B.F. Sisk Dam Safety of Dam Modification Project Environmental Impact Statement / Environmental Impact Report

Appendix C2: Air Quality Emission Calculations

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Criteria Pollutant Construction Emissions Summary

Table C-1. Reservoir Restriction Alternative - Maximum Daily Emissions

	Daily Emissions (lbs/day)					
Source	**VOC**	**NOx**	**CO**	**SO2**	**PM10**	**PM2.5**
Onsite Construction Equipment	9	113	57	0	6	4
Construction Worker Commuting	0	1	5	0	1	0
Fugitive Dust	-	-	-	-	52	26
Total	**9**	**114**	**62**	**0**	**59**	**30**
Significance Threshold	100	100	100	100	100	100
Significant?	No	Yes	No	No	No	No

Note:

The San Joaquin Valley Air Pollution Control District recommends that an ambient air quality analysis (i.e., air dispersion modeling) be performed when the increase in on-site emissions exceeds the 100 pounds per day screening level of any criteria pollutant, after implementation of all enforceable mitigation measures.

Table C-2. Crest Raise Alternative (Shear Key Option) - Unmitigated Maximum Daily Emissions

	Daily Emissions (lbs/day)					
Source	**VOC**	**NOx**	**CO**	**SO2**	**PM10**	**PM2.5**
Onsite Construction Equipment	54	561	474	1	24	21
Construction Worker Commuting	0	1	10	0	2	1
Haul Truck Trips	1	34	4	0	2	1
Fugitive Dust	-	-	-	-	49	17
Total	**55**	**597**	**488**	**1**	**77**	**39**
Significance Threshold	100	100	100	100	100	100
Significant?	No	Yes	Yes	No	No	No

Note:

The San Joaquin Valley Air Pollution Control District recommends that an ambient air quality analysis (i.e., air dispersion modeling) be performed when the increase in on-site emissions exceeds the 100 pounds per day screening level of any criteria pollutant, after implementation of all enforceable mitigation measures.

Table C-3. Crest Raise Alternative (No Shear Key) - Unmitigated Maximum Daily Emissions

	Daily Emissions (lbs/day)					
Source	**VOC**	**NOx**	**CO**	**SO2**	**PM10**	**PM2.5**
Onsite Construction Equipment	48	477	467	1	21	18
Construction Worker Commuting	0	1	10	0	2	1
Haul Truck Trips	1	43	4	0	2	1
Fugitive Dust	-	-	-	-	35	12
Total	**49**	**521**	**482**	**1**	**60**	**31**
Significance Threshold	100	100	100	100	100	100
Significant?	No	Yes	Yes	No	No	No

Note:

The San Joaquin Valley Air Pollution Control District recommends that an ambient air quality analysis (i.e., air dispersion modeling) be performed when the increase in on-site emissions exceeds the 100 pounds per day screening level of any criteria pollutant, after implementation of all enforceable mitigation measures.

Criteria Pollutant Construction Emissions Summary

Table C-4. Crest Raise Alternative (Shear Key Option) - Mitigated Maximum Daily Emissions

	Daily Emissions (lbs/day)					
Source	**VOC**	**NOx**	**CO**	**SO2**	**PM10**	**PM2.5**
Onsite Construction Equipment	18	55	315	1	5	3
Construction Worker Commuting	0	1	10	0	2	1
Haul Truck Trips	0	6	3	0	2	1
Fugitive Dust	-	-	-	-	23	6
Total	**19**	**63**	**328**	**1**	**31**	**11**
Significance Threshold	100	100	100	100	100	100
Significant?	No	No	Yes	No	No	No

Note:

The San Joaquin Valley Air Pollution Control District recommends that an ambient air quality analysis (i.e., air dispersion modeling) be performed when the increase in on-site emissions exceeds the 100 pounds per day screening level of any criteria pollutant, after implementation of all enforceable mitigation measures.

Table C-5. Crest Raise Alternative (No Shear Key) - Mitigated Maximum Daily Emissions

	Daily Emissions (lbs/day)					
Source	**VOC**	**NOx**	**CO**	**SO2**	**PM10**	**PM2.5**
Onsite Construction Equipment	17	48	327	1	5	3
Construction Worker Commuting	0	1	10	0	2	1
Haul Truck Trips	1	8	3	0	2	1
Fugitive Dust	-	-	-	-	23	5
Total	**18**	**57**	**340**	**1**	**32**	**10**
Significance Threshold	100	100	100	100	100	100
Significant?	No	No	Yes	No	No	No

Note:

The San Joaquin Valley Air Pollution Control District recommends that an ambient air quality analysis (i.e., air dispersion modeling) be performed when the increase in on-site emissions exceeds the 100 pounds per day screening level of any criteria pollutant, after implementation of all enforceable mitigation measures.

Criteria Pollutant Construction Emissions Summary

Table C-6. Reservoir Restriction Alternative - Annual Emissions

	Annual Emissions (tons per year)					
Source	**VOC**	**NOx**	**CO**	**SOx**	**PM10**	**PM2.5**
Onsite Construction Equipment	0.3	4.6	1.8	0.0	0.2	0.2
Construction Worker Commuting	0.0	0.0	0.4	0.0	0.1	0.0
Fugitive Dust	-	-	-	-	1.6	0.8
Total	**0.3**	**4.7**	**2.3**	**0.0**	**1.9**	**1.0**
General Conformity Threshold	10	10	n/a	100	100	100
CEQA Significance Threshold	10	10	100	27	15	15
Exceed De Minimis Threshold?	No	No	No	No	No	No
Exceed CEQA Threshold?	No	No	No	No	No	No

Table C-7. Crest Raise Alternative (Shear Key Option) - Unmitigated Annual Emissions

	Annual Emissions (tons per year)					
Source	**VOC**	**NOx**	**CO**	**SOx**	**PM10**	**PM2.5**
Onsite Construction Equipment	8.3	85.1	65.2	0.2	3.5	3.1
Construction Worker Commuting	0.0	0.2	1.8	0.0	0.4	0.1
Haul Truck Trips	0.2	6.2	0.7	0.0	0.3	0.1
Fugitive Dust	-	-	-	-	8.9	3.0
Total	**8.5**	**91.6**	**67.7**	**0.2**	**13.2**	**6.4**
General Conformity Threshold	10	10	n/a	100	100	100
CEQA Significance Threshold	10	10	100	27	15	15
Exceed De Minimis Threshold?	No	Yes	No	No	No	No
Exceed CEQA Threshold?	No	Yes	No	No	No	No

Table C-8. Crest Raise Alternative (No Shear Key) - Unmitigated Annual Emissions

	Annual Emissions (tons per year)					
Source	**VOC**	**NOx**	**CO**	**SOx**	**PM10**	**PM2.5**
Onsite Construction Equipment	7.2	71.3	63.1	0.1	3.1	2.7
Construction Worker Commuting	0.0	0.2	1.8	0.0	0.4	0.1
Haul Truck Trips	0.2	7.8	0.8	0.0	0.4	0.1
Fugitive Dust	-	-	-	-	6.4	2.2
Total	**7.4**	**79.3**	**65.8**	**0.2**	**10.2**	**5.1**
General Conformity Threshold	10	10	n/a	100	100	100
CEQA Significance Threshold	10	10	100	27	15	15
Exceed De Minimis Threshold?	No	Yes	No	No	No	No
Exceed CEQA Threshold?	No	Yes	No	No	No	No

Table C-9. Crest Raise Alternative (Shear Key Option) - Mitigated Annual Emissions

	Annual Emissions (tons per year)					
Source	**VOC**	**NOx**	**CO**	**SOx**	**PM10**	**PM2.5**
Onsite Construction Equipment	2.7	8.2	40.9	0.2	0.6	0.4
Construction Worker Commuting	0.0	0.2	1.8	0.0	0.4	0.1
Haul Truck Trips	0.1	1.1	0.5	0.0	0.3	0.1
Fugitive Dust	-	-	-	-	4.1	1.2
Total	**2.8**	**9.5**	**43.2**	**0.2**	**5.4**	**1.8**
General Conformity Threshold	10	10	n/a	100	100	100
CEQA Significance Threshold	10	10	100	27	15	15
Exceed De Minimis Threshold?	No	No	No	No	No	No
Exceed CEQA Threshold?	No	No	No	No	No	No

Table C-10. Crest Raise Alternative (No Shear Key) - Mitigated Annual Emissions

	Annual Emissions (tons per year)					
Source	**VOC**	**NOx**	**CO**	**SOx**	**PM10**	**PM2.5**
Onsite Construction Equipment	2.5	7.1	42.1	0.1	0.7	0.5
Construction Worker Commuting	0.0	0.2	1.8	0.0	0.4	0.1
Haul Truck Trips	0.1	1.4	0.6	0.0	0.4	0.1
Fugitive Dust	-	-	-	-	4.1	0.9
Total	**2.6**	**8.7**	**44.5**	**0.2**	**5.5**	**1.6**
General Conformity Threshold	10	10	n/a	100	100	100
CEQA Significance Threshold	10	10	100	27	15	15
Exceed De Minimis Threshold?	No	No	No	No	No	No
Exceed CEQA Threshold?	No	No	No	No	No	No

Reservoir Restriction Alternative

Table C-11. Unmitigated Daily Emissions Summary

Source	Maximum Daily Emissions (pounds per day)					
	ROG	NOx	CO	SOx	PM10	PM2.5
Onsite Construction Equipment	8.6	113.3	57.0	0.2	5.6	4.5
Construction Worker Commuting	0.1	0.5	5.0	0.0	1.0	0.3
Fugitive Dust						
Bulldozing	--	--	--	--	45.2	24.8
Grading	--	--	--	--	7.2	0.8
Total	**8.7**	**113.8**	**62.1**	**0.2**	**58.9**	**30.4**

Table C-12. Unmitigated Annual Emissions Summary

Source	Annual Emissions (tons per year)					
	ROG	NOx	CO	SOx	PM10	PM2.5
Onsite Construction Equipment	0.3	4.6	1.8	0.0	0.2	0.2
Construction Worker Commuting	0.0	0.0	0.4	0.0	0.1	0.0
Fugitive Dust						
Bulldozing	--	--	--	--	1.4	0.8
Grading	--	--	--	--	0.2	0.0
Total	**0.3**	**4.7**	**2.3**	**0.0**	**1.9**	**1.0**

Reservoir Restriction Alternative

Table C-13. Onsite Exhaust Emissions

Quantity	Equipment Description--General	OFFROAD Equipment	Fuel Type	Size (hp)	ROG	CO	NOx	SOx	PM10	PM2.5	Unit	ROG, lbs/day	CO, lbs/day	NOx, lbs/day	SOx, lbs/day	PM10, lbs/day	PM2.5, lbs/day
Temporary Access Road Construction																	
1	5000 gal water truck--full time	n/a	Diesel	n/a	2.28491	8.13656	112.451	0.46518	6.3189	2.95265	g/hr	0.06045	0.21525	2.9749	0.01231	0.16717	0.07811
2	Cat D6R size dozers-Full time	ConstMin - Crawler Tractors	Diesel	175	0.20541	1.43664	2.09948	0.00209	0.11745	0.10805	g/hp-hr	1.90194	13.3022	19.4397	0.01933	1.0875	1.0005
1	Crewcab 4x4 pickup	n/a	Gasoline	n/a	1.56111	72.5344	8.52331	0.21568	1.84896	0.76429	g/hr	0.0413	1.9189	0.22548	0.00571	0.04891	0.02022
											Temporary Access Road Construction Subtotal	**2.00368**	**15.4363**	**22.64**	**0.03734**	**1.30359**	**1.09884**
Obliterate Access Road																	
1	5000 gal water truck--full time	n/a	Diesel	n/a	2.28491	8.13656	112.451	0.46518	6.3189	2.95265	g/hr	0.06045	0.21525	2.9749	0.01231	0.16717	0.07811
1	Cat D6R size dozers-Full time	ConstMin - Crawler Tractors	Diesel	175	0.20541	1.43664	2.09948	0.00209	0.11745	0.10805	g/hp-hr	0.95097	6.65109	9.71983	0.00966	0.54375	0.50025
1	Crewcab 4x4 pickup	n/a	Gasoline	n/a	1.56111	72.5344	8.52331	0.21568	1.84896	0.76429	g/hr	0.0413	1.9189	0.22548	0.00571	0.04891	0.02022
											Obliterate Access Road Subtotal	**1.05271**	**8.78524**	**12.9202**	**0.02768**	**0.75983**	**0.59858**
Seed Exposed Reservoir Slopes																	
Grading Support																	
2	4000 gal water trucks	n/a	Diesel	n/a	2.28491	8.13656	112.451	0.46518	6.3189	2.95265	g/hr	0.12089	0.43051	5.9498	0.02461	0.33433	0.15622
2	Cat 14H size motorgraders	ConstMin - Graders	Diesel	240	0.14042	0.56512	1.75578	0.00199	0.05823	0.05357	g/hp-hr	1.78309	7.17613	22.2957	0.0253	0.73944	0.68029
2	Cat D6R size dozers	ConstMin - Crawler Tractors	Diesel	175	0.20541	1.43664	2.09948	0.00209	0.11745	0.10805	g/hp-hr	1.90194	13.3022	19.4397	0.01933	1.0875	1.0005
1	Cat 623 size scraper	ConstMin - Scrapers	Diesel	407	0.14263	1.02359	1.68173	0.00235	0.06412	0.05899	g/hp-hr	1.53577	11.0212	18.1075	0.02535	0.69044	0.6352
											Grading Support Subtotal	**5.34169**	**31.93**	**65.7926**	**0.09459**	**2.85172**	**2.47222**
Seeding Subcontractor																	
4	Hydroseed trucks	n/a	Diesel	n/a	2.28491	8.13656	112.451	0.46518	6.3189	2.95265	g/hr	0.24179	0.86101	11.8996	0.04923	0.66867	0.31245
											Grand Total	**8.63988**	**57.0126**	**113.252**	**0.20883**	**5.5838**	**4.48209**

Source: CARB 2007; Hart 2017.

Table C-14. Phase Durations

Phase	Duration (Months)
Temporary Access Road Construction	2
Obliterate Access Road	2
Seed Exposed Reservoir Slopes	
Grading Support	2
Seeding Subcontractor	8
Total	**14**

Reservoir Restriction Alternative

Table C-13. Onsite Exhaust Emissions

Quantity	Equipment Description--General	ROG, tpy	CO, tpy	NOx, tpy	SOx, tpy	PM10, tpy	PM2.5, tpy
Temporary Access Road Construction							
1	5000 gal water truck--full time	0.00187	0.00667	0.09222	0.00038	0.00518	0.00242
2	Cat D6R size dozers-Full time	0.05896	0.41237	0.60263	0.0006	0.03371	0.03102
1	Crewcab 4x4 pickup	0.00128	0.05949	0.00699	0.00018	0.00152	0.00063
		0.06211	**0.47853**	**0.70184**	**0.00116**	**0.04041**	**0.03406**
Obliterate Access Road							
1	5000 gal water truck--full time	0.00187	0.00667	0.09222	0.00038	0.00518	0.00242
1	Cat D6R size dozers-Full time	0.02948	0.20618	0.30131	0.0003	0.01686	0.01551
1	Crewcab 4x4 pickup	0.00128	0.05949	0.00699	0.00018	0.00152	0.00063
		0.03263	**0.27234**	**0.40053**	**0.00086**	**0.02355**	**0.01856**
Seed Exposed Reservoir Slopes							
Grading Support							
2	4000 gal water trucks	0.00375	0.01335	0.18444	0.00076	0.01036	0.00484
2	Cat 14H size motorgraders	0.05528	0.22246	0.69117	0.00078	0.02292	0.02109
2	Cat D6R size dozers	0.05896	0.41237	0.60263	0.0006	0.03371	0.03102
1	Cat 623 size scraper	0.04761	0.34166	0.56133	0.00079	0.0214	0.01969
		0.16559	**0.98983**	**2.03957**	**0.00293**	**0.0884**	**0.07664**
Seeding Subcontractor							
4	Hydroseed trucks	0.02998	0.10677	1.47555	0.0061	0.08291	0.03874
		0.29032	**1.84747**	**4.61749**	**0.01105**	**0.23528**	**0.168**

Source: CARB 2007; Hart 2017.

Table C-14. Phase Durations

Phase
Temporary Access Road Construction
Obliterate Access Road
Seed Exposed Reservoir Slopes
Grading Support
Seeding Subcontractor
Total

PMSIZE Profiles (Weight Fraction of PM2.5/PM10)

6209	2020 OFFROAD DIESEL VEHL EXST	0.9567
115	STAT. I.C. ENGINE-GASOLINE	0.998

Source: CARB 2017

Conversions

453.6	grams per pound
2000	pounds per ton

Construction Start Year

2020

Hours of Operation

12	hours per day
	(6 AM to 6 PM)
7	days per week
31	days per month

Onsite vehicle speed

40 mph

Legend

On-highway engines - emission factors from EMFAC2014

Reservoir Restriction Alternative
Construction Worker Commuting Emissions

Table C-15. Daily Emissions (pounds per day)

Emission Factor, g/mi		*0.015*	*0.753*	*0.078*	*0.003*		*0.002*	*0.008*	*0.037*	*0.100*		*0.002*	*0.002*	*0.016*	*0.025*
Construction Phase	**No. Employees**	**ROG**	**CO**	**NOx**	**SOx**	**PM10 Total**	**PM10 Exhaust**	**PM10 Tire Wear**	**PM10 Brake Wear**	**PM10 Paved Road Dust**	**PM2.5 Total**	**PM2.5 Exhaust**	**PM2.5 Tire Wear**	**PM2.5 Brake Wear**	**PM2.5 Paved Road Dust**
Temporary Access Road Construction	5	0.01	0.66	0.07	0.00	0.13	0.00	0.01	0.03	0.09	0.04	0.00	0.00	0.01	0.02
Obliterate Access Road	4	0.01	0.53	0.05	0.00	0.10	0.00	0.01	0.03	0.07	0.03	0.00	0.00	0.01	0.02
Seed Exposed Reservoir Slopes															
Grading Support	9	0.02	1.20	0.12	0.00	0.23	0.00	0.01	0.06	0.16	0.07	0.00	0.00	0.03	0.04
Seeding Subcontractor	20	0.05	2.66	0.27	0.01	0.52	0.01	0.03	0.13	0.35	0.16	0.01	0.01	0.06	0.09
Total	**38**	**0.10**	**5.05**	**0.52**	**0.02**	**0.99**	**0.01**	**0.05**	**0.25**	**0.67**	**0.30**	**0.01**	**0.01**	**0.11**	**0.17**

Table C-16. Annual Emissions (tons per year)

Source	**Months per Phase**	**ROG**	**CO**	**NOx**	**SOx**	**PM10 Total**	**PM10 Exhaust**	**PM10 Tire Wear**	**PM10 Brake Wear**	**PM10 Paved Road Dust**	**PM2.5 Total**	**PM2.5 Exhaust**	**PM2.5 Tire Wear**	**PM2.5 Brake Wear**	**PM2.5 Paved Road Dust**
Temporary Access Road Construction	2	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Obliterate Access Road	2	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Seed Exposed Reservoir Slopes															
Grading Support	2	0.00	0.04	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Seeding Subcontractor	8	0.01	0.33	0.03	0.00	0.06	0.00	0.00	0.02	0.04	0.02	0.00	0.00	0.01	0.01
Total		**0.01**	**0.40**	**0.04**	**0.00**	**0.08**	**0.00**	**0.00**	**0.02**	**0.05**	**0.02**	**0.00**	**0.00**	**0.01**	**0.01**

<u>One-way trip distance</u>
Workers 40 miles per trip

<u>Conversions</u>
453.6 grams per pound
2,000 pounds per ton

Reservoir Restriction Alternative
Fugitive Dust Emissions - Grading

Table C-17. Equipment-Specific Grading Rates

Equipment Type	Acres/ 8hr-day	Equipment Count	Total Grading (acres/day)	Total Grading (acres/year)	Daily VMT	Annual VMT
Temporary Access Road Construction						
Crawler Tractors	0.5	2	1.5	93	1.03	63.94
	Subtotal	**2**	**1.5**	**93**	**1.03**	**63.94**
Obliterate Access Road						
Crawler Tractors	0.5	1	0.75	47	0.52	31.97
	Subtotal	**1**	**0.75**	**46.5**	**0.52**	**31.97**
Seed Exposed Reservoir Slopes						
Crawler Tractors	0.5	2	1.5	93	1.03	63.94
Graders	0.5	2	1.5	93	1.03	63.94
Scrapers	1	1	1.5	93	1.03	63.94
	Subtotal	**5**	**4.5**	**279**	**3.09**	**191.81**
	Grand Total	**8**	**6.75**	**418.5**	**4.64**	**287.72**

Source: CAPCOA. 2017. CalEEMod User's Guide, Appendix A.
Note: Grading totals increased by 50% to account for 12-hour work days.

VMT Estimate

$$VMT = A_s/W_b \times 43560(\frac{sqft}{acre})/5280(\frac{ft}{mile})$$

where:
VMT = vehicle miles traveled
As = the acreage of the grading site (acre)
Wb = blade width of the grading equipment (assumed to be 12 feet)

Equations (AP-42, Chapter 11.9):

$TSP = 0.040(S)^{2.5}$ and $PM15 = 0.051(S)^{2.0}$

where:
S = mean vehicle speed, miles per hour

Scaling Factors
PM10 0.60 (multiply the 15-micron equation by this fraction to determine emissions)
PM2.5 0.031 (multiply the TSP equation by this fraction to determine emissions)

Table C-18. Grading Emissions

	EF	Emissions	
Size	lb/VMT	lbs/day	tpy
PM10	1.54	7.2	0.2
PM2.5	0.17	0.8	0.0

Dust Control
0% reduction

Vehicle Speed
7.1 miles per hour *Source: CAPCOA 2017*

Reservoir Restriction Alternative
Fugitive Dust Emissions - Bulldozing

Table C-19. Operating Schedule

Phase	No. Dozers	Duration (months)	Hours per Day	Hours per Year
Temporary Access Road Construction	2	2	24	1,488
Obliterate Access Road	1	2	12	744
Seed Exposed Reservoir Slopes	2	2	24	1,488
Total	**5**	**6**	**60**	**3,720**

Equations (AP-42, Chapter 11.9):

$$TSP = \frac{5.7(s)^{1.2}}{M^{1.3}} \quad \text{and} \quad PM15 = \frac{1.0(s)^{1.5}}{M^{1.4}}$$

where:

s = silt content	6.9 %	(AP-42, Table 11.9-3, Overburden)
M = material moisture content	7.9 %	(AP-42, Table 11.9-3, Overburden)

Scaling Factors

PM10	0.75	(multiply the 15-micron equation by this fraction to determine emissions)
PM2.5	0.105	(multiply the TSP equation by this fraction to determine emissions)

Table C-20. Bulldozing Emissions

	EF	Emissions	
Size	lb/hr	lbs/day	tpy
PM10	0.75	45.2	1.4
PM2.5	0.41	24.8	0.8

Dust Control

0% reduction

Emission Factors
Paved Road Dust Emissions

Equation 1:

$$E = k(sL)^{0.91} \times (W)^{1.02}$$

where: E = particulate emission factor (having units matching the units of k),
k = particle size multiplier for particle size range and units of interest (see below),
sL = road surface silt loading (grams per square meter) (g/m2), and
W = average weight (tons) of the vehicles traveling the road.

