

**Engineering Evaluation
Hanson Aggregates, Mid-Pacific, Inc.
SF Pier 92 Sand Yard
Plant No. 13407; Application No. 28839
480 Amador Street, San Francisco, CA 94124**

Site Background

Hanson Aggregates, Mid-Pacific, Inc. has applied for an Authority to Construct and Permit to Operate for the following:

- S-1 Sand Material Transfer
(Two transfer points: Off-loaded Sand Pile to Hopper and Hopper to Wash Plant)
Abated by A-1 Water Spray System
Maximum Yearly Sand Throughput at Wash Plant: 800,000 tons per year
Maximum Daily Sand Throughput at Wash Plant: 6,000 tons per day
Maximum Hourly Sand Throughput at Wash Plant: 400 tons per hour**

- S-2 Sand Stockpiles
Abated by A-1 Water Spray System
Maximum Stockpile Size: 1.5 acres**

- S-3 Road Dust (Exempt)**

Tidewater Sand & Gravel (Previous Plant #9180) operated the sand terminal at the Port of San Francisco since 1982. Permit application #12062 was submitted in 1993 for processing a Bay mined wet sand operation. This application resulted in an exemption that was issued to Tidewater Sand & Gravel in 1994, since the sand operation at the facility was expected to have a moisture content over 5%, which meets the permit exemption criteria of Regulation 2-1-115.1.4.5. The exemption, however, does not apply to stockpiles. This error will be corrected in this evaluation.

Regulation 2-1-115 states:

2-1-115 Exemption, Particulate Sources at Quarries, Mineral Processing and Biomass Facilities:

The following potential PM_{2.5} and PM₁₀ sources are exempt from the requirements of sections 2-1-301 and 302, provided that the source does not require permitting pursuant to Section 2-1-319.

115.1 Sources located at quarrying; mineral or ore handling or processing; concrete production; asphaltic concrete production; marine bulk transfer stations; concrete or asphaltic concrete recycling; vehicle shredding; glass manufacturing; handling or processing of cement, coke, lime, flyash, fertilizer, or catalyst; or other similar facility which meets one of the following:

- 1.4 Operating, loading and unloading the following sources which process exclusively material with a moisture content greater than or equal to 5 percent by weight:
 - 1.4.1 Screen or other size classification;
 - 1.4.2 Conveyor, screw, auger, stacker or bucket elevator;
 - 1.4.3 Grizzly, or other material loading or unloading;
 - 1.4.4 Storage silos;
 - 1.4.5 Storage or weigh hopper/bin system.

Current Site Conditions and Permit Application Criteria

An Air District Inspector conducted a site inspection at Pier 92 in June 2018 and noted the following observations:

- Only the material directly off-loaded at the barge has a moisture content of over 5%.
- The owner/operator sprays water at the active areas at the stockpiles.
- Water truck usage should occur at least twice a day at the storage pile area to keep the fugitive particulate emissions low.
- The top surface of the storage pile dries out in the summer.

Following the Air District's site visit, the facility submitted a permit application for an Authority to Construct and Permit to Operate for S-1 and S-2, which were previously considered exempt in Application #12062. S-1 no longer meets the permit exemption criteria of Regulation 2-1-115.1.4 because the moisture content of the processed material is less than 5%. Since S-1 is losing its exemption for permit requirements due to an operational change rather than the regulatory change, Regulation 2-1-424, "Loss of Exemption," does not apply. S-2 was erroneously given an exemption in the original application. The exemption criteria of Regulation 2-1-115.1.4 does not apply to stockpiles.

Pursuant to Air District's Regulation 2-1-232, S-1 and S-2 will be evaluated as new sources and will be subject to New Source Review requirements of Regulation 2, Rule 2 and Regulation 2, Rule 5.

Under Application #12062, in which the facility was determined to be exempt, the sand throughput at the facility was 160,000 tons per year (TPY). This throughput level was based on customer demand and usage from 1996.

The operating throughputs at the facility for the last four years have increased and are presented in the following table:

Year	Throughput [tons/year]
2019	614,196
2018	663,932
2017	517,595
2016	468,272
Average	565,999

In this application, the plant is proposing to increase the throughput limit to 800,000 TPY of sand.

Overview of Facility Operations

Sand mined from State Land Commission leases in San Francisco Bay is barged into Pier 92, where it is offloaded by electrically powered equipment powered by the barge.¹ The material is then conveyed on exempt conveyors to the off-loaded pile. Mobile cargo handling equipment, such as loaders or forklifts, transfer the material into a feed hopper. The engines that propel mobile cargo handling equipment, such as a forklift or dump truck, are excluded from District regulations pursuant to Regulation 1-110.1.

The sand moves from the hopper onto a conveyor and is discharged into a wash plant. The sand is washed with fresh water then is stockpiled for loading into customer trucks for use off-site.

¹ Applicant confirmed in the email, dated March 29, 2019

Wash plant process rate and details

The sand processing rates at the wash plant are 400 TPH, and approximately, 6,000 tons per day (TPD). The applicant provided a process flow diagram and an aerial map below to show the source locations.

Figure 1 – Pier 92 Sand Wash Plant Process Flow

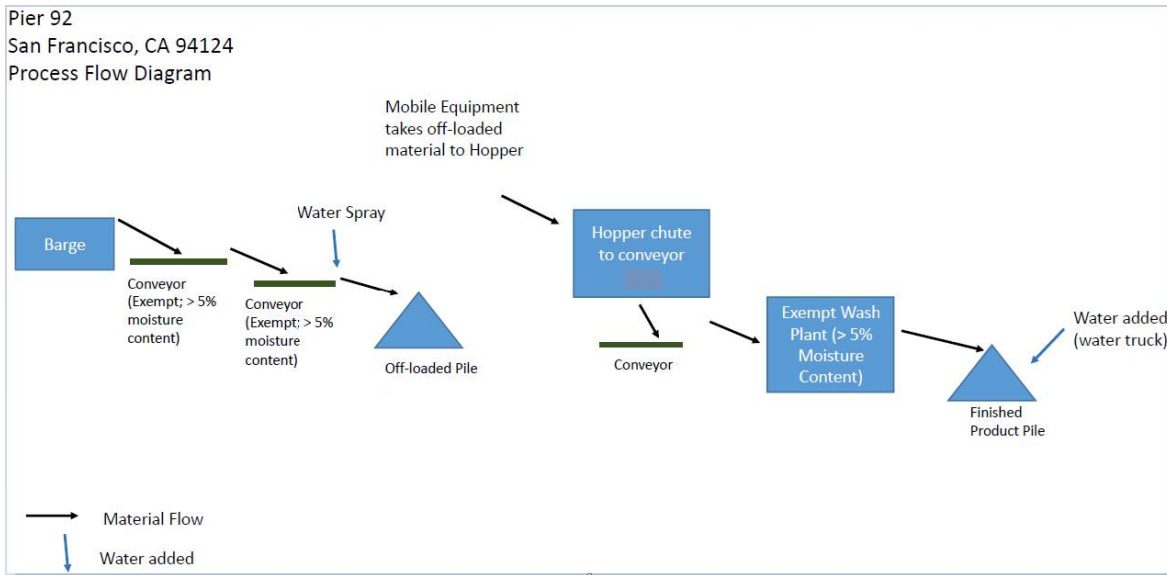


Figure 2 – Pier 92 Sand Wash Plant Proposed Sources Locations



Figure 3 – Property Boundaries at Piers 92 and 94 ¹



1. Hanson Aggregates provided the property boundaries for its operations at Pier 92 and Pier 94. The District concluded that these operations do not meet the definition of “facility”. Therefore, the operations have been assigned separate Air District plant numbers. This is discussed in more detail in the Statement of Compliance section of this evaluation.

