Appendix 6.4.1 – GHG Emissions

Table 1 - GHG Emissions from On Road and Non Road Construction Vehicles

Machine Type	Total Fuel Consumption	CO_2[1] Emissions	CH_4[1] Emissions	N_2O[1] Emissions	CO_2e[2]
	L	tonnes/year	tonnes/year	tonnes/year	tonnes/year
Mass Earth Works	4,900,000	13,132	0.8	0.3	13,251
Civil, Mechanical, Electrical Work	244,999	657	0.04	0.02	663
Worker Accomodation	328,205	880	0.1	0.0	888
Bussing	1,091,823	2,926	0.2	0.1	2,953
Power Generator Sets	522,826	1,401	0.1	0.0	1,414
All Vehicles Total	**7,087,853**	18,995	1.1	0.5	19,168

Sources:

1. CO_2, CH_4, N_2O emissions were estimated based on The Climate Registry Reporting Protocol Table 12.5, 13.3, 13.6
2. CO_2e emissions were estimated based on a global warming potential of 1, 25, and 2980 for CO_2, CH_4, and N_2O, respectively (40 CFR Part 98, Subpart C).

Table 2 – GHG Emissions from use of Explosives during Construction

Explosives		Emissions			
Type	Usage	CO2	CH_4	N_2O	CO_2e^2
	Kg	Tonnes/year	Tonnes/year	Tonnes/Year	Tonnes
ANFO	1,419,700	241.3	0.48	0.48	397

1. Source : http://www.epa.gov/ttnchie1/ap42/ch13/final/c13s03.pdf and NGA Factors Table 4 found here: http://bocorockwindfarm.com.au/FCKfiles/File/AGO%20workbook-feb2008.pdf
2. Methane and nitrogen oxide factors were estimated based on CO2 emissions.
3.CO2e emissions were estimated based on a global warming potential of 1, 25, and 298 for CO2, CH4, and N2O, respectively (40 CFR Part 98, Subpart C).

Table 3 – Mine Operation Transportation Fuel Use

Machine Type	Total Fuel Consumption	CO_2 Emissions	CH_4 Emissions	N_2O Emissions	CO_2e
Non- Road Vehicles	**L**	**tons/year**	**tons/year**	**tons/year**	**tons/year**
Load and Haul					
Shovel	3,204,243	8,619	0.49	0.22	8,697
Loader	1,020,853	2,746	0.16	0.07	2,771
180T Truck	14,270,323	38,387	2.19	0.98	38,734
Support					
Mass Excavator	24,500	66	0.00	0.00	67
Loader	24,500	66	0.00	0.00	67
Dozer D10	63,000	169	0.01	0.00	171
Grader 16H	588,000	1,582	0.09	0.04	1,596
Rubber Tire Dozer	490,000	1,318	0.08	0.03	1,330
Portable Crushing Plant and Generators	17,500	47	0.00	0.00	48
Tool carrier	84,000	226	0.01	0.01	228
Lighting Plant	50,400	136	0.01	0.00	137
Compactor	105,000	282	0.02	0.01	285
Flatbed	50,400	136	0.01	0.00	137
Forklift	16,800	45	0.00	0.00	46
Explosives Truck	42,000				
Maintenance					
Mechanics Truck	14,000	38	0.00	0.00	38
Terrain Crane	44,800	121	0.01	0.00	122
Hydraulic Crane	63,000	169	0.01	0.00	171
T- Crane	42,000	113	0.01	0.00	114
Drill and Blast					
Hydraulic Drill	284,855	766	0.04	0.02	773
Rotary Drill	1,198,630	3,224	0.18	0.08	3,253
Fuel for Explosives	760,305	2,045	0.12	0.05	2,064
Non- Road Vehicles Total	22,459,109	60,415	3.45	1.54	60,961
On- Road Vehicles					
Water Truck	672,000	1,808	0.10	0.05	1,824
Lube Truck	490,000	1,318	0.08	0.03	1,330
Sand Truck/Stem Truck	17,500	47	0.00	0.00	48
Crew Van	94,500	254	0.01	0.01	257
On-Road Vehicles Total	1,274,000	3,427	0.20	0.09	**3,458**
All Vehicles Total	**22,972,804**	**63,842**	**3.64**	**1.63**	**64,419**

