layout**



## 2 Background

These calculations are in support of the ARAR application within the Air Monitoring Plan. The RD/RAWP addresses the actions to demolish and remove the 105KW Basin and the 105KW ECRTS Annex. The following demolition activities are included in the work plan:

- Demolition preparation activities that include identifying and removing asbestos and hazardous substances and conducting utility isolations
- Demolition activities that include rubblizing, removing, packaging, treating (as needed), and disposing of the basin superstructure, basin substructure, and 105KW sludge transfer annex
- Removing high dose debris staged in vertical pipe vasings (VPCs)
- Removing and disposing of large debris items including grouted vessels and tanks
- Removing the basin leachate collection system (under-drainage system) to the extent practicable during basin demolition
- Stabilizing the remaining waste site (soil contamination) following demolition
- Remediating underlying contaminated soil
- Removing sludge
- Deactivating 105KW Basin and 105KW ECRTS Annex, and remediating soil

This document describes the operations at 105KW which may have a potential to emit airborne emissions from diesel fuel-fired engines, the CBP, and vehicle traffic – all activities which will support the demolition activities listed above. This document does not address radiological constituents: radiological constituents are address in separate analyses.

# 3 Assumptions and Inputs

The sources on the 105KW site that have the potential to emit criteria air pollutants include diesel fuel-fired engines, CBP, and vehicle traffic. Pollutant emissions were calculated for the 105KW CERCLA activities according to the assumptions and procedures below. Emissions were estimated using site-specific emission factors where available. Emission factors were identified using a hierarchy of:

1. Manufacturer specifications (engines)
2. Empirically derived formulas from AP-42 (EPA's "Compilation of Air Pollutant Emissions Factors", which contains emissions factors and process information for various air pollution source categories) using site-specific data (vehicle traffic)
3. Published AP-42 emission factors (CBP)

Detailed emissions calculations are included in Appendix A.

## 3.1 Engines

1. Fuel-fired engines at the site may include three 48-bhp diesel fuel-fired generators, and seven 16.6-bhp diesel fuel-fired light stands.
2. Diesel generators will be used for up to 10 hours per day, operating Monday-Friday, for 26 weeks per year. On an annual basis this would equate to 1,040 hours per year per generator.
3. Light stands will be used a maximum of 616 hours per year per light stand (4 hours per day, 7 days per week, 22 weeks per year, assuming lights are used in the months with the least amount of daylight hours).
4. For conservative estimates, the annual anticipated operating hours of the engines was doubled in the calculations. In addition, worst case operating assumptions use 24 hours per day.

## 3.2 Concrete Batch Plant (CBP)

1. The CBP will produce 8,500 cubic yards of grout over a 16 month period (per P. Sauer via 1/3/2023 email). Therefore, the plant will produce 6,375 cubic yards of grout on an annual basis. For conservative estimate, the annual production was increased to 7,650 cubic yard to incorporate a 20% margin.
2. The plant is expected to be able to produce a maximum of 200 cubic yards per hour.
3. Three types of grout will be produced by the CBP for the project, using a range of formulations. A worst-case formulation was developed using maximum of the three sample types of grout provided by American Rock Products, and adding a 50% safety factor. The maximum quantity was limited to 100% of the composition. Based on the conservative assumptions, the maximum quantity represents worst case 24-hour emissions for each component and over estimates annual quantity for all components. See data in Table 1.

**Table 1: Grout Formulations**

| Material Type | Description | Design Range | Worst Case +50% |
|---|---|---|---|
| Cement | Ash Grove Type I-II | 118 to 535 lbs | 1,065 lbs |
| Fly Ash | Ash Grove ENX Class F | 376 to 600 lbs | 1,065 lbs |
| Fine Aggregate | American Rock Products Construction Sand | 905 to 2,337 lbs | 3,549 lbs |
| Water | Water | 43 to 102 gal | 390 lbs[1] |

1. Lower water amounts are worst case for CBP emissions.

On an annual basis the CBP will use up to 13,575 tons of sand, 4,073 tons of cement, 4,073 tons of cement supplement (fly ash), and 1,493 tons of water. This is equivalent to 7,650 cubic yards of sand, 2,245 cubic yards of cement, 2,245 cubic yards of cement supplement, and 842 cubic yards of water.

4. The CBP will operate a maximum of 260 days per year (5 days per week, 52 weeks per year).

5. Emissions from the CBP will be controlled by a dust collector capable of removing 99% of PM at the cement silo and 70% of PM at the weigh hopper, and a vinyl curtain and watering system capable of removing 95.5% of PM at the truck loading point.

### 3.3 Vehicle Traffic

1. The surface material silt content, 5%, was derived from testing of Northern 2004, a similar unpaved road at the Hanford site, and was the percent of sample passing through a 0.075 mm sieve.

2. The number of days in a year with at least 0.01" of precipitation is 122, which includes data from 1947 to 2021, and was obtained from the the Hanford Meteorologic Station (HMS) Website.

3. Vehicle operations will occur a maximum 260 days per year (a maximum of 5 days per week, 52 weeks per year).

4. The mean vehicle weight, W, for excavators onsite is 56 tons. Three of four excavators will operate at any one time. The total distance traveled is estimated to be 600 feet per day.

$$\text{VMT}=\left(\frac{600\text{ feet}}{\text{trip}}\right)\left(\frac{\text{mile}}{5{,}280\text{ feet}}\right)\left(\frac{3\text{ trips}}{\text{day}}\right)\left(\frac{260\text{ days}}{\text{year}}\right)=89\text{ miles per year}$$

**Because total feet traveled per day was provided, 1 trip per day was assumed for each excavator.*

5. The mean vehicle weight, W, for loaders onsite is 36 tons. One of two loaders will operate at any one time. The total distance traveled is estimated to be 3,000 feet per day.

$$\text{VMT}=\left(\frac{3{,}000\text{ feet}}{\text{trip}}\right)\left(\frac{\text{mile}}{5{,}280\text{ feet}}\right)\left(\frac{1\text{ trip}}{\text{day}}\right)\left(\frac{260\text{ days}}{\text{year}}\right)=148\text{ miles per year}$$

**Because total feet traveled per day was provided, 1 trip per day was assumed for the loader.*

6. The mean vehicle weight, W, for ERDF trucks onsite is 33 tons (22 tons empty, 44 tons loaded). One of the three trucks will operate at any one time. The total distance traveled is estimated to be 0.25 miles per round trip, up to 5 trips per day.

$$\text{VMT}=\left(\frac{0.25\text{ miles}}{\text{trip}}\right)\left(\frac{5\text{ trips}}{\text{day}}\right)\left(\frac{260\text{ days}}{\text{year}}\right)=325\text{ miles per year}$$

A summary of the vehicle weights used for Fugitive PM emissions calculations is included in Table 2.

**Table 2: Vehicle Weights Used for PM Calculations**

| 105KW Vehicle | Weight (tons) | Basis for Weight |
|---|---|---|
| Excavator Komatsu PC800 | 83 | *Per D. Idler 5/16/2022 e-mail* |
| Excavator Komatsu PC400 | 46 | *Per D. Idler 5/16/2022 e-mail* |
| Excavator Hitachi ZX450 | 47 | *Per D. Idler 5/16/2022 e-mail* |
| Excavator Hitachi ZX450 | 47 | *Per D. Idler 5/16/2022 e-mail* |
| Loader Komatsu WA500 | 39 | *Per D. Idler 5/16/2022 e-mail* |
| Loader CAT 980H | 33 | *Per D. Idler 5/16/2022 e-mail* |
| ERDF Trucks (x3) | 33 | *22 tons empty, 44 tons loaded Per F. Carleo 5/16/2022 e-mail* |

7. Soil sampling detected chromium, including hexavalent chromium, in the soil at the site, with the highest measures values being 22,300 µg/kilogram of total chromium and 2,040 µg/kilogram of hexavalent chromium. These concentrations were applied to total fugitive PM to calculate chromium emissions.

8. For all fugitive PM emissions, a 70% mitigation factor was used, based on the application of water and fixatives to unpaved and disturbed areas (in accordance with DD-63014, 105KW Basin Deactivation Air Monitoring Plan). This is consistent with fugitive PM mitigation plans at the Integrated Disposal Facility.

# 4 Methodology

## 4.1 Engines

1. Fuel heat values for emission calculations were obtained from AP-42 Chapter 3.3, "Gasoline and Diesel Industrial Engines" (10/1996), Table 3.3-1, footnote c. Density of diesel was obtained from AP-42 Chapter 3.4 "Large Stationary Diesel and All Stationary Dual-fuel Engines" (10/1996), Table 3.4-1, footnote a.

2. Criteria pollutant emission factors for the diesel fuel-fired generator (Generac/John Deere MMG35DF4) and diesel fuel-fired light stands (MQPower/Kubota D1105)were obtained from the manufacturer specifications, except for $SO_2$.

3. Per June 28, 2004 California Air Resources Board Policy: "CARB Emission Factors for CI Diesel Engines –% HC in Relation to NMHC + NOx", when the non-methane hydrocarbon (NMHC) and nitrogen oxide (NOx) is combined in a single emission factor, assume a breakdown of 5% and 95%, respectively.

4. $SO_2$ emission factors are calculated based on AP-42 Chapter 3.4, "Large Stationary Diesel and All Stationary Dual-fuel Engines" (10/1996) Table 3.4-1, using ultra low sulfur diesel (15 ppm) because it uses a formula based on diesel sulfur content, rather than a general emission factor.

5. Greenhouse gas emissions were calculated for PSD determination purposes. Emission factors were obtained from "Greenhouse Gas Inventory Guidance: Direct Emissions from Mobile Combustion Sources" (January 2016), and global warming potentials were obtained from 40 CFR Part 98 Table A-1 (August 2016) and WAC 173-441-040.

6. Emission factors for TAPs were obtained from AP-42 Chapter 3.3, "Gasoline and Diesel Industrial Engines" (10/1996), Table 3.3-2.

7. EPA's Nitrogen Dioxide/Nitrogen Oxide In-Stack Ratio (ISR) Database (updated 10-29-2020) for smaller diesel engines similar to this project had ISR's less than 0.2. Per EPA's "Technical support document (TSD) for $NO_2$-related AERMOD modifications" (December 2015) the $NO_2$ to NOx ISR should be a minimum of 0.2. $NO_2$ emissions conservatively assumed to be 20% of NOx emissions.

The specifications and operating parameters for the project planned engines are in Table 3.

**Table 3: Engine Specifications and Operating Parameters**

<table>
<tr><th>Engine</th><th>Number</th><th>Fuel Consumption (gal/hr)</th><th>Brake Horsepower</th><th>Hours/ Year (PTE)</th><th>Hours/Yr (Expected, 2x Project Planned)</th><th>Hours/ Day</th><th>Energy Input (MMBtu/ hr)</th></tr>
<tr><td>Diesel Generators[1]</td><td>3</td><td>1.66</td><td>48</td><td rowspan="2">8,760</td><td>2,080</td><td rowspan="2">24</td><td>0.23</td></tr>
<tr><td>Diesel Light Stands[2]</td><td>7</td><td>0.7</td><td>16.6</td><td>1,232</td><td>0.10</td></tr>
</table>

1) Generac/John Deere MMG35DF4
2) MQPower/Kubota D1105
3) 8,760 hours per year was used to calculate "potential-to-emit" in accordance with regulatory definitions

See Section 6.1 for calculation details.

### 4.2 Concrete Batch Plant (CBP)

1. Emission factors were obtained from Chapter 11, Section 11.12 “Concrete Batching”AP-42 (June 2006). Grout composition was derived as described in Section 3.2

2. Particulate matter (PM) emission factors for sand delivery to ground storage, sand transfer to feed conveyor, sand transfer to elevated storage (silo), cement delivery to elevated storage, cement supplement delivery to elevated storage, weigh hopper loading, and central mix were obtained from Table 11.12-2 of AP-42.

3. The PM2.5/PM10 ratio of 0.15 was obtained from AP-42 Chapter 13.2.4 “Background Document for Revisions to Fine Fraction Ratios Used for AP-42 Fugitive Dust Emission Factors” (November 1, 2006).

4. TAP emission factors for cement unloading, supplement unloading, and central mix batching with fabric filter were obtained from AP-42, Table 11.12-8 (June 2006).

5. Hexavalent chromium is up to 27% of total chromium emissions based on data San Diego County Air Pollution Control District’s 1998 Guidance for Concrete Batch Plants (1998), and 20% based on Idaho DEQ Statement of Basis for “Concrete Batch Plant General Permit - Permit to Construct No. P-2021.0033” (2021). Hexavalent chromium emissions were conservatively assumed to be 27% of total chromium.

See Section 6.2 for calculation details.