Emission Calculations

Particulate matter (PM) emissions are generated by sand transfer operations at S-1, S-2, on-site vehicle travel (road dust), and engines on barges and tugboats. The barge and tugboat engines are sources of nitrogen oxide (NO_x), carbon monoxide (CO), precursor organic compounds (POC), and sulfur dioxide (SO₂). Barge and tugboat engine emissions are included in this analysis for the purpose of assessing cumulative increase and offset requirements in accordance with the emission calculation procedures in Regulation 2-2-610. Emissions from cargo carriers are not subject to other new source review (NSR) requirements, such as Best Available Control Technology (BACT) and the toxic NSR requirements of Regulation 2, Rule 5.

Three emission summary tables are presented below. Detailed emission calculations are presented in Appendix A at the end of this evaluation report.

Table 1: Summarized Criteria Pollutants Emissions in tons per year [TPY]

Sources	PM _{2.5} [TPY]	PM ₁₀ [TPY]	NO _x [TPY]	CO [TPY]	POC [TPY]	SO ₂ [TPY]
S-1	0.12	0.24	--	--	--	--
S-2	0.01	0.08	--	--	--	--
Road Dust	0.43	3.73	--	--	--	--
Barge and Tug Emissions ¹	0.17	0.17	14.02	3.04	0.64	1.41
Total	0.74	4.22	14.02	3.04	0.64	1.41

¹ Barge and tug engine emissions are included here pursuant to Regulation 2-2-610 for the purpose of assessing the cumulative increase and offset requirements of Regulations 2-2-302 and 2-2-303. These barge and tug engine emissions are not subject to BACT, PSD, or toxic NSR requirements of Regulation 2, Rule 5. Therefore, barge and tug engine emissions are not included in the subsequent summary tables. For the purposes of calculating PM emissions from the engines, it is assumed that emissions of PM_{2.5} equal emissions of PM₁₀.

Table 2: Summarized Criteria Pollutants Emissions in pounds per day [lb/day]

Sources	PM _{2.5} [lb/day]	PM ₁₀ [lb/day]	BACT Trigger PM ₁₀ [lb/day]	Is Source Subject to BACT? [Yes/No]
S-1	1.80	3.56	10.0	No
S-2	0.07	0.46	10.0	No
Road Dust (Exempt Source)	--	--	--	--

Pursuant to Air District's Regulation 2-1-115.1.5, haul or access roads at mineral processing facilities are exempt from the permitting requirements of Section 2-1-301 and 302, provided that the source is not subject to the permitting requirements pursuant to Section 2-1-319. Both requirements state:

2-1-115 Exemption, Particulate Sources at Quarries, Mineral Processing and Biomass Facilities:

The following potential PM_{2.5} and PM₁₀ sources are exempt from the requirements of sections 2-1-301 and 302, provided that the source does not require permitting pursuant to Section 2-1-319.

115.1 Sources located at quarrying; mineral or ore handling or processing; concrete production; asphaltic concrete production; marine bulk transfer stations; concrete or asphaltic concrete recycling; vehicle shredding; glass manufacturing; handling or processing of cement, coke, lime, flyash, fertilizer, or catalyst; or other similar facility which meets one of the following:

- 1.5 Haul or access roads;

2-1-319 Source Expressly Subject to Permitting Requirements: Notwithstanding any exemption contained in Section 2-1-103 or Sections 2-1-114 through 2-1-128, any source meeting any of the following criteria shall be subject to the requirements of Section 2-1-302:

319.1 The emission rate of any regulated air pollutant (except greenhouse gases) from the source is greater than 5 tons per year, after abatement.

319.2 The source is subject to the requirements of Section 2-1-316, 317, or 318.

(Adopted May 17, 2000)

The plant haul roads comply with Regulation 2-1-319.1 since road dust emissions are less than five tons per year, after abatement (presented in Table 2).

The plant haul roads also comply with Regulation 2-1-319.2 by complying with the following regulations:

The source is not subject to the requirements of Section 2-1-316:

- 1) A Health risk assessment (HRA) was conducted which demonstrated that Best Available Control Technology for Toxics (TBACT) is not required, and the project complies with the project risk limits of Regulation 2-5-302.
- 2) The source will not emit 2.5 or more tons per year of any single hazardous air pollutant or 6.25 or more tons per year of any combination of hazardous air pollutants.

The source is not subject to the requirements of Section 2-1-317:

The facility has not received any violations from the Air District in the previous five years.

The source is not subject to the requirements of Section 2-1-318:

The source does not emit any of the air contaminants/hazardous substances listed in 2-1-318.

The plant road dust source meets the permit exemption criteria of Regulation 2-1-115.1.5. Therefore, road dust source does not subject to New Source Review requirements of Regulation 2, Rule 2.

Toxic Air Contaminant (TAC) Emissions

Respirable crystalline silica is a TAC that is often found in sand. Emissions of respirable crystalline silica at this facility are expected from S-1, S-2, and from road dust. To estimate respirable crystalline silica, an emission factor obtained from the Journal of the Air & Waste Management Association article, “PM₄ Crystalline Silica Emission Factors and Ambient Concentrations at Aggregate-Producing Sources in California” was used. This emission factor is based on averaged source test results.

The facility has unpaved and paved portions of roadways. Also, part of the roadway is a steal scale. Emissions of the steal scale are expected to be similar to paved roadways and are treated as such for HRA purposes.

A HRA was conducted using the estimated respirable crystalline silica emissions presented in Table 3. Detailed respirable crystalline silica calculations are presented in Appendix A.

Table 3: Comparison of TAC Emissions to HRA Trigger Levels

TAC	Annual Emission from Unpaved Roads [lb/year]	Trigger Level Table 2-5-1 [lb/year]	Trigger HRA [Yes/ No]
Respirable Crystalline Silica (CAS #7631-86-9)	532.85	120	Yes

The results of the HRA indicate that this project does not require Best Available Control Technology for Toxics (TBACT) because the estimated project risk is less than the 0.2 threshold. This project complies with the Regulation 2-5-302 project risk requirements.

