APPENDIX E

AIR POLLUTANT EMISSION CALCULATIONS

RSC Upper Reach Construction - Emission Calculation Assumptions

Proposed Project General Assumptions

1) Worst case day includes concurrent overlap of three pipe jacking operations, three open trench operations, three tunneling operations and three site restoration operations. The other identified construction activities: pre-construction activities, right of way clearing, weld inspection, applying protective coating to the weld joints, hydrostatic testing, and backfilling are minor in comparison to the worst case day activities and would not impact LST emission findings.
2) Main work schedule maximum would be during the day and graveyard shifts (8 am to 11 pm) for 15 hour total.

Offroad Equipment Emission Calculation Assumptions

1) Emission factors are the latest available from the SCAQMD website, where the assumed horsepower is interpolated between the available horsepower data given in the SCAQMD emission factor database to determine equipment specific hourly emission factors.
2) Emission factors from 2009 are assumed to calculate the maximum daily emissions.
3) Equipment type, number, and usage estimates are used as estimated using equipment data and quantity estimates provided by the LADWP with additional engineering assumptions for generator to power dewatering, lighting and air blowers.

Onroad Equipment Emission Calculations Assumptions

1) Emission factors are the latest available from the SCAQMD website, where the vehicles have been assigned three classes, passenger (i.e. employee vehicles and pickups), delivery (all nonpassenger vehicles smaller than Heavy-Heavy Duty), and heavy-heavy duty vehicles.
2) Emission factors from 2009 are assumed to calculate the maximum daily emissions.
3) Trip estimates are based on import/export quantities, equipment and worker trips estimated using information provided by LADWP and determined through engineering estimates.
4) All onroad traffic for the project is assumed to occur within SCAQMD jurisdiction.
5) Dump truck waste loads are 20 cubic yards. Grout loads are 10 cubic yards.

Fugitive Dust Emission Calculations Assumptions

1) Unpaved road travel is considered negligible for this project.
2) Paved road fugitive dust emission factors are calculated using the most current version of USEPA AP-42 Section 13.2.1 and use the following assumptions: a) Silt loading is average for >10000 ADT road; b) average vehicle weight is calculated on VMT average basis.
3) Earthmoving emission factors are calculated using the recent version of USEPA AP-42 Section 11.9 for Trenching, and Section 13.2.4 for soil handling (drop emissions).
4) Considering work areas are in pits and trenches or underground, the wind erosion potential is considered negligible.
5) Asphalt emissions from restoration repaving is considered to be negligible in comparison with the other emissions sources.

Table E-1
RSC Upper Reach Maximum Daily Emissions (lbs/day)

	Onroad Emissions (1)	Offroad Emissions (1)	Fugitive Dust (2)	Total Emissions
CO	184.70	367.35	---	552.05
NOx	469.70	753.27	---	1222.97
ROG	40.83	115.46	---	156.29
SOx	0.49	0.78	---	1.27
PM10	20.89	41.71	328.15	390.76
PM2.5	19.12	38.37	77.54	135.03

(1) Tailpipe emissions only.

(2) Construction fugitive dust emissions including paved road fugitive dust.

Table E-2
RSC Upper Reach Maximum Day Offroad Emissions

Pipe Jacking/Tunneling Spread			SCAQMD Emission Factor lbs/hour						Daily Emissions lbs				
	HP	Number	ROG	CO	NOX	SOX	PM	Hours/day	ROG	CO	NOX	SOX	PM
Main Diesel Generator	600	1	0.3138	1.1967	3.9866	0.0042	0.1221	14	4.39	16.75	55.81	0.06	1.71
Excavator/Drill 315B	99	1	0.1439	0.4742	0.7101	0.0007	0.0678	14	2.02	6.64	9.94	0.01	0.95
Crane	187	1	0.1282	0.4706	1.0370	0.0010	0.0554	8	1.03	3.77	8.30	0.01	0.44
Diesel Generator (dewatering, lights, air blower)	50	1	0.1182	0.2970	0.3115	0.0004	0.0296	24	2.84	7.13	7.47	0.01	0.71
Diesel Powered Welder	50	1	0.1292	0.3084	0.2760	0.0003	0.0299	12	1.55	3.70	3.31	0.00	0.36
								Total	11.82	37.99	84.84	0.09	4.17
								x6 spreads	70.93	227.91	509.02	0.54	25.03