### 4.3 Vehicle Traffic

For vehicle travel on unpaved roads at industrial sites, emissions were calculated based on equations from Section 13.2.2 of AP-42, Chapter 13.2.2 “Unpaved Road” (January 1995). The emission factor is calculated as follows:

$$E_{ext} = (E)\left(\frac{365 - P}{365}\right)$$

where:

$E_{ext}$ = annual size-specific emission factor extrapolated for natural mitigation, lb/VMT
P = number of days in a year with at least 0.254 mm (0.01 in) of precipitation
E = emission factor

E, the emission factor, was calculated using Equation 1a and Table 13.2.2-2 of AP-42, Chapter 13.2.2 “Unpaved Road”:

$$E = (k)\left(\frac{s}{12}\right)^{a}\left(\frac{W}{3}\right)^{b}$$

where:

E = Emission factor, pounds of emissions per vehicle mile traveled (VMT) (lbs/VMT)
k, a, b = particle size multiplier (dimensionless)
s = surface material silt content (%)
W = mean vehicle weight, tons

The particle size multiplier, k. a, and b vary with aerodynamic particle size. For 105KW, three particulate sizes are evaluated and obtained from Table 13.2.2-2 of AP-42, Chapter 13.2.2 "Unpaved Road". These constants are included in the Table 4, below.

**Table 4: PM Size Multiplier for Unpaved Roads**

| Constant | PM | $PM_{10}$ | $PM_{2.5}$ |
|---|---|---|---|
| k (lb/VMT) | 4.9 | 1.5 | 0.15 |
| a | 0.7 | 0.9 | 0.9 |
| b | 0.45 | 0.45 | 0.45 |

A 70% mitigation factor was used, as described in Section 3.3.

See Section 6.3 for calculation details.

# 5 Software Applications

A Microsoft EXCEL® spreadsheet was used to calculate estimated emissions so that an assessment against the WAC 173-400-110 and WAC 173-460-150 regulations could be performed, as necessary.

# 6 Calculations

The following section details emission factors, formulas, sample calculations, and emissions results for the sources at 105KW. A table of calculated emissions is included in each sub-section. The entire emissions inventory is included in Appendix A.

## 6.1 Engines

A. Criteria pollutant emissions were calculated using the emissions factors in grams per brake horsepower-hour (Table 5), which were obtained as described in Section 4.1.

**Table 5: Engine Criteria Pollutant Emission Factors (EF)**

| Pollutant | Diesel Generator EF (gr/bhp-hr) | Light Stand EF (gr/bhp-hr) |
|---|---|---|
| $PM=PM_{10}=PM_{2.5}$ | 0.19 | 0.11 |
| $NO_X$ | 4.67 | 7.02 |
| CO | 1.49 | 0.74 |
| $SO_2$ | 1.52E-03 | 1.52E-03 |
| VOCs (Total Organic Hydrocarbons) | 0.25 | 0.37 |

1. Determine the total brake horsepower of the engines in that category.
2. Convert grams to pounds using a conversion factor of 453.592 grams/pound.
3. Determine PTE by multiplying the emission factor by total brake horsepower times 8,760 hours per year times the number of engines.
4. Determine project planned emissions by multiplying the emission factor by expected hours per year times the number of engines. Results are included in Table 6. (Note that slight differences between example and table results are due to rounding performed at the end in the spreadsheet.)

PM Example:

$$PM\left(\frac{lb}{yr}\right) = EF\left(\frac{g}{bhp*hr}\right) * \text{Engine Power (bhp)} * \frac{lb}{453.592g} * 8{,}760\,\frac{hr}{yr} * \#engines$$

$$PM\left(\frac{lb}{yr}\right) = 0.19\left(\frac{g}{bhp*hr}\right) * 48\ (bhp) / \frac{453.592g}{lb} * 8{,}760\,\frac{hr}{yr} * 3\ \text{generators} = \mathbf{528\ lb/yr}$$

$$PM\left(\frac{lb}{yr}\right) = 0.11\left(\frac{g}{bhp*hr}\right) * 16.6\ (bhp) / \frac{453.592g}{lb} * 8{,}760\,\frac{hr}{yr} * 7\ \text{light stands} = \mathbf{247\ lb/yr}$$

**Table 6: Engine Criteria Pollutant Emissions**

| Pollutant | Potential Emissions (PTE) | | | Project planned Emissions | | |
|---|---|---|---|---|---|---|
| | Diesel Generators (lb/yr) | Light Stands (lb/yr) | Total (tpy) | Diesel Generators (lb/yr) | Light Stands (lb/yr) | Total (tpy) |
| PM=PM10= PM2.5 | 528 | 247 | 0.39 | 125 | 35 | 0.08 |
| $NO_X$ | 12,998 | 15,755 | 14 | 3,086 | 2,216 | 2.7 |
| CO | 4,144 | 1,661 | 2.9 | 984 | 234 | 0.61 |

| Pollutant | Potential Emissions (PTE) | | | Project planned Emissions | | |
|---|---|---|---|---|---|---|
| | Diesel Generators (lb/yr) | Light Stands (lb/yr) | Total (tpy) | Diesel Generators (lb/yr) | Light Stands (lb/yr) | Total (tpy) |
| $SO_2$ | 4 | 3 | 3.8E-03 | 1 | 0 | 7.4E-04 |
| VOCs (Total Organic Hydrocarbons) | 684 | 829 | 0.76 | 162 | 117 | 0.14 |

B. Greenhouse Gas emissions were calculated using the emissions factors in grams per gallon of fuel for diesel, which were obtained as described in Section 4.1. Total potential Greenhouse Gas emissions are summarized in Table 8.

**Table 7: Engine Greenhouse Gas Emission Factors (EF)**

| Pollutant | Diesel Engine EF (gr/gal) |
|---|---|
| $CO_2$ | 10,210 |
| $CH_4$ | 0.57 |
| $N_2O$ | 0.26 |

1. Obtain fuel usage in gallons per hour from equipment specifications.
2. Determine project planned emissions by multiplying the emission factor by fuel usage times expected hours per year times the number of engines.
3. Convert to $CO_2$e in metric tons using appropriate conversion factor, and Global Warming Potential (GWP) from 40 CFR Part 98 Table A-1 (August 2016) and WAC 173-441-040.

$$CO_2\text{e Emissions (metric tons)} = \#\text{ Engines } * \text{ Fuel Use }\left(\frac{gal}{hr}\right) * \text{ EF}\left(\frac{gr}{gal}\right) * \frac{\frac{hr}{yr}}{1{,}000{,}000\frac{gr}{\text{metric ton}}}$$

$CH_4$ PTE Example:

$$= \left[\begin{array}{l} 3\text{ diesel generators } * 1.66\left(\frac{gal}{hr}\right) * 0.57\left(\frac{gr}{gal}\right) * 8{,}760\left(\frac{hr}{yr}\right) \\ \quad +7\text{ light stands} * 0.7\left(\frac{gal}{hr}\right) * 0.57\left(\frac{gr}{gal}\right) * 8{,}760\left(\frac{hr}{yr}\right) \end{array}\right] \Big/ 1{,}000{,}000\,\frac{gr}{\text{metric ton}}$$

**= 4.9E-02 metric tons/yr**

$CO_2$e=Pollutant emissions * GWP = 4.9E-02 metric tons/yr * 25 = **1.23 mtpy**

**Table 8: Engine Greenhouse Gas Emissions**

| Pollutant | Potential to Emit (metric tons/yr) | GWP | $CO_2$e (mtpy) | Expected Emissions (metric tons/yr) | GWP | $CO_2$e (mtpy) |
|---|---|---|---|---|---|---|
| $CO_2$ | 884 | 1 | 884 | 167 | 1 | 167 |
| $CH_4$ | 4.9E-02 | 25 | 1.23 | 9.3E-02 | 25 | 0.23 |
| $N_2O$ | 2.3E-02 | 298 | 6.71 | 4.3E-03 | 298 | 1.27 |
| Total $CO_2$e, mtpy | | | 892 | Total $CO_2$e, mtpy | | 169 |

C. Toxic pollutant emissions were calculated using the emissions factors in lbs/MMBtu (Table 9), which were obtained as described in Section 4.1.

**Table 9: Engine Toxic Pollutant Emission Factors**

| **Diesel Pollutants** | **Emission Factor** | **Units** |
|---|---|---|
| 1,3-Butadiene | 3.91E-05 | lb/MMBtu |
| Acetaldehyde | 7.67E-04 | lb/MMBtu |
| Acrolein | 9.25E-05 | lb/MMBtu |
| Benzo(a)anthracene | 1.68E-06 | lb/MMBtu |
| Benzene | 9.33E-04 | lb/MMBtu |
| Benzo(a)pyrene | 1.88E-07 | lb/MMBtu |
| Benzo(b)fluoranthene | 9.91E-08 | lb/MMBtu |
| Benzo(k)fluoranthene | 1.55E-07 | lb/MMBtu |
| Chrysene | 3.53E-07 | lb/MMBtu |
| Dibenz(a,h)anthracene | 5.83E-07 | lb/MMBtu |
| DEEP[1] | See below | |
| Fluorene | 2.92E-05 | lb/MMBtu |
| Formaldehyde | 1.18E-03 | lb/MMBtu |
| Indeno(1,2,3-cd)pyrene | 3.75E-07 | lb/MMBtu |
| Naphthalene | 8.48E-05 | lb/MMBtu |
| Nitrogen dioxide[2] | See below | |
| Propylene | 2.58E-03 | lb/MMBtu |
| Toluene | 4.09E-04 | lb/MMBtu |
| Xylenes | 2.85E-04 | lb/MMBtu |
| Polycyclic aromatic hydrocarbons (PAH) | 1.68E-04 | lb/MMBtu |

1. Diesel Engine Exhaust Particulate emissions assumed equivalent to PM2.5 emissions plus total VOC for diesel fuel-fired engines.
2. EPA's Nitrogen Dioxide/Nitrogen Oxide In-Stack Ratio (ISR) Database (updated 10-29-2020) for smaller diesel engines similar to this project had ISR's less than 0.2. Per EPA's "Technical support document (TSD) for $NO_2$-related AERMOD modifications" (December 2015) the $NO_2$ to NOx in-stack ratio (ISR) should be a minimum of 0.2. $NO_2$ emissions conservatively assumed to be 20% of NOx emissions.

1. Determine energy input of engine in MMBtu/hr using:

$$\text{Fuel use}\left(\frac{\text{gal}}{\text{hr}}\right) * \text{ density}\left(\frac{\text{lb}}{\text{gal}}\right) * \text{ heating value}\frac{(Btu)}{\text{lb} * 1\text{E}+06}$$

Diesel Generator Example:

$$1.66\left(\frac{\text{gal}}{\text{hr}}\right) * 7.1\left(\frac{\text{lb}}{\text{gal}}\right) * 19{,}300\frac{(Btu)}{\text{lb}*1\text{E}+06} = \mathbf{0.23\ MMBtu/hr}$$

2. Determine PTE by multiplying the emission factor by energy input by 8,760 hours per year.
3. Determine project planned emissions by multiplying the emission factor by energy input, by expected hours per year.

1,3-Butadiene Example:

$$\left(\text{Diesel Generator}\left(\frac{\text{MMBtu}}{\text{hr}}\right) * \#\text{Engines} + \text{Light Stands}\left(\frac{\text{MMBtu}}{\text{hr}}\right) * \#\text{Engines}\right) * \text{Emission Factor}\left(\frac{\text{lb}}{\text{MMBtu}}\right) * \frac{\text{hr}}{\text{yr}}$$

$$\text{Potential} = \left(0.23\left(\frac{\text{MMBtu}}{\text{hr}}\right)*3 + 0.10\left(\frac{\text{MMBtu}}{\text{hr}}\right)*7\right) * 3.91\text{E-}05\left(\frac{\text{lb}}{\text{MMBtu}}\right) * 8{,}760\left(\frac{\text{hr}}{\text{yr}}\right)$$

**= 4.6 E-01 lb/yr**

$$\text{Expected} = \left(0.23\left(\frac{\text{MMBtu}}{\text{hr}}\right) * 3 * 2{,}080\left(\frac{\text{hr}}{\text{yr}}\right) + 0.10\left(\frac{\text{MMBtu}}{\text{hr}}\right) * 7 * 1{,}232\left(\frac{\text{hr}}{\text{yr}}\right)\right) * 3.91\text{E-}05\left(\frac{\text{lb}}{\text{MMBtu}}\right)$$

**= 8.8 E-02 lb/yr**

A summary of calculated emissions is included in Table 10.