Equation 2:

$$E_{ext} = [k(sL)^{0.91} \times (W)^{1.02}](1 - P/4N)$$

where: k, sL, and W are as defined in Equation 1 and
E_{ext} = annual or other long-term average emission factor in the same units as k,
P = number of "wet" days with at least 0.254 mm (0.01 in) of precipitation during the averaging period, and
N = number of days in the averaging period (e.g., 365 for annual, 91 for seasonal, 30 for monthly).

Table C-21. Particle Size Multipliers for Paved Road Equation

Size Range [a]	Ref.	Particle Size Multiplier, k [b]		
		g/VKT	g/VMT	lb/VMT
$PM_{2.5}$	[c]	0.15	0.25	0.00054
PM_{10}		0.62	1.00	0.0022
PM_{15}		0.77	1.23	0.0027
PM_{30}	[d]	3.23	5.24	0.011

Source: USEPA. 2011. Compilation of Air Pollutant Emission Factors (AP-42). Fifth Edition, Volume I. Chapter 13.2.1 Paved Roads. January. Available online at: http://www.epa.gov/ttn/chief/ap42/ch13/final/c13s0201.pdf [Accessed July 17, 2012].

Notes:

[a] Refers to airborne particulate matter (PM-x) with an aerodynamic diameter equal to or less than x micrometers.

[b] Units shown are grams per vehicle kilometer traveled (g/VKT), grams per vehicle mile traveled (g/VMT), and pounds per vehicle mile traveled (lb/VMT). The multiplier k includes unit conversions to produce emission factors in the units shown for the indicated size range from the mixed units required in Equation 1.

[c] The k-factors for $PM_{2.5}$ were based on the average $PM_{2.5}$:PM_{10} ratio of test runs in Reference 30.

[d] PM-30 is sometimes termed "suspendable particulate" (SP) and is often used as a surrogate for TSP.

Offsite Construction Vehicles

Number precipitation days >0.1 inches
Merced County 49

Road silt loading 0.03 g/m^2 (AP-42, Table 13.2.1-2, ADT > 10,000, ubiquitous baseline)
Average vehicle weight 2.4 tons

Source: CAPCOA. 2016. California Emissions Estimator Model User's Guide, Version 2016.3.1, Appendix D: Default Data Tables. September. Available online at: http://www.caleemod.com/ [Accessed on October 6, 2017].

Table C-22. Paved Road Dust Emission Factors - Offsite Construction Vehicles

	Emission Factor (g/VMT)			
	Uncontrolled		Controlled	
County	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$
Merced	0.100	0.025	0.097	0.024

Note:
Controlled emission factor only valid for long-term (annual) emissions; uncontrolled emission factor used for daily emissions.

Haul Road Vehicles

Number precipitation days >0.1 inches			
Merced County	49		
Road silt loading	0.2	g/m^2	(AP-42, Table 13.2.1-2, ADT 500-5,000, ubiquitous baseline)
Unloaded truck weight	50	tons	
	126	tons	
Average vehicle weight	88	tons	(estimated from eqiupment specifications)

Table C-23. Paved Road Dust Emission Factors - Onsite Haul Trucks

	Emission Factor (g/VMT)			
	Uncontrolled		Controlled	
County	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$
Merced	22.2	5.6	21.5	5.4

Note:
Controlled emission factor only valid for long-term (annual) emissions; uncontrolled emission factor used for daily emissions.

Crest Raise Alternative - Shear Key Option

Table C-24. Unmitigated Daily Emissions Summary

Source	Maximum Daily Emissions (pounds per day)					
	ROG	NOx	CO	SOx	PM10	PM2.5
Onsite Construction Equipment	54.2	561.4	474.4	1.1	23.8	20.7
Construction Worker Commuting	0.2	1.0	10.1	0.0	2.0	0.6
Haul Truck Trips	0.9	34.2	3.6	0.1	1.8	0.7
Fugitive Dust						
Material Handling	--	--	--	--	0.5	0.1
Bulldozing	--	--	--	--	27.2	14.9
Grading	--	--	--	--	9.9	1.1
Crushing	--	--	--	--	11.3	0.5
Blasting	--	--	--	--	0.0	0.0
Total	**55.3**	**596.7**	**488.1**	**1.2**	**76.6**	**38.6**

Table C-25. Unmitigated Annual Emissions Summary

Source	Annual Emissions (tons per year)					
	ROG	NOx	CO	SOx	PM10	PM2.5
Onsite Construction Equipment	8.3	85.1	65.2	0.2	3.5	3.1
Construction Worker Commuting	0.0	0.2	1.8	0.0	0.4	0.1
Haul Truck Trips	0.2	6.2	0.7	0.0	0.3	0.1
Fugitive Dust						
Material Handling	--	--	--	--	0.1	0.0
Bulldozing	--	--	--	--	5.0	2.7
Grading	--	--	--	--	1.8	0.2
Crushing	--	--	--	--	2.1	0.1
Blasting	--	--	--	--	0.0	0.0
Total	**8.5**	**91.6**	**67.7**	**0.2**	**13.2**	**6.4**

Construction Schedule

7 days per week

365 days per year

Crest Raise Alternative - Shear Key Option

Table C-26. Onsite Exhaust Emissions (Includes Berm and Shear Key)

Hours per Project	Equipment Description--General	Current Equipment Model	OFFROAD Equipment	Fuel Type	Size (hp)	ROG	CO	NOx	SOx	PM10	PM2.5	Unit
34,500	4" Trash pump-----Operation only!	Misc. 4" Trash Pump	OFF - Light Commercial - Pumps	Gasoline	11	4.29945	156.839	3.21856	0.00904	1.844365526	1.39352062	g/hp-hr
2,850	Crawler Mounted Hydraulic Excavator - Cat 1.25 cy bucket - 138 HP (Diesel)	Cat 320L	ConstMin - Excavators	Diesel	138	0.08898	1.17953	0.87487	0.00186	0.042521521	0.0391198	g/hp-hr
61,000	Crawler Mounted Hydra ulic Excavator - Cat S cy bucket - 513 HP (Diesel)	Cat 385	ConstMin - Excavators	Diesel	513	0.05807	0.41739	0.59221	0.00186	0.019493904	0.01793439	g/hp-hr
130	Small Engine Generator, 1.SKW, Gas, 3.5 HP	Misc. 1.5kw generator	OFF - Light Commercial - Generator Sets	Gasoline	3.5	3.05434	170.659	2.31363	0.008	0.193202905	0.14597553	g/hp-hr
58	Grove 8x4x4 Truck Mounted Hyd Crane, Single Engine, 82MT, 142' Boom, 450 HP (Diesel)	Grove TMS 900	ConstMin - Cranes	Diesel	450	0.08601	0.69198	1.04609	0.0014	0.041227065	0.0379289	g/hp-hr
225	Link-Belt Rough Terrain Hyd Crane 36 MT 105' Boom, 165 HP (Diesel)	Link belt RTC 8040	ConstMin - Cranes	Diesel	165	0.15394	1.0237	1.59026	0.0014	0.085471394	0.07863368	g/hp-hr
58	Articulated Crane for Truck Mounting 105-38 (15,000# Cap.)	misc truck crane	ConstMin - Cranes	Attachment		0	0	0	0	0	0	g/hp-hr
58	Broderson 4x4 Hyd Yard Crane Diesel 28.2MT 60.7' Boom	Broderson IC-250	ConstMin - Cranes	Diesel	120	0.15394	1.0237	1.59026	0.0014	0.085471394	0.07863368	g/hp-hr
630	Cat-Te1BoomliftTrk-4Ton (10,000 lbs), TLIOSS 42'6" ft boom	CatTHS14C	ConstMin - Cranes	Attachment		0	0	0	0	0	0	g/hp-hr
79,000	6" dia Submersible Trash Pump, 3" Solids, 230 Volt (Electric)	misc. 6" pump	OFF - Light Commercial - Pumps	Electric		0	0	0	0	0	0	g/hp-hr
130	12" Gas Cut-off Saw, 4 cubic inch engine (Blade costs are not included)	misc. cut-off saw	OFF - ConstMin - Concrete/Industrial Saws	Gasoline	9	4.39245	196.897	3.67656	0.00922	2.465494552	1.86281811	g/hp-hr
3,100	On-Highway Water Truck, 3000 Gal, 210 HP (Gas)	misc. 3000 gal water truck	n/a	Gasoline	210	3.85553	118.904	27.6463	0.50872	5.73507392	2.39253291	g/hr
106,500	On-Highway Water Truck, 4000 Gal, 250 HP (Diese l)	misc. 4000 gal water truck	n/a	Diesel	250	2.28491	8.13656	112.451	0.46518	6.318901628	2.95265047	g/hr
64,000	On-Highway li ght Duty Truck/Pickup - 4X4, 1/2T, Conventional, 191 HP (Gas)	misc. light pickup	n/a	Gasoline	191	1.56111	72.5344	8.52331	0.21568	1.848964256	0.76428653	g/hr
151,500	On-Highway Light Duty Truck/Pickup - 4X4, 1/2T, Conventional, 191 HP (Gas)	misc. light pickup	n/a	Gasoline	191	1.56111	72.5344	8.52331	0.21568	1.848964256	0.76428653	g/hr
2,950	On-Highway Light Duty Truck/Pickup - 4X4, non, CREW, 195 HP (Diesel)	1 Ton truck	n/a	Diesel	195	3.42169	18.5162	111.137	0.24588	4.878768696	2.44439476	g/hr
90,000	On-Highway Light Duty Truck/Pickup - 4X4, 3/4T, Crew, 285 HP (Gas)	Heavy duty pickup	n/a	Gasoline	285	2.03867	55.8587	16.3497	0.34008	3.425836286	1.43477711	g/hr
454,000	Cat Truck - Mechanical Drive Rear Dump, 55 MT, 35-46.S CY, 703 HP (Diesel}	Cat 773G	ConstMin - Off-Highway Trucks	Diesel	703	0.11766	0.75527	1.13756	0.00186	0.044496886	0.04093714	g/hp-hr
188	On-Highway Flatbed Truck, 4x2, 15k GVW, 210 HP (Gas)	misc. flatbed truck	n/a	Gasoline	210	3.85553	118.904	27.6463	0.50872	5.73507392	2.39253291	g/hr
2,800	On-Highway Truck Tractor - 6X6, 70K gvw, 450 HP (Diesel)	misc. heavy duty 6x6 truck tractor	n/a	Diesel	450	5.44453	21.9114	199.774	0.62595	4.999085538	2.46075421	g/hr
485	On Highway Rear Dump Truck, 8x4, 15-18 CY, 85k GVW, 450 HP (Diesel)	misc. heavy duty dump	n/a	Diesel	450	3.67646	15.6235	153.843	0.6214	4.60979958	2.08830859	g/hr
158,000	Off-Highway Water Tanker, 5000 Gal, 175 HP (Diesel}	Cat 740C w/ 5000 gal water tank	ConstMin - Off-Highway Trucks	Diesel	175	0.12029	1.28182	1.01891	0.00186	0.053401004	0.04912892	g/hp-hr
450	Hand Held Rammer - 4" to13", 3180 lb/b low, 4 HP (Gas}	misc. jumping jack	OFF - ConstMin - Tampers/Rammers	Gasoline	4	2.46402	124.919	2.27128	0.00945	1.783543616	1.34756629	g/hp-hr
107,000	Cat 825H Pad Foot Compactor, Self Propelled, 51.6"x44.4" Front Wheel Size (Diesel}	Cat 825K	ConstMin - Rollers	Diesel	435	0.06346	0.58312	0.78977	0.00184	0.026714286	0.02457714	g/hp-hr
1,650	Cat Single Drum Self Propelled Vibratory Compactor - 84" drum Width, Padfoot 163 HP (Diesel}	Cat CP74B	ConstMin - Rollers	Diesel	163	0.08067	1.09951	0.91901	0.00183	0.042214906	0.03883771	g/hp-hr
2,850	Cat Single Drum Self Propelled Vibratory Compactor - 67" drum width, Smooth drum, 96 HP (Diesel)	Cat CP44B	ConstMin - Rollers	Diesel	96	0.14195	1.3144	1.42686	0.00183	0.090756004	0.08349552	g/hp-hr
165	Skid Steer Loader, Bobcat, 3000 lb Capacity, 81 HP (Diesel)	misc. skid steer loader	ConstMin - Skid Steer Loaders	Diesel	81	0.05688	1.04592	0.62913	0.00179	0.026461497	0.02434458	g/hp-hr
120,000	Art Frm Grader-Cat. 160M, 218 hp-EROPS	Cat 14M3	ConstMin - Graders	Diesel	218	0.14042	0.56512	1.75578	0.00199	0.05823103	0.05357255	g/hp-hr
615	Dual Engine Conventional Scraper, Cat 627G, 15.7-22cy, 365 hp, (Diesel)	Cat 623K	ConstMin - Scrapers	Diesel	365	0.14263	1.02359	1.68173	0.00235	0.064124383	0.05899443	g/hp-hr
8,400	Dual Engine Conventional Scraper, Cat, 24-34 cy, 500 HP, EROPS (Diesel}	Cat 637K	ConstMin - Scrapers	Diesel	500	0.14263	1.02359	1.68173	0.00235	0.064124383	0.05899443	g/hp-hr
2,850	4WD Articulated Wheel Loader - Cat 3.65 cy bucket - 172.0 HP - EROPS (Diesel)	Cat 938K	ConstMin - Rubber Tired Loaders	Diesel	172	0.13699	1.21807	1.27227	0.00176	0.070030022	0.06442762	g/hp-hr
260	4WD Articulated Wheel Loader - Cat 5.50 cy bucket- 262 HP - EROPS (Diesel)	Cat 966K	ConstMin - Rubber Tired Loaders	Diesel	262	0.10013	0.4594	1.16422	0.00176	0.038650182	0.03555817	g/hp-hr
20,600	4WD Articu lated Wheel Loader - Cat 8.33 cy bucket- 475 HP - EROPS (Diesel)	Cat 988K	ConstMin - Rubber Tired Loaders	Diesel	475	0.10909	0.58408	1.13836	0.00175	0.04281926	0.03939372	g/hp-hr
1,270	Standard Crawler Dozer - Cat 200 hp - EROPS - Semi U (Diesel}	Cat D6T	ConstMin - Crawler Tractors	Diesel	200	0.17856	0.93854	2.21573	0.00209	0.088911462	0.08179855	g/hp-hr
116,000	Standard Crawler Dozer - Cat 310 hp - EROPS - Semi U (Diesel)	Cat D8T	ConstMin - Crawler Tractors	Diesel	310	0.11449	0.71769	1.38586	0.00209	0.052090828	0.04792356	g/hp-hr
14,500	Standard Crawler Dozer - Cat 405 hp - EROPS - Semi U (Diesel)	Cat D9T	ConstMin - Crawler Tractors	Diesel	405	0.11449	0.71769	1.38586	0.00209	0.052090828	0.04792356	g/hp-hr
1,608,772												Total

Crest Raise Alternative - Shear Key Option

Table C-26. Onsite Exhaust Emissions (Includes Berm and Shear Key)

Hours per Project	Equipment Description--General	ROG, lbs/day	CO, lbs/day	NOx, lbs/day	SOx, lbs/day	PM10, lbs/day	PM2.5, lbs/day	ROG, tpy	CO, tpy	NOx, tpy	SOx, tpy	PM10, tpy	PM2.5, tpy	Estimated Quantity	Quantity - Day	Quantity - Night	Maximum Annual Hours
34,500	4" Trash pump-----Operation only!	1.04264	38.0341	0.78052	0.00219	0.44727	0.33793	0.19028	6.94122	0.14244	0.0004	0.08163	0.06167	1	1	0	3,650
2,850	Crawler Mounted Hydraulic Excavator - Cat 1.25 cy bucket - 138 HP (Diesel)	0.2707	3.58851	2.66166	0.00567	0.12936	0.11902	0.03858	0.51136	0.37929	0.00081	0.01843	0.01696	1	1	0	2,850
61,000	Crawler Mounted Hydra ulic Excavator - Cat S cy bucket - 513 HP (Diesel)	1.97006	14.1613	20.0927	0.06306	0.6614	0.60849	0.29961	2.1537	3.05577	0.00959	0.10059	0.09254	3	2	1	9,125
130	Small Engine Generator, 1.SKW, Gas, 3.5 HP	0.23567	13.1681	0.17852	0.00062	0.01491	0.01126	0.00153	0.08559	0.00116	4E-06	9.7E-05	7.3E-05	1	1	0	130
58	Grove 8x4x4 Truck Mounted Hyd Crane, Single Engine, 82MT, 142' Boom, 450 HP (Diesel)	0.85328	6.86484	10.3779	0.0139	0.409	0.37628	0.00247	0.01991	0.0301	4E-05	0.00119	0.00109	1	1	0	58
225	Link-Belt Rough Terrain Hyd Crane 36 MT 105' Boom, 165 HP (Diesel)	0.55998	3.72376	5.78468	0.00511	0.31091	0.28604	0.0063	0.04189	0.06508	5.7E-05	0.0035	0.00322	1	1	0	225
58	Articulated Crane for Truck Mounting 105-38 (15,000# Cap.)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	58
58	Broderson 4x4 Hyd Yard Crane Diesel 28.2MT 60.7' Boom	0.40726	2.70819	4.20704	0.00371	0.22611	0.20803	0.00118	0.00785	0.0122	1.1E-05	0.00066	0.0006	1	1	0	58
630	Cat-Te1BoomliftTrk-4Ton (10,000 lbs), TLIOSS 42'6" ft boom	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	630
79,000	6" dia Submersible Trash Pump, 3" Solids, 230 Volt (Electric)	0	0	0	0	0	0	0	0	0	0	0	0	3	3	0	10,950
130	12" Gas Cut-off Saw, 4 cubic inch engine (Blade costs are not included)	0.87152	39.0669	0.72948	0.00183	0.48919	0.36961	0.00566	0.25394	0.00474	1.2E-05	0.00318	0.0024	1	1	0	130
3,100	On-Highway Water Truck, 3000 Gal, 210 HP (Gas)	0.085	2.62135	0.60949	0.01122	0.12643	0.05275	0.01317	0.40631	0.09447	0.00174	0.0196	0.00818	1	1	0	3,100
106,500	On-Highway Water Truck, 4000 Gal, 250 HP (Diese l)	0.15112	0.53813	7.43725	0.03077	0.41792	0.19528	0.02758	0.09821	1.3573	0.00561	0.07627	0.03564	3	3	0	10,950
64,000	On-Highway li ght Duty Truck/Pickup - 4X4, 1/2T, Conventional, 191 HP (Gas)	0.10325	4.79725	0.56371	0.01426	0.12229	0.05055	0.0157	0.72958	0.08573	0.00217	0.0186	0.00769	3	2	1	9,125
151,500	On-Highway Light Duty Truck/Pickup - 4X4, 1/2T, Conventional, 191 HP (Gas)	0.27533	12.7927	1.50323	0.03804	0.3261	0.13479	0.04083	1.89691	0.2229	0.00564	0.04835	0.01999	8	5	3	23,725
2,950	On-Highway Light Duty Truck/Pickup - 4X4, non, CREW, 195 HP (Diesel)	0.15087	0.81641	4.90024	0.01084	0.21511	0.10778	0.01113	0.06021	0.36139	0.0008	0.01586	0.00795	2	1	1	2,950
90,000	On-Highway Light Duty Truck/Pickup - 4X4, 3/4T, Crew, 285 HP (Gas)	0.17978	4.92581	1.44177	0.02999	0.3021	0.12652	0.02871	0.78659	0.23023	0.00479	0.04824	0.0202	4	3	1	12,775
454,000	Cat Truck - Mechanical Drive Rear Dump, 55 MT, 35-46.S CY, 703 HP (Diesel}	27.3527	175.58	264.454	0.43172	10.3443	9.5168	4.65907	29.9071	45.0453	0.07354	1.76199	1.62103	15	13	2	51,100
188	On-Highway Flatbed Truck, 4x2, 15k GVW, 210 HP (Gas)	0.085	2.62135	0.60949	0.01122	0.12643	0.05275	0.0008	0.02464	0.00573	0.00011	0.00119	0.0005	1	1	0	188
2,800	On-Highway Truck Tractor - 6X6, 70K gvw, 450 HP (Diesel)	0.24006	0.96611	8.8084	0.0276	0.22042	0.1085	0.0168	0.06763	0.61659	0.00193	0.01543	0.00759	2	1	1	2,800
485	On Highway Rear Dump Truck, 8x4, 15-18 CY, 85k GVW, 450 HP (Diesel)	0.1621	0.68887	6.78321	0.0274	0.20325	0.09208	0.00197	0.00835	0.08225	0.00033	0.00246	0.00112	2	1	1	485
158,000	Off-Highway Water Tanker, 5000 Gal, 175 HP (Diesel}	1.85627	19.7812	15.7239	0.02867	0.82409	0.75816	0.46581	4.96385	3.94573	0.00719	0.20679	0.19025	4	5	1	20,075
450	Hand Held Rammer - 4" to13", 3180 lb/b low, 4 HP (Gas}	0.21729	11.0158	0.20029	0.00083	0.15728	0.11883	0.00489	0.24786	0.00451	1.9E-05	0.00354	0.00267	1	1	0	450
107,000	Cat 825H Pad Foot Compactor, Self Propelled, 51.6"x44.4" Front Wheel Size (Diesel}	2.43433	22.3685	30.2954	0.07054	1.02475	0.94277	0.38873	3.57198	4.83779	0.01127	0.16364	0.15055	4	3	1	12,775
1,650	Cat Single Drum Self Propelled Vibratory Compactor - 84" drum Width, Padfoot 163 HP (Diesel}	0.28989	3.95107	3.30242	0.00657	0.1517	0.13956	0.02392	0.32596	0.27245	0.00054	0.01252	0.01151	1	1	0	1,650
2,850	Cat Single Drum Self Propelled Vibratory Compactor - 67" drum width, Smooth drum, 96 HP (Diesel)	0.60086	5.56361	6.03964	0.00774	0.38415	0.35342	0.04281	0.39641	0.43032	0.00055	0.02737	0.02518	2	1	1	2,850
165	Skid Steer Loader, Bobcat, 3000 lb Capacity, 81 HP (Diesel)	0.20315	3.73544	2.24689	0.0064	0.09451	0.08694	0.00084	0.01541	0.00927	2.6E-05	0.00039	0.00036	2	1	1	165
120,000	Art Frm Grader-Cat. 160M, 218 hp-EROPS	2.6994	10.8639	33.7532	0.0383	1.11943	1.02988	0.49264	1.98266	6.15995	0.00699	0.2043	0.18795	4	4	0	14,600
615	Dual Engine Conventional Scraper, Cat 627G, 15.7-22cy, 365 hp, (Diesel)	1.14774	8.23657	13.5324	0.01894	0.51599	0.47471	0.03529	0.25327	0.41612	0.00058	0.01587	0.0146	1	1	0	615
8,400	Dual Engine Conventional Scraper, Cat, 24-34 cy, 500 HP, EROPS (Diesel}	1.57225	11.283	18.5376	0.02595	0.70684	0.65029	0.28694	2.05914	3.38311	0.00474	0.129	0.11868	1	1	0	3,650
2,850	4WD Articulated Wheel Loader - Cat 3.65 cy bucket - 172.0 HP - EROPS (Diesel)	0.51946	4.61877	4.8243	0.00667	0.26555	0.2443	0.07402	0.65818	0.68746	0.00095	0.03784	0.03481	1	1	0	2,850
260	4WD Articulated Wheel Loader - Cat 5.50 cy bucket- 262 HP - EROPS (Diesel)	0.57836	2.65348	6.72458	0.01016	0.22324	0.20538	0.00752	0.0345	0.08742	0.00013	0.0029	0.00267	1	1	0	260
20,600	4WD Articu lated Wheel Loader - Cat 8.33 cy bucket- 475 HP - EROPS (Diesel)	1.14241	6.11632	11.9207	0.01836	0.44839	0.41252	0.20849	1.11623	2.17553	0.00335	0.08183	0.07529	1	1	0	3,650
1,270	Standard Crawler Dozer - Cat 200 hp - EROPS - Semi U (Diesel}	0.78729	4.13817	9.76954	0.0092	0.39203	0.36066	0.04999	0.26277	0.62037	0.00058	0.02489	0.0229	1	1	0	1,270
116,000	Standard Crawler Dozer - Cat 310 hp - EROPS - Semi U (Diesel)	3.1299	19.6194	37.885	0.05717	1.424	1.31008	0.57121	3.58055	6.91402	0.01043	0.25988	0.23909	4	4	0	14,600
14,500	Standard Crawler Dozer - Cat 405 hp - EROPS - Semi U (Diesel)	2.04453	12.8159	24.7475	0.03734	0.93019	0.85578	0.27985	1.75418	3.38731	0.00511	0.12732	0.11713	2	1	1	5,475
1,608,772		**54.2194**	**474.425**	**561.426**	**1.07197**	**23.7547**	**20.6978**	**8.29432**	**65.2239**	**85.124**	**0.16005**	**3.51534**	**3.10209**	**86**	**72**	**16**	**229,997**