The results of the HRA is discussed in more detail in the Statement of Compliance Section below.

Plant Cumulative Increase

Hanson Aggregates, Mid-Pacific, Inc. – SF Pier 92 Sand Yard, located at Pier 92 in San Francisco, is an existing unpermitted facility. Therefore, the District has recorded no cumulative emissions at this plant to date. The operations of the wash plant are exempt from permitting requirements. Therefore, there are no cumulative emissions recorded at Plant #13407 to date.

Table 5. Cumulative Emissions Increase in tons/year

Pollutants	Existing Emissions [TPY]	New Emissions [TPY]	Total Emissions [TPY]
NO _x	0.000	14.018	14.018
CO	0.000	3.037	3.037
POC	0.000	0.635	0.635
PM ₁₀	0.000	4.222	4.222
PM _{2.5}	0.000	0.737	0.737
SO ₂	0.000	1.412	1.412

The increase in cumulative emissions for this facility includes emissions from S-1, S-2, road dust and barge emissions.

Statement of Compliance

Regulation 1: General Provisions and Definitions

Both S-1 and S-2 are subject to Regulation 1, Section 301, which prohibits discharge of air contaminants resulting in public nuisance. The facility has not received any violations from the Air District in the previous five years.

Regulation 2, Rule 1: General Requirements

Regulation 2, Rule 1: California Environmental Quality Act (CEQA) Requirements

Regulation 2, Rule 1, Section 310, Applicability of California Environmental Quality Act (CEQA), specifies that all proposed new and modified sources subject to District permit requirements must be reviewed in accordance with CEQA requirements, except for ministerial projects meeting the requirements of Regulation 2-1-311 or projects exempt from CEQA under Regulation 2-1-312.

The engineering review for this project used standard emission factors and procedures to estimate emissions from this project as described in Permit Handbook Chapter 11.5 Concrete Batch Plants. The decision to approve the permit for this project does not involve any element of discretion. Therefore, this project is ministerial.

In addition, this application is categorically exempt from CEQA review pursuant to Regulations 2-1-312.2 and 2-1-312.11. This project involves the permitting of air pollution control measures, which are exempt from CEQA review pursuant to Regulation 2-1-312.2. This project is also exempt from CEQA review because it involves the permitting of new sources that satisfy the “No Net Emissions Increase” provisions of Regulation 2, Rule 2, and there is no possibility that the project will have any significant environmental effect in connection with resources other than air quality. The new sources in this application meet the no net emission increase provisions of Regulation 2, Rule 2. BACT is not triggered for any of the new sources, and the project meets Air District offset requirements. Since this facility is not major for particulate matter (PM₁₀ or PM_{2.5}) or sulfur dioxide (SO₂), offsets are not required for these pollutants. This facility is a small facility for POC and NO_x emissions. This facility does not trigger offsets for POC emissions. This facility

triggers offsets for NO_x emissions, but full NO_x emission offsets will be provided from the small facility banking account. Therefore, this project meets the requirements of Regulation 2-1-312.11.3. This project involves the permitting of new sources that result in some toxic emission increases, but the Air District's health risk assessment found that the chronic hazard index is less than 0.2 and the project has no cancer risk. Therefore, this project meets the requirements of Regulation 2-1-312.11.4. This project has no other potentially significant environmental impacts. Therefore, this permitting action is categorically exempt, and no CEQA review is required.

This facility is not within 1,000 feet from the nearest K-12 school and is therefore, not subject to the public notification requirements of Regulation 2-1-412.

Regulation 2-2-301 Best Available Control Technology

In accordance with Regulation 2, Rule 2, Section 301, BACT is triggered for any new or modified source with the potential to emit (PTE) 10 pounds or more per highest day of POC, NPOC, NO_x, CO, SO₂, **PM**_{2.5} or PM₁₀. Although NO_x, CO, and POC emissions exceed 10 pounds per day, these emissions are all due to cargo carrier engines. The Air District is restricted from imposing emission standards on cargo carrier engines that are more stringent than the applicable federal standards for these engines. Therefore, no additional BACT review is necessary for these barge engine emissions.

As demonstrated in Table 2 above, emissions from S-1 and S-2 do not trigger BACT.

Regulation 2-2-302 Offset Requirements, Precursor Organic Compounds and Nitrogen Oxides

Offsets must be provided for any new or modified source at a facility that emits more than 10 tons/year of POC or NO_x per Regulation 2, Rule 2, Section 302. As shown in Table 1 above, this facility will have a PTE more than 10 tons per year of NO_x (including emissions from cargo carries per Section 2-2-610).

Regulation 2, Rule 1-213 defines a Facility as:

Any source, building, structure or installation that emits or may emit any air pollutant; or any aggregation of such sources, buildings, structures or installations that re (i) located on one or more contiguous or adjacent properties; (ii) are under common ownership or control' and (iii) are considered to be in the same major industrial grouping (identified by the first two digits of the applicable code in The Standard Industrial Classification Manual).

The Hanson owned Pier 92 facility (Plant #13407) is adjacent to Pier 94 and under common ownership. However, Pier 92's SIC code is 1442 (construction sand and gravel) while Pier 94's SIC code is 4491 (marine cargo handling).

Pier 92 receives sand off-loaded from a domestic barge that mines aggregate from the San Francisco Bay. After off-loading, the facility screens and washes the sand before stockpiling and loading it into customer trucks. Pier 92 is considered a mine site, and as such is regulated by the Mine Safety and Health Administration (MSHA) for safety matters.

Pier 94 is an international maritime cargo terminal. Cargo (sand and gravel) is unloaded in bulk from international ocean-going vessels into stockpiles which is loaded into customer trucks with no processing onsite. Furthermore, employees at Pier 94 are stevedores employed by Pacific Warehouse, not Hanson. Pier 94 is not considered a mine site.

Because the two facilities do not share the first two digits of the SIC code and have different operations, they are not considered the same facility per the definition. As a result, offsets for both facilities will not be combined.

Regulation 2-2-610 Emissions Calculation Procedures, Cargo Carriers

For the purposes of applying the offset requirements of Section 2-2-302 and 2-2-303, a facility’s PTE and cumulative increase shall be calculated including emissions from cargo carriers associated with the sources at the facility. When applying these offset requirements, facilities that include cargo loading or unloading from cargo carriers other than motor vehicles shall include the cargo carriers as part of the source that receives or loads the cargo.

All emissions from such cargo carriers while operating in the District, or within California Coastal Waters up to 11 nautical miles from the Golden Gate Bridge, shall be included as part of the source’s emissions.