**Table 10: Engine Toxic Pollutant Emissions**

| Diesel Pollutant | Potential Emissions (PTE) | | Project planned Emissions | |
|---|---|---|---|---|
| | lb/hr | lb/yr | lb/hr | Total (lb/yr) |
| 1,3-Butadiene | 5.29E-05 | 4.64E-01 | 5.29E-05 | 8.78E-02 |
| Acetaldehyde | 1.04E-03 | 9.10E+00 | 1.04E-03 | 1.72E+00 |
| Acrolein | 1.25E-04 | 1.10E+00 | 1.25E-04 | 2.08E-01 |
| Benzo(a)anthracene | 2.27E-06 | 1.99E-02 | 2.27E-06 | 3.77E-03 |
| Benzene | 1.26E-03 | 1.11E+01 | 1.26E-03 | 2.10E+00 |
| Benzo(a)pyrene | 2.55E-07 | 2.23E-03 | 2.55E-07 | 4.22E-04 |
| Benzo(b)fluoranthene | 1.34E-07 | 1.18E-03 | 1.34E-07 | 2.23E-04 |
| Benzo(k)fluoranthene | 2.10E-07 | 1.84E-03 | 2.10E-07 | 3.48E-04 |
| Chrysene | 4.78E-07 | 4.19E-03 | 4.78E-07 | 7.93E-04 |
| Dibenz(a,h)anthracene | 7.89E-07 | 6.91E-03 | 7.89E-07 | 1.31E-03 |
| DEEP[7] | 2.61E-01 | 2.29E+03 | 2.61E-01 | 4.39E+02 |
| Fluorene | 3.95E-05 | 3.46E-01 | 3.95E-05 | 6.56E-02 |
| Formaldehyde | 1.60E-03 | 1.40E+01 | 1.60E-03 | 2.65E+00 |
| Indeno(1,2,3-cd)pyrene | 5.08E-07 | 4.45E-03 | 5.08E-07 | 8.42E-04 |
| Naphthalene | 1.15E-04 | 1.01E+00 | 1.15E-04 | 1.91E-01 |
| Nitrogen dioxide | 6.56E-01 | 5.75E+03 | 6.56E-01 | 1.06E+03 |
| Propylene | 3.49E-03 | 3.06E+01 | 3.49E-03 | 5.80E+00 |
| Toluene | 5.54E-04 | 4.85E+00 | 5.54E-04 | 9.19E-01 |
| Xylenes | 3.86E-04 | 3.38E+00 | 3.86E-04 | 6.40E-01 |
| Polycyclic aromatic hydrocarbons (PAH) | 2.27E-04 | 1.99E+00 | 2.27E-04 | 3.77E-01 |

*Note that slight differences between example and table results are due to all figures carried through to the end of the spreadsheet calculations.

### 6.2 Concrete Batch Plant (CBP)

A. Particulate emissions factors for grout production were calculated using maximum expected annual amount of grout components, and emission factors in Table 11, which were obtained as described in Section 4.2.

**Table 11: CBP Particulate Emission Factors**

| Process Step | Uncontrolled PM EF (lb/ton) | Uncontrolled PM10 EF (lb/ton) | Uncontrolled PM2.5 EF (lb/ton) |
|---|---|---|---|
| Aggregate delivery to ground storage | 6.90E-03 | 3.30E-03 | 4.95E-04 |
| Sand delivery to ground storage | 2.10E-03 | 9.90E-04 | 1.49E-04 |
| Aggregate Transfer to feed conveyor | 6.90E-03 | 3.30E-03 | 4.95E-04 |
| Sand Transfer to feed conveyor | 2.10E-03 | 9.90E-04 | 1.49E-04 |
| Aggregate transfer to elevated storage | 6.90E-03 | 3.30E-03 | 4.95E-04 |
| Sand Transfer to elevated storage | 2.10E-03 | 9.90E-04 | 1.49E-04 |
| Cement delivery to elevated storage | 7.30E-01 | 4.70E-01 | 7.05E-02 |
| Cement supplement delivery to elevated storage | 3.14E+00 | 1.10E+00 | 1.65E-01 |
| Weigh hopper loading* | 4.80E-03 | 2.80E-03 | 4.20E-04 |
| Mixer Loading* | 5.72E-01 | 1.56E-01 | 2.34E-02 |

**Weigh hopper loading emission factors are in terms of lb/ton sand & aggregate, and Mixer loading emission factor are in terms of lb/ton cement and cement supplement.*

1. Annual grout produced was calculated as follows:

$$\frac{10{,}200\ yd^3}{16\ months} * \frac{12\ months}{year} = 7{,}650\,\frac{yd^3}{yr}$$

$$\frac{7{,}650\ yd^3}{year} * \frac{3{,}549\ lbs}{yd^3} * \frac{ton}{2000\ lbs} = 13{,}575\,\frac{ton}{yr}$$

2. Annual raw component masses were calculated using the annual production as follows:

$$\frac{Component\ density\ \left(\frac{lb}{yd^3}\right)}{2{,}000(\frac{lb}{ton})} * 7{,}650\,\frac{yd^3}{yr}$$

3. Sand example:

$$\frac{3{,}549\ \frac{lb}{yd^3}}{2000\,\frac{lb}{ton}} * 7{,}650\,\frac{yd^3}{yr} = 13{,}575\,\frac{tons}{yr}$$

B. Uncontrolled emissions were calculated by multiplying the Table 12 emission factors and the raw component volumes as summarized in the first column of Table 13.

Example: Sand delivery to ground storage:

$$\mathrm{PM}\left(\frac{\mathrm{lb}}{\mathrm{yr}}\right) = \mathrm{EF}\left(\frac{\mathrm{lb}}{\mathrm{ton}}\right) * \left(\frac{\mathrm{ton}}{\mathrm{yr}}\right) = 2.10\text{E-}03\,\frac{\mathrm{lb}}{\mathrm{ton}} * 13{,}575\,\frac{ton}{\mathrm{yr}} = 28.5\,\frac{\mathrm{lb}}{\mathrm{yr}}$$

**Table 12: CBP Uncontrolled Emissions**

| Process Step | Material (tons/yr) | Uncontrolled PM (lb/yr) | Uncontrolled PM10 (lb/yr) | Uncontrolled PM2.5 (lb/yr) |
|---|---|---|---|---|
| Aggregate delivery to ground storage | 0 | - | - | - |
| Sand delivery to ground storage | 13,575 | 2.85E+01 | 1.34E+01 | 2.02E+00 |
| Aggregate Transfer to feed conveyor | 0 | - | - | - |
| Sand Transfer to feed conveyor | 13,575 | 2.85E+01 | 1.34E+01 | 2.02E+00 |
| Aggregate transfer to elevated storage | 0 | - | - | - |
| Sand Transfer to elevated storage | 13,575 | 2.85E+01 | 1.34E+01 | 2.02E+00 |
| Cement delivery to elevated storage | 4,073 | 2.97E+03 | 1.91E+03 | 2.87E+02 |
| Cement supplement delivery to elevated storage | 4,073 | 1.28E+04 | 4.48E+03 | 6.72E+02 |
| Weigh hopper loading | 13,575 | 6.52E+01 | 3.80E+01 | 5.70E+00 |
| Mixer loading | 5,566 | 4.66E+03 | 1.27E+03 | 1.91E+02 |
| **Total PM Emissions** | | 2.28E+03 | 2.06E+04 | 7.74E+03 |

**Note that there is no aggregate in the grout formula.*

C. Controlled emission factors for grout production were calculated by applying the control efficiencies in Table 13 to emission factors in Table 11:

**Table 13: CBP Control Efficiencies**

| Process Step | Control Method | Control Method Efficiency |
|---|---|---|
| Sand storage bins | None | 0% |
| Cement silo | Dust Collector | 99% |
| Weigh hopper loading | Partial capture and reroute to dust collector | 70% |
| Truck loading | Vinyl curtain and water spray | 95.5% |

Example: Weigh hopper loading:

$$EF\left(\frac{lb}{ton}\right) * (1 - Control\ Efficiency) = 4.80\text{E-}03\,\frac{lb}{ton} * (1 - 0.7) = 1.44\text{E-}03\,\frac{lb}{ton}$$

**Table 14: CBP Controlled Emission Factors**

| Process Step | Controlled PM EF (lb/ton) | Controlled PM10 EF (lb/ton) | Controlled PM2.5 EF (lb/ton) |
|---|---|---|---|
| Aggregate delivery to ground storage | 6.90E-03 | 3.30E-03 | 4.95E-04 |
| Sand delivery to ground storage | 2.10E-03 | 9.90E-04 | 1.49E-04 |
| Aggregate Transfer to feed conveyor | 6.90E-03 | 3.30E-03 | 4.95E-04 |
| Sand Transfer to feed conveyor | 2.10E-03 | 9.90E-04 | 1.49E-04 |
| Aggregate transfer to elevated storage | 6.90E-03 | 3.30E-03 | 4.95E-04 |
| Sand Transfer to elevated storage | 2.10E-03 | 9.90E-04 | 1.49E-04 |
| Cement delivery to elevated storage | 7.30E-03 | 4.70E-03 | 7.05E-04 |
| Cement supplement delivery to elevated storage | 3.14E-02 | 1.10E-02 | 1.65E-03 |
| Weigh hopper loading* | 1.44E-03 | 8.40E-04 | 1.26E-04 |
| Mixer loading* | 2.57E-02 | 7.02E-03 | 1.05E-03 |

**Weigh hopper loading emission factors are in terms of lb/ton sand & aggregate, and Mixer loading emission factor are in terms of lb/ton cement and cement supplement.*

D. Controlled emissions were calculated by multiplying the Table 14 emission factors and the raw component volumes as summarized in the first column of Table 15.

Example: Weigh hopper loading:

$$\mathrm{PM}\left(\frac{\mathrm{lb}}{\mathrm{yr}}\right)=\mathrm{EF}\left(\frac{\mathrm{lb}}{\mathrm{ton}}\right)*\left(\frac{\text{tons weighed}}{\mathrm{yr}}\right)=4.80\text{E-}03\,\frac{\mathrm{lb}}{\mathrm{ton}}*(13{,}575)\,\frac{\mathrm{ton}}{\mathrm{yr}}=65.2\,\frac{\mathrm{lb}}{\mathrm{yr}}$$

**Table 15: CBP Controlled Emissions**

| Process Step | Volume (tons/yr) | Controlled PM (lb/yr) | Controlled PM10 (lb/yr) | Controlled PM2.5 (lb/yr) |
|---|---|---|---|---|
| Aggregate delivery to ground storage | 0 | - | - | - |
| Sand delivery to ground storage | 13,575 | 2.85E+01 | 1.34E+01 | 2.02E+00 |
| Aggregate Transfer to feed conveyor | 0 | - | - | - |
| Sand Transfer to feed conveyor | 13,575 | 2.85E+01 | 1.34E+01 | 2.02E+00 |
| Aggregate transfer to elevated storage | 0 | - | - | - |
| Sand Transfer to elevated storage | 13,575 | 2.85E+01 | 1.34E+01 | 2.02E+00 |
| Cement delivery to elevated storage | 4,073 | 2.97E+01 | 1.91E+01 | 2.87E+00 |
| Cement supplement delivery to elevated storage | 4,073 | 1.28E+02 | 4.48E+01 | 6.72E+00 |
| Weigh hopper loading | 13,575 | 1.95E+01 | 1.14E+01 | 1.71E+00 |
| Loading of transit mix truck | 8,146 | 2.10E+02 | 5.72E+01 | 8.58E+00 |
| **Total PM Emissions** | | 4.72E+02 | 1.73E+02 | 2.59E+02 |

**Note that there is no aggregate in the grout formula.*

E. TAP emissions factors for grout production were calculated using annual amount of grout components, and emission factors in Table 16, which were obtained as described in Section 4.2.

**Table 16: CBP TAP Emission Factors**

| Pollutant | Cement Unloading EF (lb/ton) | Cement Supplement Unloading EF (lb/ton) | Central Mix Batching EF (lb/ton) |
|---|---|---|---|
| Arsenic | 4.24E-09 | 1.00E-06 | 2.96E-07 |
| Beryllium | 4.86E-10 | 9.04E-08 | ND |
| Cadmium | ND | 1.98E-10 | 7.10E-10 |
| Total Chromium | 2.90E-08 | 1.22E-06 | 1.27E-07 |
| Hexavalent Chromium | 7.83E-09 | 3.29E-07 | 3.43E-08 |
| Lead | 1.09E-08 | 5.20E-07 | 3.66E-08 |
| Manganese | 1.17E-07 | 2.56E-07 | 3.78E-06 |
| Nickel | 4.18E-08 | 2.28E-06 | 2.48E-07 |
| Total Phosphorus | ND | 3.54E-06 | 1.20E-06 |
| Selenium | ND | 7.24E-08 | ND |

**ND indicates not detected.*

F. Grout TAP emissions were calculated using the following annual production input values:
   1. Cement unloading to elevated storage: 4,073 tons per year
   2. Cement supplement unloading to elevated storage: 4,073 tons per year
   3. Mixer Loading: 8,145 tons per year

   Example: Cement Unloading:

$$\text{Arsenic}\left(\frac{\text{lb}}{\text{yr}}\right)=\text{EF}\left(\frac{\text{lb}}{\text{ton}}\right)*\left(\frac{\text{ton}}{\text{yr}}\right)=4.24\text{E-}09\,\frac{\text{lb}}{\text{ton}}*4{,}073\,\frac{\text{ton}}{\text{yr}}=1.73\text{E-}05\,\frac{\text{lb}}{\text{yr}}$$

   Toxic emissions are summarized in Table 17.

**Table 17: CBP TAP Emissions**

| Pollutant | Cement Unloading Emissions (lb/yr) | Cement Supplement Unloading Emissions (lb/yr) | Central Mix Batching Emissions (lb/yr) | Total TAP Emissions (lb/yr) |
|---|---|---|---|---|
| Arsenic | 1.73E-05 | 4.07E-03 | 2.41E-03 | 6.50E-03 |
| Beryllium | 1.98E-06 | 3.68 E-04 | -- | 3.70E-04 |
| Cadmium | -- | 8.06E-07 | 5.78E-06 | 6.59E-06 |
| Total Chromium | 1.18E-04 | 4.97E-03 | 1.03E-03 | 6.12E-03 |
| Hexavalent Chromium | 3.19E-05 | 1.34E-03 | 2.79E-04 | 1.65E-03 |
| Lead | 4.44E-05 | 2.12E-03 | 2.98E-04 | 2.46E-03 |
| Manganese | 4.76E-04 | 1.04E-03 | 3.08E-03 | 3.23E-02 |
| Nickel | 1.70E-04 | 9.29E-03 | 2.02E-03 | 1.15E-02 |
| Total Phosphorus | -- | 1.44E-02 | 9.77E-03 | 2.42E-02 |
| Selenium | -- | 2.95E-04 | -- | 2.95E-04 |

### 6.3 Vehicle Traffic

Fugitive particulate matter emissions may occur from Vehicle Traffic, and calculated results are summarized in Tables 18 through 20 using the following methodology.