Trenching Spread			SCAQMD Emission Factor lbs/hour						Daily Emissions lbs				
	HP	Number	ROG	CO	NOX	SOX	PM	Hours/day	ROG	CO	NOX	SOX	PM
Backhoe - 436C	89	1	0.1170	0.3672	0.4784	0.0005	0.0458	10	1.17	3.67	4.78	0.01	0.46
Forklift - RT-708H	80	1	0.1549	0.4399	0.5407	0.0006	0.0537	10	1.55	4.40	5.41	0.01	0.54
Loader - 962G	200	1	0.1569	0.5711	1.3611	0.0014	0.0665	10	1.57	5.71	13.61	0.01	0.67
Excavator/Drill 315B	99	1	0.1439	0.4742	0.7101	0.0007	0.0678	10	1.44	4.74	7.10	0.01	0.68
Compactor 224C	90	1	0.1311	0.3808	0.5644	0.0005	0.0516	4	0.52	1.52	2.26	0.00	0.21
Crane	187	1	0.1282	0.4706	1.0370	0.0010	0.0554	4	0.51	1.88	4.15	0.00	0.22
Diesel Generator (dewatering, lights, air blower)	50	1	0.1182	0.2970	0.3115	0.0004	0.0296	24	2.84	7.13	7.47	0.01	0.71
Diesel Powered Welder	50	1	0.1292	0.3084	0.2760	0.0003	0.0299	8	1.03	2.47	2.21	0.00	0.24
								Total	10.63	31.53	46.99	0.05	3.72
								x3 spreads	31.90	94.58	140.98	0.15	11.15

Restoration Spread			SCAQMD Emission Factor lbs/hour						Daily Emissions lbs				
	HP	Number	ROG	CO	NOX	SOX	PM	Hours/day	ROG	CO	NOX	SOX	PM
Paver	200	1	0.2283	0.7815	1.9396	0.0017	0.0963	8	1.83	6.25	15.52	0.01	0.77
Pavement Roller	145	1	0.1408	0.5168	1.0021	0.0009	0.0679	8	1.13	4.13	8.02	0.01	0.54
Loader - 962G	200	1	0.1569	0.5711	1.3611	0.0014	0.0665	8	1.26	4.57	10.89	0.01	0.53
								Total	4.21	14.96	34.42	0.03	1.85
								x3 spreads	12.63	44.87	103.27	0.10	5.54

Assumptions:
Daily emissions include a total of six pipe jacking/tunneling spreads, three trenching spreads, and three restoration spreads.
PM2.5 is 0.92 of PM10 emissions per CEIDARS fraction assumption for diesel engines.

	Project Emissions					
	ROG	CO	NOX	SOX	PM	PM2.5
Maximum lbs/day	115.46	367.35	753.27	0.78	41.71	38.37

Table E-3
RSC Upper Reach Maximum Day Onroad Emissions

Passenger Vehicles (Worker Travel and Pickups)

Pollutant	**(pounds/mile)**	**miles/trip**	**trips/day**	**pounds/day**
CO	0.009686	30	126	36.61
NOx	0.001005	30	126	3.80
ROG	0.000992	30	126	3.75
SOx	0.000011	30	126	0.04
PM10	0.000086	30	126	0.33
PM2.5	0.000054	30	126	0.20

Delivery Size Trucks (crew trucks, welding trucks, fueling, etc.)

	(pounds/mile)	miles/trip	trips/day	pounds/day
CO	0.020161	20	20	8.06
NOx	0.022366	20	20	8.95
ROG	0.002789	20	20	1.12
SOx	0.000027	20	20	0.01
PM10	0.000805	20	20	0.32
PM2.5	0.000692	20	20	0.28

Heavy Heavy Diesel Trucks (Dump trucks, concrete trucks, semi trucks, etc.)

	(pounds/mile)	miles/trip	trips/day	pounds/day
CO	0.012822	30	364	140.02
NOx	0.041846	30	364	456.96
ROG	0.003293	30	364	35.96
SOx	0.000040	30	364	0.44
PM10	0.001854	30	364	20.24
PM2.5	0.001707	30	364	18.64

Total Onroad Emissions

Pollutant	**pounds/day**
CO	**184.70**
NOx	**469.70**
ROG	**40.83**
SOx	**0.49**
PM10	**20.89**
PM2.5	**19.12**

Assumptions:

SCAQMD 2009 Onroad Emission Factors

Delivery truck estimates assume 144 trips (to deliver materials such as grout, backfill, and steel pipe), 12 trips for water trucks, and 208 trips for excavated soil waste.