Only barge and tugboat emissions are included for this project because construction grade clean sand is dredged directly from the central bay and barged to the dock of the sand terminal at Pier 92.

Pier 92 (Plant #13407) has a PTE of 14.02 TPY of NOx from the operation of barge and tugboat emissions. Offsets are required for this application because NOx is more than 10 TPY but less than 35 TPY. The emission offsets will be provided by the District’s Small Facility Banking Account at a 1:1 ratio.

The emissions of POC from the facility are less than 10 tons per year and no POC offsets are required.

Regulation 2-2-303 Offset Requirements, PM_{2.5}, PM₁₀ and Sulfur Dioxide

Regulation 2-2-303 requires offsets for any new or modified source at a major facility with a potential to emit 100 tons per year or more of PM₁₀, PM_{2.5}, or sulfur dioxide (SO₂). As shown in Table 1, emissions are: 4.22 tons per year of PM₁₀, 0.74 tons per year of PM_{2.5}, and 1.41 tons per year of SO₂. Since this facility has a potential to emit that is less than 100 tons per year for each of these pollutants, this facility is not a major facility. Therefore, the offset requirements of Regulation 2-2-303 do not apply to this facility.

Regulation 2-2-304 Prevention of Significant Deterioration (PSD)

The operation of S-1 and S-2 will not trigger a PSD review because the facility is not a major facility per Regulation 2-2-304.

Regulation 2, Rule 5 New Source Review for Toxic Air Contaminants

Since respirable crystalline silica emissions are greater than the chronic risk screen trigger level of 120 pounds per year, a HRA is required.

A HRA for this application was completed and approved by the Air District Toxicologist on March 4, 2021. Results from the HRA indicated that the maximum chronic HI was estimated at 0.0903. Respirable crystalline silica is the only TAC in this analysis. Since crystalline silica has no cancer potency value or acute reference exposure level, this HRA has no cancer risk or acute hazard index. In accordance with the District’s Regulation 2-5-301, this project does not require TBACT because the estimated source risk less than 1.0 a million, and/or a chronic hazard index less than 0.2. This project complies with the Regulation 2-5-302 project risk requirements because the chronic HI is less than 1.0.

HRA Results – Pier 92 (S1, S2, and Road Dust)

Receptor	NAD 83 UTM Coordinates (meters)		Cancer Risk (in a million)	Chronic HI	Acute HI
	Easting (x)	Northing (y)			
Resident	553957.2	4177092.8	NA	0.0018	NA
Worker	554741.1	4177851.0	NA	0.0903	NA

Student risk values were not calculated because there are no K-12 schools within 1,000 feet of the source.

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As mentioned above, Hanson Pier 92 and Hanson Pier 94 are considered adjacent facilities. However, since they operate as separate entities and there is no exchange of material between the two facilities unless one sells to another. Therefore, TAC emissions are modeled separately for the facilities.

Regulation 2, Rule 6: Major Facility Review

The requirements of federal operating permit program have been codified in District Regulation 2, Rule 6. This rule requires that major and designated facilities apply for and obtain a Title V federal operating permit. Since this facility will emit less than 100 tons/year each of NO_x, CO, POC, PM₁₀, and SO₂, less 10 tons/year of any single Hazardous Air Pollutant (HAP), and less than 25 tons/year of all HAPs combined, it is not considered to be a major facility of regulated air pollutants. This facility is also not a designated facility pursuant to any federal NSPS or NESHAP requirements. Therefore, Regulation 2, Rule 6 does not apply to this site.

NEW SOURCES PERFORMANCE STANDARDS (NSPS)

40 CFR Part 60 Subpart OOO

Pursuant to §60.670, affected facilities are subject to the provisions of this subpart. Affected facilities are the following process units at a fixed or portable nonmetallic mineral processing plant:

- Crusher
- Grinding Mill
- Screening Operation
- Bucket Elevator
- Belt Conveyor
- Bagging Operation
- Storage Bin
- Enclosed Truck or Railcar Loading Station

Hanson Aggregates is proposing to operate a sand and aggregates import terminal at 94.

However, this standard does not apply to this facility because Section 60.670 (a)(2) states that the standard does not apply to facilities that do not have crusher or grinding mills.

Regulation 6, Rule 1 Particulate Matter

Both S-1 and S-2 are subject to Regulation 6, Rule 1.

Pursuant to Regulation 6-1-301, a person shall not emit from any source for a period or aggregate periods of more than 3 minutes in any hour, a visible emission that is as dark or darker than No. 1 on the Ringelmann Chart, or of such opacity as to obscure an observer's view to an equivalent or greater degree.

A person shall not emit from any source for a period of more than three minutes in any hour an emission equal to greater than 20% opacity per Regulation 6-1-302.

Regulation 6-1-305, Visible Particles, prohibits a public nuisance caused by the fallout of visible particulate emissions. This Section only applies if such particles fall on real property other than the property of the person responsible for the emissions.

This facility is expected to comply with these requirements since each source is abated by water spray. The limited to these requirements are listed in the permit conditions.

Regulation 6-1-310 Total Suspended Particulate (TSP) Concentration Limits, limits the concentration of TSP in the exhaust from devices such as baghouses and stacks. The sources at this facility are controlled by water spray and do not exhaust to any baghouse or stack. Therefore, this Section does not apply.

Regulation 6-1-311 limits the Total Suspended Particulate (TSP) Weight Limits.

The maximum processing rate at S-1 is 400 tons/hour (800,000 lb/hour). Since the processing rate exceeds 55,116 pounds/hour, Regulation 6-1-311.1 limits TSP emissions to 40.0 pounds/hour. Section 6-1-311.2 limits TSP to 28.5 pounds/hour.

TSP is the measurement of particulate matter that can be filtered out of a gas stream (filterable PM). From Table 11-12-2 of AP-42 Chapter 11.12 Concrete Batching, the total PM (which is also considered to be TSP) emission factor for uncontrolled sand transfer operations is 0.0021 pounds of TSP per tons of material transferred. At 400 tons/hour maximum processing rate, the uncontrolled TSP emission rate is 0.84 pounds/hour, which is far below the TSP limit of 28.5 pounds/hour. Therefore, this project complies with Section 6-1-311.

Table 6-1-311.1: Process Weight Rate vs. Allowable TSP Emission Limits

Process Weight Rate		TSP Emission Limit	
kg/hour	lb/hour	kg/hour	lb/hour
>25,000	>55,116	18.1	40.0

Table 6-1-311.2: Process Weight Rate vs. Allowable TSP Emission Limits

Process Weight Rate		TSP Emission Limit	
kg/hour	lb/hour	kg/hour	lb/hour
>300,000 - 400,000	>661,387 - 881,849	12.9	28.5

Regulation 6, Rule 6 – Particulate Matter Prohibition of Track-out

Both S-1, S-2, and road dust are subject to Regulation 6, Rule 6. Regulation 6-6 shall only apply to limit the quantity of particulate matter in the atmosphere through control of track-out of solid materials onto paved public roads outside the boundaries of large bulk material sites, large construction sites, and large disturbed surface sites including landfills.