PMSIZE Profiles (Weight Fraction of PM2.5/PM10)
6209 2020 OFFROAD DIESEL VEHL EXST 0.9567
115 STAT. I.C. ENGINE-GASOLINE 0.998
Source: CARB 2017

Conversions
453.6 grams per pound
2,000 pounds per ton

Construction Start Year
2020

Hours of Operation
10 hours per shift

Duration
10 years
6 months per year for night construction

Onsite vehicle speed
40 mph

Legend
On-highway engines - emission factors from EMFAC2014
Value estimated
Equipment operated during night shift

Maximum Operating Hours per Equipment
36,500 hours per project
(assumes 365 days per year)

Crest Raise Alternative - Shear Key Option
Offsite Exhaust Emissions

Table C-27. Estimated Number of Truckloads

Material	Tons	Tons/ Load	Total Trips
CAS--Zone 6	1,106,280	22	50,285
Stab. Berm--Zone 6	*1,404,000*	*22*	*63,818*
CAS--Zone 9A	1,240,200	22	56,373
CAS--Zone 9B	1,066,320	22	48,469
Zone 9B from onsite	*(1,066,320)*	*22*	*(48,469)*
CAS--Pipe Bedding	1,500	22	68
Stab. Berm--Pipe Bedding	*1,700*	*22*	*77*
CAS--Pipe			6
Stab. Berm--Pipe			*7*
Asphalt	7,900	21	376
Demo asphalt	7,000	20	350
Mobilization			100
Demobilization			100
Dispose of asbestos CMP			*40*
	CAS Subtotal		156,128
	Stability Berm Subtotal		15,473
Number of Truck Loads from CAS and Stability Berm			171,601
Seeding			0
Dewatering			20
MgCl			100
Total Truck Trips (Round Trips)			**171,721**
Average Daily Round Trips			**47**

Source: Hart 2017.

Table C-28. Emission Factors (g/mi)

Source	ROG	CO	NOx	SOx	PM10 Exhaust	PM10 Tire Wear	PM10 Brake Wear	PM10 Paved Road Dust	PM2.5 Exhaust	PM2.5 Tire Wear	PM2.5 Brake Wear	PM2.5 Paved Road Dust
Construction workers	0.015	0.753	0.078	0.003	0.002	0.008	0.037	0.100	0.002	0.002	0.016	0.025
Haul trucks	0.104	0.430	4.124	0.016	0.019	0.036	0.062	0.100	0.018	0.009	0.026	0.025

Source: CARB 2014

Table C-29. Daily Emissions (pounds per day)

Source	ROG	CO	NOx	SOx	PM10 Exhaust	PM10 Tire Wear	PM10 Brake Wear	PM10 Paved Road Dust	PM2.5 Exhaust	PM2.5 Tire Wear	PM2.5 Brake Wear	PM2.5 Paved Road Dust
Construction workers	0.21	10.10	1.04	0.04	0.02	0.11	0.49	1.35	0.02	0.03	0.21	0.34
Haul trucks	0.86	3.57	34.22	0.13	0.16	0.30	0.51	0.83	0.15	0.07	0.22	0.21
Total	**1.07**	**13.67**	**35.26**	**0.17**	**0.18**	**0.41**	**1.00**	**2.18**	**0.17**	**0.10**	**0.43**	**0.55**

Table C-30. Annual Emissions (tons per year)

Source	ROG	CO	NOx	SOx	PM10 Exhaust	PM10 Tire Wear	PM10 Brake Wear	PM10 Paved Road Dust	PM2.5 Exhaust	PM2.5 Tire Wear	PM2.5 Brake Wear	PM2.5 Paved Road Dust
Construction workers	0.04	1.84	0.19	0.01	0.00	0.02	0.09	0.25	0.00	0.00	0.04	0.06
Haul trucks	0.16	0.65	6.25	0.02	0.03	0.05	0.09	0.15	0.03	0.01	0.04	0.04
Total	**0.19**	**2.49**	**6.44**	**0.03**	**0.03**	**0.07**	**0.18**	**0.40**	**0.03**	**0.02**	**0.08**	**0.10**

One-way trip distance

Workers 40 miles per trip

Trucks 40 miles per trip

Maximum Daily Workers

76 workers per day

(46 for day shift; 30 for night shift)

Conversions

453.6 grams per pound

2,000 pounds per ton

Operating Schedule

365 days per year

10 years

Crest Raise Alternative - Shear Key Option
Fugitive Dust Emissions - Material Handling

Excavated Volume

733	cubic yards per shift
2,676,000	cubic yards per project
267,600	cubic yards per year

Equation (AP-42, Chapter 13.2.4):

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

where:
E = emission factor, pound per ton
k = particle size multiplier
U = mean wind speed, miles per hour
M = material moisture content, %

Average Wind Speed 9.18 mph
Source: MesoWest, Station CF031 (Rt. 152 San Luis), 2016 data. Accessed on: October 6, 2017. Available at: mesowest.utah.edu.

Material Moisture Content: 12 %
Source: EPA. 2006. AP-42, Chapter 13.2.4, cover moisture content (default used by CalEEMod)

Table C-31. Material Handling Emissions

		EF	Emissions	
Size	**k**	**lb/ton**	**lbs/day**	**tpy**
PM10	0.35	2.0E-04	0.53	0.10
PM2.5	0.053	3.0E-05	0.08	0.01

Operating Schedule

1	shift per day
7	days per week
365	days per year
10	years

Density
1.8 tons per cubic yard
Note: Provided by Reclamation

Number of Drops
2 drops per truck *(one drop at borrow site and one drop at dam site)*

Crest Raise Alternative - Shear Key Option
Fugitive Dust Emissions - Grading

Table C-32. Equipment-Specific Grading Rates

Equipment Type	Acres/ 8hr-day	Equipment Count	Total Grading (acres/day)	Total Grading (acres/year)
Crawler Tractors	0.5	7	4.375	1,597
Graders	0.5	4	2.5	913
Rubber Tired Dozers	0.5	0	0	0
Scrapers	1	2	2.5	913
Total		**13**	**9.375**	**3,422**

Source: CAPCOA. 2017. CalEEMod User's Guide, Appendix A.
Note: Grading totals increased by 50% to account for 12-hour work days.

VMT Estimate

$$VMT = A_s/W_b \times 43560(\frac{sqft}{acre})/5280(\frac{ft}{mile})$$

where:
VMT = vehicle miles traveled
As = the acreage of the grading site (acre)
Wb = blade width of the grading equipment (assumed to be 12 feet)

Calculated VMT

Daily	6.45	miles per day
Annual	2,352.54	miles per year

Equations (AP-42, Chapter 11.9):

$TSP = 0.040(S)^{2.5}$ and $PM15 = 0.051(S)^{2.0}$

where:
S = mean vehicle speed, miles per hour

Scaling Factors

PM10	0.60	(multiply the 15-micron equation by this fraction to determine emissions)
PM2.5	0.031	(multiply the TSP equation by this fraction to determine emissions)

Table C-33. Grading Emissions

Size	EF	Emissions	
	lb/VMT	lbs/day	tpy
PM10	1.54	9.9	1.8
PM2.5	0.17	1.1	0.2

Dust Control

0% reduction from watering at least 3 times per day

Construction Schedule

365	days per year
10	years
10	hours per day

Vehicle Speed

7.1 miles per hour *Source: CAPCOA 2017*

Crest Raise Alternative - Shear Key Option
Fugitive Dust Emissions - Bulldozing

Operating Schedule

131,770	hours per project
365	days per year
10	years
36	hours per day (total)
13,177	hours per year (total)

Equations (AP-42, Chapter 11.9):

$$TSP = \frac{5.7(s)^{1.2}}{M^{1.3}} \quad \text{and} \quad PM15 = \frac{1.0(s)^{1.5}}{M^{1.4}}$$

where:

s = silt content	6.9 %	(AP-42, Table 11.9-3, Overburden)
M = material moisture content	7.9 %	(AP-42, Table 11.9-3, Overburden)

Scaling Factors

PM10	0.75	(multiply the 15-micron equation by this fraction to determine emissions)
PM2.5	0.105	(multiply the TSP equation by this fraction to determine emissions)

Table C-34. Bulldozing Emissions

	EF	Emissions	
Size	lb/hr	lbs/day	tpy
PM10	0.75	27.2	5.0
PM2.5	0.41	14.9	2.7

Dust Control

0% reduction from watering at least 3 times per day

Crest Raise Alternative - Shear Key Option
Crushed Stone Processing Operations

Table C-35. Emission Factors (lb/ton)

Source	Total Particulate Matter	Total PM-10	Total PM-2.5
Primary Crushing (SCC 3-05-020-01)	ND	ND	ND
Primary Crushing (controlled) (SCC 3-05-020-01)	ND	ND	ND
Secondary Crushing (SCC 3-05-020-02)	ND	ND	ND
Secondary Crushing (controlled) (SCC 3-05-020-02)	ND	ND	ND
Tertiary Crushing (SCC 3-050030-03)	0.0054	0.0024	ND
Tertiary Crushing (controlled) (SCC 3-05-020-03)	0.0012	0.00054	0.0001
Fines Crushing (SCC 3-05-020-05)	0.039	0.015	ND
Fines Crushing (controlled) (SCC 3-05-020-05)	0.003	0.0012	0.00007
Screening (SCC 3-05-020-02, 03)	0.025	0.0087	ND
Screening (controlled) (SCC 3-05-020-02, 03)	0.0022	0.00074	0.00005
Fines Screening (SCC 3-05-020-21)	0.3	0.072	ND
Fines Screening (controlled) (SCC 3-05-020-21)	0.0036	0.0022	ND
Conveyor Transfer Point (SCC 3-05-020-06)	0.003	0.0011	ND
Conveyor Transfer Point (controlled) (SCC 3-05-020-06)	0.00014	4.60E-05	1.30E-05
Wet Drilling - Unfragmented Stone (SCC 3-05-020-10)	ND	8.00E-05	ND
Truck Unloading -Fragmented Stone (SCC 3-05-020-31)	ND	1.60E-05	ND
Truck Loading - Conveyor, crushed stone (SCC 3-05-020-32)	ND	0.0001	ND
Total Controlled Emission Factor	**0.01014**	**0.004922**	**0.000233**

Source: EPA. 2004. AP-42, Chapter 11.19.2: Crushed Stone Processing and Pulverized Mineral Processing.

Table C-36. Crushing Emissions from Stockpile/Borrow

Source	Cubic Yards	Tons	Daily Emissions (lbs/day)		Annual Emissions (tons/year)	
			PM10	PM2.5	PM10	PM2.5
Probable High Estimate						
Zone 4	11,660	28,963	0.04	0.00	0.01	0.00
Zone 5	18,160	45,109	0.06	0.00	0.01	0.00
Zone 7	1,777,000	4,414,068	5.95	0.28	1.09	0.05
Zone 9B	1,400,000	3,477,600	4.69	0.22	0.86	0.04
Rock Blanket	181,500	450,846	0.61	0.03	0.11	0.01
Total	**3,388,320**	**8,416,587**	**11.35**	**0.54**	**2.07**	**0.10**

Source: Bureau of Reclamation. 2017. Alternative 5: 12-ft crest raise-Rev 1 Estimate Worksheet. November 30.

Basalt Density

184	pounds per cubic foot
4,968	pounds per cubic yard
2.484	tons per cubic yard

Source:
Perry, Robert H. and Cecil H. Chilton. 1973. Chemical Engineers' Handbook; Fifth Edition.

Operating Schedule

1	shift per day
7	days per week
365	days per year
10	years

Crest Raise Alternative - Shear Key Option
Blasting Activities

Equations (AP-42, Chapter 11.9):

$$TSP = 0.000014(A)^{1.5}$$

where:
A = horizontal area (ft^2), with blasting depth ≤ 70 ft. Not for vertical face of a bench.

Scaling Factors

PM10	0.52
PM2.5	0.03

Total Blasted Quantity

3,388,320	cubic yards per project
928	cubic yards per day
4	blasts per day (estimated)
90	square feet per blast (assuming depth of 70 feet)

Table C-37. Blasting Emissions

Size	Emission Factor, lb/blast	Daily Emissions, lbs/day	Annual Emissions, tons/year
PM10	6.17E-03	2.47E-02	4.50E-03
PM2.5	3.56E-04	1.42E-03	2.60E-04

Operating Schedule

365	days per year
10	years

Emission Factors
Paved Road Dust Emissions

Equation 1:

$$E = k(sL)^{0.91} \times (W)^{1.02}$$

where: E = particulate emission factor (having units matching the units of k),
k = particle size multiplier for particle size range and units of interest (see below),
sL = road surface silt loading (grams per square meter) (g/m2), and
W = average weight (tons) of the vehicles traveling the road.

Equation 2:

$$E_{ext} = [k(sL)^{0.91} \times (W)^{1.02}](1 - P/4N)$$

where: k, sL, and W are as defined in Equation 1 and
E_{ext} = annual or other long-term average emission factor in the same units as k,
P = number of "wet" days with at least 0.254 mm (0.01 in) of precipitation during the averaging period, and
N = number of days in the averaging period (e.g., 365 for annual, 91 for seasonal, 30 for monthly).

Table C-38. Particle Size Multipliers for Paved Road Equation

Size Range [a]	Ref.	Particle Size Multiplier, k [b]		
		g/VKT	g/VMT	lb/VMT
$PM_{2.5}$	[c]	0.15	0.25	0.00054
PM_{10}		0.62	1.00	0.0022
PM_{15}		0.77	1.23	0.0027
PM_{30}	[d]	3.23	5.24	0.011

Source: USEPA. 2011. Compilation of Air Pollutant Emission Factors (AP-42). Fifth Edition, Volume I. Chapter 13.2.1 Paved Roads. January. Available online at: http://www.epa.gov/ttn/chief/ap42/ch13/final/c13s0201.pdf [Accessed July 17, 2012].

Notes:
[a] Refers to airborne particulate matter (PM-x) with an aerodynamic diameter equal to or less than x micrometers.
[b] Units shown are grams per vehicle kilometer traveled (g/VKT), grams per vehicle mile traveled (g/VMT), and pounds per vehicle mile traveled (lb/VMT). The multiplier k includes unit conversions to produce emission factors in the units shown for the indicated size range from the mixed units required in Equation 1.
[c] The k-factors for $PM_{2.5}$ were based on the average $PM_{2.5}$:PM_{10} ratio of test runs in Reference 30.
[d] PM-30 is sometimes termed "suspendable particulate" (SP) and is often used as a surrogate for TSP.

Offsite Construction Vehicles

Number precipitation days >0.1 inches
Merced County 49

Road silt loading 0.03 g/m^2 (AP-42, Table 13.2.1-2, ADT > 10,000, ubiquitous baseline)
Average vehicle weight 2.4 tons
Source: CAPCOA. 2016. California Emissions Estimator Model User's Guide, Version 2016.3.1, Appendix D: Default Data Tables. September. Available online at: http://www.caleemod.com/ [Accessed on October 6, 2017].

Table C-39. Paved Road Dust Emission Factors - Offsite Construction Vehicles

	Emission Factor (g/VMT)			
	Uncontrolled		Controlled	
County	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$
Merced	0.100	0.025	0.097	0.024

Note:
Controlled emission factor only valid for long-term (annual) emissions; uncontrolled emission factor used for daily emissions.

Haul Road Vehicles

Number precipitation days >0.1 inches			
Merced County	49		
Road silt loading	0.2	g/m^2	(AP-42, Table 13.2.1-2, ADT 500-5,000, ubiquitous baseline)
Unloaded truck weight	50	tons	
	126	tons	
Average vehicle weight	88	tons	(estimated from eqiupment specifications)

Table C-40. Paved Road Dust Emission Factors - Onsite Haul Trucks

	Emission Factor (g/VMT)			
	Uncontrolled		Controlled	
County	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$
Merced	22.2	5.6	21.5	5.4

Note:
Controlled emission factor only valid for long-term (annual) emissions; uncontrolled emission factor used for daily emissions.