Column C – Emission factors for each PM size are calculated with the following equation: [Section 4.3]

$$E_{ext} = (k)\left(\frac{s}{12}\right)^{a}\left(\frac{W}{3}\right)^{b}\left(\frac{365-P}{365}\right)$$

Where k, a, and b are constants; and s is silt content, W is vehicle weight, and P is days of precipitation, as discussed in Section 3.3.

Column D – Uncontrolled emissions (lb/hr) are calculated as follows:

$$= \left(E_{ext,}\frac{lbs}{VMT}\right)\left(\frac{miles}{trip}\right)\left(\frac{trips}{day}\right)\left(\frac{day}{10\ hours}\right)(\#vehicles)$$

Where VMT=vehicle miles traveled, as discussed in Section 3.3.

Column E – Uncontrolled emissions (lb/day) are calculated as follows:

$$= \left(E_{ext,}\frac{lbs}{VMT}\right)\left(\frac{miles}{trip}\right)\left(\frac{trips}{day}\right)(\#vehicles)$$

Column F – Uncontrolled emissions (lb/yr) are calculated as follows:

$$= \left(E_{ext,}\frac{lbs}{VMT}\right)\left(\frac{VMT}{yr}\right)(\#vehicles)$$

Column G – Uncontrolled emissions (tons/yr) are calculated as follows:

$$= \left(\frac{lb}{yr}\right)\left(\frac{tons}{2000\ lbs}\right)$$

Column H – Controlled emissions (lbs/hr) are calculated as follows:

$$= (\text{Uncontrolled Emissions from Column C, lb/hr})(1 - \text{Control Factor of 70\%})$$

Column I – Controlled emissions (lbs per day) are calculated as follows:

$$= (\text{Uncontrolled Emissions from Column D, lb/day})(1 - \text{Control Factor of 70\%})$$

Column J – Controlled emissions (lbs/yr) are calculated as follows:

$$= (\text{Uncontrolled Emissions from Column E, lb/hr})(1 - \text{Control Factor of 70\%})$$

Column K – Controlled emissions (tons/yr) are calculated as follows:

$$= (\text{Uncontrolled Emissions from Column F, tons/yr})(1 - \text{Control Factor of 70\%})$$

Emissions from Excavator traffic are summarized in Table 18.

**Table 18: Excavator Traffic Fugitive Emissions**

| B | C | D | E | F | G | H | I | J | K |
|---|---|---|---|---|---|---|---|---|---|
| | | Uncontrolled Emissions | | | | Controlled Emissions | | | |
| Pollutant | Emission Factor, $E_{ext}$ (lb/VMT) | lb/hr | lb/day | lb/yr | tpy | lb/hr | lb/day | lb/yr | tpy |
| PM | 6.78 | 0.23 | 2.31 | 601 | 0.30 | 0.07 | 0.69 | 180 | 0.09 |
| $PM_{10}$ | 1.74 | 0.06 | 0.59 | 154 | 0.08 | 0.02 | 0.18 | 46 | 0.02 |
| $PM_{2.5}$ | 0.174 | 0.01 | 0.06 | 15 | 0.01 | 1.8E-03 | 0.02 | 5 | 2.3E-03 |

Emissions from Loader traffic are summarized in Table 19.

**Table 19: Loader Traffic Fugitive Emissions**

| B | C | D | E | F | G | H | I | J | K |
|---|---|---|---|---|---|---|---|---|---|
| | | Uncontrolled Emissions | | | | Controlled Emissions | | | |
| Pollutant | Emission Factor, $E_{ext}$ (lb/VMT) | lb/hr | lb/day | lb/yr | tpy | lb/hr | lb/day | lb/yr | tpy |
| PM | 5.42 | 0.31 | 3.08 | 801 | 0.40 | 0.09 | 0.92 | 240 | 0.12 |
| $PM_{10}$ | 1.39 | 0.079 | 0.79 | 206 | 0.10 | 0.024 | 0.24 | 62 | 0.031 |
| $PM_{2.5}$ | 0.139 | 7.9E-03 | 0.079 | 21 | 0.010 | 2.4E-03 | 0.024 | 6.2 | 3.1E-03 |

Emissions from ERDF truck traffic are summarized in Table 20.

**Table 20: ERDF Truck Traffic Fugitive Emissions**

| B | C | D | E | F | G | H | I | J | K |
|---|---|---|---|---|---|---|---|---|---|
| | | Uncontrolled Emissions | | | | Controlled Emissions | | | |
| Pollutant | Emission Factor, $E_{ext}$ (lb/VMT) | lb/hr | lb/day | lb/yr | tpy | lb/hr | lb/day | lb/yr | tpy |
| PM | 5.22 | 0.65 | 6.53 | 1,697 | 0.85 | 0.20 | 1.96 | 509 | 0.25 |
| $PM_{10}$ | 1.34 | 0.17 | 1.68 | 436 | 0.22 | 0.050 | 0.50 | 131 | 0.065 |
| $PM_{2.5}$ | 0.134 | 0.017 | 0.17 | 44 | 0.022 | 5.0E-03 | 0.050 | 13 | 6.5E-03 |

Because chromium was detected in soil samples taken at the site, total chromium and hexavalent chromium emissions were calculated by multiplying the total PM emissions by the concentration in the soil, as summarized in Table 21.

Example: Total Chromium:

$$Total\ Chromium\left(\frac{\text{lb}}{\text{yr}}\right)=\text{Total PM}\left(\frac{\text{lb}}{\text{year}}\right)*\left(\frac{22{,}300\mu\text{g}}{\text{kg}}\right)=(585+801+1{,}697)\,\frac{\text{lb}}{\text{year}}*(22{,}300)\,\frac{\mu\text{g}}{\text{kg}}$$

$$Total\ Chromium\left(\frac{\text{lb}}{\text{yr}}\right)=3{,}083\left(\frac{\text{lb}}{\text{year}}\right)*\left(\frac{22.300\mu\text{g}}{\text{1E+06 g}}\right)*\left(\frac{1}{\text{1E+09}}\right)=\text{6.88E-02}\,\frac{\text{lb}}{\text{yr}}$$

**Table 21: Traffic Fugitive Chromium Emissions**

| | Uncontrolled Emissions | | | | Controlled Emissions | | | |
|---|---|---|---|---|---|---|---|---|
| **Pollutant** | **lb/hr** | **lb/day** | **lb/yr** | **tpy** | **lb/hr** | **lb/day** | **lb/yr** | **tpy** |
| Total Chromium | 2.64E-05 | 2.64E-04 | 6.88E-02 | 3.44E-05 | 7.93E-06 | 7.93E-05 | 2.06E-02 | 1.03E-05 |
| Hexavalent Chromium | 2.42E-06 | 2.42E-05 | 6.29E-03 | 3.14E-06 | 7.26E-07 | 7.26E-06 | 1.89E-03 | 9.34E-07 |

# 7 Comparison to Applicable Regulatory Thresholds

1. Compare estimated emissions against WAC 173-400-110(5). Criteria Pollutant emissions are summarized in Table 22.

   NOx is the only criteria pollutant that requires air dispersion modeling.

**Table 22: Criteria Pollutant Threshold Comparison**

| Pollutant | Uncontrolled Emissions (tpy) | Controlled Emissions (tpy) | NSR Threshold (tpy) | Modeling Required? |
|---|---|---|---|---|
| TSP (assume = PM) | 12.2 | 0.8 | 1.25 | NA |
| $PM_{10}$ | 4.7 | 0.3 | 0.75 | No |
| $PM_{2.5}$ | 1.0 | 0.1 | 0.5 | No |
| $NO_X$ | 14.4 | 2.7 | 2.0 | Yes |
| CO | 2.9 | 0.6 | 5.0 | No |
| $SO_2$ | 3.81E-03 | 7.39E-04 | 2.0 | No |
| Lead | 0 | 0 | 0.005 | No |
| VOCs | 0.8 | 0.1 | 2.0 | NA |

2. Compare estimated emissions against 40 CFR 51.21(b)(23)(i) SERs. PSD-applicable emissions are included in Table 23.
   - PSD is evaluated based on project potential to emit. As there are no current operations, existing emissions are "0".
   - SERs were obtained from WAC 173-400-810(27)(a) and 40 CFR § 52.21 – "Prevention of significant deterioration of air quality".
   - Per WAC 173-400-820 and 40 CFR § 52.21, fugitive emissions do not count toward PSD, except for specific listed sources. None of the 105KW sources are listed.
   - Ozone is equal to greater of NOx or VOC for PSD applicability purpose. Potential emissions do not exceed the PSD.

**Table 23: PSD Applicability Determination**

| Pollutant | Potential to Emit (tpy) | PSD SER (tpy) | PSD Review Required? |
|---|---|---|---|
| $PM_{10}$ | 10.7 | 15 | No |
| $PM_{2.5}$ | 4.3 | 10 | No |
| $NO_X$ | 14.4 | 40 | No |
| CO | 2.9 | 100 | No |
| $SO_2$ | 0.0 | 40 | No |
| Lead | 0.0 | 0.6 | No |
| Ozone | 14.4 | 40 | No |
| $CO_2e$ | 809 | 75,000 | No |

3. Determine Greenhouse Gas Reporting applicability in accordance with WAC 173-441.

Reporting is mandatory for an owner or operator of any facility located in Washington State with total GHG emissions that exceeds the reporting threshold of 10,000 metric tons $CO_2e$ per year. 105KW has the potential to emit 809 metric tons $CO_2e$ per year. Although 105KW does not trigger GHG reporting itself, the Hanford site does trigger GHG reporting. Therefore, GHG emissions from the 105KW site will be included in the annual Hanford inventory.

4. Compare estimated emissions against WAC 173-460-150 thresholds. TAP emissions are summarized in Table 24.

   105KW has the potential to emit above the SQER threshold for 2 toxics, therefore air dispersion modeling is required for Chromium VI and DEEP.

5. Compare estimated emissions against 40 CFR 61.1. HAP emissions are defined in Table 24. The facility has the potential to emit 2.4E-02 total tons of HAPs each year.