This site has one or more stockpiles of bulk material greater than five feet high or with a footprint greater than 100 square feet. Therefore, this site is considered a bulk material site, and Regulation 6, Rule 6 applies to this facility.

Pursuant to Regulation 6-6-301, the owner/operator shall not cause or allow track-out at any active exit from such site onto an adjacent paved public roadway or shoulder of a paved public roadway that exceeds cumulative 25 linear feet and creates fugitive dust visible emissions without cleaning up such track-out within four hours of when the owner/operator identifies such excessive track-out; and shall not cause or allow more than one quart of track-out to remain on the adjacent paved public roadway or the paved shoulder of the paved public roadway at the end of any workday.

Pursuant to Regulation 6-6-302, the owner/operator shall not cause or allow a fugitive dust visible emission during cleanup of any track-out that exceeds 20 percent opacity as determined by EPA Method 203B or as dark in shade as that designated as Number 1 on the Ringelmann Chart, for a period or aggregate periods of more than three minutes in any 60-minute period.

Hanson will be required to maintain the recordkeeping requirements of Regulation 6-6-501 in the permit conditions.

Permit Conditions [Condition# 27368]

1. The owner/operator shall only receive and process sand at this facility. Sand shall only be received from barges pulled by tugboats. Other types of ocean-going vessels shall not deliver sand to this site. The total number of barge deliveries shall not exceed 260 during any consecutive 12-month period. [Basis: Cumulative Increase and Avoidance of 2-2-302.2]
2. The owner/operator shall not receive or process more than following quantities of sand at S-1:
 - a. 6,000 tons during any day.
 - b. 800,000 tons during any consecutive 12-month period. [Basis: Regulation 2-1-403, Cumulative Increase]
3. Visible dust emission from S-1 and S-2 shall not exceed Ringelmann 1.0 or result in fallout on adjacent properties in such quantities as to cause a public nuisance per Regulation 1-301. To ensure compliance with this Part and with Regulation 6-1-301 and 6-1-305, the owner/operator shall visually observe all material handling operations associated with S-1 and S-2 and shall immediately initiate corrective actions, if any visible dust emissions are detected that persist for longer than 3 minutes in any hour. [Basis: Regulation 1-301, 6-1-301, and 6-1-305]
4. The owner/operator shall abate emissions from S-1, S-2, and unpaved roads with A-1 Water Spray System, and shall utilize sweeping, flushing or other appropriate measures to abate emissions from roadways, as necessary to maintain compliance with Part 3 of this condition, Regulations 6-1-305, 6-1-311, 6-6-301 and 6-6-302. The owner/operator shall ensure water sprays are at each drop point at the conveyor for S-1. For the stockpile area, S-2, the owner/operator shall ensure the water spray reaches the entire surface area of the stockpile and the entire surface area remains wet at all times. The owner/operator is required to maintain compliance with the facility's Dust Control Plan at all times. [Basis: Cumulative Increase, Regulations 1-301, 6-1-305, 6-1-311, 6-6-301, 6-6-302 and Dust Control Plan]
5. To verify compliance with Regulation 2, Rule 5, the owner/operator shall conduct the following testing:
 - a. Within 60 days of issuance of this Authority to Construct and at least once every 3 years after issuance of the Permit to Operate, the owner/operator shall collect three (3) representative samples of the sand handled at this facility.
 - b. The owner/operator shall have these representative samples of sand analyzed for crystalline silica using NIOSH Method 7500 or other District-approved methods. The owner/operator shall consult with the Engineering Division of the Air District prior to conducting the testing to obtain approval of all collection and analysis methods used.
 - c. The owner/operator shall submit the results of the crystalline silica analyses to the Engineering Division of the Air District within 30 days of receiving the results. [Basis: Regulation 2-5]
6. In the event the District's Compliance and Enforcement staff issues the facility two or more Notices of Violation citing "Regulation 1-301: Public Nuisance" related to dust in any consecutive, rolling, 12-month period, the owner/operator shall implement one or more of following control measures (as applicable), or shall implement any other measures that the District deems necessary and appropriate, within a time period mutually agreeable to the facility and the District:
 - a. Initiate use of dust suppressants on unpaved roadways.
 - b. Initiate high power water flushing on roadways.
 - c. Pave or otherwise stabilize the most frequently used unpaved areas.
 - d. Reduce the permitted sand throughput at S-1 and S-2 in Part 2 of this Permit Condition.
 - e. Enclose dust nuisance operations in a warehouse-like building.

Within 30-days of receiving the second Notice of Violation, the owner/ operator shall submit a Permit Application to the District to modify these Permit Conditions in order to memorialize the applicable control measures.

[Basis: Regulation 1-301]

7. To demonstrate compliance with this Permit Condition, the owner/operator shall maintain dated records of the following:
 - a. Record the date and the total number of barge deliveries per month.
 - b. Record the amount of sand processed at S-1 on a daily and monthly basis.
 - c. The owner/operator shall use the monthly records to calculate and record the sand deliveries and throughput at S-1 on a consecutive, rolling 12-month basis.
 - d. Maintain written procedures describing events or observations of emissions that shall trigger the use of A-1 Water Sprays at S-1, S-2, and unpaved roads and that trigger sweeping, flushing, or other control measures on paved roads. These procedures shall include descriptions of when, where, at what frequency, and what amount water shall be applied to S-1, S-2, and unpaved roads and frequency of sweeping and flushing of paved roads. Maintain checklists or other records to demonstrate that these emission control procedures are followed.

[Basis: Cumulative Increase, Recordkeeping]

8. The owner/operator of this facility shall:
 - a. Monitor the extent of the trackout at each active exit from the site onto a paved public road at least twice during each workday, at times when vehicle traffic exiting the site is most likely to create an accumulation of trackout, or as otherwise specified by the APCO;
 - b. Document the active exit locations monitored each workday;
 - c. Document each occasion when the trackout exceeds cumulative 25 linear feet and all trackout control and cleanup actions initiated as a result of monitoring Part a of this condition; and
 - d. Maintain the records required by Part b and Part c of this condition for two years, in electronic, paper hard copy or log book format, and make them available to the APCO upon request.

[Basis: Regulation 6-6-501]

The owner/operator shall maintain these records and any related correspondence with any division of the District in a District-approved log and shall retain the records on-site for at least two years from the date of entry and shall make the records available to District staff for review upon request.

[Basis: Cumulative increase, Regulation 2-1-403]

9. The owner/operator of this facility shall limit the trips of front loader on unpaved road to:
 - a. 546 trips during any day and
 - b. 72,727 trips during any consecutive 12-month period.