Table 4 On-Road Passenger Transportation Fuel Use during Operations

Vehicle	No. of Vehicles	Fuel use	CO_2	CH_4	N_2O	CO_2e
		L	tonnes/year	tonnes/year	tonnes/year	tonnes/year
Buses	5	122,500	329.5	2.04E-03	1.02E-03	330
SUV	5	52,500	141.2	5.25E-03	8.40E-03	144
Pick up	22	308,000	828.5	3.08E-02	4.93E-02	844
Vans	3	47,250	127.1	4.73E-03	7.56E-03	129
Front end loader	2	42,000	113	6.44E-03	2.88E-03	114
Crane	1	21,000	56.5	3.22E-03	1.44E-03	57
Other	2	35,000	94.1	5.37E-03	2.40E-03	95
Total	**40**	**628,250**	**1,690**	**5.79E-02**	**7.30E-02**	**1,713**

Table 5 GHG Emissions from Explosives

Explosives		Emissions			
Type	Usage	CO	CH_4	N_2O	CO_2e^2
	Kg	Tonnes/year	Tonnes/year	Tonnes/Year	Tonnes/year
ANFO	8,231,000	1,399	2.8	2.8	2,303
Emulsion	975,500	166	0.3	0.3	273
Total		1,565	3.1	3.1	2,576

1. Source : http://www.epa.gov/ttnchie1/ap42/ch13/final/c13s03.pdf and NGA Factors Table 4 found here: http://bocorockwindfarm.com.au/FCKfiles/File/AGO%20workbook-feb2008.pdf
2. Methane and nitrogen oxide factors were estimated based on CO2 emissions.
3.CO2e emissions were estimated based on a global warming potential of 1, 25, and 298 for CO2, CH4, and N2O, respectively (40 CFR Part 98, Subpart C).

Table 6 Indirect Emissions from Grid Electricity Usage during Operations

Description	Demand	CO_2 Emissions
Process Plant	**MWh/year**	**tCO_2/year**
Primary Crushing	5,726	2,709
Secondary Crushing	3,038	1,437
Ore Stacking	2,210	1,045
Heap Leach	11,499	5,439
Carbon Adsorption	187	88
Acid Wash	145.6	68.9
Carbon Strip	0.0	-
Strip Solution Handling	658.7	311.6
Refining	1,963	928
Carbon Regeneration & Handling	371	175
Reagent Mix/Storagge	277	131.1
Barren Solution Pumping	13,999	6,622
Raw Water	3,338	1,579
Other Loads		
Ancillary Buildings	82	39
Lighting & Controls etc	1,543	730
Hotel - Mining Accomodation	4,599	2,175
Total	**49,636**	**23,478**

Source:
1. United Nations Framework Convention on Climate Change, Clean Development Mechanism. 2015. Grid emission factor for the electricity system of the Republic of Armenia. January 8, 2015.

Table 7 Emissions from Fuel Use during Decommissioning and Closure

Machine Type	Total Fuel Consumption	CO_2 Emissions	CH_4 Emissions	N_20 Emissions	CO_2e
Non- Road Vehicles	**L**	**Metric tons**	**Metric tons**	**Metric tons**	**Metric tons**
Load and Haul					
Trucks (Production)	325,000	871	0.0	0.0	879
Excavators (Production)	120,000	322	0.02	0.01	325
Ancillary	100,000	268	0.0	0.0	270
On-Road					
Vehicles	30,000	80	0.0	0.0	81
All Vehicles Total	**575,000**	**1,541**	**0.1**	**0.0**	**1,555**

Table 8 - Indirect Emissions from Grid Electricity Usage during Decommissioning and Closure

Source	Demand	Emissions
	MWh	**CO_2**
		tons/year
Electricity Y1	3,168	1,498.46
Electricity Y2	6,336	2,996.93
Total	**9,504**	**4,495.39**