Crest Raise Alternative - Shear Key Option

Table C-41. Unmitigated Daily Emissions Summary

Source	Maximum Daily Emissions (pounds per day)					
	ROG	NOx	CO	SOx	PM10	PM2.5
Onsite Construction Equipment	17.9	55.2	315.0	1.1	4.8	3.3
Construction Worker Commuting	0.2	1.0	10.1	0.0	2.0	0.6
Haul Truck Trips	0.4	6.3	2.6	0.1	1.7	0.5
Fugitive Dust						
Material Handling	--	--	--	--	0.5	0.1
Bulldozing	--	--	--	--	10.6	5.8
Grading	--	--	--	--	3.9	0.4
Crushing	--	--	--	--	11.3	0.5
Blasting	--	--	--	--	0.0	0.0
Total	**18.5**	**62.5**	**327.7**	**1.2**	**34.8**	**11.3**

Table C-42. Unmitigated Annual Emissions Summary

Source	Annual Emissions (tons per year)					
	ROG	NOx	CO	SOx	PM10	PM2.5
Onsite Construction Equipment	2.7	8.2	40.9	0.2	0.6	0.4
Construction Worker Commuting	0.0	0.2	1.8	0.0	0.4	0.1
Haul Truck Trips	0.1	1.1	0.5	0.0	0.3	0.1
Fugitive Dust						
Material Handling	--	--	--	--	0.1	0.0
Bulldozing	--	--	--	--	1.9	1.1
Grading	--	--	--	--	0.7	0.1
Crushing	--	--	--	--	2.1	0.1
Blasting	--	--	--	--	0.0	0.0
Total	**2.8**	**9.5**	**43.2**	**0.2**	**6.1**	**1.9**

Construction Schedule

7 days per week

365 days per year

Crest Raise Alternative - Shear Key Option

Table C-43. Onsite Exhaust Emissions (Includes Berm and Shear Key)

Hours per Project	Equipment Description--General	Current Equipment Model	OFFROAD Equipment	Fuel Type	Size (hp)	ROG	CO	NOx	SOx	PM10	PM2.5	Unit
34,500	4" Trash pump-----Operation only!	Misc. 4" Trash Pump	OFF - Light Commercial - Pumps	Gasoline	11	4.13702	160.786	3.18837	0.00889	1.928111636	1.45679546	g/hp-hr
2,850	Crawler Mounted Hydraulic Excavator - Cat 1.25 cy bucket - 138 HP (Diesel)	Cat 320L	ConstMin - Excavators	Diesel	138	0.0265	1.10168	0.10134	0.00187	0.003670187	0.00337657	g/hp-hr
61,000	Crawler Mounted Hydra ulic Excavator - Cat S cy bucket - 513 HP (Diesel)	Cat 385	ConstMin - Excavators	Diesel	513	0.02601	0.36826	0.10103	0.00186	0.003549062	0.00326514	g/hp-hr
130	Small Engine Generator, 1.SKW, Gas, 3.5 HP	Misc. 1.5kw generator	OFF - Light Commercial - Generator Sets	Gasoline	3.5	2.56774	170.583	2.09556	0.00796	0.170913739	0.12913483	g/hp-hr
58	Grove 8x4x4 Truck Mounted Hyd Crane, Single Engine, 82MT, 142' Boom, 450 HP (Diesel)	Grove TMS 900	ConstMin - Cranes	Diesel	450	0.01786	0.27404	0.07545	0.0014	0.002616882	0.00240753	g/hp-hr
225	Link-Belt Rough Terrain Hyd Crane 36 MT 105' Boom, 165 HP (Diesel)	Link belt RTC 8040	ConstMin - Cranes	Diesel	165	0.01883	0.82628	0.09652	0.00141	0.002709838	0.00249305	g/hp-hr
58	Articulated Crane for Truck Mounting 105-38 (15,000# Cap.)	misc truck crane	ConstMin - Cranes	Attachment		0	0	0	0	0	0	g/hp-hr
58	Broderson 4x4 Hyd Yard Crane Diesel 28.2MT 60.7' Boom	Broderson IC-250	ConstMin - Cranes	Diesel	120	0.01883	0.82628	0.09652	0.00141	0.002709838	0.00249305	g/hp-hr
630	Cat-Te1BoomliftTrk-4Ton (10,000 lbs), TLIOSS 42'6" ft boom	CatTHS14C	ConstMin - Cranes	Attachment		0	0	0	0	0	0	g/hp-hr
79,000	6" dia Submersible Trash Pump, 3" Solids, 230 Volt (Electric)	misc. 6" pump	OFF - Light Commercial - Pumps	Electric		0	0	0	0	0	0	g/hp-hr
130	12" Gas Cut-off Saw, 4 cubic inch engine (Blade costs are not included)	misc. cut-off saw	OFF - ConstMin - Concrete/Industrial Saws	Gasoline	9	4.39245	196.897	3.67656	0.00922	2.465494552	1.86281811	g/hp-hr
3,100	On-Highway Water Truck, 3000 Gal, 210 HP (Gas)	misc. 3000 gal water truck	n/a	Gasoline	210	0.31714	7.05919	3.29911	0.48866	5.728491262	2.3864804	g/hr
106,500	On-Highway Water Truck, 4000 Gal, 250 HP (Diese l)	misc. 4000 gal water truck	n/a	Diesel	250	0.95855	5.04551	11.7526	0.44691	5.783652242	2.44055574	g/hr
64,000	On-Highway li ght Duty Truck/Pickup - 4X4, 1/2T, Conventional, 191 HP (Gas)	misc. light pickup	n/a	Gasoline	191	0.26681	18.9928	1.56944	0.17463	1.855767937	0.77047092	g/hr
151,500	On-Highway Light Duty Truck/Pickup - 4X4, 1/2T, Conventional, 191 HP (Gas)	misc. light pickup	n/a	Gasoline	191	0.26681	18.9928	1.56944	0.17463	1.855767937	0.77047092	g/hr
2,950	On-Highway Light Duty Truck/Pickup - 4X4, non, CREW, 195 HP (Diesel)	1 Ton truck	n/a	Diesel	195	1.13837	3.63431	3.11206	0.2285	4.322035818	1.91174591	g/hr
90,000	On-Highway Light Duty Truck/Pickup - 4X4, 3/4T, Crew, 285 HP (Gas)	Heavy duty pickup	n/a	Gasoline	285	0.16495	4.4352	1.81774	0.3198	3.41263423	1.42261219	g/hr
454,000	Cat Truck - Mechanical Drive Rear Dump, 55 MT, 35-46.S CY, 703 HP (Diesel}	Cat 773G	ConstMin - Off-Highway Trucks	Diesel	703	0.03898	0.39072	0.10539	0.00186	0.003949737	0.00363376	g/hp-hr
188	On-Highway Flatbed Truck, 4x2, 15k GVW, 210 HP (Gas)	misc. flatbed truck	n/a	Gasoline	210	0.31714	7.05919	3.29911	0.48866	5.728491262	2.3864804	g/hr
2,800	On-Highway Truck Tractor - 6X6, 70K gvw, 450 HP (Diesel)	misc. heavy duty 6x6 truck tractor	n/a	Diesel	450	2.22462	13.1359	23.2896	0.56227	4.076319514	1.57790664	g/hr
485	On Highway Rear Dump Truck, 8x4, 15-18 CY, 85k GVW, 450 HP (Diesel)	misc. heavy duty dump	n/a	Diesel	450	1.90628	11.2562	18.2416	0.56157	4.043009744	1.54603783	g/hr
158,000	Off-Highway Water Tanker, 5000 Gal, 175 HP (Diesel}	Cat 740C w/ 5000 gal water tank	ConstMin - Off-Highway Trucks	Diesel	175	0.03722	1.17302	0.1047	0.00186	0.004107709	0.00377909	g/hp-hr
450	Hand Held Rammer - 4" to13", 3180 lb/b low, 4 HP (Gas}	misc. jumping jack	OFF - ConstMin - Tampers/Rammers	Gasoline	4	2.4479	124.645	2.25837	0.00951	1.783059199	1.34720028	g/hp-hr
107,000	Cat 825H Pad Foot Compactor, Self Propelled, 51.6"x44.4" Front Wheel Size (Diesel}	Cat 825K	ConstMin - Rollers	Diesel	435	0.02187	0.35856	0.09897	0.00185	0.003399773	0.00312779	g/hp-hr
1,650	Cat Single Drum Self Propelled Vibratory Compactor - 84" drum Width, Padfoot 163 HP (Diesel}	Cat CP74B	ConstMin - Rollers	Diesel	163	0.02088	1.0437	0.09751	0.00183	0.003383164	0.00311251	g/hp-hr
2,850	Cat Single Drum Self Propelled Vibratory Compactor - 67" drum width, Smooth drum, 96 HP (Diesel)	Cat CP44B	ConstMin - Rollers	Diesel	96	0.03015	1.18467	0.50719	0.00183	0.003624309	0.00333436	g/hp-hr
165	Skid Steer Loader, Bobcat, 3000 lb Capacity, 81 HP (Diesel)	misc. skid steer loader	ConstMin - Skid Steer Loaders	Diesel	81	0.01981	1.01923	0.09543	0.00179	0.003290923	0.00302765	g/hp-hr
120,000	Art Frm Grader-Cat. 160M, 218 hp-EROPS	Cat 14M3	ConstMin - Graders	Diesel	218	0.02864	0.39988	0.10806	0.00199	0.003812098	0.00350713	g/hp-hr
615	Dual Engine Conventional Scraper, Cat 627G, 15.7-22cy, 365 hp, (Diesel)	Cat 623K	ConstMin - Scrapers	Diesel	365	0.03203	0.46487	0.12772	0.00236	0.004467149	0.00410978	g/hp-hr
8,400	Dual Engine Conventional Scraper, Cat, 24-34 cy, 500 HP, EROPS (Diesel}	Cat 637K	ConstMin - Scrapers	Diesel	500	0.03203	0.46487	0.12772	0.00236	0.004467149	0.00410978	g/hp-hr
2,850	4WD Articulated Wheel Loader - Cat 3.65 cy bucket - 172.0 HP - EROPS (Diesel)	Cat 938K	ConstMin - Rubber Tired Loaders	Diesel	172	0.03158	1.08493	0.09785	0.00176	0.003736011	0.00343713	g/hp-hr
260	4WD Articulated Wheel Loader - Cat 5.50 cy bucket- 262 HP - EROPS (Diesel)	Cat 966K	ConstMin - Rubber Tired Loaders	Diesel	262	0.02913	0.36321	0.09675	0.00176	0.003492423	0.00321303	g/hp-hr
20,600	4WD Articu lated Wheel Loader - Cat 8.33 cy bucket- 475 HP - EROPS (Diesel)	Cat 988K	ConstMin - Rubber Tired Loaders	Diesel	475	0.03356	0.36589	0.09908	0.00177	0.003651105	0.00335902	g/hp-hr
1,270	Standard Crawler Dozer - Cat 200 hp - EROPS - Semi U (Diesel}	Cat D6T	ConstMin - Crawler Tractors	Diesel	200	0.02765	0.41563	0.11281	0.00209	0.003932293	0.00361771	g/hp-hr
116,000	Standard Crawler Dozer - Cat 310 hp - EROPS - Semi U (Diesel)	Cat D8T	ConstMin - Crawler Tractors	Diesel	310	0.02815	0.41184	0.11318	0.0021	0.003953981	0.00363766	g/hp-hr
14,500	Standard Crawler Dozer - Cat 405 hp - EROPS - Semi U (Diesel)	Cat D9T	ConstMin - Crawler Tractors	Diesel	405	0.02815	0.41184	0.11318	0.0021	0.003953981	0.00363766	g/hp-hr
1,608,772												Total

Crest Raise Alternative - Shear Key Option

Table C-43. Onsite Exhaust Emissions (Includes Berm and Shear Key)

Hours per Project	Equipment Description--General	ROG, lbs/day	CO, lbs/day	NOx, lbs/day	SOx, lbs/day	PM10, lbs/day	PM2.5, lbs/day	ROG, tpy	CO, tpy	NOx, tpy	SOx, tpy	PM10, tpy	PM2.5, tpy	Estimated Quantity	Quantity - Day	Quantity - Night	Maximum Annual Hours
34,500	4" Trash pump-----Operation only!	1.00325	38.9913	0.77319	0.00216	0.46758	0.35328	0.18309	7.11591	0.14111	0.00039	0.08533	0.06447	1	1	0	3,650
2,850	Crawler Mounted Hydraulic Excavator - Cat 1.25 cy bucket - 138 HP (Diesel)	0.08063	3.35166	0.3083	0.00568	0.01117	0.01027	0.01149	0.47761	0.04393	0.00081	0.00159	0.00146	1	1	0	2,850
61,000	Crawler Mounted Hydra ulic Excavator - Cat S cy bucket - 513 HP (Diesel)	0.88243	12.4945	3.42777	0.06327	0.12041	0.11078	0.1342	1.9002	0.52131	0.00962	0.01831	0.01685	3	2	1	9,125
130	Small Engine Generator, 1.SKW, Gas, 3.5 HP	0.19813	13.1623	0.16169	0.00061	0.01319	0.00996	0.00129	0.08555	0.00105	4E-06	8.6E-05	6.5E-05	1	1	0	130
58	Grove 8x4x4 Truck Mounted Hyd Crane, Single Engine, 82MT, 142' Boom, 450 HP (Diesel)	0.17718	2.71868	0.74855	0.01392	0.02596	0.02388	0.00051	0.00788	0.00217	4E-05	7.5E-05	6.9E-05	1	1	0	58
225	Link-Belt Rough Terrain Hyd Crane 36 MT 105' Boom, 165 HP (Diesel)	0.06851	3.00565	0.35108	0.00512	0.00986	0.00907	0.00077	0.03381	0.00395	5.8E-05	0.00011	0.0001	1	1	0	225
58	Articulated Crane for Truck Mounting 105-38 (15,000# Cap.)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	58
58	Broderson 4x4 Hyd Yard Crane Diesel 28.2MT 60.7' Boom	0.04982	2.18593	0.25533	0.00372	0.00717	0.0066	0.00014	0.00634	0.00074	1.1E-05	2.1E-05	1.9E-05	1	1	0	58
630	Cat-Te1BoomliftTrk-4Ton (10,000 lbs), TLIOSS 42'6" ft boom	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	630
79,000	6" dia Submersible Trash Pump, 3" Solids, 230 Volt (Electric)	0	0	0	0	0	0	0	0	0	0	0	0	3	3	0	10,950
130	12" Gas Cut-off Saw, 4 cubic inch engine (Blade costs are not included)	0.87152	39.0669	0.72948	0.00183	0.48919	0.36961	0.00566	0.25394	0.00474	1.2E-05	0.00318	0.0024	1	1	0	130
3,100	On-Highway Water Truck, 3000 Gal, 210 HP (Gas)	0.00699	0.15563	0.07273	0.01077	0.12629	0.05261	0.00108	0.02412	0.01127	0.00167	0.01957	0.00815	1	1	0	3,100
106,500	On-Highway Water Truck, 4000 Gal, 250 HP (Diese l)	0.0634	0.3337	0.77729	0.02956	0.38252	0.16141	0.01157	0.0609	0.14186	0.00539	0.06981	0.02946	3	3	0	10,950
64,000	On-Highway li ght Duty Truck/Pickup - 4X4, 1/2T, Conventional, 191 HP (Gas)	0.01765	1.25613	0.1038	0.01155	0.12274	0.05096	0.00268	0.19104	0.01579	0.00176	0.01867	0.00775	3	2	1	9,125
151,500	On-Highway Light Duty Truck/Pickup - 4X4, 1/2T, Conventional, 191 HP (Gas)	0.04706	3.34969	0.2768	0.0308	0.3273	0.13589	0.00698	0.4967	0.04104	0.00457	0.04853	0.02015	8	5	3	23,725
2,950	On-Highway Light Duty Truck/Pickup - 4X4, non, CREW, 195 HP (Diesel)	0.05019	0.16024	0.13722	0.01007	0.19057	0.08429	0.0037	0.01182	0.01012	0.00074	0.01405	0.00622	2	1	1	2,950
90,000	On-Highway Light Duty Truck/Pickup - 4X4, 3/4T, Crew, 285 HP (Gas)	0.01455	0.39111	0.16029	0.0282	0.30094	0.12545	0.00232	0.06246	0.0256	0.0045	0.04806	0.02003	4	3	1	12,775
454,000	Cat Truck - Mechanical Drive Rear Dump, 55 MT, 35-46.S CY, 703 HP (Diesel}	9.06218	90.832	24.5013	0.43248	0.91821	0.84475	1.54359	15.4717	4.17338	0.07367	0.1564	0.14389	15	13	2	51,100
188	On-Highway Flatbed Truck, 4x2, 15k GVW, 210 HP (Gas)	0.00699	0.15563	0.07273	0.01077	0.12629	0.05261	6.6E-05	0.00146	0.00068	0.0001	0.00119	0.00049	1	1	0	188
2,800	On-Highway Truck Tractor - 6X6, 70K gvw, 450 HP (Diesel)	0.09809	0.57918	1.02688	0.02479	0.17973	0.06957	0.00687	0.04054	0.07188	0.00174	0.01258	0.00487	2	1	1	2,800
485	On Highway Rear Dump Truck, 8x4, 15-18 CY, 85k GVW, 450 HP (Diesel)	0.08405	0.4963	0.8043	0.02476	0.17826	0.06817	0.00102	0.00602	0.00975	0.0003	0.00216	0.00083	2	1	1	485
158,000	Off-Highway Water Tanker, 5000 Gal, 175 HP (Diesel}	0.57443	18.1021	1.61571	0.02868	0.06339	0.05832	0.14415	4.5425	0.40544	0.0072	0.01591	0.01463	4	5	1	20,075
450	Hand Held Rammer - 4" to13", 3180 lb/b low, 4 HP (Gas}	0.21586	10.9916	0.19915	0.00084	0.15724	0.1188	0.00486	0.24731	0.00448	1.9E-05	0.00354	0.00267	1	1	0	450
107,000	Cat 825H Pad Foot Compactor, Self Propelled, 51.6"x44.4" Front Wheel Size (Diesel}	0.83903	13.7543	3.79632	0.07102	0.13041	0.11998	0.13398	2.19639	0.60623	0.01134	0.02083	0.01916	4	3	1	12,775
1,650	Cat Single Drum Self Propelled Vibratory Compactor - 84" drum Width, Padfoot 163 HP (Diesel}	0.07503	3.7505	0.35038	0.00657	0.01216	0.01118	0.00619	0.30942	0.02891	0.00054	0.001	0.00092	1	1	0	1,650
2,850	Cat Single Drum Self Propelled Vibratory Compactor - 67" drum width, Smooth drum, 96 HP (Diesel)	0.12762	5.0145	2.14684	0.00776	0.01534	0.01411	0.00909	0.35728	0.15296	0.00055	0.00109	0.00101	2	1	1	2,850
165	Skid Steer Loader, Bobcat, 3000 lb Capacity, 81 HP (Diesel)	0.07074	3.64012	0.34081	0.00641	0.01175	0.01081	0.00029	0.01502	0.00141	2.6E-05	4.8E-05	4.5E-05	2	1	1	165
120,000	Art Frm Grader-Cat. 160M, 218 hp-EROPS	0.55065	7.68735	2.07736	0.03821	0.07328	0.06742	0.10049	1.40294	0.37912	0.00697	0.01337	0.0123	4	4	0	14,600
615	Dual Engine Conventional Scraper, Cat 627G, 15.7-22cy, 365 hp, (Diesel)	0.25771	3.7407	1.0277	0.01901	0.03595	0.03307	0.00792	0.11503	0.0316	0.00058	0.00111	0.00102	1	1	0	615
8,400	Dual Engine Conventional Scraper, Cat, 24-34 cy, 500 HP, EROPS (Diesel}	0.35303	5.12425	1.40781	0.02604	0.04924	0.0453	0.06443	0.93518	0.25692	0.00475	0.00899	0.00827	1	1	0	3,650
2,850	4WD Articulated Wheel Loader - Cat 3.65 cy bucket - 172.0 HP - EROPS (Diesel)	0.11975	4.11392	0.37103	0.00667	0.01417	0.01303	0.01706	0.58623	0.05287	0.00095	0.00202	0.00186	1	1	0	2,850
260	4WD Articulated Wheel Loader - Cat 5.50 cy bucket- 262 HP - EROPS (Diesel)	0.16823	2.0979	0.55881	0.01016	0.02017	0.01856	0.00219	0.02727	0.00726	0.00013	0.00026	0.00024	1	1	0	260
20,600	4WD Articu lated Wheel Loader - Cat 8.33 cy bucket- 475 HP - EROPS (Diesel)	0.35145	3.83148	1.03751	0.01856	0.03823	0.03517	0.06414	0.69925	0.18934	0.00339	0.00698	0.00642	1	1	0	3,650
1,270	Standard Crawler Dozer - Cat 200 hp - EROPS - Semi U (Diesel}	0.1219	1.83257	0.4974	0.00922	0.01734	0.01595	0.00774	0.11637	0.03158	0.00059	0.0011	0.00101	1	1	0	1,270
116,000	Standard Crawler Dozer - Cat 310 hp - EROPS - Semi U (Diesel)	0.76959	11.2585	3.09406	0.05727	0.10809	0.09944	0.14045	2.05467	0.56467	0.01045	0.01973	0.01815	4	4	0	14,600
14,500	Standard Crawler Dozer - Cat 405 hp - EROPS - Semi U (Diesel)	0.50272	7.35432	2.02112	0.03741	0.07061	0.06496	0.06881	1.00662	0.27664	0.00512	0.00966	0.00889	2	1	1	5,475
1,608,772		**17.8804**	**314.981**	**55.2307**	**1.05392**	**4.81472**	**3.26529**	**2.68885**	**40.8595**	**8.20981**	**0.15801**	**0.60536**	**0.42388**	**86**	**72**	**16**	**229,997**

PMSIZE Profiles (Weight Fraction of PM2.5/PM10)
6209 2020 OFFROAD DIESEL VEHL EXST 0.9567
115 STAT. I.C. ENGINE-GASOLINE 0.998
Source: CARB 2017

Conversions
453.6 grams per pound
2,000 pounds per ton

Construction Start Year
2020

Hours of Operation
10 hours per shift
(two 10-hour shifts with 1/2 hour for lunch each shift p

Duration
10 years
6 months per year for night construction

Onsite vehicle speed
40 mph

Legend
On-highway engines - emission factors from EMFAC2014
Value estimated
Equipment operated during night shift

Maximum Operating Hours per Equipment
36,500 hours per project
(assumes 365 days per year)

Crest Raise Alternative - Shear Key Option
Offsite Exhaust Emissions

Table C-44. Estimated Number of Truckloads

Material	Tons	Tons/ Load	Total Trips
CAS--Zone 6	1,106,280	22	50,285
Stab. Berm--Zone 6	*1,404,000*	*22*	*63,818*
CAS--Zone 9A	1,240,200	22	56,373
CAS--Zone 9B	1,066,320	22	48,469
Zone 9B from onsite	*(1,066,320)*	*22*	*(48,469)*
CAS--Pipe Bedding	1,500	22	68
Stab. Berm--Pipe Bedding	*1,700*	*22*	*77*
CAS--Pipe			6
Stab. Berm--Pipe			*7*
Asphalt	7,900	21	376
Demo asphalt	7,000	20	350
Mobilization			100
Demobilization			100
Dispose of asbestos CMP			*40*
	CAS Subtotal		156,128
	Stability Berm Subtotal		15,473
Number of Truck Loads from CAS and Stability Berm			171,601
Seeding			0
Dewatering			20
MgCl			100
Total Truck Trips (Round Trips)			**171,721**
Average Daily Round Trips			**47**

Source: Hart 2017.