The owner/operator of the facility shall limit the trips of transfer trucks on unpaved road to:

- a. 188 trips during any day and
- b. 25,000 trips during any consecutive 12-month period.

The owner/operator of this facility shall limit the trips of transfer trucks on paved road to:

- a. 188 trips during any day and
- b. 25,000 trips during any consecutive 12-month period.

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To demonstrate compliance with this permit condition, the owner/operator shall maintain records in a District-approved log of vehicle trips per day, per month and per rolling 12-month period for each type of vehicle traveling on roadways at this facility. All records shall be retained on site for at least two years from the date of entry and be made available for inspection by District staff on request.
[Basis: Cumulative Increase, Regulation 2-5, Recordkeeping]

Recommendation

It is recommended that an Authority to Construct be issued to Hanson Aggregates, Mid-Pacific, Inc. for the following:

- S-1 Sand Material Transfer**
(Two transfer points: Off-loaded Sand Pile to Hopper and Hopper to Wash Plant)
Abated by A-1 Water Spray System
Maximum Yearly Sand Throughput at Wash Plant: 800,000 tons per year
Maximum Daily Sand Throughput at Wash Plant: 6,000 tons per day
Maximum Hourly Sand Throughput at Wash Plant: 400 tons per hour

- S-2 Sand Stockpiles**
Abated by A-1 Water Spray System
Maximum Stockpile Size: 1.5 acres
Includes Road Dust Emissions

- S-3 Road Dust (Exempt)**

by _____ date _____
Flora Chan
Senior Air Quality Engineer

Appendix A

This Appendix includes:

1. Particulate emissions from the Off-loaded Pile to Hopper and Hopper to Wash Plant (S-1) – Two Drop Points;
2. Particulate emissions from Sand Stockpiles (S-2) using two methods:
 - a. from EPA document, “Control of Open Fugitive Dust Sources” dated 9/1988;
 - b. from AP-42 Chapter 13.2.5, dated 11/2006;
3. Particulate emissions from vehicles traveling on roadways; and
4. Barge and tug emissions.

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Emission Calculations at S-1

PM Emissions:

PM emissions are generated from sand dropped to the hopper and also from sand dropped to the wash plant. The other drop points are exempt from permitting requirements because the moisture content is greater than 5%.

The estimated maximum sand throughput rates to the wash plant are: 400 tons/hour, 6,000 tons/day and 800,000 tons/year.

PM₁₀ emissions from both sand drops is calculated using EPA's AP-42, Chapter 11.12 Concrete Batching, Table 11.12-2 for sand transfer. This emission factor is acceptable because it is specific to sand and represents the emissions generated from the transfer of sand from one location to another.

According to the Air District's Permit Handbook Chapter 11.5 for Concrete Batch Plants, PM_{2.5} is equal to 15% of PM₁₀ emissions for sand transfer.

As mentioned previously, respirable crystalline silica emission factor obtained from the Journal of the Air & Waste Management Association article, "PM₄ Crystalline Silica Emission Factors and Ambient Concentrations at Aggregate-Producing Sources in California" was used. The emission factor is based on averaged source test results.

Maximum Hourly Emissions from S-1 (Sand off-loading facility)

Source #	Source Description	Pollutant	Emissions Factor [lb/ton]	Reference	Maximum Hourly Sand Throughput [tons/hour]	PM Emissions [lbs/hour]	
1	Sand off-loading facility Off-loaded Pile to Hopper	PM10	0.00099 (unabated) 0.000297 (abated)*	AP 42 Chapter 11.12-2 Concrete Batching for Unabated Sand Transfer *If watering is used to suppress dust, 70% abatement efficiency is used	400	0.119	
		PM2.5	0.00015	AP 42 Chapter 11.12-2 Concrete Batching for Unabated Sand Transfer		0.060	
		Crystalline Silica	1.95E-05	Technical Paper		0.008	
	Sand off-loading facility Hopper to Wash Plant	PM10	0.00099 (unabated) 0.000297 (abated)*	AP 42 Chapter 11.12-2 Concrete Batching for Unabated Sand Transfer *If watering is used to suppress dust, 70% abatement efficiency is used		0.119	
		PM2.5	0.00015	AP 42 Chapter 11.12-2 Concrete Batching for Unabated Sand Transfer		0.060	
		Crystalline Silica	1.95E-05	Technical Paper		0.008	
			PM10	--	--	--	0.238
			PM2.5	--	--	--	0.120
			Crystalline Silica	--	--	--	0.016

Maximum Daily Emissions from S-1 (Sand off-loading facility)

Source #	Source Description	Pollutant	Emissions Factor [lb/ton]	Reference	Maximum Daily Sand Throughput [tons/day]	Abated PM Emissions [lbs/day]	
1	Sand off-loading facility Off-loaded Pile to Hopper	PM10	0.00099 (unabated) 0.000297 (abated)*	AP 42 Chapter 11.12-2 Concrete Batching for Unabated Sand Transfer *If watering is used to suppress dust, 70% abatement efficiency is used	6,000	1.782	
		PM2.5	0.00015	AP 42 Chapter 11.12-2 Concrete Batching for Unabated Sand Transfer		0.900	
		Crystalline Silica	1.95E-05	Technical Paper		0.117	
	Sand off-loading facility Hopper to Wash Plant	PM10	0.00099 (unabated) 0.000297 (abated)*	AP 42 Chapter 11.12-2 Concrete Batching for Unabated Sand Transfer *If watering is used to suppress dust, 70% abatement efficiency is used		1.782	
		PM2.5	0.00015	AP 42 Chapter 11.12-2 Concrete Batching for Unabated Sand Transfer		0.900	
		Crystalline Silica	1.95E-05	Technical Paper		0.117	
			PM10	--	--	--	3.564
			PM2.5	--	--	--	1.800
			Crystalline Silica	--	--	--	0.234

Maximum Annual Emissions from S-1 (Sand off-loading facility)

Source #	Source Description	Pollutant	Emissions Factor [lb/ton]	Reference	Maximum Annual Sand Throughput [tons/year]	PM Emissions [lbs/year]
1	Sand off-loading facility Off-loaded Pile to Hopper	PM10	0.00099 (unabated) 0.000297 (abated)*	AP 42 Chapter 11.12-2 Concrete Batching for Unabated Sand Transfer *If watering is used to suppress dust, 70% abatement efficiency is used	800,000	237.600
		PM2.5	0.00015	AP 42 Chapter 11.12-2 Concrete Batching for Unabated Sand Transfer		120.000
		Crystalline Silica	1.95E-05	Technical Paper		15.623
	Sand off-loading facility Hopper to Wash Plant	PM10	0.00099 (unabated) 0.000297 (abated)*	AP 42 Chapter 11.12-2 Concrete Batching for Unabated Sand Transfer *If watering is used to suppress dust, 70% abatement efficiency is used		127.600
		PM2.5	0.00015	AP 42 Chapter 11.12-2 Concrete Batching for Unabated Sand Transfer		120.000
		Crystalline Silica	1.95E-05	Technical Paper		15.623
		PM10	--	--		--
	PM2.5	--	--	--		--
Crystalline Silica	--	--	--	--	31.246	

S-2 Emission Calculations

There are two different procedures to estimate the stockpiles emissions (S-2):

- 1) EPA document “Control of Open Fugitive Dust Sources”, dated 9/1988
- 2) AP-42 Chapter 13.2.5 Industrial Wind Erosion, dated 11/2006

Emission estimates were calculated using both procedures to determine the most conservative approach, which will be used in this application.