**Table 24: TAP Threshold Comparison**

| | | | Uncontrolled Emissions | | | Controlled Emissions | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Pollutant** | **CAS** | **TAP/HAP?** | **Total (lb/hr)** | **Total (lb/day)** | **Total (lb/yr)** | **Total (lb/hr)** | **Total (lb/day)** | **Total (lb/yr)** | **Averaging Period** | **SQER (lb/averaging period)** | **Requires Modeling?[1]** |
| 1,3-Butadiene | 106-99-0 | TAP/HAP | 5.29E-05 | 1.27E-03 | 4.64E-01 | 5.29E-05 | 1.27E-03 | 8.78E-02 | year | 5.4E+00 | No |
| Acetaldehyde | 75-07-0 | TAP/HAP | 1.04E-03 | 2.49E-02 | 9.10E+00 | 1.04E-03 | 2.49E-02 | 1.72E+00 | year | 6.0E+01 | No |
| Acrolein | 107-02-8 | TAP/HAP | 1.25E-04 | 3.01E-03 | 1.10E+00 | 1.25E-04 | 3.01E-03 | 2.08E-01 | 24-hr | 2.6E-02 | No |
| Arsenic & inorganic arsenic compounds, NOS | — | TAP/HAP | 7.42E-07 | 1.78E-05 | 6.50E-03 | 2.50E-06 | 2.50E-05 | 6.50E-03 | year | 4.9E-02 | No |
| Benzene | 71-43-2 | TAP/HAP | 1.26E-03 | 3.03E-02 | 1.11E+01 | 1.26E-03 | 3.03E-02 | 2.10E+00 | year | 2.1E+01 | No |
| Benzo(a)anthracene | 56-55-3 | TAP/HAP | 2.27E-06 | 5.46E-05 | 1.99E-02 | 2.27E-06 | 5.46E-05 | 3.77E-03 | year | 8.9E-01 | No |
| Benzo(a)pyrene | 50-32-8 | TAP/HAP | 2.55E-07 | 6.11E-06 | 2.23E-03 | 2.55E-07 | 6.11E-06 | 4.22E-04 | year | 8.2E-03 | No |
| Benzo(b)fluoranthene | 205-99-2 | TAP/HAP | 1.34E-07 | 3.22E-06 | 1.18E-03 | 1.34E-07 | 3.22E-06 | 2.23E-04 | year | 8.9E-01 | No |
| Benzo(k)fluoranthene | 207-08-9 | TAP/HAP | 2.10E-07 | 5.04E-06 | 1.84E-03 | 2.10E-07 | 5.04E-06 | 3.48E-04 | year | 8.9E-01 | No |
| Beryllium & compounds, NOS | — | TAP/HAP | 4.23E-08 | 1.01E-06 | 3.70E-04 | 1.42E-07 | 1.42E-06 | 3.70E-04 | year | 6.8E-02 | No |
| Cadmium & compounds, NOS | — | TAP/HAP | 7.52E-10 | 1.81E-08 | 6.59E-06 | 2.53E-09 | 2.53E-08 | 6.59E-06 | year | 3.9E-02 | No |
| Carbon monoxide | 630-08-0 | TAP | 6.63E-01 | 1.59E+01 | 5.80E+03 | 6.63E-01 | 3.34E+00 | 1.22E+03 | 1-hr | 4.3E+01 | No |
| Chromium Compounds | — | HAP | 2.71E-05 | 2.81E-04 | 7.49E-02 | 1.03E-05 | 1.03E-04 | 2.67E-02 | NA | — | -- |
| Chromium(VI) & compounds, NOS | — | TAP/HAP | 2.61E-06 | 2.87E-05 | 7.94E-03 | 1.36E-06 | 1.36E-05 | 3.54E-03 | year | 6.5E-04 | Yes |
| Chrysene | 218-01-9 | TAP/HAP | 4.78E-07 | 1.15E-05 | 4.19E-03 | 4.78E-07 | 1.15E-05 | 7.93E-04 | year | 8.9E+00 | No |
| DEEP | — | TAP | 2.61E-01 | 6.27E+00 | 2.29E+03 | 2.61E-01 | 1.20E+00 | 4.39E+02 | year | 5.4E-01 | Yes |
| Dibenz(a,h)anthracene | 53-70-3 | TAP/HAP | 7.89E-07 | 1.89E-05 | 6.91E-03 | 7.89E-07 | 1.89E-05 | 1.31E-03 | year | 8.2E-02 | No |
| Fluorine gas $F_2$ | 7782-41-4 | TAP | 3.95E-05 | 9.49E-04 | 3.46E-01 | 3.95E-05 | 9.49E-04 | 6.56E-02 | 24-hr | 1.2E+00 | No |
| Formaldehyde | 50-00-0 | TAP/HAP | 1.60E-03 | 3.83E-02 | 1.40E+01 | 1.60E-03 | 3.83E-02 | 2.65E+00 | year | 2.7E+01 | No |
| Indeno(1,2,3-cd)pyrene | 193-39-5 | TAP/HAP | 5.08E-07 | 1.22E-05 | 4.45E-03 | 5.08E-07 | 1.22E-05 | 8.42E-04 | year | 8.9E-01 | No |
| Lead & compounds, NOS | — | TAP/HAP | 2.81E-07 | 6.74E-06 | 2.46E-03 | 9.46E-07 | 9.46E-06 | 2.46E-03 | year | 1.4E+01 | No |
| Manganese & compounds | — | TAP/HAP | 3.69E-06 | 8.85E-05 | 3.23E-02 | 1.24E-05 | 1.24E-04 | 3.23E-02 | 24-hr | 2.2E-02 | No |
| Naphthalene | 91-20-3 | TAP/HAP | 1.15E-04 | 2.76E-03 | 1.01E+00 | 1.15E-04 | 2.76E-03 | 1.91E-01 | year | 4.8E+00 | No |
| Nickel & compounds, NOS | — | TAP/HAP | 1.31E-06 | 3.14E-05 | 1.15E-02 | 4.41E-06 | 4.41E-05 | 1.15E-02 | year | 6.2E-01 | No |
| Nitrogen dioxide | 10102-44-0 | TAP | 6.56E-01 | 1.58E+01 | 5.75E+03 | 6.56E-01 | 2.91E+00 | 1.06E+03 | 1-hr | 8.7E-01 | No |
| Polycyclic Aromatic Hydrocarbons (PAH) | — | HAP | 2.27E-04 | 5.46E-03 | 1.99E+00 | 2.27E-04 | 5.46E-03 | 3.77E-01 | NA | — | -- |
| Phosphorus | 7723-14-0 | TAP/HAP | 2.76E-06 | 6.63E-05 | 2.42E-02 | 9.30E-06 | 9.30E-05 | 2.42E-02 | 24-hr | 1.5E+00 | No |
| Propylene | 115-07-1 | TAP | 3.49E-03 | 8.38E-02 | 3.06E+01 | 3.49E-03 | 8.38E-02 | 5.80E+00 | 24-hr | 2.2E+02 | No |
| Selenium & selenium compounds (other than hydrogen selenide) | — | TAP/HAP | 3.37E-08 | 8.08E-07 | 2.95E-04 | 1.13E-07 | 1.13E-06 | 2.95E-04 | 24-hr | 1.5E+00 | No |
| Sulfur dioxide | 7446-09-5 | TAP | 8.69E-04 | 2.09E-02 | 7.61E+00 | 8.69E-04 | 4.05E-03 | 1.48E+00 | 1-hr | 1.2E+00 | No |
| Toluene | 108-88-3 | TAP/HAP | 5.54E-04 | 1.33E-02 | 4.85E+00 | 5.54E-04 | 1.33E-02 | 9.19E-01 | 24-hr | 3.7E+02 | No |
| Xylenes (total) | 1330-20-7 | TAP/HAP | 3.86E-04 | 9.26E-03 | 3.38E+00 | 3.86E-04 | 9.26E-03 | 6.40E-01 | 24-hr | 1.6E+01 | No |

*Notes:*
*1 – Air dispersion modeling is required when the controlled emissions have the potential to exceed the SQER threshold*

# 8 References


40 CFR Part 98 Table A-1 (August 2016)

40 CFR Part 52 §52.21 (October 2016)

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AP-42 Chapter 11.12 "Concrete Batching" (June 2006)

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San Diego APCD, "Concrete Batch Plant Operations", November 1998

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WAC 173-441-040, "Reporting of Emissions of Greenhouse Gases," Washington Administrative Code, Olympia, Washington. Available at: http://apps.leg.wa.gov/WAC/default.aspx?cite=173-441

WAC 173-460, "Controls for New Sources of Toxic Air Pollutants," Washington Administrative Code, Olympia, Washington. Available at: http://apps.leg.wa.gov/WAC/default.aspx?cite=173-460

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# Appendix A
# Emissions Inventory

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## *Emissions Summary*

**Criteria Pollutants**

| Pollutant | Potential (Uncontrolled) Emissions: Engine Emissions (lb/yr) | Fugitive PM Emissions (lb/yr) | CBP Emissions (lb/yr) | Total Emissions (tpy) | Project Planned Emissions: Engine Emissions (lb/yr) | Fugitive PM Emissions (lb/yr) | CBP Emissions (lb/yr) | Total Emissions (tpy) | NSR Threshold[1] (tpy) | Permitting Required? | Modeling Required?[2] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| TSP (assume = PM) | 775 | 3,083 | 20,570 | 12.2 | 160 | 925 | 472 | 0.8 | 1.25 | Yes | NA |
| $PM_{10}$ | 775 | 792 | 7,743 | 4.7 | 160 | 238 | 173 | 0.3 | 0.75 | Yes | No |
| $PM_{2.5}$ | 775 | 79 | 1,161 | 1.0 | 160 | 24 | 26 | 0.1 | 0.5 | Yes | No |
| $NO_x$ | 28,753 | -- | -- | 14.4 | 5,302 | -- | -- | 2.7 | 2.0 | Yes | Yes |
| CO | 5,804 | -- | -- | 2.9 | 1,217 | -- | -- | 0.6 | 5.0 | No | No |
| $SO_2$ | 8 | -- | -- | 3.81E-03 | 1 | -- | -- | 7.39E-04 | 2.0 | No | No |
| Lead | -- | -- | 2.46E-03 | 1.23E-06 | -- | -- | 9.46E-07 | 4.73E-10 | 0.005 | No | No |
| VOCs | 1,513 | -- | -- | 0.8 | 279 | -- | -- | 0.1 | 2.0 | No | NA |

1. From WAC 173-400-110(5)(b)
2. There are no NAAQs thresholds applicable to pollutants listed as N/A.

### *PSD Determination* [1]

| Pollutant | Potential to Emit (tpy) | PSD SER (tpy)[2] | PSD Review Required? |
|---|---|---|---|
| $PM_{10}$ [3] | 10.7 | 15 | No |
| $PM_{2.5}$ [3] | 4.3 | 10 | No |
| $NO_x$ | 14.4 | 40 | No |
| CO | 2.9 | 100 | No |
| $SO_2$ | 0.0 | 40 | No |
| Lead | 0.0 | 0.6 | No |
| Ozone[4] | 14.4 | 40 | No |
| $CO_2e$ | 809 | 75000 | No |

1. PSD evaluated based on project potential to emit, as there are no current operations, so existing emissions are "0".
2. From WAC 173-400-810(27)(a) and 40 CFR § 52.21 - Prevention of significant deterioration of air quality.
3. Per WAC 173-400-820 and 40 CFR § 52.21, fugitive emissions do not count toward PSD, except for specific listed sources.
4. Ozone is equal to greater of NOx and VOC for PSD applicability purpose.

**Toxic Pollutants**

Potential (Uncontrolled) Emissions

| Pollutant | CAS | TAP/HAP? | Engine Emissions (lb/hr) | Engine Emissions (lb/day) | Engine Emissions (lb/yr) | CBP Emissions (lb/hr) | CBP Emissions (lb/day) | CBP Emissions (lb/yr) | Fugitive Emissions (lb/hr) | Fugitive Emissions (lb/day | Fugitive Emissions (lb/yr) | Total (lb/hr) | Total (lb/day) | Total (lb/yr) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1,3-Butadiene | 106-99-0 | TAP/HAP | 5.29E-05 | 1.27E-03 | 4.64E-01 | | | | | | | 5.29E-05 | 1.27E-03 | 4.64E-01 |
| Acetaldehyde | 75-07-0 | TAP/HAP | 1.04E-03 | 2.49E-02 | 9.10E+00 | | | | | | | 1.04E-03 | 2.49E-02 | 9.10E+00 |
| Acrolein | 107-02-8 | TAP/HAP | 1.25E-04 | 3.01E-03 | 1.10E+00 | | | | | | | 1.25E-04 | 3.01E-03 | 1.10E+00 |
| Arsenic & inorganic arsenic compounds, NOS | — | TAP/HAP | | | | 7.42E-07 | 1.78E-05 | 6.50E-03 | | | | 7.42E-07 | 1.78E-05 | 6.50E-03 |
| Benzene | 71-43-2 | TAP/HAP | 1.26E-03 | 3.03E-02 | 1.11E+01 | | | | | | | 1.26E-03 | 3.03E-02 | 1.11E+01 |
| Benzo(a)anthracene | 56-55-3 | TAP/HAP | 2.27E-06 | 5.46E-05 | 1.99E-02 | | | | | | | 2.27E-06 | 5.46E-05 | 1.99E-02 |
| Benzo(a)pyrene | 50-32-8 | TAP/HAP | 2.55E-07 | 6.11E-06 | 2.23E-03 | | | | | | | 2.55E-07 | 6.11E-06 | 2.23E-03 |
| Benzo(b)fluoranthene | 205-99-2 | TAP/HAP | 1.34E-07 | 3.22E-06 | 1.18E-03 | | | | | | | 1.34E-07 | 3.22E-06 | 1.18E-03 |
| Benzo(k)fluoranthene | 207-08-9 | TAP/HAP | 2.10E-07 | 5.04E-06 | 1.84E-03 | | | | | | | 2.10E-07 | 5.04E-06 | 1.84E-03 |
| Beryllium & compounds, NOS | — | TAP/HAP | | | | 4.23E-08 | 1.01E-06 | 3.70E-04 | | | | 4.23E-08 | 1.01E-06 | 3.70E-04 |
| Cadmium & compounds, NOS | — | TAP/HAP | | | | 7.52E-10 | 1.81E-08 | 6.59E-06 | | | | 7.52E-10 | 1.81E-08 | 6.59E-06 |
| Carbon monoxide | 630-08-0 | TAP | 6.63E-01 | 1.59E+01 | 5.80E+03 | | | | | | | 6.63E-01 | 1.59E+01 | 5.80E+03 |
| Chromium Compounds | | HAP | | | | 6.99E-07 | 1.68E-05 | 6.12E-03 | 2.64E-05 | 2.64E-04 | 6.88E-02 | 2.71E-05 | 2.81E-04 | 7.49E-02 |
| Chromium(VI) & compounds, NOS | — | TAP/HAP | | | | 1.89E-07 | 4.53E-06 | 1.65E-03 | 2.42E-06 | 2.42E-05 | 6.29E-03 | 2.61E-06 | 2.87E-05 | 7.94E-03 |
| Chrysene | 218-01-9 | TAP/HAP | 4.78E-07 | 1.15E-05 | 4.19E-03 | | | | | | | 4.78E-07 | 1.15E-05 | 4.19E-03 |
| DEEP | — | TAP | 2.61E-01 | 6.27E+00 | 2.29E+03 | | | | | | | 2.61E-01 | 6.27E+00 | 2.29E+03 |
| Dibenz(a,h)anthracene | 53-70-3 | TAP/HAP | 7.89E-07 | 1.89E-05 | 6.91E-03 | | | | | | | 7.89E-07 | 1.89E-05 | 6.91E-03 |
| Fluorine gas F2 | 7782-41-4 | TAP | 3.95E-05 | 9.49E-04 | 3.46E-01 | | | | | | | 3.95E-05 | 9.49E-04 | 3.46E-01 |
| Formaldehyde | 50-00-0 | TAP/HAP | 1.60E-03 | 3.83E-02 | 1.40E+01 | | | | | | | 1.60E-03 | 3.83E-02 | 1.40E+01 |
| Indeno(1,2,3-cd)pyrene | 193-39-5 | TAP/HAP | 5.08E-07 | 1.22E-05 | 4.45E-03 | | | | | | | 5.08E-07 | 1.22E-05 | 4.45E-03 |
| Lead & compounds, NOS | — | TAP/HAP | | | | 2.81E-07 | 6.74E-06 | 2.46E-03 | | | | 2.81E-07 | 6.74E-06 | 2.46E-03 |
| Manganese & compounds | — | TAP/HAP | | | | 3.69E-06 | 8.85E-05 | 3.23E-02 | | | | 3.69E-06 | 8.85E-05 | 3.23E-02 |
| Naphthalene | 91-20-3 | TAP/HAP | 1.15E-04 | 2.76E-03 | 1.01E+00 | | | | | | | 1.15E-04 | 2.76E-03 | 1.01E+00 |
| Nickel & compounds, NOS | — | TAP/HAP | | | | 1.31E-06 | 3.14E-05 | 1.15E-02 | | | | 1.31E-06 | 3.14E-05 | 1.15E-02 |
| Nitrogen dioxide | 10102-44-0 | TAP | 6.56E-01 | 1.58E+01 | 5.75E+03 | | | | | | | 6.56E-01 | 1.58E+01 | 5.75E+03 |
| Polycyclic Aromatic Hydrocarbons (PAH) | — | HAP | 2.27E-04 | 5.46E-03 | 1.99E+00 | | | | | | | 2.27E-04 | 5.46E-03 | 1.99E+00 |
| Phosphorus | 7723-14-0 | TAP/HAP | | | | 2.76E-06 | 6.63E-05 | 2.42E-02 | | | | 2.76E-06 | 6.63E-05 | 2.42E-02 |
| Propylene | 115-07-1 | TAP | 3.49E-03 | 8.38E-02 | 3.06E+01 | | | | | | | 3.49E-03 | 8.38E-02 | 3.06E+01 |
| Selenium & selenium compounds (other than hydrogen selenide) | — | TAP/HAP | | | | 3.37E-08 | 8.08E-07 | 2.95E-04 | | | | 3.37E-08 | 8.08E-07 | 2.95E-04 |
| Sulfur dioxide | 7446-09-5 | TAP | 8.69E-04 | 2.09E-02 | 7.61E+00 | | | | | | | 8.69E-04 | 2.09E-02 | 7.61E+00 |
| Toluene | 108-88-3 | TAP/HAP | 5.54E-04 | 1.33E-02 | 4.85E+00 | | | | | | | 5.54E-04 | 1.33E-02 | 4.85E+00 |
| Xylenes (total) | 1330-20-7 | TAP/HAP | 3.86E-04 | 9.26E-03 | 3.38E+00 | | | | | | | 3.86E-04 | 9.26E-03 | 3.38E+00 |
| | | | | | | | | | | | | | Total HAPs | 2.4E-02 tpy |