Table C-45. Emission Factors (g/mi)

Source	ROG	CO	NOx	SOx	PM10 Exhaust	PM10 Tire Wear	PM10 Brake Wear	PM10 Paved Road Dust	PM2.5 Exhaust	PM2.5 Tire Wear	PM2.5 Brake Wear	PM2.5 Paved Road Dust
Construction workers	0.015	0.753	0.078	0.003	0.002	0.008	0.037	0.100	0.002	0.002	0.016	0.025
Haul trucks	0.053	0.311	0.755	0.014	0.003	0.036	0.062	0.100	0.003	0.009	0.026	0.025

Source: CARB 2014

Table C-46. Daily Emissions (pounds per day)

Source	ROG	CO	NOx	SOx	PM10 Exhaust	PM10 Tire Wear	PM10 Brake Wear	PM10 Paved Road Dust	PM2.5 Exhaust	PM2.5 Tire Wear	PM2.5 Brake Wear	PM2.5 Paved Road Dust
Construction workers	0.21	10.10	1.04	0.04	0.02	0.11	0.49	1.35	0.02	0.03	0.21	0.34
Haul trucks	0.44	2.58	6.27	0.12	0.03	0.30	0.51	0.83	0.03	0.07	0.22	0.21
Total	**0.64**	**12.68**	**7.31**	**0.16**	**0.05**	**0.41**	**1.00**	**2.18**	**0.05**	**0.10**	**0.43**	**0.55**

Table C-47. Annual Emissions (tons per year)

Source	ROG	CO	NOx	SOx	PM10 Exhaust	PM10 Tire Wear	PM10 Brake Wear	PM10 Paved Road Dust	PM2.5 Exhaust	PM2.5 Tire Wear	PM2.5 Brake Wear	PM2.5 Paved Road Dust
Construction workers	0.04	1.84	0.19	0.01	0.00	0.02	0.09	0.25	0.00	0.00	0.04	0.06
Haul trucks	0.08	0.47	1.14	0.02	0.00	0.05	0.09	0.15	0.00	0.01	0.04	0.04
Total	**0.12**	**2.31**	**1.33**	**0.03**	**0.01**	**0.07**	**0.18**	**0.40**	**0.01**	**0.02**	**0.08**	**0.10**

One-way trip distance

Workers	40	miles per trip
Trucks	40	miles per trip

Maximum Daily Workers

76 workers per day
(46 for day shift; 30 for night shift)

Conversions

453.6	grams per pound
2,000	pounds per ton

Operating Schedule

365	days per year
10	years

Crest Raise Alternative - Shear Key Option
Fugitive Dust Emissions - Material Handling

Excavated Volume

733 cubic yards per shift
2,676,000 cubic yards per project
267,600 cubic yards per year

Equation (AP-42, Chapter 13.2.4):

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

where:
E = emission factor, pound per ton
k = particle size multiplier
U = mean wind speed, miles per hour
M = material moisture content, %

Average Wind Speed 9.18 mph
Source: MesoWest, Station CF031 (Rt. 152 San Luis), 2016 data. Accessed on: October 6, 2017. Available at: mesowest.utah.edu.

Material Moisture Content: 12 %
Source: EPA. 2006. AP-42, Chapter 13.2.4, cover moisture content (default used by CalEEMod)

Table C-48. Material Handling Emissions

		EF	Emissions	
Size	k	lb/ton	lbs/day	tpy
PM10	0.35	2.0E-04	0.53	0.10
PM2.5	0.053	3.0E-05	0.08	0.01

Operating Schedule

1 shift per day
7 days per week
365 days per year
10 years

Density

1.8 tons per cubic yard
Note: Provided by Reclamation

Number of Drops

2 drops per truck *(one drop at borrow site and one drop at dam site)*

Crest Raise Alternative - Shear Key Option
Fugitive Dust Emissions - Grading

Table C-49. Equipment-Specific Grading Rates

Equipment Type	Acres/ 8hr-day	Equipment Count	Total Grading (acres/day)	Total Grading (acres/year)
Crawler Tractors	0.5	7	4.375	1,597
Graders	0.5	4	2.5	913
Rubber Tired Dozers	0.5	0	0	0
Scrapers	1	2	2.5	913
Total		**13**	**9.375**	**3,422**

Source: CAPCOA. 2017. CalEEMod User's Guide, Appendix A.
Note: Grading totals increased by 50% to account for 12-hour work days.

VMT Estimate

$$VMT = A_s/W_b \times 43560(\frac{sqft}{acre})/5280(\frac{ft}{mile})$$

where:
VMT = vehicle miles traveled
As = the acreage of the grading site (acre)
Wb = blade width of the grading equipment (assumed to be 12 feet)

Calculated VMT

Daily	6.45	miles per day
Annual	2,352.54	miles per year

Equations (AP-42, Chapter 11.9):

$TSP = 0.040(S)^{2.5}$ and $PM15 = 0.051(S)^{2.0}$

where:
S = mean vehicle speed, miles per hour

Scaling Factors

PM10	0.60	(multiply the 15-micron equation by this fraction to determine emissions)
PM2.5	0.031	(multiply the TSP equation by this fraction to determine emissions)

Table C-50. Grading Emissions

Size	EF lb/VMT	Emissions lbs/day	Emissions tpy
PM10	1.54	3.9	0.7
PM2.5	0.17	0.4	0.1

Dust Control

61% reduction from watering at least 3 times per day
Source: CalEEMod

Construction Schedule

365	days	per year
10	years	
10	hours	per day

Vehicle Speed

7.1 miles per hour *Source: CAPCOA 2017*

Crest Raise Alternative - Shear Key Option
Fugitive Dust Emissions - Bulldozing

Operating Schedule

131,770	hours per project
365	days per year
10	years
36	hours per day (total)
13,177	hours per year (total)

Equations (AP-42, Chapter 11.9):

$$TSP = \frac{5.7(s)^{1.2}}{M^{1.3}} \quad \text{and} \quad PM15 = \frac{1.0(s)^{1.5}}{M^{1.4}}$$

where:

s = silt content	6.9 %	(AP-42, Table 11.9-3, Overburden)
M = material moisture content	7.9 %	(AP-42, Table 11.9-3, Overburden)

Scaling Factors

PM10	0.75	(multiply the 15-micron equation by this fraction to determine emissions)
PM2.5	0.105	(multiply the TSP equation by this fraction to determine emissions)

Table C-51. Bulldozing Emissions

	EF	Emissions	
Size	lb/hr	lbs/day	tpy
PM10	0.75	10.6	1.9
PM2.5	0.41	5.8	1.1

Dust Control

61% reduction from watering at least 3 times per day

Source: CalEEMod

Crest Raise Alternative - Shear Key Option
Crushed Stone Processing Operations

Table C-52. Emission Factors (lb/ton)

Source	Total Particulate Matter	Total PM-10	Total PM-2.5
Primary Crushing (SCC 3-05-020-01)	ND	ND	ND
Primary Crushing (controlled) (SCC 3-05-020-01)	ND	ND	ND
Secondary Crushing (SCC 3-05-020-02)	ND	ND	ND
Secondary Crushing (controlled) (SCC 3-05-020-02)	ND	ND	ND
Tertiary Crushing (SCC 3-050030-03)	0.0054	0.0024	ND
Tertiary Crushing (controlled) (SCC 3-05-020-03)	0.0012	0.00054	0.0001
Fines Crushing (SCC 3-05-020-05)	0.039	0.015	ND
Fines Crushing (controlled) (SCC 3-05-020-05)	0.003	0.0012	0.00007
Screening (SCC 3-05-020-02, 03)	0.025	0.0087	ND
Screening (controlled) (SCC 3-05-020-02, 03)	0.0022	0.00074	0.00005
Fines Screening (SCC 3-05-020-21)	0.3	0.072	ND
Fines Screening (controlled) (SCC 3-05-020-21)	0.0036	0.0022	ND
Conveyor Transfer Point (SCC 3-05-020-06)	0.003	0.0011	ND
Conveyor Transfer Point (controlled) (SCC 3-05-020-06)	0.00014	4.60E-05	1.30E-05
Wet Drilling - Unfragmented Stone (SCC 3-05-020-10)	ND	8.00E-05	ND
Truck Unloading -Fragmented Stone (SCC 3-05-020-31)	ND	1.60E-05	ND
Truck Loading - Conveyor, crushed stone (SCC 3-05-020-32)	ND	0.0001	ND
Total Controlled Emission Factor	**0.01014**	**0.004922**	**0.000233**

Source: EPA. 2004. AP-42, Chapter 11.19.2: Crushed Stone Processing and Pulverized Mineral Processing.

Table C-53. Crushing Emissions from Stockpile/Borrow

Source	Cubic Yards	Tons	Daily Emissions (lbs/day)		Annual Emissions (tons/year)	
			PM10	PM2.5	PM10	PM2.5
Probable High Estimate						
Zone 4	11,660	28,963	0.04	0.00	0.01	0.00
Zone 5	18,160	45,109	0.06	0.00	0.01	0.00
Zone 7	1,777,000	4,414,068	5.95	0.28	1.09	0.05
Zone 9B	1,400,000	3,477,600	4.69	0.22	0.86	0.04
Rock Blanket	181,500	450,846	0.61	0.03	0.11	0.01
Total	**3,388,320**	**8,416,587**	**11.35**	**0.54**	**2.07**	**0.10**

Source: Bureau of Reclamation. 2017. Alternative 5: 12-ft crest raise-Rev 1 Estimate Worksheet. November 30.

Basalt Density

184	pounds per cubic foot
4,968	pounds per cubic yard
2.484	tons per cubic yard

Source:
Perry, Robert H. and Cecil H. Chilton. 1973. Chemical Engineers' Handbook; Fifth Edition.

Operating Schedule

1	shift per day
7	days per week
365	days per year
10	years

Crest Raise Alternative - Shear Key Option
Blasting Activities

Equations (AP-42, Chapter 11.9):

$$TSP = 0.000014(A)^{1.5}$$

where:

A = horizontal area (ft^2), with blasting depth ≤ 70 ft. Not for vertical face of

Scaling Factors

PM10	0.52
PM2.5	0.03

Total Blasted Quantity

3,388,320 cubic yards per project
928 cubic yards per day
4 blasts per day (estimated)
90 square feet per blast (assuming depth of 70 feet)

Table C-54. Blasting Emissions

Size	Emission Factor, lb/blast	Daily Emissions, lbs/day	Annual Emissions, tons/year
PM10	6.17E-03	2.47E-02	4.50E-03
PM2.5	3.56E-04	1.42E-03	2.60E-04

Operating Schedule

365 days per year
10 years

Emission Factors
Paved Road Dust Emissions

Equation 1:

$$E = k(sL)^{0.91} \times (W)^{1.02}$$

where: E = particulate emission factor (having units matching the units of k),
k = particle size multiplier for particle size range and units of interest (see below),
sL = road surface silt loading (grams per square meter) (g/m2), and
W = average weight (tons) of the vehicles traveling the road.

Equation 2:

$$E_{ext} = [k(sL)^{0.91} \times (W)^{1.02}](1 - P/4N)$$

where: k, sL, and W are as defined in Equation 1 and
E_{ext} = annual or other long-term average emission factor in the same units as k,
P = number of "wet" days with at least 0.254 mm (0.01 in) of precipitation during the averaging period, and
N = number of days in the averaging period (e.g., 365 for annual, 91 for seasonal, 30 for monthly).

Table C-55. Particle Size Multipliers for Paved Road Equation

Size Range [a]	Ref.	Particle Size Multiplier, k [b]		
		g/VKT	g/VMT	lb/VMT
$PM_{2.5}$	[c]	0.15	0.25	0.00054
PM_{10}		0.62	1.00	0.0022
PM_{15}		0.77	1.23	0.0027
PM_{30}	[d]	3.23	5.24	0.011

Source: USEPA. 2011. Compilation of Air Pollutant Emission Factors (AP-42). Fifth Edition, Volume I. Chapter 13.2.1 Paved Roads. January. Available online at: http://www.epa.gov/ttn/chief/ap42/ch13/final/c13s0201.pdf [Accessed July 17, 2012].

Notes:

[a] Refers to airborne particulate matter (PM-x) with an aerodynamic diameter equal to or less than x micrometers.

[b] Units shown are grams per vehicle kilometer traveled (g/VKT), grams per vehicle mile traveled (g/VMT), and pounds per vehicle mile traveled (lb/VMT). The multiplier k includes unit conversions to produce emission factors in the units shown for the indicated size range from the mixed units required in Equation 1.

[c] The k-factors for $PM_{2.5}$ were based on the average $PM_{2.5}$:PM_{10} ratio of test runs in Reference 30.

[d] PM-30 is sometimes termed "suspendable particulate" (SP) and is often used as a surrogate for TSP.

Offsite Construction Vehicles

Number precipitation days >0.1 inches
Merced County 49

Road silt loading 0.03 g/m^2 (AP-42, Table 13.2.1-2, ADT > 10,000, ubiquitous baseline)
Average vehicle weight 2.4 tons

Source: CAPCOA. 2016. California Emissions Estimator Model User's Guide, Version 2016.3.1, Appendix D: Default Data Tables. September. Available online at: http://www.caleemod.com/ [Accessed on October 6, 2017].

Table C-56. Paved Road Dust Emission Factors - Offsite Construction Vehicles

	Emission Factor (g/VMT)			
	Uncontrolled		Controlled	
County	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$
Merced	0.100	0.025	0.097	0.024

Note:
Controlled emission factor only valid for long-term (annual) emissions; uncontrolled emission factor used for daily emissions.

Haul Road Vehicles

Number precipitation days >0.1 inches			
Merced County	49		
Road silt loading	0.2	g/m^2	(AP-42, Table 13.2.1-2, ADT 500-5,000, ubiquitous baseline)
Unloaded truck weight	50	tons	
	126	tons	
Average vehicle weight	88	tons	(estimated from eqiupment specifications)

Table C-57. Paved Road Dust Emission Factors - Onsite Haul Trucks

	Emission Factor (g/VMT)			
	Uncontrolled		Controlled	
County	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$
Merced	22.2	5.6	21.5	5.4

Note:
Controlled emission factor only valid for long-term (annual) emissions; uncontrolled emission factor used for daily emissions.

Crest Raise Alternative - No Shear Key

Table C-58. Unmitigated Daily Emissions Summary

Source	Maximum Daily Emissions (pounds per day)					
	ROG	NOx	CO	SOx	PM10	PM2.5
Onsite Construction Equipment	48.0	477.2	467.2	0.9	21.2	18.3
Construction Worker Commuting	0.2	1.0	10.1	0.0	2.0	0.6
Haul Truck Trips	1.1	42.8	4.5	0.2	2.3	0.8
Fugitive Dust						
Material Handling	--	--	--	--	0.7	0.1
Bulldozing	--	--	--	--	20.0	11.0
Grading	--	--	--	--	8.0	0.9
Crushing	--	--	--	--	14.2	0.7
Blasting	--	--	--	--	0.0	0.0
Total	**49.3**	**521.0**	**481.8**	**1.1**	**68.3**	**32.3**

Table C-59. Unmitigated Annual Emissions Summary

Source	Annual Emissions (tons per year)					
	ROG	NOx	CO	SOx	PM10	PM2.5
Onsite Construction Equipment	7.2	71.3	63.1	0.1	3.1	2.7
Construction Worker Commuting	0.0	0.2	1.8	0.0	0.4	0.1
Haul Truck Trips	0.2	7.8	0.8	0.0	0.4	0.1
Fugitive Dust						
Material Handling	--	--	--	--	0.1	0.0
Bulldozing	--	--	--	--	3.7	2.0
Grading	--	--	--	--	1.5	0.2
Crushing	--	--	--	--	2.6	0.1
Blasting	--	--	--	--	0.0	0.0
Total	**7.4**	**79.3**	**65.8**	**0.2**	**11.7**	**5.2**

Construction Schedule

7 days per week

365 days per year

Crest Raise Alternative - No Shear Key

Table C-60. Onsite Exhaust Emissions (No Shear Key)

Hours per Project	Equipment Description--General	Current Equipment Model	OFFROAD Equipment	Fuel Type	Size (hp)	ROG	CO	NOx	SOx	PM10	PM2.5	Unit
34,500	4" Trash pump-----Operation only!	Misc. 4" Trash Pump	OFF - Light Commercial - Pumps	Gasoline	11	4.29945	156.839	3.21856	0.00904	1.844365526	1.3935206	g/hp-hr
2,850	Crawler Mounted Hydraulic Excavator - Cat 1.25 cy bucket - 138 HP (Diesel)	Cat 320L	ConstMin - Excavators	Diesel	138	0.08898	1.17953	0.87487	0.00186	0.042521521	0.0391198	g/hp-hr
34,000	Crawler Mounted Hydraulic Excavator - Cat 5 cy bucket- 513 HP (Diesel)	Cat 385	ConstMin - Excavators	Diesel	513	0.05807	0.41739	0.59221	0.00186	0.019493904	0.0179344	g/hp-hr
130	Small Engine Generator, I.5KW, Gas, 3.5 HP	Misc. I .5kw generator	OFF - Light Commercial - Generator Sets	Gasoline	3.5	3.05434	170.659	2.31363	0.008	0.193202905	0.1459755	g/hp-hr
58	Grove 8x4x4 Truck Mounted Hyd Crane, Single Engine, 82MT, 142' Boom, 450 HP (Diesel)	Grove TMS 900	ConstMin - Cranes	Diesel	450	0.08601	0.69198	1.04609	0.0014	0.041227065	0.0379289	g/hp-hr
225	Link-Belt Rough Terrain Hyd Crane 36 MT 105' Boom, 165 HP (Diesel)	Link belt RTC 8040	ConstMin - Cranes	Diesel	165	0.15394	1.0237	1.59026	0.0014	0.085471394	0.0786337	g/hp-hr
58	Articulated Crane for Truck Mounting 105-38 {15,000# Cap.)	misc truck crane	ConstMin - Cranes	Attachment		0	0	0	0	0	0	g/hp-hr
58	Broderson 4x4 Hyd Yard Crane Diesel 28.2MT 60.7' Boom	Broderson IC-250	ConstMin - Cranes	Diesel	120	0.15394	1.0237	1.59026	0.0014	0.085471394	0.0786337	g/hp-hr
630	Cat-TelBoomliftTrk-4Ton {10,000 lbs), TI1055 42'6" ft boom	CatTH514C	ConstMin - Cranes	Attachment		0	0	0	0	0	0	g/hp-hr
52,000	6" dia Submersible Trash Pump, 3" Solids, 230 Volt (Electric)	misc. 6" pump	OFF - Light Commercial - Pumps	Electric		0	0	0	0	0	0	g/hp-hr
130	12" Gas Cut-off Saw, 4 cubic inch engine (Blade costs are not included)	misc. cut-off saw	OFF - ConstMin - Concrete/Industrial Saws	Gasoline	9	4.39245	196.897	3.67656	0.00922	2.465494552	1.8628181	g/hp-hr
3,100	On-Highway Water Truck, 3000 Gal, 210 HP (Gas)	misc. 3000 gal water truck	n/a	Gasoline	210	3.85553	118.904	27.6463	0.50872	5.73507392	2.3925329	g/hr
76,200	On-Highway Water Truck, 4000 Gal, 250 HP (Diesel)	misc. 4000 gal water truck	n/a	Diesel	250	2.28491	8.13656	112.451	0.46518	6.318901628	2.9526505	g/hr
37,000	On-Highway Light Duty Truck/Pickup - 4X4, 1/2T, Conventional, 191 HP (Gas)	misc. light pickup	n/a	Gasoline	191	1.56111	72.5344	8.52331	0.21568	1.848964256	0.7642865	g/hr
151,500	On-Highway Light Duty Truck/Pickup - 4X4, 1/2T, Conventional, 191 HP (Gas)	misc. light pickup	n/a	Gasoline	191	1.56111	72.5344	8.52331	0.21568	1.848964256	0.7642865	g/hr
2,950	On-Highway Light Duty Truck/Pickup- 4X4, IT on , CREW, 195 HP (Diesel)	1 Ton truck	n/a	Diesel	195	3.42169	18.5162	111.137	0.24588	4.878768696	2.4443948	g/hr
63,000	On-Highway Light Duty Truck/Pickup - 4X4, 3/4T, Crew, 285 HP (Gas)	Heavy duty pickup	n/a	Gasoline	285	2.03867	55.8587	16.3497	0.34008	3.425836286	1.4347771	g/hr
293,000	Cat Truck- Mechanical Drive Rear Dump, 55 MT, 35-46.5 CY, 703 HP (Diesel)	Cat 773G	ConstMin - Off-Highway Trucks	Diesel	703	0.11766	0.75527	1.13756	0.00186	0.044496886	0.0409371	g/hp-hr
188	On-Highway Flatbed Truck, 4x2, 15k GVW, 210 HP (Gas)	misc . flatbed truck	n/a	Gasoline	210	3.85553	118.904	27.6463	0.50872	5.73507392	2.3925329	g/hr
2,800	On-Highway Truck Tractor - 6X6, 70K gvw, 450 HP (Diesel)	misc. heavy duty 6x6 truck tractor	n/a	Diesel	450	5.44453	21.9114	199.774	0.62595	4.999085538	2.4607542	g/hr
485	On Highway Rear Dump Truck, 8x4, 15-18 CV, 85k GVW, 450 HP (Diesel)	misc. heavy duty dump	n/a	Diesel	450	3.67646	15.6235	153.843	0.6214	4.60979958	2.0883086	g/hr
76,200	Off-Highway Water Tanker, 5000 Gal, 175 HP (Diesel)	Cat 740C w/ 5000 gal water tank	ConstMin - Off-Highway Trucks	Diesel	175	0.12029	1.28182	1.01891	0.00186	0.053401004	0.0491289	g/hp-hr
450	Hand Held Rammer - 4" to13", 3180 lb/blow, 4 HP (Gas)	misc. jumping jack	OFF - ConstMin - Tampers/Rammers	Gasoline	4	2.46402	124.919	2.27128	0.00945	1.783543616	1.3475663	g/hp-hr
53,000	Cat 825H Pad Foot Compactor, Self Propelled, 51.6"x44.4" Front Wheel Size (Diesel)	Cat 825K	ConstMin - Rollers	Diesel	435	0.06346	0.58312	0.78977	0.00184	0.026714286	0.0245771	g/hp-hr
1,650	Cat Single Drum Self Propelled Vibratory Compactor - 84" drum Width, Padfoot 163 HP (Diesel)	Cat CP74B	ConstMin - Rollers	Diesel	163	0.08067	1.09951	0.91901	0.00183	0.042214906	0.0388377	g/hp-hr
2,850	Cat Single Drum Self Propelled Vibratory Compactor - 67" drum width, Smooth drum, 96 HP (Diesel)	Cat CP44B	ConstMin - Rollers	Diesel	96	0.14195	1.3144	1.42686	0.00183	0.090756004	0.0834955	g/hp-hr
165	Skid Steer Loader, Bobcat, 3000 lb Capacity, 81 HP (Diesel)	misc. skid steer loader	ConstMin - Skid Steer Loaders	Diesel	81	0.05688	1.04592	0.62913	0.00179	0.026461497	0.0243446	g/hp-hr
64,000	Art Frm Grader-Cat. 160M, 218 hp-EROPS	Cat 14M3	ConstMin - Graders	Diesel	218	0.14042	0.56512	1.75578	0.00199	0.05823103	0.0535725	g/hp-hr
615	Dual Engine Conventional Scraper , Cat 627G, 15.7-22cy , 365 hp, (Diesel)	Cat 623K	ConstMin - Scrapers	Diesel	365	0.14263	1.02359	1.68173	0.00235	0.064124383	0.0589944	g/hp-hr
8,400	Dual Engine Conventional Scraper, Cat, 24-34 cy, 500 HP, EROPS (Diesel)	Cat 637K	ConstMin - Scrapers	Diesel	500	0.14263	1.02359	1.68173	0.00235	0.064124383	0.0589944	g/hp-hr
2,850	4WD Articulated Wheel Loader - Cat 3.65 cy bucket - 172.0 HP - EROPS (Diesel)	Cat 938K	ConstMin - Rubber Tired Loaders	Diesel	172	0.13699	1.21807	1.27227	0.00176	0.070030022	0.0644276	g/hp-hr
260	4WD Articulated Wheel Loader - Cat 5.50 cy bucket - 262 HP - EROPS (Diesel)	Cat 966K	ConstMin - Rubber Tired Loaders	Diesel	262	0.10013	0.4594	1.16422	0.00176	0.038650182	0.0355582	g/hp-hr
20,600	4WD Articulated Wheel Loader - Cat 8.33 cy bucket - 475 HP - EROPS (Diesel)	Cat 988K	ConstMin - Rubber Tired Loaders	Diesel	475	0.10909	0.58408	1.13836	0.00175	0.04281926	0.0393937	g/hp-hr
1,270	Standard Crawler Dozer - Cat 200 hp - EROPS - Semi U (Diesel)	Cat D6T	ConstMin - Crawler Tractors	Diesel	200	0.17856	0.93854	2.21573	0.00209	0.088911462	0.0817985	g/hp-hr
62,000	Standard Crawler Dozer - Cat 310 hp - EROPS - Semi U (Diesel)	Cat D8T	ConstMin - Crawler Tractors	Diesel	310	0.11449	0.71769	1.38586	0.00209	0.052090828	0.0479236	g/hp-hr
14,500	Standard Crawler Dozer - Cat 405 hp - EROPS - Semi U (Diesel)	Cat D9T	ConstMin - Crawler Tractors	Diesel	405	0.11449	0.71769	1.38586	0.00209	0.052090828	0.0479236	g/hp-hr
1,063,672												**Total**