Method 1: Emission Calculations at S-2 (Wind Erosion at Sand Stockpiles) using EPA document “Control of Open Fugitive Dust Sources”, dated 1988

The PM₁₀ emission factor for S-2 was calculated using Equation 4-9 from the EPA document “Control of Open Fugitive Dust Sources”, dated 9/1988:

$$E_{30} = (1.7) \left(\frac{s}{1.5} \right) \left(\frac{365-p}{235} \right) \left(\frac{f}{15} \right) \text{ (lb/acre-day)} = 2.027$$

where:

E₃₀ = PM₃₀ emission factor, lb/acre-day

s = 1.58% = silt content of sand. Material passing the 200 mesh: average 0.5% and range of 0.2-1.58%

p = 65 = number of days with at least 0.01 in of precipitation per year, based on AP-42 Figure 13.2.2-1.

f² = 13.3% = percentage of time that the unobstructed wind speed exceeds 12 mph., based on Mojave Desert Air Quality Management District (MDAQMD) Emissions Inventory Guidance for Mineral Handling and Processing Industries, Wind Erosion from Stockpiles section (page 18/31)

The PM₁₀ fraction is estimated as 0.5 E₃₀ from EPA document “Control of Open Fugitive Dust Sources”, dated 9/1988. The document is available at this website: https://www3.epa.gov/ttn/chief/old/ap42/ch13/s025/reference/ref_10c13s025_1995.pdf

Therefore, the PM₁₀ emission factor = 1.014 lb/acre-day

The PM₁₀ emission factor with a wet spray system is 1.014 * (1-70%) = 0.304. Storage piles are wetted by water truck and 70% control efficiency is assumed.

The respirable crystalline silica emission factor was obtained from the Journal of the Air & Waste Management Association article, “PM₄ Crystalline Silica Emission Factors and Ambient Concentrations at Aggregate-Producing Sources in California.” The emission factor for crystalline silica is 0.020 lb/acre-day.

Annual emissions calculated by multiplying the emission factor (lb/acre-day) by the acres of exposed area and 365 days/year.

² A draft Environmental Impact Report from the San Francisco Planning Department indicates that the percentage of time wind speed exceeds 12 mph in San Francisco is 10% (Source: https://sfmea.sfplanning.org/CentralSoMaPlanDEIR_13-iv-g-wind.pdf). For a more conservative estimate of emissions, data from MDAQMD was used.

Maximum Annual Emission from S-2 (Sand Stockpile)

Source #	Source Description	Pollutant	Emissions Factor [lb/acres/day]	Reference	Maximum Sand Stockpile Area [acres]	PM Emissions [lbs/year]
2	Sand Stockpiles	PM10	0.304	EPA Document - "Control of Open Fugitive Dust Sources"	1.5	166.467
		PM2.5		15% of PM10	1.5	24.97
		Crystalline Silica	0.020	Technical Paper	1.5	10.946

Maximum Daily Emission from S-2 (Sand Stockpile)

Source #	Source Description	Pollutant	Emissions Factor [lb/acres/day]	Reference	Maximum Sand Stockpile Area [acres]	PM Emissions [lbs/day]
2	Sand Stockpiles	PM10	0.304	EPA Document - "Control of Open Fugitive Dust Sources"	1.5	0.456
		PM2.5		15% of PM10	1.5	0.068
		Crystalline Silica	0.020	Technical Paper	1.5	0.030

Method 2: Emission Calculations at S-2 (Wind Erosion from Sand Stockpiles) using AP-42 Chapter 13.2.5 Industrial Wind Erosion, dated 2006

There are approximately 1.5 acres of total stockpiles at Pier 92 (P# 13407).

AP-42 procedure for calculating wind erosion from stockpiles:

Chapter 13.2.5 Industrial Wind Erosion, dated 11/2006.

(Website: <https://www3.epa.gov/ttn/chief/ap42/ch13/final/c13s0205.pdf>)

EF =	emission factor, g/m ² (EF _c is for chronic conditions, EF _a is for acute conditions)
k =	particle size multiplier, dimensionless
N =	number of days of disturbances per year
P _i =	erosion potential for disturbed area, g/m ² (Per AP-42, erosion potential is assumed to be 0 between disturbances and for undisturbed areas.)
u* =	friction velocity, m/s
u _t * =	threshold friction velocity, m/s
u ₁₀ ⁺ =	fastest mile of wind, m/s, at reference anemometer height of 10 m.
A =	disturbed area, m ²
E =	emissions, grams/year

If $u^* < u_t^*$, $P_i = 0$

Equation (1):	$u^* = 0.053 * u_{10}^+$		
Equation (2):	$P_i = 58*(u^* - u_t^*)^2 + 25*(u^* - u_t^*)$		
		N	
Equation (3):	$EF = k * \sum_{i=1} P_i$		
Equation (4):	$E = EF * A$		

Variables for Conditions at Pier 92:

For Pier 92, CA $u_{10}^+ = 14.0$ mph (6.26 m/s) at reference height 10 m from weather underground webpage
 Assume $u_t^* = 1.02$ m/s for overburden at a coal mine (from Table 13.2.5-2). The typical roughness height $z = 0.005$ m

Variable	Working Face		Daily Cover Stockpile	
	Annual	Daily	Annual	Daily
u ₁₀ ⁺	6.26	6.26	6.26	6.26
u*	0.332	0.332	0.332	0.332
u _t *	1.02	1.02	1.02	1.02
P _i	0.00	0.00	0.00	0.00
N	365	1	365	1

Calculated using Equation (2): $P_i = 0$. Therefore, there will be no wind erosion emissions from the sand stockpiles using this method.

Air District will use the more conservative emissions for sand stockpiles. These are reflected in Tables 1 and 2 of the evaluation.