Controlled Emissions / From WAC 173-460-150

| Pollutant | Engine Emissions (lb/hr) | Engine Emissions (lb/day) | Engine Emissions (lb/yr) | CBP Emissions (lb/hr) | CBP Emissions (lb/day) | CBP Emissions (lb/yr) | Fugitive Emissions (lb/hr) | Fugitive Emissions (lb/day) | Fugitive Emissions (lb/yr) | Total (lb/hr) | Total (lb/day) | Total (lb/yr) | Averaging Period | De Minimis (lb/averaging period) | Requires Permitting? | SQER (lb/averaging period) | Requires Modeling? |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1,3-Butadiene | 5.29E-05 | 1.27E-03 | 8.78E-02 | | | | | | | 5.29E-05 | 1.27E-03 | 8.78E-02 | year | 2.7E-01 | Yes | 5.4E+00 | No |
| Acetaldehyde | 1.04E-03 | 2.49E-02 | 1.72E+00 | | | | | | | 1.04E-03 | 2.49E-02 | 1.72E+00 | year | 3.0E+00 | Yes | 6.0E+01 | No |
| Acrolein | 1.25E-04 | 3.01E-03 | 2.08E-01 | | | | | | | 1.25E-04 | 3.01E-03 | 2.08E-01 | 24-hr | 1.3E-03 | Yes | 2.6E-02 | No |
| Arsenic & inorganic arsenic compounds, NOS | | | | 2.50E-06 | 2.50E-05 | 6.50E-03 | | | | 2.50E-06 | 2.50E-05 | 6.50E-03 | year | 2.5E-03 | Yes | 4.9E-02 | No |
| Benzene | 1.26E-03 | 3.03E-02 | 2.10E+00 | | | | | | | 1.26E-03 | 3.03E-02 | 2.10E+00 | year | 1.0E+00 | Yes | 2.1E+01 | No |
| Benzo(a)anthracene | 2.27E-06 | 5.46E-05 | 3.77E-03 | | | | | | | 2.27E-06 | 5.46E-05 | 3.77E-03 | year | 4.5E-02 | No | 8.9E-01 | No |
| Benzo(a)pyrene | 2.55E-07 | 6.11E-06 | 4.22E-04 | | | | | | | 2.55E-07 | 6.11E-06 | 4.22E-04 | year | 1.6E-01 | No | 8.2E-03 | No |
| Benzo(b)fluoranthene | 1.34E-07 | 3.22E-06 | 2.23E-04 | | | | | | | 1.34E-07 | 3.22E-06 | 2.23E-04 | year | 4.5E-02 | No | 8.9E-01 | No |
| Benzo(k)fluoranthene | 2.10E-07 | 5.04E-06 | 3.48E-04 | | | | | | | 2.10E-07 | 5.04E-06 | 3.48E-04 | year | 8.9E-01 | No | 8.9E-01 | No |
| Beryllium & compounds, NOS | | | | 1.42E-07 | 1.42E-06 | 3.70E-04 | | | | 1.42E-07 | 1.42E-06 | 3.70E-04 | year | 3.4E-03 | No | 6.8E-02 | No |
| Cadmium & compounds, NOS | | | | 2.53E-09 | 2.53E-08 | 6.59E-06 | | | | 2.53E-09 | 2.53E-08 | 6.59E-06 | year | 1.9E-03 | No | 3.9E-02 | No |
| Carbon monoxide | 6.63E-01 | 3.34E+00 | 1.22E+03 | | | | | | | 6.63E-01 | 3.34E+00 | 1.22E+03 | 1-hr | 1.1E+00 | No | 4.3E+01 | No |
| Chromium Compounds | | | | 2.35E-06 | 2.35E-05 | 6.12E-03 | 7.93E-06 | 7.93E-05 | 2.06E-02 | 1.03E-05 | 1.03E-04 | 2.67E-02 | NA | -- | -- | -- | -- |
| Chromium(VI) & compounds, NOS | | | | 6.36E-07 | 6.36E-06 | 1.65E-03 | 7.26E-07 | 7.26E-06 | 1.89E-03 | 1.36E-06 | 1.36E-05 | 3.54E-03 | year | 3.3E-05 | Yes | 6.5E-04 | Yes |
| Chrysene | 4.78E-07 | 1.15E-05 | 7.93E-04 | | | | | | | 4.78E-07 | 1.15E-05 | 7.93E-04 | year | 4.5E-01 | No | 8.9E+00 | No |
| DEEP | 2.61E-01 | 1.20E+00 | 4.39E+02 | | | | | | | 2.61E-01 | 1.20E+00 | 4.39E+02 | year | 2.7E-02 | Yes | 5.4E-01 | Yes |
| Dibenz(a,h)anthracene | 7.89E-07 | 1.89E-05 | 1.31E-03 | | | | | | | 7.89E-07 | 1.89E-05 | 1.31E-03 | year | 4.1E-03 | Yes | 8.2E-02 | No |
| Fluorine gas F2 | 3.95E-05 | 9.49E-04 | 6.56E-02 | | | | | | | 3.95E-05 | 9.49E-04 | 6.56E-02 | 24-hr | 5.9E-02 | No | 1.2E+00 | No |
| Formaldehyde | 1.60E-03 | 3.83E-02 | 2.65E+00 | | | | | | | 1.60E-03 | 3.83E-02 | 2.65E+00 | year | 1.4E+00 | Yes | 2.7E+01 | No |
| Indeno(1,2,3-cd)pyrene | 5.08E-07 | 1.22E-05 | 8.42E-04 | | | | | | | 5.08E-07 | 1.22E-05 | 8.42E-04 | year | 4.5E-02 | No | 8.9E-01 | No |
| Lead & compounds, NOS | | | | 9.46E-07 | 9.46E-06 | 2.46E-03 | | | | 9.46E-07 | 9.46E-06 | 2.46E-03 | year | 1.0E+01 | No | 1.4E+01 | No |
| Manganese & compounds | | | | 1.24E-05 | 1.24E-04 | 3.23E-02 | | | | 1.24E-05 | 1.24E-04 | 3.23E-02 | 24-hr | 1.1E-03 | No | 2.2E-02 | No |
| Naphthalene | 1.15E-04 | 2.76E-03 | 1.91E-01 | | | | | | | 1.15E-04 | 2.76E-03 | 1.91E-01 | year | 2.4E-01 | Yes | 4.8E+00 | No |
| Nickel & compounds, NOS | | | | 4.41E-06 | 4.41E-05 | 1.15E-02 | | | | 4.41E-06 | 4.41E-05 | 1.15E-02 | year | 3.1E-02 | No | 6.2E-01 | No |
| Nitrogen dioxide | 6.56E-01 | 2.91E+00 | 1.06E+03 | | | | | | | 6.56E-01 | 2.91E+00 | 1.06E+03 | 1-hr | 4.6E-01 | Yes | 8.7E-01 | No |
| Polycyclic Aromatic Hydrocarbons (PAH) | 2.27E-04 | 5.46E-03 | 3.77E-01 | | | | | | | 2.27E-04 | 5.46E-03 | 3.77E-01 | NA | -- | -- | -- | -- |
| Phosphorus | | | | 9.30E-06 | 9.30E-05 | 2.42E-02 | | | | 9.30E-06 | 9.30E-05 | 2.42E-02 | 24-hr | 7.4E-02 | No | 1.5E+00 | No |
| Propylene | 3.49E-03 | 8.38E-02 | 5.80E+00 | | | | | | | 3.49E-03 | 8.38E-02 | 5.80E+00 | 24-hr | 1.1E+01 | No | 2.2E+02 | No |
| Selenium & selenium compounds (other than hydrogen selenide) | | | | 1.13E-07 | 1.13E-06 | 2.95E-04 | | | | 1.13E-07 | 1.13E-06 | 2.95E-04 | 24-hr | 7.4E-02 | No | 1.5E+00 | No |
| Sulfur dioxide | 8.69E-04 | 4.05E-03 | 1.48E+00 | | | | | | | 8.69E-04 | 4.05E-03 | 1.48E+00 | 1-hr | 4.6E-01 | No | 1.2E+00 | No |
| Toluene | 5.54E-04 | 1.33E-02 | 9.19E-01 | | | | | | | 5.54E-04 | 1.33E-02 | 9.19E-01 | 24-hr | 1.9E+01 | No | 3.7E+02 | No |
| Xylenes (total) | 3.86E-04 | 9.26E-03 | 6.40E-01 | | | | | | | 3.86E-04 | 9.26E-03 | 6.40E-01 | 24-hr | 8.2E-01 | No | 1.6E+01 | No |
| | | | | | | | | | | | 4.5E-03 | tpy | | | | | |

**Engines**

| | Diesel Gen | Light Stands | |
|---|---|---|---|
| Rating | 48 | 16.6 | bhp |
| Quantity | 3 | 7 | # |
| Fuel Consumption | 1.66 | 0.7 | gph |
| Energy Input | 0.23 | 0.10 | MMBTU/hr |
| Operating Schedule | 24 | 24 | hr/day [maximum] |
| Operating Schedule | 2,080 | 1,232 | hr/year [maximum] |

**References**

| | | | |
|---|---|---|---|
| Diesel fuel | 7.1 | lb/gal | 19,300 BTU/lb |

**Concrete Batch Plant** 10,200 $yd^3$ over 16 month period

*production per P. Sauer 1/3/2023 e-mail plus 20% safety factor per B. Hodgson 2/23/2023*

| | | | | | | |
|---|---|---|---|---|---|---|
| Production | 7,650 | $yd^3$/yr | 13,575 | tons/yr | | |
| *aggregate* | - | lb/$yd^3$ | - | $yd^3$/yr | - | tons/year |
| *sand* | 3,549 | lb/$yd^3$ | 7,650 | $yd^3$/yr | 13,575 | tons/year |
| *cement* | 1,065 | lb/$yd^3$ | 2,295 | $yd^3$/yr | 4,073 | tons/year |
| *cement supplement (fly ash)* | 1,065 | lb/$yd^3$ | 2,295 | $yd^3$/yr | 4,073 | tons/year |
| *water* | 390 | lb/$yd^3$ | 842 | $yd^3$/yr | 1,493 | tons/year |
| Operating Schedule | 10 | hrs/day | 260 | days/year | 2,600 | hrs/year |