Crest Raise Alternative - No Shear Key

Table C-60. Onsite Exhaust Emissions (No Shear Key)

Hours per Project	Equipment Description--General	ROG, lbs/day	CO, lbs/day	NOx, lbs/day	SOx, lbs/day	PM10, lbs/day	PM2.5, lbs/day	ROG, tpy	CO, tpy	NOx, tpy	SOx, tpy	PM10, tpy	PM2.5, tpy	Estimated Quantity	Quantity - Day	Quantity - Night	Maximum Annual Hours
34,500	4" Trash pump-----Operation only!	2.08527	76.0682	1.56103	0.00438	0.89453	0.67587	0.38056	13.8824	0.28489	0.0008	0.16325	0.12335	2	2	0	7,300
2,850	Crawler Mounted Hydraulic Excavator - Cat 1.25 cy bucket - 138 HP (Diesel)	0.2707	3.58851	2.66166	0.00567	0.12936	0.11902	0.03858	0.51136	0.37929	0.00081	0.01843	0.01696	1	1	0	2,850
34,000	Crawler Mounted Hydraulic Excavator - Cat 5 cy bucket- 513 HP (Diesel)	2.62675	18.8818	26.7903	0.08408	0.88187	0.81132	0.35954	2.58444	3.66693	0.01151	0.12071	0.11105	4	2	2	10,950
130	Small Engine Generator, I.5KW, Gas, 3.5 HP	0.23567	13.1681	0.17852	0.00062	0.01491	0.01126	0.00153	0.08559	0.00116	4E-06	9.7E-05	7.3E-05	1	1	0	130
58	Grove 8x4x4 Truck Mounted Hyd Crane, Single Engine, 82MT, 142' Boom, 450 HP (Diesel)	0.85328	6.86484	10.3779	0.0139	0.409	0.37628	0.00247	0.01991	0.0301	4E-05	0.00119	0.00109	1	1	0	58
225	Link-Belt Rough Terrain Hyd Crane 36 MT 105' Boom, 165 HP (Diesel)	0.55998	3.72376	5.78468	0.00511	0.31091	0.28604	0.0063	0.04189	0.06508	5.7E-05	0.0035	0.00322	1	1	0	225
58	Articulated Crane for Truck Mounting 105-38 {15,000# Cap.)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	58
58	Broderson 4x4 Hyd Yard Crane Diesel 28.2MT 60.7' Boom	0.40726	2.70819	4.20704	0.00371	0.22611	0.20803	0.00118	0.00785	0.0122	1.1E-05	0.00066	0.0006	1	1	0	58
630	Cat-TelBoomliftTrk-4Ton {10,000 lbs), Tl1055 42'6" ft boom	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	630
52,000	6" dia Submersible Trash Pump, 3" Solids, 230 Volt (Electric)	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	7,300
130	12" Gas Cut-off Saw, 4 cubic inch engine (Blade costs are not included)	0.87152	39.0669	0.72948	0.00183	0.48919	0.36961	0.00566	0.25394	0.00474	1.2E-05	0.00318	0.0024	1	1	0	130
3,100	On-Highway Water Truck, 3000 Gal, 210 HP (Gas)	0.085	2.62135	0.60949	0.01122	0.12643	0.05275	0.01317	0.40631	0.09447	0.00174	0.0196	0.00818	1	1	0	3,100
76,200	On-Highway Water Truck, 4000 Gal, 250 HP (Diesel)	0.15112	0.53813	7.43725	0.03077	0.41792	0.19528	0.02758	0.09821	1.3573	0.00561	0.07627	0.03564	3	3	0	10,950
37,000	On-Highway Light Duty Truck/Pickup - 4X4, 1/2T, Conventional, 191 HP (Gas)	0.13766	6.39633	0.75161	0.01902	0.16305	0.0674	0.01884	0.8755	0.10288	0.0026	0.02232	0.00923	4	2	2	10,950
151,500	On-Highway Light Duty Truck/Pickup - 4X4, 1/2T, Conventional, 191 HP (Gas)	0.30974	14.3918	1.69113	0.04279	0.36686	0.15164	0.04711	2.18875	0.25719	0.00651	0.05579	0.02306	9	6	3	27,375
2,950	On-Highway Light Duty Truck/Pickup- 4X4, IT on , CREW, 195 HP (Diesel)	0.15087	0.81641	4.90024	0.01084	0.21511	0.10778	0.01113	0.06021	0.36139	0.0008	0.01586	0.00795	2	1	1	2,950
63,000	On-Highway Light Duty Truck/Pickup - 4X4, 3/4T, Crew, 285 HP (Gas)	0.22472	6.15727	1.80221	0.03749	0.37763	0.15815	0.03281	0.89896	0.26312	0.00547	0.05513	0.02309	5	3	2	14,600
293,000	Cat Truck- Mechanical Drive Rear Dump, 55 MT, 35-46.5 CY, 703 HP (Diesel)	23.7056	152.169	229.193	0.37416	8.9651	8.24789	3.99349	25.6346	38.6103	0.06303	1.51027	1.38945	13	11	2	43,800
188	On-Highway Flatbed Truck, 4x2, 15k GVW, 210 HP (Gas)	0.085	2.62135	0.60949	0.01122	0.12643	0.05275	0.0008	0.02464	0.00573	0.00011	0.00119	0.0005	1	1	0	188
2,800	On-Highway Truck Tractor - 6X6, 70K gvw, 450 HP (Diesel)	0.12003	0.48306	4.4042	0.0138	0.11021	0.05425	0.0168	0.06763	0.61659	0.00193	0.01543	0.00759	1	1	0	2,800
485	On Highway Rear Dump Truck, 8x4, 15-18 CV, 85k GVW, 450 HP (Diesel)	0.08105	0.34443	3.39161	0.0137	0.10163	0.04604	0.00197	0.00835	0.08225	0.00033	0.00246	0.00112	1	1	0	485
76,200	Off-Highway Water Tanker, 5000 Gal, 175 HP (Diesel)	1.3922	14.8359	11.793	0.0215	0.61807	0.56862	0.25408	2.70756	2.15222	0.00392	0.1128	0.10377	3	3	0	10,950
450	Hand Held Rammer - 4" to13", 3180 lb/blow, 4 HP (Gas)	0.21729	11.0158	0.20029	0.00083	0.15728	0.11883	0.00489	0.24786	0.00451	1.9E-05	0.00354	0.00267	1	1	0	450
53,000	Cat 825H Pad Foot Compactor, Self Propelled, 51.6"x44.4" Front Wheel Size (Diesel)	1.21716	11.1843	15.1477	0.03527	0.51238	0.47139	0.22213	2.04113	2.76445	0.00644	0.09351	0.08603	2	2	0	7,300
1,650	Cat Single Drum Self Propelled Vibratory Compactor - 84" drum Width, Padfoot 163 HP (Diesel)	0.28989	3.95107	3.30242	0.00657	0.1517	0.13956	0.02392	0.32596	0.27245	0.00054	0.01252	0.01151	1	1	0	1,650
2,850	Cat Single Drum Self Propelled Vibratory Compactor - 67" drum width, Smooth drum, 96 HP (Diesel)	0.60086	5.56361	6.03964	0.00774	0.38415	0.35342	0.04281	0.39641	0.43032	0.00055	0.02737	0.02518	2	1	1	2,850
165	Skid Steer Loader, Bobcat, 3000 lb Capacity, 81 HP (Diesel)	0.20315	3.73544	2.24689	0.0064	0.09451	0.08694	0.00084	0.01541	0.00927	2.6E-05	0.00039	0.00036	2	1	1	165
64,000	Art Frm Grader-Cat. 160M, 218 hp-EROPS	2.02455	8.1479	25.3149	0.02873	0.83957	0.77241	0.36948	1.48699	4.61996	0.00524	0.15322	0.14096	3	3	0	10,950
615	Dual Engine Conventional Scraper , Cat 627G, 15.7-22cy , 365 hp, (Diesel)	1.14774	8.23657	13.5324	0.01894	0.51599	0.47471	0.03529	0.25327	0.41612	0.00058	0.01587	0.0146	1	1	0	615
8,400	Dual Engine Conventional Scraper, Cat, 24-34 cy, 500 HP, EROPS (Diesel)	1.57225	11.283	18.5376	0.02595	0.70684	0.65029	0.28694	2.05914	3.38311	0.00474	0.129	0.11868	1	1	0	3,650
2,850	4WD Articulated Wheel Loader - Cat 3.65 cy bucket - 172.0 HP - EROPS (Diesel)	0.51946	4.61877	4.8243	0.00667	0.26555	0.2443	0.07402	0.65818	0.68746	0.00095	0.03784	0.03481	1	1	0	2,850
260	4WD Articulated Wheel Loader - Cat 5.50 cy bucket - 262 HP - EROPS (Diesel)	0.57836	2.65348	6.72458	0.01016	0.22324	0.20538	0.00752	0.0345	0.08742	0.00013	0.0029	0.00267	1	1	0	260
20,600	4WD Articulated Wheel Loader - Cat 8.33 cy bucket - 475 HP - EROPS (Diesel)	1.14241	6.11632	11.9207	0.01836	0.44839	0.41252	0.20849	1.11623	2.17553	0.00335	0.08183	0.07529	1	1	0	3,650
1,270	Standard Crawler Dozer - Cat 200 hp - EROPS - Semi U (Diesel)	0.78729	4.13817	9.76954	0.0092	0.39203	0.36066	0.04999	0.26277	0.62037	0.00058	0.02489	0.0229	1	1	0	1,270
62,000	Standard Crawler Dozer - Cat 310 hp - EROPS - Semi U (Diesel)	2.34743	14.7146	28.4138	0.04287	1.068	0.98256	0.42841	2.68541	5.18551	0.00782	0.19491	0.17932	3	3	0	10,950
14,500	Standard Crawler Dozer - Cat 405 hp - EROPS - Semi U (Diesel)	1.02227	6.40796	12.3737	0.01867	0.4651	0.42789	0.18656	1.16945	2.25821	0.00341	0.08488	0.07809	1	1	0	3,650
1,063,672		**48.0236**	**467.212**	**477.223**	**0.94215**	**21.169**	**18.2608**	**7.15489**	**63.1109**	**71.2625**	**0.13969**	**3.06081**	**2.66139**	**80**	**66**	**14**	**208,097**

PMSIZE Profiles (Weight Fraction of PM2.5/PM10)
6209 2020 OFFROAD DIESEL VEHL EXST 0.9567
115 STAT. I.C. ENGINE-GASOLINE 0.998
Source: CARB 2017

Conversions
453.6 grams per pound
2000 pounds per ton

Construction Start Year
2020

Hours of Operation
10 hours per day

Duration
8 years
6 months per year for night construction

Onsite vehicle speed
40 mph

Legend
On-highway engines - emission factors from EMFAC2014
Value estimated
Equipment operated during night shift

Maximum Operating Hours per Equipment
29,200 hours per project
(assumes 365 days per year)

Crest Raise Alternative - No Shear Key
Offsite Exhaust Emissions

Table C-61. Estimated Number of Truckloads

Material	Tons	Tons/ Load	Total Trips
CAS--Zone 6	1,106,280	22	50,285
Stab. Berm--Zone 6	*1,404,000*	*22*	*63,818*
CAS--Zone 9A	1,240,200	22	56,373
CAS--Zone 9B	1,066,320	22	48,469
Zone 9B from onsite	*(1,066,320)*	*22*	*(48,469)*
CAS--Pipe Bedding	1,500	22	68
Stab. Berm--Pipe Bedding	*1,700*	*22*	*77*
CAS--Pipe			6
Stab. Berm--Pipe			*7*
Asphalt	7,900	21	376
Demo asphalt	7,000	20	350
Mobilization			100
Demobilization			100
Dispose of asbestos CMP			*40*
	CAS Subtotal		156,128
	Stability Berm Subtotal		15,473
Number of Truck Loads from CAS and Stability Berm			171,601
Seeding			0
Dewatering			20
MgCl			100
Total Truck Trips (Round Trips)			**171,721**
Average Daily Round Trips			**59**

Table C-62. Emission Factors (g/mi)

Source	ROG	CO	NOx	SOx	PM10 Exhaust	PM10 Tire Wear	PM10 Brake Wear	PM10 Paved Road Dust	PM2.5 Exhaust	PM2.5 Tire Wear	PM2.5 Brake Wear	PM2.5 Paved Road Dust
Construction workers	0.015	0.753	0.078	0.003	0.002	0.008	0.037	0.100	0.002	0.002	0.016	0.025
Haul trucks	0.104	0.430	4.124	0.016	0.019	0.036	0.062	0.100	0.018	0.009	0.026	0.025

Table C-63. Daily Emissions (pounds per day)

Source	ROG	CO	NOx	SOx	PM10 Exhaust	PM10 Tire Wear	PM10 Brake Wear	PM10 Paved Road Dust	PM2.5 Exhaust	PM2.5 Tire Wear	PM2.5 Brake Wear	PM2.5 Paved Road Dust
Construction workers	0.21	10.10	1.04	0.04	0.02	0.11	0.49	1.35	0.02	0.03	0.21	0.34
Haul trucks	1.08	4.46	42.78	0.16	0.20	0.37	0.64	1.04	0.19	0.09	0.27	0.26
Total	**1.28**	**14.56**	**43.82**	**0.20**	**0.22**	**0.48**	**1.13**	**2.39**	**0.21**	**0.12**	**0.49**	**0.60**

Table C-64. Annual Emissions (tons per year)

Source	ROG	CO	NOx	SOx	PM10 Exhaust	PM10 Tire Wear	PM10 Brake Wear	PM10 Paved Road Dust	PM2.5 Exhaust	PM2.5 Tire Wear	PM2.5 Brake Wear	PM2.5 Paved Road Dust
Construction workers	0.04	1.84	0.19	0.01	0.00	0.02	0.09	0.25	0.00	0.00	0.04	0.06
Haul trucks	0.20	0.81	7.81	0.03	0.04	0.07	0.12	0.19	0.03	0.02	0.05	0.05
Total	**0.23**	**2.66**	**8.00**	**0.04**	**0.04**	**0.09**	**0.21**	**0.44**	**0.04**	**0.02**	**0.09**	**0.11**

One-way trip distance

Workers	40	miles per trip
Trucks	40	miles per trip

Maximum Daily Workers

76 workers per day
(46 for day shift; 30 for night shift)

Conversions

453.6	grams per pound
2,000	pounds per ton

Operating Schedule

365	days per year
8	years

Crest Raise Alternative - No Shear Key
Fugitive Dust Emissions - Material Handling

Excavated Volume

916 cubic yards per shift
2,676,000 cubic yards per project
334,500 cubic yards per year

Equation (AP-42, Chapter 13.2.4):

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

where:

E = emission factor, pound per ton
k = particle size multiplier
U = mean wind speed, miles per hour
M = material moisture content, %

Average Wind Speed 9.18 mph

Source: MesoWest, Station CF031 (Rt. 152 San Luis), 2016 data. Accessed on: October 6, 2017. Available at: mesowest.utah.edu.

Material Moisture Content: 12 %

Source: EPA. 2006. AP-42, Chapter 13.2.4, cover moisture content (default used by CalEEMod)

Table C-65. Material Handling Emissions

		EF	Emissions	
Size	k	lb/ton	lbs/day	tpy
PM10	0.35	2.0E-04	0.66	0.12
PM2.5	0.053	3.0E-05	0.10	0.02

Operating Schedule

1 shift per day
7 days per week
365 days per year
8 years

Density

1.8 tons per cubic yard

Note: Provided by Reclamation

Number of Drops

2 drops per truck *(one drop at borrow site and one drop at dam site)*

Crest Raise Alternative - No Shear Key Option
Fugitive Dust Emissions - Grading

Table C-66. Equipment-Specific Grading Rates

Equipment Type	Acres/ 8hr-day	Equipment Count	Total Grading (acres/day)	Total Grading (acres/year)
Crawler Tractors	0.5	5	3.125	1,141
Graders	0.5	3	1.875	684
Rubber Tired Dozers	0.5	0	0	0
Scrapers	1	2	2.5	913
	Total	**10**	**7.5**	**2,738**

Source: CAPCOA. 2017. CalEEMod User's Guide, Appendix A.
Note: Grading totals increased by 50% to account for 12-hour work days.

VMT Estimate

$$VMT = A_s/W_b \times 43560(\frac{sqft}{acre})/5280(\frac{ft}{mile})$$

where:
VMT = vehicle miles traveled
As = the acreage of the grading site (acre)
Wb = blade width of the grading equipment (assumed to be 12 feet)

Calculated VMT

Daily	5.16	miles per day
Annual	1,882.03	miles per year

Equations (AP-42, Chapter 11.9):

$TSP = 0.040(S)^{2.5}$ and $PM15 = 0.051(S)^{2.0}$

where:
S = mean vehicle speed, miles per hour

Scaling Factors

PM10	0.60	(multiply the 15-micron equation by this fraction to determine emissions)
PM2.5	0.031	(multiply the TSP equation by this fraction to determine emissions)

Table C-67. Grading Emissions

Size	EF	Emissions	
	lb/VMT	lbs/day	tpy
PM10	1.54	8.0	1.5
PM2.5	0.17	0.9	0.2

Dust Control

0% reduction from watering at least 3 times per day

Construction Schedule

365	days per year
8	years
10	hours per day

Vehicle Speed

7.1 miles per hour *Source: CAPCOA 2017*

Crest Raise Alternative - No Shear Key
Fugitive Dust Emissions - Bulldozing

Operating Schedule

77,770	hours per project	
365	days per year	
8	years	
27	hours per day (total)	
9,721	hours per year (total)	*assumes 365 days per year*

Equations (AP-42, Chapter 11.9):

$$TSP = \frac{5.7(s)^{1.2}}{M^{1.3}} \quad \text{and} \quad PM15 = \frac{1.0(s)^{1.5}}{M^{1.4}}$$

where:

s = silt content	6.9 %	(AP-42, Table 11.9-3, Overburden)
M = material moisture content	7.9 %	(AP-42, Table 11.9-3, Overburden)

Scaling Factors

PM10	0.75	(multiply the 15-micron equation by this fraction to determine emissions)
PM2.5	0.105	(multiply the TSP equation by this fraction to determine emissions)

Table C-68. Bulldozing Emissions

	EF	Emissions	
Size	lb/hr	lbs/day	tpy
PM10	0.75	20.0	3.7
PM2.5	0.41	11.0	2.0

Dust Control

0% reduction from watering at least 3 times per day

Crest Raise Alternative - No Shear Key
Crushed Stone Processing Operations

Table C-69. Emission Factors (lb/ton)

Source	Total Particulate Matter	Total PM-10	Total PM-2.5
Primary Crushing (SCC 3-05-020-01)	ND	ND	ND
Primary Crushing (controlled) (SCC 3-05-020-01)	ND	ND	ND
Secondary Crushing (SCC 3-05-020-02)	ND	ND	ND
Secondary Crushing (controlled) (SCC 3-05-020-02)	ND	ND	ND
Tertiary Crushing (SCC 3-050030-03)	0.0054	0.0024	ND
Tertiary Crushing (controlled) (SCC 3-05-020-03)	0.0012	0.00054	0.0001
Fines Crushing (SCC 3-05-020-05)	0.039	0.015	ND
Fines Crushing (controlled) (SCC 3-05-020-05)	0.003	0.0012	0.00007
Screening (SCC 3-05-020-02, 03)	0.025	0.0087	ND
Screening (controlled) (SCC 3-05-020-02, 03)	0.0022	0.00074	0.00005
Fines Screening (SCC 3-05-020-21)	0.3	0.072	ND
Fines Screening (controlled) (SCC 3-05-020-21)	0.0036	0.0022	ND
Conveyor Transfer Point (SCC 3-05-020-06)	0.003	0.0011	ND
Conveyor Transfer Point (controlled) (SCC 3-05-020-06)	0.00014	4.60E-05	1.30E-05
Wet Drilling - Unfragmented Stone (SCC 3-05-020-10)	ND	8.00E-05	ND
Truck Unloading -Fragmented Stone (SCC 3-05-020-31)	ND	1.60E-05	ND
Truck Loading - Conveyor, crushed stone (SCC 3-05-020-32)	ND	0.0001	ND
Total Controlled Emission Factor	**0.01014**	**0.004922**	**0.000233**

Source: EPA. 2004. AP-42, Chapter 11.19.2: Crushed Stone Processing and Pulverized Mineral Processing.