Table E-4
RSC Upper Reach Fugitive Dust Emissions

Emission Categories
1) Earthmoving
2) Road Dust Paved

1) Earthmoving

Emission Types
A) Trenching
B) Material Loading/Handling

A) Trenching (AP-42 Section 11.9 for drag-line)

E = (k)(0.0021)(d^0.7)/(M^0.3)
E = lb/cuyd
k = Scaling Constant (0.75 for PM10 and 0.017 for PM2.5)
d = Drop Height = 5 feet (conservative estimate)
M = Moisture Content = 10% (assumes moist watered soils - controlled)

PM10 Emission Factor
0.00243534 lb/cuyd

PM2.5 Emission Factor
0.000055 lb/hr

Maximum Daily Trenching Quantity
2400 Cuyds

Excavator Trenching Emissions

Lbs/Day	
PM10	PM2.5
5.84	0.13

B) Material Loading/Handling (AP-42, p. 13.2.4-3)

$E = (k)(0.0032)[(U/5)^{1.3}]/[(M/2)^{1.4}]$
E = lb/ton
k = Particle Size Constant (0.35 for PM10 and 0.11 for PM2.5)
U = average wind speed = 16.0 MPH worst day (5th percentile SCAQMD 1981 Burbank Met File)
M = moisture content = 10% (mitigated)
Three separate drops are assumed

14400 Maximum daily tons (all nine active tunnel/trenches - 2 drops - one for final disposal)

Emission Factors and Emissions
Emission Factors

PM10 Daily	PM2.5 Daily
0.00053	0.00017

Emissions lbs/day

PM10	PM2.5
7.69	2.42

Table E-4
RSC Upper Reach Fugitive Dust Emissions

2) Paved Road Dust
Emission Types
A) Paved Road Dust
B) Unpaved Road Dust

A) Paved Road Dust

E = [k x (sL/2)0.65 x (W/3)1.5 -C] x (1-P/4N)
E = lb/VMT
k = Constant (0.016 for PM10 and 0.0040 for PM2.5)
sL = Silt Loading (assumed to be 0.03 g/m2 - assumes >10,000 ADT profile of Table 13.2.1-3 ubiquitous baseline)
W = Average weight of vehicles in tons (calculated below)
C = Correction for exhaust, break wear, tire wear (0.00047 lb/VMT for PM10, 0.00036 lb/VMT for PM2.5)
No correction for number of wet days due to assumption of working in dry season

Average Vehicle Weight Calculation

Assumptions
Passenger Vehicles = 2 tons average
Midsize "Delivery" Vehicles = 8 ton average
Heavy-Heavy Duty Trucks = 30 tons average (loaded 40 tons, unloaded 20 tons)

Worst Case Day VMT

3780	Passenger Vehicles
400	Delivery/Work Vehicles
10920	Heavy-Heavy Duty Vehicles
15100	Total Paved VMT (2009)

Average Weight = 22.4 Tons

Emission Factors and Emissions
Emission Factors

PM10 Daily	PM2.5 Daily
0.0208	0.0050

Emissions lbs/day

PM10	PM2.5
314.62	74.99

Fugitive Dust Maximum Day Emission Totals

		PM10 lb/day	PM2.5 lb/day	Location
Trenching		5.84	0.13	on-site
Soil Handling		7.69	2.42	on-site
Paved Road Dust		314.62	74.99	off-site
	Totals	328.15	77.54	

Table E-5
RSC Upper Reach Maximum LST Construction Emissions

Assumptions:
1) Only single spread on-site construction activity is included, onroad equipment emissions not included.
2) Project area is within SRA 7 (although a very small portion at the south tip of the route may be in SRA 1).
3) Only NOx, CO, PM10, and PM2.5 have LSTs

Pipe Jacking/MTBM Tunneling

Worst-Case Onsite Day	Emissions (lb/day)			
	NOx	CO	PM10	PM2.5
Offroad Vehicles/Equipment	84.84	37.99	4.17	3.84
Fugitive Dust	---	---	0.17	0.05
Totals	84.84	37.99	4.34	3.89

Trenching

Worst-Case Onsite Day	Emissions (lb/day)			
	NOx	CO	PM10	PM2.5
Offroad Vehicles/Equipment	46.99	31.53	3.72	3.42
Fugitive Dust	---	---	2.38	0.18
Totals	46.99	31.53	6.09	3.60

Restoration

Worst-Case Onsite Day	Emissions (lb/day)			
	NOx	CO	PM10	PM2.5
Offroad Vehicles/Equipment	34.42	14.96	1.85	1.70
Fugitive Dust	---	---	0.17	0.05
Totals	34.42	14.96	2.02	1.75