*Based on worst case of 3 American Rock Products Concrete Mixes designed for project, with a 50% safety factor added*

| *Lbs/CuYd* | | *Percent* |
|---|---|---|
| *3,549* | *Con Sand Fine Aggregate* | *100%* |
| *1,065* | *Ash Grove Cement* | *30%* |
| *1,065* | *ENX Fly Ash* | *30%* |
| *390* | *Water* | *11%* |
| *3,549* | *Total* | |
| *50%* | *Safety Margin* | |

| **control factors** | | **Controls** | **Reference** |
|---|---|---|---|
| *bins, aggregate & sand* | 0% | No air emissions control | |
| *cement silo* | 99% | Dust collector | |
| *loading: weigh hopper* | 70% | a portion to dust collector | |
| *loading: truck loading* | 95.5% | vinyl curtain + watering | |
| *unpaved road* | 70% | application of water and fixatives | DD-63014, 105 KW Basin Deactivation Air Monitoring Plan |

A-2

**Traffic Fugitives**

| Vehicle | Weight (tons) | Distance (ft/day) | Reference |
|---|---|---|---|
| Excavator Komatsu PC800 | 83 | *600* | *1 loader and 3 excavators operate at any one time* |
| Excavator Komatsu PC400 | 46 | *600* | *per 5/16/22 e-mail from D. Idler* |
| Excavator Hitachi ZX450 | 47 | *600* | |
| Excavator Hitachi ZX450 | 47 | *600* | |
| Loader Komatsu WA500 | 39 | *3000* | |
| Loader CAT 980H | 33 | *3000* | |
| ERDF Trucks | 22 | *1320* | *per F. Carleo 5/16/2022 e-mail* |

## *Engine Emissions - Diesel and Gasoline*

**Engine Specs**[1]

| Parameter | Diesel Generator | Light Stands | |
|---|---|---|---|
| Rating | 48 | 16.6 | bhp |
| Quantity | 3 | 7 | # |
| Fuel Consumption | 1.66 | 0.7 | gph |
| Energy Input | 0.23 | 0.10 | MMBTU/hr |
| Operating Schedule | 24 | 24 | hr/day [maximum] |
| Operating Schedule | 2080 | 1232 | hr/year [maximum] |

**PTE Criteria Pollutants**

| | | | Potential Emissions | | | Project Planned Operating Emissions | | |
|---|---|---|---|---|---|---|---|---|
| Pollutant | Diesel Generator Emissions Factors (grams/bhp-hr)[4] | Light Stand Emission Factors (gr/bhp-hr)[4] | Diesel Generator Emissions (lb/yr) | Light Stand Emissions (lb/yr) | Total Emissions (tpy) | Diesel Generator Emissions (lb/yr) | Light Stand Emissions (lb/yr) | Total Emissions (tpy) |
| $PM=PM_{10}=PM_{2.5}$ | 0.19 | 0.11 | 528 | 247 | 0.39 | 125 | 35 | 0.08 |
| $NO_X$ | 4.67 | 7.02 | 12,998 | 15,755 | 14.4 | 3,086 | 2,216 | 2.7 |
| CO | 1.49 | 0.74 | 4,144 | 1,661 | 2.90 | 984 | 234 | 0.61 |
| $SO_2$ | 1.52E-03 | 1.52E-03 | 4 | 3 | 3.8E-03 | 1 | 0 | 7.4E-04 |
| VOCs (Total Organic Hydrocarbons) | 0.25 | 0.37 | 684 | 829 | 0.76 | 162 | 117 | 0.14 |

**Greenhouse Gases**[5]

| | | Potential | | Project Planned | |
|---|---|---|---|---|---|
| Pollutant | Diesel Emission Factor grams/gal | Emission Estimate (metric tons/yr) | GWP | Emission Estimate (metric tons/yr) | GWP |
| $CO_2$ | 10,210 | 884 | 1 | 167 | 1 |
| $CH_4$ | 0.57 | 4.9E-02 | 25 | 9.3E-03 | 25 |
| $N_2O$ | 0.26 | 2.3E-02 | 298 | 4.3E-03 | 298 |
| | | $CO_2e$, mtpy | 892 | | 169 |

**Diesel Combustion Toxic Air Pollutants**

| | | Potential Emissions | | | | Project Planned Operating Emissions | | | |
|---|---|---|---|---|---|---|---|---|---|
| Pollutant | Emission Factor[6] (lb/MMBtu) | Emissions (lb/hr) | Emissions (lb/day) | Emissions (lb/yr) | Total Emissions (tpy) | Emissions (lb/hr) | Emissions (lb/day) | Emissions (lb/yr) | Total Emissions (tpy) |
| 1,3-Butadiene | 3.91E-05 | 5.29E-05 | 1.27E-03 | 4.64E-01 | 2.32E-04 | 5.29E-05 | 1.27E-03 | 8.78E-02 | 4.39E-05 |
| Acetaldehyde | 7.67E-04 | 1.04E-03 | 2.49E-02 | 9.10E+00 | 4.55E-03 | 1.04E-03 | 2.49E-02 | 1.72E+00 | 8.62E-04 |
| Acrolein | 9.25E-05 | 1.25E-04 | 3.01E-03 | 1.10E+00 | 5.49E-04 | 1.25E-04 | 3.01E-03 | 2.08E-01 | 1.04E-04 |
| Benzo(a)anthracene | 1.68E-06 | 2.27E-06 | 5.46E-05 | 1.99E-02 | 9.96E-06 | 2.27E-06 | 5.46E-05 | 3.77E-03 | 1.89E-06 |
| Benzene | 9.33E-04 | 1.26E-03 | 3.03E-02 | 1.11E+01 | 5.53E-03 | 1.26E-03 | 3.03E-02 | 2.10E+00 | 1.05E-03 |
| Benzo(a)pyrene | 1.88E-07 | 2.55E-07 | 6.11E-06 | 2.23E-03 | 1.11E-06 | 2.55E-07 | 6.11E-06 | 4.22E-04 | 2.11E-07 |
| Benzo(b)fluoranthene | 9.91E-08 | 1.34E-07 | 3.22E-06 | 1.18E-03 | 5.88E-07 | 1.34E-07 | 3.22E-06 | 2.23E-04 | 1.11E-07 |
| Benzo(k)fluoranthene | 1.55E-07 | 2.10E-07 | 5.04E-06 | 1.84E-03 | 9.19E-07 | 2.10E-07 | 5.04E-06 | 3.48E-04 | 1.74E-07 |
| Chrysene | 3.53E-07 | 4.78E-07 | 1.15E-05 | 4.19E-03 | 2.09E-06 | 4.78E-07 | 1.15E-05 | 7.93E-04 | 3.97E-07 |
| Dibenz(a,h)anthracene | 5.83E-07 | 7.89E-07 | 1.89E-05 | 6.91E-03 | 3.46E-06 | 7.89E-07 | 1.89E-05 | 1.31E-03 | 6.55E-07 |
| DEEP[7] | -- | 2.61E-01 | 6.27E+00 | 2.29E+03 | 1.14E+00 | 5.01E-02 | 1.20E+00 | 4.39E+02 | 2.20E-01 |
| Fluorene | 2.92E-05 | 3.95E-05 | 9.49E-04 | 3.46E-01 | 1.73E-04 | 3.95E-05 | 9.49E-04 | 6.56E-02 | 3.28E-05 |
| Formaldehyde | 1.18E-03 | 1.60E-03 | 3.83E-02 | 1.40E+01 | 7.00E-03 | 1.60E-03 | 3.83E-02 | 2.65E+00 | 1.33E-03 |
| Indeno(1,2,3-cd)pyrene | 3.75E-07 | 5.08E-07 | 1.22E-05 | 4.45E-03 | 2.22E-06 | 5.08E-07 | 1.22E-05 | 8.42E-04 | 4.21E-07 |
| Naphthalene | 8.48E-05 | 1.15E-04 | 2.76E-03 | 1.01E+00 | 5.03E-04 | 1.15E-04 | 2.76E-03 | 1.91E-01 | 9.53E-05 |
| Nitrogen dioxide[8] | -- | 6.56E-01 | 1.58E+01 | 5.75E+03 | 2.88E+00 | 1.21E-01 | 2.91E+00 | 1.06E+03 | 5.30E-01 |
| Propylene | 2.58E-03 | 3.49E-03 | 8.38E-02 | 3.06E+01 | 1.53E-02 | 3.49E-03 | 8.38E-02 | 5.80E+00 | 2.90E-03 |
| Toluene | 4.09E-04 | 5.54E-04 | 1.33E-02 | 4.85E+00 | 2.43E-03 | 5.54E-04 | 1.33E-02 | 9.19E-01 | 4.59E-04 |
| Xylenes | 2.85E-04 | 3.86E-04 | 9.26E-03 | 3.38E+00 | 1.69E-03 | 3.86E-04 | 9.26E-03 | 6.40E-01 | 3.20E-04 |
| Polycyclic aromatic hydrocarbons (PAH) | 1.68E-04 | 2.27E-04 | 5.46E-03 | 1.99E+00 | 9.96E-04 | 2.27E-04 | 5.46E-03 | 3.77E-01 | 1.89E-04 |

1. Data from Manufacturer Specifications (Generac John Deere MMG35DF4 diesel generator, MQPower/Kubota D1105 light plant, Honda EU3000is gasoline generators). Specifications included in project description section 3.0.
2. Generators are Project Planned to be used for up to 10 hours per day, operating Monday-Thursday, one-half of the time, which would equate to 1040 hours/year (52 weeks/year x 20 hours/week). Multiplying by a factor of 2 for flexibility.
Light stands are Project Planned to be used 4 hours/day, 7 days/week, 22 weeks/year in the months with the least amount of daylight hours (last 11 weeks of the year and first 11 weeks of the year), which would equate to 616 hours/year. Multiplying by a factor of 2 for flexibility.
3. Fuel heat value from AP-42 Chapter 3.3, "Gasoline and Diesel Industrial Engines" (10/1996), Tables 3.3-1, and diesel density from 3.4-1
4. Diesel emission factors for criteria pollutants from manufacturer specifications, except for $SO_2$. $SO_2$ is based on AP-42 Chapter 3.4, Table 3.4-1 "Large Stationary Diesel and All Stationary Dual-fuel Engines" (10/1996) using ULSD (15 ppm Sulfur).
Per California Air Resources Board, when the non-methane hydrocarbon (NMHC) and nitrogen oxide (NOx) emission factor is combined, assume a breakdown of 5% and 95%, respectively. Gasoline emission factors for criteria pollutants from AP-42, Chapter 3.3.
5. Emission Factors from Tables A-1 and B-8 of "Greenhouse Gas Inventory Guidance: Direct Emissions from Mobile Combustion Sources" (January 2016). Global warming potentials from 40 CFR Part 98 Table A-1 (August 2016) and WAC 173-441-040.
6. Emission factors for diesel TAPs from from AP-42 Chapter 3.3, "Gasoline and Diesel Industrial Engines" (10/1996), Table 3.3-2
7. Diesel Engine Exhaust Particulate emissions assumed equivalent to $PM_{2.5}$ emissions plus total hydrocarbons.
8. EPA's Nitrogen Dioxide/Nitrogen Oxide In-Stack Ratio (ISR) Database (updated 10-29-2020) for smaller diesel engines similar to this project had ISR's less than 0.2. Per EPA's "Technical support document (TSD) for $NO_2$-related AERMOD modifications" (December 2015) the $NO_2$ to NOx in-stack ratio (ISR) should be a minimum of 0.2. $NO_2$ emissions conservatively assumed to be 20% of NOx emissions.