Table C-70. Crushing Emissions from Stockpile/Borrow

Source	Cubic Yards	Tons	Daily Emissions (lbs/day)		Annual Emissions (tons/year)	
			PM10	PM2.5	PM10	PM2.5
Probable High Estimate						
Zone 4	11,660	28,963	0.05	0.00	0.01	0.00
Zone 5	18,160	45,109	0.08	0.00	0.01	0.00
Zone 7	1,777,000	4,414,068	7.44	0.35	1.36	0.06
Zone 9B	1,400,000	3,477,600	5.86	0.28	1.07	0.05
Rock Blanket	181,500	450,846	0.76	0.04	0.14	0.01
Total	**3,388,320**	**8,416,587**	**14.19**	**0.67**	**2.59**	**0.12**

Source: Bureau of Reclamation. 2017. Alternative 5: 12-ft crest raise-Rev 1 Estimate Worksheet. November 30.

Basalt Density

184	pounds per cubic foot
4,968	pounds per cubic yard
2.484	tons per cubic yard

Source:
Perry, Robert H. and Cecil H. Chilton. 1973. Chemical Engineers' Handbook; Fifth Edition.

Operating Schedule

1	shift per day
7	days per week
365	days per year
8	years

Crest Raise Alternative - No Shear Key
Blasting Activities

Equations (AP-42, Chapter 11.9):

$$TSP = 0.000014(A)^{1.5}$$

where:

A = horizontal area (ft^2), with blasting depth ≤ 70 ft. Not for vertical face of

Scaling Factors

PM10	0.52
PM2.5	0.03

Total Blasted Quantity

3,388,320 cubic yards per project
1,160 cubic yards per day
4 blasts per day (estimated)
112 square feet per blast (assuming depth of 70 feet)

Table C-71. Blasting Emissions

Size	Emission Factor, lb/blast	Daily Emissions, lbs/day	Annual Emissions, tons/year
PM10	8.62E-03	3.45E-02	6.29E-03
PM2.5	4.97E-04	1.99E-03	3.63E-04

Operating Schedule

365 days per year
8 years

Emission Factors
Paved Road Dust Emissions

Equation 1:

$$E = k(sL)^{0.91} \times (W)^{1.02}$$

where: E = particulate emission factor (having units matching the units of k),
k = particle size multiplier for particle size range and units of interest (see below),
sL = road surface silt loading (grams per square meter) (g/m2), and
W = average weight (tons) of the vehicles traveling the road.

Equation 2:

$$E_{ext} = [k(sL)^{0.91} \times (W)^{1.02}](1 - P/4N)$$

where: k, sL, and W are as defined in Equation 1 and
E_{ext} = annual or other long-term average emission factor in the same units as k,
P = number of "wet" days with at least 0.254 mm (0.01 in) of precipitation during the averaging period, and
N = number of days in the averaging period (e.g., 365 for annual, 91 for seasonal, 30 for monthly).

Table C-72. Particle Size Multipliers for Paved Road Equation

Size Range [a]	Ref.	Particle Size Multiplier, k [b]		
		g/VKT	g/VMT	lb/VMT
$PM_{2.5}$	[c]	0.15	0.25	0.00054
PM_{10}		0.62	1.00	0.0022
PM_{15}		0.77	1.23	0.0027
PM_{30}	[d]	3.23	5.24	0.011

Source: USEPA. 2011. Compilation of Air Pollutant Emission Factors (AP-42). Fifth Edition, Volume I. Chapter 13.2.1 Paved Roads. January. Available online at: http://www.epa.gov/ttn/chief/ap42/ch13/final/c13s0201.pdf [Accessed July 17,
Notes:
[a] Refers to airborne particulate matter (PM-x) with an aerodynamic diameter equal to or less than x micrometers.
[b] Units shown are grams per vehicle kilometer traveled (g/VKT), grams per vehicle mile traveled (g/VMT), and pounds per vehicle mile traveled (lb/VMT). The multiplier k includes unit conversions to produce emission factors in the units shown for the indicated size range from the mixed units required in Equation 1.
[c] The k-factors for $PM_{2.5}$ were based on the average $PM_{2.5}$:PM_{10} ratio of test runs in Reference 30.
[d] PM-30 is sometimes termed "suspendable particulate" (SP) and is often used as a surrogate for TSP.

Offsite Construction Vehicles

Number precipitation days >0.1 inches
Merced County 49

Road silt loading 0.03 g/m^2 (AP-42, Table 13.2.1-2, ADT > 10,000, ubiquitous baseline)
Average vehicle weight 2.4 tons
Source: CAPCOA. 2016. California Emissions Estimator Model User's Guide, Version 2016.3.1, Appendix D: Default Data Tables. September. Available online at: http://www.caleemod.com/ [Accessed on October 6, 2017].

Table C-73. Paved Road Dust Emission Factors - Offsite Construction Vehicles

	Emission Factor (g/VMT)			
	Uncontrolled		Controlled	
County	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$
Merced	0.100	0.025	0.097	0.024

Note:
Controlled emission factor only valid for long-term (annual) emissions; uncontrolled emission factor used for daily emissions.

Haul Road Vehicles

Number precipitation days >0.1 inches			
Merced County	49		
Road silt loading	0.2	g/m^2	(AP-42, Table 13.2.1-2, ADT 500-5,000, ubiquitous baseline)
Unloaded truck weight	50	tons	
	126	tons	
Average vehicle weight	88	tons	(estimated from eqiupment specifications)

Table C-74. Paved Road Dust Emission Factors - Onsite Haul Trucks

	Emission Factor (g/VMT)			
	Uncontrolled		Controlled	
County	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$
Merced	22.2	5.6	21.5	5.4

Note:
Controlled emission factor only valid for long-term (annual) emissions; uncontrolled emission factor used for daily emissions.

Crest Raise Alternative - No Shear Key

Table C-75. Unmitigated Daily Emissions Summary

Source	Maximum Daily Emissions (pounds per day)					
	ROG	NOx	CO	SOx	PM10	PM2.5
Onsite Construction Equipment	16.7	48.5	326.6	0.9	5.0	3.4
Construction Worker Commuting	0.2	1.0	10.1	0.0	2.0	0.6
Haul Truck Trips	0.5	7.8	3.2	0.1	2.1	0.7
Fugitive Dust						
Material Handling	--	--	--	--	0.7	0.1
Bulldozing	--	--	--	--	7.8	4.3
Grading	--	--	--	--	3.1	0.3
Crushing	--	--	--	--	14.2	0.7
Blasting	--	--	--	--	0.0	0.0
Total	**17.5**	**57.3**	**339.9**	**1.1**	**34.9**	**10.1**

Table C-76. Unmitigated Annual Emissions Summary

Source	Annual Emissions (tons per year)					
	ROG	NOx	CO	SOx	PM10	PM2.5
Onsite Construction Equipment	2.5	7.1	42.1	0.1	0.7	0.5
Construction Worker Commuting	0.0	0.2	1.8	0.0	0.4	0.1
Haul Truck Trips	0.1	1.4	0.6	0.0	0.4	0.1
Fugitive Dust						
Material Handling	--	--	--	--	0.1	0.0
Bulldozing	--	--	--	--	1.4	0.8
Grading	--	--	--	--	0.6	0.1
Crushing	--	--	--	--	2.6	0.1
Blasting	--	--	--	--	0.0	0.0
Total	**2.6**	**8.7**	**44.5**	**0.2**	**6.1**	**1.7**

Construction Schedule

7 days per week

365 days per year

Crest Raise Alternative - No Shear Key

Table C-77. Onsite Exhaust Emissions (No Shear Key)

Hours per Project	Equipment Description--General	Current Equipment Model	OFFROAD Equipment	Fuel Type	Size (hp)	ROG	CO	NOx	SOx	PM10	PM2.5	Unit
34,500	4" Trash pump-----Operation only!	Misc. 4" Trash Pump	OFF - Light Commercial - Pumps	Gasoline	11	4.13702	160.786	3.18837	0.00889	1.928111636	1.4567955	g/hp-hr
2,850	Crawler Mounted Hydraulic Excavator - Cat 1.25 cy bucket - 138 HP (Diesel)	Cat 320L	ConstMin - Excavators	Diesel	138	0.0265	1.10168	0.10134	0.00187	0.003670187	0.0033766	g/hp-hr
34,000	Crawler Mounted Hydraulic Excavator - Cat 5 cy bucket- 513 HP (Diesel)	Cat 385	ConstMin - Excavators	Diesel	513	0.02601	0.36826	0.10103	0.00186	0.003549062	0.0032651	g/hp-hr
130	Small Engine Generator, I.5KW, Gas, 3.5 HP	Misc. I .5kw generator	OFF - Light Commercial - Generator Sets	Gasoline	3.5	2.56774	170.583	2.09556	0.00796	0.170913739	0.1291348	g/hp-hr
58	Grove 8x4x4 Truck Mounted Hyd Crane, Single Engine, 82MT, 142' Boom, 450 HP (Diesel)	Grove TMS 900	ConstMin - Cranes	Diesel	450	0.01786	0.27404	0.07545	0.0014	0.002616882	0.0024075	g/hp-hr
225	Link-Belt Rough Terrain Hyd Crane 36 MT 105' Boom, 165 HP (Diesel)	Link belt RTC 8040	ConstMin - Cranes	Diesel	165	0.01883	0.82628	0.09652	0.00141	0.002709838	0.0024931	g/hp-hr
58	Articulated Crane for Truck Mounting 105-38 {15,000# Cap.)	misc truck crane	ConstMin - Cranes	Attachment		0	0	0	0	0	0	g/hp-hr
58	Broderson 4x4 Hyd Yard Crane Diesel 28.2MT 60.7' Boom	Broderson IC-250	ConstMin - Cranes	Diesel	120	0.01883	0.82628	0.09652	0.00141	0.002709838	0.0024931	g/hp-hr
630	Cat-TelBoomliftTrk-4Ton {10,000 lbs), TI1055 42'6" ft boom	CatTH514C	ConstMin - Cranes	Attachment		0	0	0	0	0	0	g/hp-hr
52,000	6" dia Submersible Trash Pump, 3" Solids, 230 Volt (Electric)	misc. 6" pump	OFF - Light Commercial - Pumps	Electric		0	0	0	0	0	0	g/hp-hr
130	12" Gas Cut-off Saw, 4 cubic inch engine (Blade costs are not included)	misc. cut-off saw	OFF - ConstMin - Concrete/Industrial Saws	Gasoline	9	4.39245	196.897	3.67656	0.00922	2.465494552	1.8628181	g/hp-hr
3,100	On-Highway Water Truck, 3000 Gal, 210 HP (Gas)	misc. 3000 gal water truck	n/a	Gasoline	210	0.31714	7.05919	3.29911	0.48866	5.728491262	2.3864804	g/hr
76,200	On-Highway Water Truck, 4000 Gal, 250 HP (Diesel)	misc. 4000 gal water truck	n/a	Diesel	250	0.95855	5.04551	11.7526	0.44691	5.783652242	2.4405557	g/hr
37,000	On-Highway Light Duty Truck/Pickup - 4X4, 1/2T, Conventional, 191 HP (Gas)	misc. light pickup	n/a	Gasoline	191	0.26681	18.9928	1.56944	0.17463	1.855767937	0.7704709	g/hr
151,500	On-Highway Light Duty Truck/Pickup - 4X4, 1/2T, Conventional, 191 HP (Gas)	misc. light pickup	n/a	Gasoline	191	0.26681	18.9928	1.56944	0.17463	1.855767937	0.7704709	g/hr
2,950	On-Highway Light Duty Truck/Pickup- 4X4, IT on , CREW, 195 HP (Diesel)	1 Ton truck	n/a	Diesel	195	1.13837	3.63431	3.11206	0.2285	4.322035818	1.9117459	g/hr
63,000	On-Highway Light Duty Truck/Pickup - 4X4, 3/4T, Crew, 285 HP (Gas)	Heavy duty pickup	n/a	Gasoline	285	0.16495	4.4352	1.81774	0.3198	3.41263423	1.4226122	g/hr
293,000	Cat Truck- Mechanical Drive Rear Dump, 55 MT, 35-46.5 CY, 703 HP (Diesel)	Cat 773G	ConstMin - Off-Highway Trucks	Diesel	703	0.03898	0.39072	0.10539	0.00186	0.003949737	0.0036338	g/hp-hr
188	On-Highway Flatbed Truck, 4x2, 15k GVW, 210 HP (Gas)	misc . flatbed truck	n/a	Gasoline	210	0.31714	7.05919	3.29911	0.48866	5.728491262	2.3864804	g/hr
2,800	On-Highway Truck Tractor - 6X6, 70K gvw, 450 HP (Diesel)	misc. heavy duty 6x6 truck tractor	n/a	Diesel	450	2.22462	13.1359	23.2896	0.56227	4.076319514	1.5779066	g/hr
485	On Highway Rear Dump Truck, 8x4, 15-18 CV, 85k GVW, 450 HP (Diesel)	misc. heavy duty dump	n/a	Diesel	450	1.90628	11.2562	18.2416	0.56157	4.043009744	1.5460378	g/hr
76,200	Off-Highway Water Tanker, 5000 Gal, 175 HP (Diesel)	Cat 740C w/ 5000 gal water tank	ConstMin - Off-Highway Trucks	Diesel	175	0.03722	1.17302	0.1047	0.00186	0.004107709	0.0037791	g/hp-hr
450	Hand Held Rammer - 4" to13", 3180 lb/blow, 4 HP (Gas)	misc. jumping jack	OFF - ConstMin - Tampers/Rammers	Gasoline	4	2.4479	124.645	2.25837	0.00951	1.783059199	1.3472003	g/hp-hr
53,000	Cat 825H Pad Foot Compactor, Self Propelled, 51.6"x44.4" Front Wheel Size (Diesel)	Cat 825K	ConstMin - Rollers	Diesel	435	0.02187	0.35856	0.09897	0.00185	0.003399773	0.0031278	g/hp-hr
1,650	Cat Single Drum Self Propelled Vibratory Compactor - 84" drum Width, Padfoot 163 HP (Diesel)	Cat CP74B	ConstMin - Rollers	Diesel	163	0.02088	1.0437	0.09751	0.00183	0.003383164	0.0031125	g/hp-hr
2,850	Cat Single Drum Self Propelled Vibratory Compactor - 67" drum width, Smooth drum, 96 HP (Diesel)	Cat CP44B	ConstMin - Rollers	Diesel	96	0.03015	1.18467	0.50719	0.00183	0.003624309	0.0033344	g/hp-hr
165	Skid Steer Loader, Bobcat, 3000 lb Capacity, 81 HP (Diesel)	misc. skid steer loader	ConstMin - Skid Steer Loaders	Diesel	81	0.01981	1.01923	0.09543	0.00179	0.003290923	0.0030276	g/hp-hr
64,000	Art Frm Grader-Cat. 160M, 218 hp-EROPS	Cat 14M3	ConstMin - Graders	Diesel	218	0.02864	0.39988	0.10806	0.00199	0.003812098	0.0035071	g/hp-hr
615	Dual Engine Conventional Scraper , Cat 627G, 15.7-22cy , 365 hp, (Diesel)	Cat 623K	ConstMin - Scrapers	Diesel	365	0.03203	0.46487	0.12772	0.00236	0.004467149	0.0041098	g/hp-hr
8,400	Dual Engine Conventional Scraper, Cat, 24-34 cy, 500 HP, EROPS (Diesel)	Cat 637K	ConstMin - Scrapers	Diesel	500	0.03203	0.46487	0.12772	0.00236	0.004467149	0.0041098	g/hp-hr
2,850	4WD Articulated Wheel Loader - Cat 3.65 cy bucket - 172.0 HP - EROPS (Diesel)	Cat 938K	ConstMin - Rubber Tired Loaders	Diesel	172	0.03158	1.08493	0.09785	0.00176	0.003736011	0.0034371	g/hp-hr
260	4WD Articulated Wheel Loader - Cat 5.50 cy bucket - 262 HP - EROPS (Diesel)	Cat 966K	ConstMin - Rubber Tired Loaders	Diesel	262	0.02913	0.36321	0.09675	0.00176	0.003492423	0.003213	g/hp-hr
20,600	4WD Articulated Wheel Loader - Cat 8.33 cy bucket - 475 HP - EROPS (Diesel)	Cat 988K	ConstMin - Rubber Tired Loaders	Diesel	475	0.03356	0.36589	0.09908	0.00177	0.003651105	0.003359	g/hp-hr
1,270	Standard Crawler Dozer - Cat 200 hp - EROPS - Semi U (Diesel)	Cat D6T	ConstMin - Crawler Tractors	Diesel	200	0.02765	0.41563	0.11281	0.00209	0.003932293	0.0036177	g/hp-hr
62,000	Standard Crawler Dozer - Cat 310 hp - EROPS - Semi U (Diesel)	Cat D8T	ConstMin - Crawler Tractors	Diesel	310	0.02815	0.41184	0.11318	0.0021	0.003953981	0.0036377	g/hp-hr
14,500	Standard Crawler Dozer - Cat 405 hp - EROPS - Semi U (Diesel)	Cat D9T	ConstMin - Crawler Tractors	Diesel	405	0.02815	0.41184	0.11318	0.0021	0.003953981	0.0036377	g/hp-hr
1,063,672												**Total**

Crest Raise Alternative - No Shear Key

Table C-77. Onsite Exhaust Emissions (No Shear Key)