S-3 Road Dust (Exempt)

Fugitive Dust Emission from Unpaved Roads at Pier 92

The onsite roadways are made of compacted sand. Fugitive emission estimates from front loaders and transfer trucks on unpaved roads were performed using AP-42 Chapter 13.2.2. The quantity of particulate emissions from resuspension of loose material on the road surface due to vehicle travel on an unpaved road is estimate using the following empirical expressions:

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

E = size-specific emission factor, pounds per vehicle miles traveled (lbs/VMT)

k = particulate size multiplier (lbs/VMT) = 1.5 for PM₁₀ and 0.15 for PM_{2.5} from Table 13.2.2-2

s = surface material silt content (%) for sand and gravel processing at the Material Storage Area= 7.10

s = surface material silt content (%) for sand and gravel processing at Plant Road =4.8

a = 0.9 and b = 0.45 for PM₁₀ and PM_{2.5} from Table 13.2.2-2

W = mean vehicle weight of entire fleet traveling the road (tons)

= 43 tons for front loader and 24 tons for transfer trucks

Vehicle Type	Empty Wt pounds	Load Wt pounds	Full Wt pounds	Avg. Wt tons	Max Round Trips/Day
front loader	75000	22000	97000	43.00	546
transfer truck	16000	64000	80000	24.00	188

Maximum Vehicle Miles Traveled for Front Loaders on Unpaved Roads

	Length Controlled by			Total Length	Units
	Rain	Watered	Salts		
Unpaved Length	0	120	0	120	feet (one way)
# of Round Trips		546		546	trips/day
Annual Trips		72727		72727	trips/year
VMT/Day	0	24.8	0	24.8	miles/day
VMT/Year	0	3306	0	3306	miles/year

Control efficiency for watering = 70%

Maximum Vehicle Miles Traveled for Transfer Truck on Unpaved Roads

	Length Controlled by			Total Length	Units
	Rain	Watered	Salts		
Unpaved Length		745		745	feet (one way)
# of Round Trips		188		188	trips/day
Annual Trips		25000		25000	trips/year
VMT/Day		53.1		53.1	miles/day
VMT/Year		7055		7055	miles/year

Daily Emissions from Front Loader

	Daily Emissions [lb/day] for Front Loader	
	PM-2.5	PM-10
Uncontrolled	7.693	76.928
Controlled	2.308	23.079

Daily Emission from Transfer Truck

	Daily Emissions [lb/day] for Transfer Truck	
	PM-2.5	PM-10
Uncontrolled	8.893	88.930
Controlled	2.668	26.679

Annual Emissions from Front Loader

	Annual Emissions [TPY] for Front Loader	
	PM-2.5	PM-10
Uncontrolled	0.512	5.123
Controlled	0.154	1.537

Annual Emission from Transfer Truck

	Annual Emissions [TPY] for Transfer Truck	
	PM-2.5	PM-10
Uncontrolled	0.591	5.913
Controlled	0.177	1.774

Fugitive Dust from Paved Road at P13407 (Pier 92)

Emission calculations for vehicle travel on paved roads at Pier 92 were calculated based on AP-42 Chapter 13.2.1, updated January 2011, Equation 2:
 (Website: <https://www3.epa.gov/ttnchie1/ap42/ch13/final/c13s0201.pdf>)

$$E = k(sL)^{0.91} \times (W)^{1.02} \times \left(1 - \frac{P}{4N}\right)$$

The silt loading (sL) values for paved roads at concrete batching facilities and sand/gravel processing facilities were obtained from Table 13.2.1-3. The sL value of 12.0 g/m² at concrete batching facilities was chosen because it more accurately reflects the operations at this facility than the other factors presented in the table. The facility does not process gravel, therefore the sL value for sand and gravel processing should not apply.

- E = size-specific emission factor, pounds per vehicle miles traveled (lbs/VMT)
- k = particulate size multiplier (lbs/VMT) = 0.0022 for PM₁₀ and 0.00054 for PM_{2.5} from Table 13.2.1-1
- sL = road surface silt loading (g/m²) = 12 from Table 13.2.1-3
- P = number of wet days with at least 0.01" of precipitation (65 for Bay Area)
- N = number of days in the averaging period (365 for annual)
- W = mean vehicle weight of entire fleet traveling the road (tons) = 24 tons

Control efficiency for sweeping 20%

Maximum Vehicle Miles Traveled by Transfer Truck on Paved Roads

Paved Length	215	feet
Max Daily Round Trips	188	trips/day
Max Annual Round Trips	25000	trips/year
VMT/Day	15.3	miles/day
VMT/Year	2036	miles/year

Barge details and emissions

The barge can hold approximately 3,200 tons. Only 1 barge can unload at a time at Pier 92. The maximum proposed site throughput rate of 800,000 tons/year equates to about 260 barge trips per year.

Parameter	Tugboat - Main Engine	Tugboat - Generator Engine	Barge - Main Engine	Barge - Generator Engine	Barge - Bow Thruster Engine
Model	Caterpillar C32	John Deere Powertech 4045TFM85	Caterpillar 3512C	Caterpillar C7.1	Caterpillar C9.3
Engine Family Name	FCPXN32.1E P3	FJDXN04.51 46	ECPXN78.1A T3	GPKXN07.0B P1	GCPXN09.3E B3
Engine Power (bhp)	1,200	99	1,750	257	375
Engines per vessel	2	2	1	1	1
Barge capacity (tons/trip)	3,150				
Barge trips (trips/yr) ¹	260				
Operating time per trip (each) (hr/trip) ²	2.5	12	4	24	1
Operating time per year (each) (hr/yr) ²	650	4,380	1,040	8,760	260

Emission Factors for Tugboat and Barge Engines

Engine	Engine Power		Emission Factors				
	Total Power (bhp)	Load (%)	CO (g/hp-hr)	NO _x (g/hp-hr)	SO ₂ (g/hp-hr)	HC (g/hp-hr)	PM ₁₀ /PM _{2.5} (g/hp-hr)
Tugboat - Main Engine	2,400	30	0.67	3.54	0.37	0.19	0.05
Tugboat - Generator Engine	198	60	1.12	3.40	0.37	0.18	0.07
Barge - Main Engine	1,750	60	0.45	3.97	0.37	0.21	0.03
Barge - Generator Engine	257	60	0.97	3.51	0.37	0.12	0.04
Barge - Bow Thruster Engine	375	60	1.04	3.65	0.37	0.11	0.05

Engine	Annual Emissions (tpy)				
	CO	NO _x	SO ₂	HC	PM ₁₀ /PM _{2.5}
Tugboat - Main Engine	0.35	1.8	0.19	0.10	0.03
Tugboat - Generator Engine	0.64	2.0	0.21	0.10	0.04
Barge - Main Engine	0.54	4.8	0.44	0.25	0.04
Barge - Generator Engine	1.44	5.2	0.55	0.18	0.07
Barge - Bow Thruster Engine	0.07	0.2	0.02	0.01	3.37E-03
Total Emissions:	3.037	14.018	1.412	0.635	0.171