## *Concrete Plant*

**General Information**

| | Production (yd³/yr) | Production (tons/year) | | Control Equipment Efficiency |
|---|---|---|---|---|
| *aggregate* | - | - | *bins, aggregate & sand* | 0% |
| *sand* | 7,650 | 13,575 | *cement silo* | 99% |
| *cement* | 2,295 | 4,073 | *loading: weigh hopper* | 70% |
| *cement supplement* | 2,295 | 4,073 | *loading: truck loading* | 95.5% |
| *water* | 842 | 1,493 | | |
| *Operating Schedule* | 10 hrs/day | | 7,650 yd³/yr | 13,575 ton/yr |

**Emission Calculations**

*Concrete Batch Plant Emission factors were derived from Section 11.12 of AP-42 (June 2006)*

| **Particulate Emissions** | | | | | Potential Emissions | | | | | | | Project Planned Operating Emissions | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Description[2] | Uncontrolled PM Emission Factors | Uncontrolled PM10 Emission Factors | Uncontrolled PM2.5 Emission Factors | Units | PM (lbs/yr)[1] | PM10 (lbs/yr)[1,3] | PM2.5 (lbs/yr)[1,3] | Controlled PM Emission Factors | Controlled PM10 Emission Factors | Controlled PM2.5 Emission Factors | Units | PM (lbs/yr)[1] | PM10 (lbs/yr)[1,3] | PM2.5 (lbs/yr)[1,3] |
| Aggregate delivery to ground storage | 6.90E-03 | 3.30E-03 | 4.95E-04 | lb/ton | - | - | - | 6.90E-03 | 3.30E-03 | 4.95E-04 | lb/ton | - | - | - |
| Sand delivery to ground storage | 2.10E-03 | 9.90E-04 | 1.49E-04 | lb/ton | 2.85E+01 | 1.34E+01 | 2.02E+00 | 2.10E-03 | 9.90E-04 | 1.49E-04 | lb/ton | 2.85E+01 | 1.34E+01 | 2.02E+00 |
| Aggregate Transfer to feed conveyor | 6.90E-03 | 3.30E-03 | 4.95E-04 | lb/ton | - | - | - | 6.90E-03 | 3.30E-03 | 4.95E-04 | lb/ton | - | - | - |
| Sand Transfer to feed conveyor | 2.10E-03 | 9.90E-04 | 1.49E-04 | lb/ton | 2.85E+01 | 1.34E+01 | 2.02E+00 | 2.10E-03 | 9.90E-04 | 1.49E-04 | lb/ton | 2.85E+01 | 1.34E+01 | 2.02E+00 |
| Aggregate transfer to elevated storage | 6.90E-03 | 3.30E-03 | 4.95E-04 | lb/ton | - | - | - | 6.90E-03 | 3.30E-03 | 4.95E-04 | lb/ton | - | - | - |
| Sand Transfer to elevated storage | 2.10E-03 | 9.90E-04 | 1.49E-04 | lb/ton | 2.85E+01 | 1.34E+01 | 2.02E+00 | 2.10E-03 | 9.90E-04 | 1.49E-04 | lb/ton | 2.85E+01 | 1.34E+01 | 2.02E+00 |
| Cement delivery to elevated storage | 7.30E-01 | 4.70E-01 | 7.05E-02 | lb/ton | 2.97E+03 | 1.91E+03 | 2.87E+02 | 7.30E-03 | 4.70E-03 | 7.05E-04 | lb/ton | 2.97E+01 | 1.91E+01 | 2.87E+00 |
| Cement supplement delivery to elevated storage | 3.14E+00 | 1.10E+00 | 1.65E-01 | lb/ton | 1.28E+04 | 4.48E+03 | 6.72E+02 | 3.14E-02 | 1.10E-02 | 1.65E-03 | lb/ton | 1.28E+02 | 4.48E+01 | 6.72E+00 |
| Weigh hopper loading | 4.80E-03 | 2.80E-03 | 4.20E-04 | lb/ton agg/sand | 6.52E+01 | 3.80E+01 | 5.70E+00 | 1.44E-03 | 8.40E-04 | 1.26E-04 | lb/ton agg/sand | 1.95E+01 | 1.14E+01 | 1.71E+00 |
| Mixer Loading | 5.72E-01 | 1.56E-01 | 2.34E-02 | lb/ton cement | 4.66E+03 | 1.27E+03 | 1.91E+02 | 2.57E-02 | 7.02E-03 | 1.05E-03 | lb/ton cement | 2.10E+02 | 5.72E+01 | 8.58E+00 |
| | | | | ***Totals*** | 2.06E+04 | 7.74E+03 | 1.16E+03 | | | | ***Totals*** | 4.72E+02 | 1.73E+02 | 2.59E+01 |

| **Toxic Emissions** | Arsenic | | Beryllium | | Cadmium | | Total Chromium | | Hexavalent Chromium[5] | | Lead | | Manganese | | Nickel | | Phosphorus | | Selenium | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Description[4]** | Emission Factor (lb/ton) | Emissions (lb/year) | Emission Factor (lb/ton) | Emissions (lb/year) | Emission Factor (lb/ton) | Emissions (lb/year) | Emission Factor (lb/ton) | Emissions (lb/year) | Emission Factor (lb/ton) | Emissions (lb/year) | Emission Factor (lb/ton) | Emissions (lb/year) | Emission Factor (lb/ton) | Emissions (lb/year) | Emission Factor (lb/ton) | Emissions (lb/year) | Emission Factor (lb/ton) | Emissions (lb/year) | Emission Factor (lb/ton) | Emissions (lb/year) |
| Cement unloading to elevated silo | 4.24E-09 | 1.73E-05 | 4.86E-10 | 1.98E-06 | - | - | 2.90E-08 | 1.18E-04 | 7.83E-09 | 3.19E-05 | 1.09E-08 | 4.44E-05 | 1.17E-07 | 4.76E-04 | 4.18E-08 | 1.70E-04 | - | 0.00E+00 | - | 0.00E+00 |
| Cement supplement unloading to elevated silo, pneumatic | 1.00E-06 | 4.07E-03 | 9.04E-08 | 3.68E-04 | 1.98E-10 | 8.06E-07 | 1.22E-06 | 4.97E-03 | 3.29E-07 | 1.34E-03 | 5.20E-07 | 2.12E-03 | 2.56E-07 | 1.04E-03 | 2.28E-06 | 9.29E-03 | 3.54E-06 | 1.44E-02 | 7.24E-08 | 2.95E-04 |
| Central Mix Batching | 2.96E-07 | 2.41E-03 | - | 0.00E+00 | 7.10E-10 | 5.78E-06 | 1.27E-07 | 1.03E-03 | 3.43E-08 | 2.79E-04 | 3.66E-08 | 2.98E-04 | 3.78E-06 | 3.08E-02 | 2.48E-07 | 2.02E-03 | 1.20E-06 | 9.77E-03 | - | 0.00E+00 |
| ***Totals*** | | **6.50E-03** | | **3.70E-04** | | **6.59E-06** | | **6.12E-03** | | **1.65E-03** | | **2.46E-03** | | **3.23E-02** | | **1.15E-02** | | **2.42E-02** | | **2.95E-04** |

1. Throughput based on 10,200 cubic yards poured over the life (16 months) of the project (8500 cy/16-mp per P. Sauer 1/3/2023 e-mail plus 20% margin)
2. Emission factors are from AP-42, Tables 11.12-2 (June 2006).
3. PM2.5/PM10 ratio 0.15 obtained from AP-42 Chapter 13.2.4 "Background Document for Revisions to Fine Fraction Ratios Used for AP-42 Fugitive Dust Emission Factors" (November 1, 2006).
4. Emission factors for cement unloading, supplement unloading, and central mix batching with fabric filter are from AP-42, Table 11.12-8 (June 2006).
5. Hexavalent Chromium is 20-27% of total Chromium based on San Diego County Air Pollution Control District's CBP Guidance (1998), and Idaho DEQ Statement of Basis "Concrete Batch Plant General Permit - Permit to Construct No. P-2021.0033" (2021). Using 27% for most conservative estimate.

### *Traffic Fugitives*
### *Excavators*

| Source | Pollutant | Emission Factor, $E_{ext}$ (lb/VMT) [1] | Uncontrolled Emissions lb/hr | Uncontrolled Emissions lb/day | Uncontrolled Emissions lb/yr | Uncontrolled Emissions tpy | Controlled Emissions lb/hr | Controlled Emissions lb/day | Controlled Emissions lb/yr | Controlled Emissions tpy |
|---|---|---|---|---|---|---|---|---|---|---|
| Traffic Fugitives | PM | 6.60 | 0.23 | 2.25 | 585 | 0.29 | 0.07 | 0.68 | 176 | 0.09 |
| | $PM_{10}$ | 1.70 | 0.06 | 0.58 | 150 | 0.08 | 0.02 | 0.17 | 45 | 0.02 |
| | $PM_{2.5}$ | 0.170 | 0.01 | 0.06 | 15 | 0.01 | 1.7E-03 | 0.02 | 5 | 2.3E-03 |

1. For vehicles traveling on unpaved surfaces at industrial sites, emissions are estimated using the following equations: $E\ [lb/VMT] = k\ (s/12)^a (W/3)^b$;
where k, a, b = empirical constants, s =silt content(%), W = mean vehicle weight (tons), and $E_{ext}$ [lb/VMT] = E(365-P)/365 where P = # of days precipitation is at least 0.254 mm (0.01 inch).
AP-42, Chapter 13.2.2 "Unpaved Road" equation 1a, and Table 13.2.2-2, (November 2006)

| Constants | | PM | $PM_{10}$ | $PM_{2.5}$ | |
|---|---|---|---|---|---|
| | k | 4.9 | 1.5 | 0.15 | |
| | a | 0.7 | 0.9 | 0.9 | |
| | b | 0.45 | 0.45 | 0.45 | |
| | s | 5 | | | *The surface material silt content, 5%, was taken from Northern 2004 area of Hanford site, and was the percent of sample passing a 0.075 mm sieve.* |
| | P | 121 | | | *Number of days in a year with at least 0.01" of precipitation at Hanford Meteorological Station* |
| | Control Factor | 70% | | | *Mitigation factor for application of water and fixatives too unpaved and distrubed areas in accordance with DD-63014, 105 KW Basin Deactivation Air Monitoring Plan* |

| | | |
|---|---|---|
| W= | 56 | *Average weight of excavators* |
| Mi= | 0.34 | *miles/round trip traveled onsite by 3 excavators traveling 600 ft/day* |
| Veh= | 1 | *assuming 1 trip per day because the distance per day was provided* |
| O= | 260 | *days/year if operating 5 days per week* |
| VMT = Mi*Veh*O= | 89 | *miles/year* |
| Hours per day | 10 | *Project plans 10 hours per day, 4 days per week* |

| Pollutant | Uncontrolled Emissions lb/hr | Uncontrolled Emissions lb/day | Uncontrolled Emissions lb/yr | Uncontrolled Emissions tpy | Controlled Emissions lb/hr | Controlled Emissions lb/day | Controlled Emissions lb/yr | Controlled Emissions tpy |
|---|---|---|---|---|---|---|---|---|
| Total Chromium[1] | 2.64E-05 | 2.64E-04 | 6.88E-02 | 3.44E-05 | 7.93E-06 | 7.93E-05 | 2.06E-02 | 1.03E-05 |
| Hexavalent Chromium[1] | 2.42E-06 | 2.42E-05 | 6.29E-03 | 3.14E-06 | 7.26E-07 | 7.26E-06 | 1.89E-03 | 9.43E-07 |

1. Based on soil sampling reported in SGW60149_R0, worst-case sample result was 22,300μg/kg total chromium. Worst case hexavalent chromium result was 2,040 μg/kg hexavalent chromium

### *Traffic Fugitives*
### *Loader*

| Source | Pollutant | Emission Factor, $E_{ext}$ (lb/VMT) [1] | Uncontrolled Emissions lb/hr | Uncontrolled Emissions lb/day | Uncontrolled Emissions lb/yr | Uncontrolled Emissions tpy | Controlled Emissions lb/hr | Controlled Emissions lb/day | Controlled Emissions lb/yr | Controlled Emissions tpy |
|---|---|---|---|---|---|---|---|---|---|---|
| Traffic Fugitives | PM | 5.42 | 0.31 | 3.08 | 801 | 0.40 | 0.09 | 0.92 | 240 | 0.12 |
| | $PM_{10}$ | 1.39 | 0.079 | 0.79 | 206 | 0.10 | 0.024 | 0.24 | 62 | 0.031 |
| | $PM_{2.5}$ | 0.139 | 7.9E-03 | 0.079 | 21 | 0.010 | 2.4E-03 | 0.024 | 6.2 | 3.1E-03 |

| | | |
|---|---|---|
| W= | 35.9 | *Average weight of loaders* |
| Mi= | 0.57 | *miles/round trip traveled by 1 loader traveling 3,000 ft/day* |
| Veh= | 1 | *assuming 1 trip per day because the distance per day was provided* |
| O= | 260 | *days/year if operating 5 days per week* |
| VMT = Mi*Veh*O= | 148 | *miles/year* |
| Hours per day | 10 | *Project plans 10 hours per day, 4 days per week* |

### *Traffic Fugitives*
### *ERDF Trucks*

| Source | Pollutant | Emission Factor, $E_{ext}$ (lb/VMT) [1] | Uncontrolled Emissions lb/hr | Uncontrolled Emissions lb/day | Uncontrolled Emissions lb/yr | Uncontrolled Emissions tpy | Controlled Emissions lb/hr | Controlled Emissions lb/day | Controlled Emissions lb/yr | Controlled Emissions tpy |
|---|---|---|---|---|---|---|---|---|---|---|
| Traffic Fugitives | PM | 5.22 | 0.65 | 6.53 | 1,697 | 0.85 | 0.20 | 1.96 | 509 | 0.25 |
| | $PM_{10}$ | 1.34 | 0.17 | 1.68 | 436 | 0.22 | 0.050 | 0.50 | 131 | 0.065 |
| | $PM_{2.5}$ | 0.134 | 0.017 | 0.17 | 44 | 0.022 | 5.0E-03 | 0.050 | 13 | 6.5E-03 |

| | | |
|---|---|---|
| W= | 33.0 | *Average weight of truck (22 tons) plus payload (22 tons for below water can)* |
| Mi= | 0.25 | *miles/round trip* |
| Veh= | 5 | *maximum trips if all 1600 waste loads hauled in the planned schedule of 4 days per week for 20 months* |
| O= | 260 | *days/year if operating 5 days per week* |
| VMT = Mi*Veh*O= | 325 | *miles/year* |
| Hours per day | 10 | *Project plans 10 hours per day, 4 days per week* |

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