Hours per Project	Equipment Description--General	ROG, lbs/day	CO, lbs/day	NOx, lbs/day	SOx, lbs/day	PM10, lbs/day	PM2.5, lbs/day	ROG, tpy	CO, tpy	NOx, tpy	SOx, tpy	PM10, tpy	PM2.5, tpy	Estimated Quantity	Quantity - Day	Quantity - Night	Maximum Annual Hours
34,500	4" Trash pump-----Operation only!	2.00649	77.9826	1.54639	0.00431	0.93515	0.70656	0.36618	14.2318	0.28222	0.00079	0.17067	0.12895	2	2	0	7,300
2,850	Crawler Mounted Hydraulic Excavator - Cat 1.25 cy bucket - 138 HP (Diesel)	0.08063	3.35166	0.3083	0.00568	0.01117	0.01027	0.01149	0.47761	0.04393	0.00081	0.00159	0.00146	1	1	0	2,850
34,000	Crawler Mounted Hydraulic Excavator - Cat 5 cy bucket- 513 HP (Diesel)	1.17658	16.6593	4.57036	0.08436	0.16055	0.14771	0.16104	2.28024	0.62557	0.01155	0.02198	0.02022	4	2	2	10,950
130	Small Engine Generator, I.5KW, Gas, 3.5 HP	0.19813	13.1623	0.16169	0.00061	0.01319	0.00996	0.00129	0.08555	0.00105	4E-06	8.6E-05	6.5E-05	1	1	0	130
58	Grove 8x4x4 Truck Mounted Hyd Crane, Single Engine, 82MT, 142' Boom, 450 HP (Diesel)	0.17718	2.71868	0.74855	0.01392	0.02596	0.02388	0.00051	0.00788	0.00217	4E-05	7.5E-05	6.9E-05	1	1	0	58
225	Link-Belt Rough Terrain Hyd Crane 36 MT 105' Boom, 165 HP (Diesel)	0.06851	3.00565	0.35108	0.00512	0.00986	0.00907	0.00077	0.03381	0.00395	5.8E-05	0.00011	0.0001	1	1	0	225
58	Articulated Crane for Truck Mounting 105-38 {15,000# Cap.)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	58
58	Broderson 4x4 Hyd Yard Crane Diesel 28.2MT 60.7' Boom	0.04982	2.18593	0.25533	0.00372	0.00717	0.0066	0.00014	0.00634	0.00074	1.1E-05	2.1E-05	1.9E-05	1	1	0	58
630	Cat-TelBoomliftTrk-4Ton {10,000 lbs), TI1055 42'6" ft boom	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	630
52,000	6" dia Submersible Trash Pump, 3" Solids, 230 Volt (Electric)	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	7,300
130	12" Gas Cut-off Saw, 4 cubic inch engine (Blade costs are not included)	0.87152	39.0669	0.72948	0.00183	0.48919	0.36961	0.00566	0.25394	0.00474	1.2E-05	0.00318	0.0024	1	1	0	130
3,100	On-Highway Water Truck, 3000 Gal, 210 HP (Gas)	0.00699	0.15563	0.07273	0.01077	0.12629	0.05261	0.00108	0.02412	0.01127	0.00167	0.01957	0.00815	1	1	0	3,100
76,200	On-Highway Water Truck, 4000 Gal, 250 HP (Diesel)	0.0634	0.3337	0.77729	0.02956	0.38252	0.16141	0.01157	0.0609	0.14186	0.00539	0.06981	0.02946	3	3	0	10,950
37,000	On-Highway Light Duty Truck/Pickup - 4X4, 1/2T, Conventional, 191 HP (Gas)	0.02353	1.67485	0.1384	0.0154	0.16365	0.06794	0.00322	0.22924	0.01894	0.00211	0.0224	0.0093	4	2	2	10,950
151,500	On-Highway Light Duty Truck/Pickup - 4X4, 1/2T, Conventional, 191 HP (Gas)	0.05294	3.7684	0.3114	0.03465	0.36821	0.15287	0.00805	0.57311	0.04736	0.00527	0.056	0.02325	9	6	3	27,375
2,950	On-Highway Light Duty Truck/Pickup- 4X4, IT on , CREW, 195 HP (Diesel)	0.05019	0.16024	0.13722	0.01007	0.19057	0.08429	0.0037	0.01182	0.01012	0.00074	0.01405	0.00622	2	1	1	2,950
63,000	On-Highway Light Duty Truck/Pickup - 4X4, 3/4T, Crew, 285 HP (Gas)	0.01818	0.48889	0.20037	0.03525	0.37617	0.15681	0.00265	0.07138	0.02925	0.00515	0.05492	0.02289	5	3	2	14,600
293,000	Cat Truck- Mechanical Drive Rear Dump, 55 MT, 35-46.5 CY, 703 HP (Diesel)	7.85389	78.721	21.2344	0.37482	0.79578	0.73212	1.32308	13.2615	3.57718	0.06314	0.13406	0.12333	13	11	2	43,800
188	On-Highway Flatbed Truck, 4x2, 15k GVW, 210 HP (Gas)	0.00699	0.15563	0.07273	0.01077	0.12629	0.05261	6.6E-05	0.00146	0.00068	0.0001	0.00119	0.00049	1	1	0	188
2,800	On-Highway Truck Tractor - 6X6, 70K gvw, 450 HP (Diesel)	0.04904	0.28959	0.51344	0.0124	0.08987	0.03479	0.00687	0.04054	0.07188	0.00174	0.01258	0.00487	1	1	0	2,800
485	On Highway Rear Dump Truck, 8x4, 15-18 CV, 85k GVW, 450 HP (Diesel)	0.04203	0.24815	0.40215	0.01238	0.08913	0.03408	0.00102	0.00602	0.00975	0.0003	0.00216	0.00083	1	1	0	485
76,200	Off-Highway Water Tanker, 5000 Gal, 175 HP (Diesel)	0.43082	13.5766	1.21178	0.02151	0.04754	0.04374	0.07863	2.47773	0.22115	0.00393	0.00868	0.00798	3	3	0	10,950
450	Hand Held Rammer - 4" to13", 3180 lb/blow, 4 HP (Gas)	0.21586	10.9916	0.19915	0.00084	0.15724	0.1188	0.00486	0.24731	0.00448	1.9E-05	0.00354	0.00267	1	1	0	450
53,000	Cat 825H Pad Foot Compactor, Self Propelled, 51.6"x44.4" Front Wheel Size (Diesel)	0.41951	6.87714	1.89816	0.03551	0.06521	0.05999	0.07656	1.25508	0.34641	0.00648	0.0119	0.01095	2	2	0	7,300
1,650	Cat Single Drum Self Propelled Vibratory Compactor - 84" drum Width, Padfoot 163 HP (Diesel)	0.07503	3.7505	0.35038	0.00657	0.01216	0.01118	0.00619	0.30942	0.02891	0.00054	0.001	0.00092	1	1	0	1,650
2,850	Cat Single Drum Self Propelled Vibratory Compactor - 67" drum width, Smooth drum, 96 HP (Diesel)	0.12762	5.0145	2.14684	0.00776	0.01534	0.01411	0.00909	0.35728	0.15296	0.00055	0.00109	0.00101	2	1	1	2,850
165	Skid Steer Loader, Bobcat, 3000 lb Capacity, 81 HP (Diesel)	0.07074	3.64012	0.34081	0.00641	0.01175	0.01081	0.00029	0.01502	0.00141	2.6E-05	4.8E-05	4.5E-05	2	1	1	165
64,000	Art Frm Grader-Cat. 160M, 218 hp-EROPS	0.41299	5.76551	1.55802	0.02866	0.05496	0.05057	0.07537	1.05221	0.28434	0.00523	0.01003	0.00923	3	3	0	10,950
615	Dual Engine Conventional Scraper , Cat 627G, 15.7-22cy , 365 hp, (Diesel)	0.25771	3.7407	1.0277	0.01901	0.03595	0.03307	0.00792	0.11503	0.0316	0.00058	0.00111	0.00102	1	1	0	615
8,400	Dual Engine Conventional Scraper, Cat, 24-34 cy, 500 HP, EROPS (Diesel)	0.35303	5.12425	1.40781	0.02604	0.04924	0.0453	0.06443	0.93518	0.25692	0.00475	0.00899	0.00827	1	1	0	3,650
2,850	4WD Articulated Wheel Loader - Cat 3.65 cy bucket - 172.0 HP - EROPS (Diesel)	0.11975	4.11392	0.37103	0.00667	0.01417	0.01303	0.01706	0.58623	0.05287	0.00095	0.00202	0.00186	1	1	0	2,850
260	4WD Articulated Wheel Loader - Cat 5.50 cy bucket - 262 HP - EROPS (Diesel)	0.16823	2.0979	0.55881	0.01016	0.02017	0.01856	0.00219	0.02727	0.00726	0.00013	0.00026	0.00024	1	1	0	260
20,600	4WD Articulated Wheel Loader - Cat 8.33 cy bucket - 475 HP - EROPS (Diesel)	0.35145	3.83148	1.03751	0.01856	0.03823	0.03517	0.06414	0.69925	0.18934	0.00339	0.00698	0.00642	1	1	0	3,650
1,270	Standard Crawler Dozer - Cat 200 hp - EROPS - Semi U (Diesel)	0.1219	1.83257	0.4974	0.00922	0.01734	0.01595	0.00774	0.11637	0.03158	0.00059	0.0011	0.00101	1	1	0	1,270
62,000	Standard Crawler Dozer - Cat 310 hp - EROPS - Semi U (Diesel)	0.57719	8.44384	2.32055	0.04296	0.08107	0.07458	0.10534	1.541	0.4235	0.00784	0.01479	0.01361	3	3	0	10,950
14,500	Standard Crawler Dozer - Cat 405 hp - EROPS - Semi U (Diesel)	0.25136	3.67716	1.01056	0.01871	0.0353	0.03248	0.04587	0.67108	0.18443	0.00341	0.00644	0.00593	1	1	0	3,650
1,063,672		**16.7492**	**326.607**	**48.4678**	**0.92422**	**5.01637**	**3.39056**	**2.47409**	**42.0627**	**7.09985**	**0.1373**	**0.66243**	**0.45324**	**80**	**66**	**14**	**208,097**

PMSIZE Profiles (Weight Fraction of PM2.5/PM10)
6209 2020 OFFROAD DIESEL VEHL EXST 0.9567
115 STAT. I.C. ENGINE-GASOLINE 0.998

Conversions
453.6 grams per pound
2000 pounds per ton

Construction Start Year
2020

Hours of Operation
10 hours per day
(two 10-hour shifts with 1/2 hour for lunch each shift p

Duration
8 years
6 months per year for night construction

Onsite vehicle speed
40 mph

Legend
On-highway engines - emission factors from EMFAC2014
Value estimated
Equipment operated during night shift

Maximum Operating Hours per Equipment
29,200 hours per project
(assumes 365 days per year)

Crest Raise Alternative - No Shear Key
Offsite Exhaust Emissions

Table C-78. Estimated Number of Truckloads

Material	Tons	Tons/ Load	Total Trips
CAS--Zone 6	1,106,280	22	50,285
Stab. Berm--Zone 6	*1,404,000*	*22*	*63,818*
CAS--Zone 9A	1,240,200	22	56,373
CAS--Zone 9B	1,066,320	22	48,469
Zone 9B from onsite	*(1,066,320)*	*22*	*(48,469)*
CAS--Pipe Bedding	1,500	22	68
Stab. Berm--Pipe Bedding	*1,700*	*22*	*77*
CAS--Pipe			6
Stab. Berm--Pipe			*7*
Asphalt	7,900	21	376
Demo asphalt	7,000	20	350
Mobilization			100
Demobilization			100
Dispose of asbestos CMP			*40*
	CAS Subtotal		156,128
	Stability Berm Subtotal		15,473
Number of Truck Loads from CAS and Stability Berm			171,601
Seeding			0
Dewatering			20
MgCl			100
Total Truck Trips (Round Trips)			**171,721**
Average Daily Round Trips			**59**

Table C-79. Emission Factors (g/mi)

Source	ROG	CO	NOx	SOx	PM10 Exhaust	PM10 Tire Wear	PM10 Brake Wear	PM10 Paved Road Dust	PM2.5 Exhaust	PM2.5 Tire Wear	PM2.5 Brake Wear	PM2.5 Paved Road Dust
Construction workers	0.015	0.753	0.078	0.003	0.002	0.008	0.037	0.100	0.002	0.002	0.016	0.025
Haul trucks	0.053	0.311	0.755	0.014	0.003	0.036	0.062	0.100	0.003	0.009	0.026	0.025

Table C-80. Daily Emissions (pounds per day)

Source	ROG	CO	NOx	SOx	PM10 Exhaust	PM10 Tire Wear	PM10 Brake Wear	PM10 Paved Road Dust	PM2.5 Exhaust	PM2.5 Tire Wear	PM2.5 Brake Wear	PM2.5 Paved Road Dust
Construction workers	0.21	10.10	1.04	0.04	0.02	0.11	0.49	1.35	0.02	0.03	0.21	0.34
Haul trucks	0.55	3.22	7.83	0.15	0.03	0.37	0.64	1.04	0.03	0.09	0.27	0.26
Total	**0.75**	**13.32**	**8.87**	**0.19**	**0.06**	**0.48**	**1.13**	**2.39**	**0.06**	**0.12**	**0.49**	**0.60**

Table C-81. Annual Emissions (tons per year)

Source	ROG	CO	NOx	SOx	PM10 Exhaust	PM10 Tire Wear	PM10 Brake Wear	PM10 Paved Road Dust	PM2.5 Exhaust	PM2.5 Tire Wear	PM2.5 Brake Wear	PM2.5 Paved Road Dust
Construction workers	0.04	1.84	0.19	0.01	0.00	0.02	0.09	0.25	0.00	0.00	0.04	0.06
Haul trucks	0.10	0.59	1.43	0.03	0.01	0.07	0.12	0.19	0.01	0.02	0.05	0.05
Total	**0.14**	**2.43**	**1.62**	**0.03**	**0.01**	**0.09**	**0.21**	**0.44**	**0.01**	**0.02**	**0.09**	**0.11**

One-way trip distance

Workers	40	miles per trip
Trucks	40	miles per trip

Maximum Daily Workers

76 workers per day
(46 for day shift; 30 for night shift)

Conversions

453.6	grams per pound
2,000	pounds per ton

Operating Schedule

365	days per year
8	years

Crest Raise Alternative - No Shear Key
Fugitive Dust Emissions - Material Handling

Excavated Volume

916 cubic yards per shift
2,676,000 cubic yards per project
334,500 cubic yards per year

Equation (AP-42, Chapter 13.2.4):

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

where:

E = emission factor, pound per ton
k = particle size multiplier
U = mean wind speed, miles per hour
M = material moisture content, %

Average Wind Speed 9.18 mph

Source: MesoWest, Station CF031 (Rt. 152 San Luis), 2016 data. Accessed on: October 6, 2017. Available at: mesowest.utah.edu.

Material Moisture Content: 12 %

Source: EPA. 2006. AP-42, Chapter 13.2.4, cover moisture content (default used by CalEEMod)

Table C-82. Material Handling Emissions

		EF	Emissions	
Size	k	lb/ton	lbs/day	tpy
PM10	0.35	2.0E-04	0.66	0.12
PM2.5	0.053	3.0E-05	0.10	0.02

Operating Schedule

1 shift per day
7 days per week
365 days per year
8 years

Density

1.8 tons per cubic yard

Note: Provided by Reclamation

Number of Drops

2 drops per truck *(one drop at borrow site and one drop at dam site)*

Crest Raise Alternative - No Shear Key Option
Fugitive Dust Emissions - Grading

Table C-83. Equipment-Specific Grading Rates

Equipment Type	Acres/ 8hr-day	Equipment Count	Total Grading (acres/day)	Total Grading (acres/year)
Crawler Tractors	0.5	5	3.125	1,141
Graders	0.5	3	1.875	684
Rubber Tired Dozers	0.5	0	0	0
Scrapers	1	2	2.5	913
Total		**10**	**7.5**	**2,738**

Source: CAPCOA. 2017. CalEEMod User's Guide, Appendix A.
Note: Grading totals increased by 50% to account for 12-hour work days.

VMT Estimate

$$VMT = A_s/W_b \times 43560(\frac{sqft}{acre})/5280(\frac{ft}{mile})$$

where:
VMT = vehicle miles traveled
As = the acreage of the grading site (acre)
Wb = blade width of the grading equipment (assumed to be 12 feet)

Calculated VMT

Daily	5.16	miles per day
Annual	1,882.03	miles per year

Equations (AP-42, Chapter 11.9):

$TSP = 0.040(S)^{2.5}$ and $PM15 = 0.051(S)^{2.0}$

where:
S = mean vehicle speed, miles per hour

Scaling Factors

PM10	0.60	(multiply the 15-micron equation by this fraction to determine emissions)
PM2.5	0.031	(multiply the TSP equation by this fraction to determine emissions)

Table C-84. Grading Emissions

Size	EF	Emissions	
	lb/VMT	lbs/day	tpy
PM10	1.54	3.1	0.6
PM2.5	0.17	0.3	0.1

Dust Control

61% reduction from watering at least 3 times per day
Source: CalEEMod

Construction Schedule

365	days per year
8	years
10	hours per day

Vehicle Speed

7.1 miles per hour *Source: CAPCOA 2017*

Crest Raise Alternative - No Shear Key
Fugitive Dust Emissions - Bulldozing

Operating Schedule

77,770	hours per project	
365	days per year	
8	years	
27	hours per day (total)	
9,721	hours per year (total)	*assumes 365 days per year*

Equations (AP-42, Chapter 11.9):

$$TSP = \frac{5.7(s)^{1.2}}{M^{1.3}} \quad \text{and} \quad PM15 = \frac{1.0(s)^{1.5}}{M^{1.4}}$$

where:

s = silt content	6.9 %	(AP-42, Table 11.9-3, Overburden)
M = material moisture content	7.9 %	(AP-42, Table 11.9-3, Overburden)

Scaling Factors

PM10	0.75	(multiply the 15-micron equation by this fraction to determine emissions)
PM2.5	0.105	(multiply the TSP equation by this fraction to determine emissions)

Table C-85. Bulldozing Emissions

	EF	Emissions	
Size	lb/hr	lbs/day	tpy
PM10	0.75	7.8	1.4
PM2.5	0.41	4.3	0.8

Dust Control

61% reduction from watering at least 3 times per day

Source: CalEEMod

Crest Raise Alternative - No Shear Key
Crushed Stone Processing Operations

Table -86. Emission Factors (lb/ton)

Source	Total Particulate Matter	Total PM-10	Total PM-2.5
Primary Crushing (SCC 3-05-020-01)	ND	ND	ND
Primary Crushing (controlled) (SCC 3-05-020-01)	ND	ND	ND
Secondary Crushing (SCC 3-05-020-02)	ND	ND	ND
Secondary Crushing (controlled) (SCC 3-05-020-02)	ND	ND	ND
Tertiary Crushing (SCC 3-050030-03)	0.0054	0.0024	ND
Tertiary Crushing (controlled) (SCC 3-05-020-03)	0.0012	0.00054	0.0001
Fines Crushing (SCC 3-05-020-05)	0.039	0.015	ND
Fines Crushing (controlled) (SCC 3-05-020-05)	0.003	0.0012	0.00007
Screening (SCC 3-05-020-02, 03)	0.025	0.0087	ND
Screening (controlled) (SCC 3-05-020-02, 03)	0.0022	0.00074	0.00005
Fines Screening (SCC 3-05-020-21)	0.3	0.072	ND
Fines Screening (controlled) (SCC 3-05-020-21)	0.0036	0.0022	ND
Conveyor Transfer Point (SCC 3-05-020-06)	0.003	0.0011	ND
Conveyor Transfer Point (controlled) (SCC 3-05-020-06)	0.00014	4.60E-05	1.30E-05
Wet Drilling - Unfragmented Stone (SCC 3-05-020-10)	ND	8.00E-05	ND
Truck Unloading -Fragmented Stone (SCC 3-05-020-31)	ND	1.60E-05	ND
Truck Loading - Conveyor, crushed stone (SCC 3-05-020-32)	ND	0.0001	ND
Total Controlled Emission Factor	**0.01014**	**0.004922**	**0.000233**

Source: EPA. 2004. AP-42, Chapter 11.19.2: Crushed Stone Processing and Pulverized Mineral Processing.

Table -87. Crushing Emissions from Stockpile/Borrow

Source	Cubic Yards	Tons	Daily Emissions (lbs/day)		Annual Emissions (tons/year)	
			PM10	PM2.5	PM10	PM2.5
Probable High Estimate						
Zone 4	11,660	28,963	0.05	0.00	0.01	0.00
Zone 5	18,160	45,109	0.08	0.00	0.01	0.00
Zone 7	1,777,000	4,414,068	7.44	0.35	1.36	0.06
Zone 9B	1,400,000	3,477,600	5.86	0.28	1.07	0.05
Rock Blanket	181,500	450,846	0.76	0.04	0.14	0.01
Total	**3,388,320**	**8,416,587**	**14.19**	**0.67**	**2.59**	**0.12**

Source: Bureau of Reclamation. 2017. Alternative 5: 12-ft crest raise-Rev 1 Estimate Worksheet. November 30.

Basalt Density

184	pounds per cubic foot
4,968	pounds per cubic yard
2.484	tons per cubic yard

Source:
Perry, Robert H. and Cecil H. Chilton. 1973. Chemical Engineers' Handbook; Fifth Edition.

Operating Schedule

1	shift per day
7	days per week
365	days per year
8	years

Crest Raise Alternative - No Shear Key
Blasting Activities

Equations (AP-42, Chapter 11.9):

$$TSP = 0.000014(A)^{1.5}$$

where:
A = horizontal area (ft^2), with blasting depth ≤ 70 ft. Not for vertical face of

Scaling Factors

PM10	0.52
PM2.5	0.03

Total Blasted Quantity

3,388,320 cubic yards per project
1,160 cubic yards per day
4 blasts per day (estimated)
112 square feet per blast (assuming depth of 70 feet)

Table C-88. Blasting Emissions

Size	Emission Factor, lb/blast	Daily Emissions, lbs/day	Annual Emissions, tons/year
PM10	8.62E-03	3.45E-02	6.29E-03
PM2.5	4.97E-04	1.99E-03	3.63E-04

Operating Schedule

365 days per year
8 years

Emission Factors
Paved Road Dust Emissions

Equation 1:

$$E = k(sL)^{0.91} \times (W)^{1.02}$$

where: E = particulate emission factor (having units matching the units of k),
k = particle size multiplier for particle size range and units of interest (see below),
sL = road surface silt loading (grams per square meter) (g/m2), and
W = average weight (tons) of the vehicles traveling the road.

Equation 2:

$$E_{ext} = [k(sL)^{0.91} \times (W)^{1.02}](1 - P/4N)$$

where: k, sL, and W are as defined in Equation 1 and
E_{ext} = annual or other long-term average emission factor in the same units as k,
P = number of "wet" days with at least 0.254 mm (0.01 in) of precipitation during the averaging period, and
N = number of days in the averaging period (e.g., 365 for annual, 91 for seasonal, 30 for monthly).

Table C-89. Particle Size Multipliers for Paved Road Equation

Size Range [a]	Ref.	Particle Size Multiplier, k [b]		
		g/VKT	g/VMT	lb/VMT
$PM_{2.5}$	[c]	0.15	0.25	0.00054
PM_{10}		0.62	1.00	0.0022
PM_{15}		0.77	1.23	0.0027
PM_{30}	[d]	3.23	5.24	0.011

Source: USEPA. 2011. Compilation of Air Pollutant Emission Factors (AP-42). Fifth Edition, Volume I. Chapter 13.2.1 Paved Roads. January. Available online at: http://www.epa.gov/ttn/chief/ap42/ch13/final/c13s0201.pdf [Accessed July 17,
Notes:
[a] Refers to airborne particulate matter (PM-x) with an aerodynamic diameter equal to or less than x micrometers.
[b] Units shown are grams per vehicle kilometer traveled (g/VKT), grams per vehicle mile traveled (g/VMT), and pounds per vehicle mile traveled (lb/VMT). The multiplier k includes unit conversions to produce emission factors in the units shown for the indicated size range from the mixed units required in Equation 1.
[c] The k-factors for $PM_{2.5}$ were based on the average $PM_{2.5}$:PM_{10} ratio of test runs in Reference 30.
[d] PM-30 is sometimes termed "suspendable particulate" (SP) and is often used as a surrogate for TSP.

Offsite Construction Vehicles

Number precipitation days >0.1 inches
Merced County 49

Road silt loading 0.03 g/m^2 (AP-42, Table 13.2.1-2, ADT > 10,000, ubiquitous baseline)
Average vehicle weight 2.4 tons
Source: CAPCOA. 2016. California Emissions Estimator Model User's Guide, Version 2016.3.1, Appendix D: Default Data Tables. September. Available online at: http://www.caleemod.com/ [Accessed on October 6, 2017].

Table C-90. Paved Road Dust Emission Factors - Offsite Construction Vehicles

	Emission Factor (g/VMT)			
	Uncontrolled		Controlled	
County	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$
Merced	0.100	0.025	0.097	0.024

Note:
Controlled emission factor only valid for long-term (annual) emissions; uncontrolled emission factor used for daily emissions.

Haul Road Vehicles

Number precipitation days >0.1 inches			
Merced County	49		
Road silt loading	0.2	g/m^2	(AP-42, Table 13.2.1-2, ADT 500-5,000, ubiquitous baseline)
Unloaded truck weight	50	tons	
	126	tons	
Average vehicle weight	88	tons	(estimated from eqiupment specifications)

Table C-91. Paved Road Dust Emission Factors - Onsite Haul Trucks

	Emission Factor (g/VMT)			
	Uncontrolled		Controlled	
County	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$
Merced	22.2	5.6	21.5	5.4

Note:
Controlled emission factor only valid for long-term (annual) emissions; uncontrolled emission factor used for daily emissions.