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>   <u>Report to the National Pollutant Release Inventory</u>

Pits and quarries reporting guide

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1. Reporting Requirements for the Pits and Quarries Sector

Prior to the 2006 reporting year, pits and quarries were exempt from reporting Part 1-3 substances. This exemption no longer exists; pits and quarries activities have been included in the list of activities with no employee threshold. For the 2007 reporting year, pits and quarries where annual production **is 500 000 tonnes or greater** are required reporting to NPRI, regardless of the number of employee hours worked, provided that the other threshold criteria are met. These are the thresholds based on the quantity of substances manufactured, processed or otherwise used (MPO), on Special Criteria (PAHs), on substances released to air (CACs) and Additional Reporting requirements (Speciated VOCs).

2. Purpose

The purpose of this document is to clarify the reporting requirements for the Pits and Quarries sector and describe some of the available tools available to estimate NPRI substances releases from major pits and quarries operations.

3. Pits and Quarries - as defined in the Gazette

A "pit" means an excavation that is open to the air and that is operated for the purpose of extracting sand, clay, marl, earth, shale, gravel, stone or other rock but not coal, a coal-bearing substance, oil sands, or oil sands-bearing substance or an ammonite shell and includes any associated infrastructure, but does not include a quarry.

A "quarry" means an excavation that is open to the air and that is operated for the purpose of working, recovering and extracting stone, limestone, sandstone, dolostone, marble, granite, construction materials and any mineral other than coal, a coal bearing substance, oil sands, or oils sands-bearing substance or an ammonite shell and includes any associated infrastructure but does not include a pit.

NOTE - All definitions are subject to modification. For the most current definitions, please consult the Canada Gazette Part I Notice and the Guide for Reporting to the NPRI for the year being reported. Other NPRI definitions can also be found in the above two documents.

The industries engaged in pits and quarries activities as defined by the Gazette fall under the following classification NAICS codes (North American Industry Classification System) *:
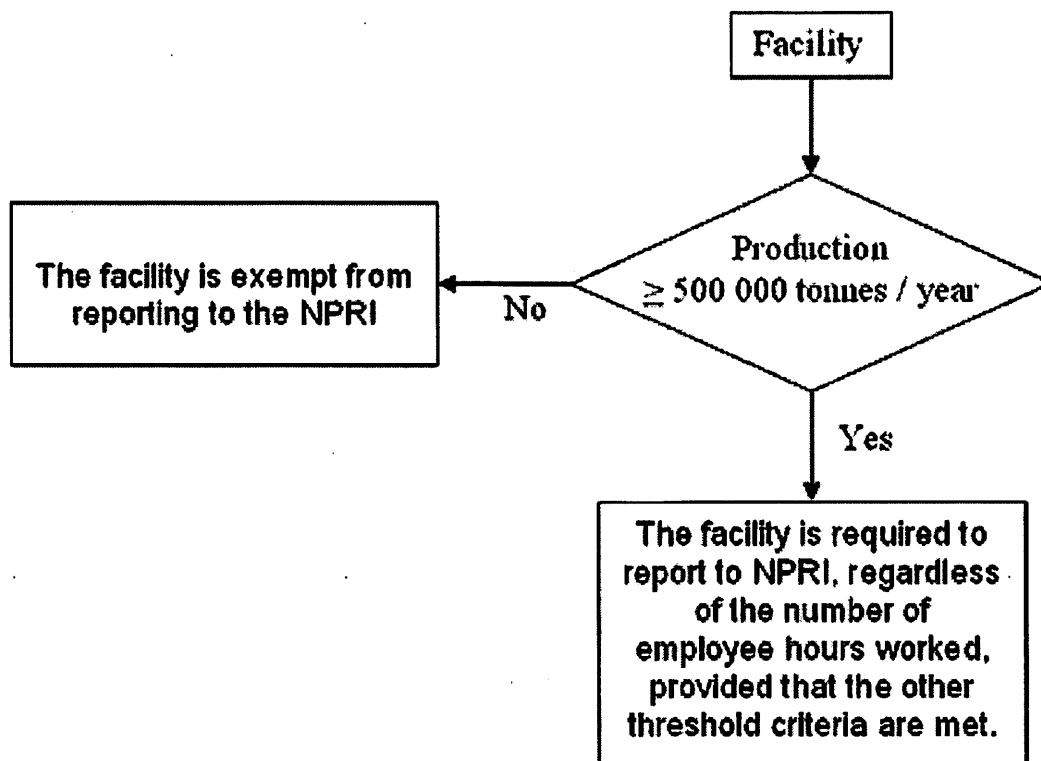
| <u>2123</u> | **Non-Metallic Mineral Mining and Quarrying** |

2123	Non-Metallic Mineral Mining and Quarrying
21231	Stone Mining and Quarrying
212314	Granite Mining and Quarrying
212315	Limestone Mining and Quarrying
212316	Marble Mining and Quarrying
212317	Sandstone Mining and Quarrying
21232	Sand, Gravel, Clay, and Ceramic and Refractory Minerals Mining and Quarrying
212323	Sand and Gravel Mining and Quarrying
212326	Shale, Clay and Refractory Mineral Mining and Quarrying

* Source: Statistics Canada, North American Industry Classification (NAICS) 2007, Catalogue no. 12-501-XWE

4. Are You Exempted From Reporting to the NPRI?

In the light of the decision mentioned in the first paragraph, are you exempt from reporting to the NPRI? The following figure illustrates the steps for determining if your facility is required to report for 2007.

Figure 1: Steps for determining if your facility is required to report for 2007.


```
                                    ┌──────────┐
                                    │ Facility │
                                    └────┬─────┘
                                         │
                                         ▼
                                   ╱───────────────╲
┌────────────────────────┐       ╱   Production     ╲
│ The facility is exempt  │◄── No  ≥ 500 000 tonnes / year
│ from reporting to the   │       ╲                 ╱
│ NPRI                    │        ╲───────────────╱
└────────────────────────┘                │
                                          Yes
                                          │
                                          ▼
                               ┌──────────────────────────┐
                               │ The facility is required  │
                               │ to report to NPRI,        │
                               │ regardless of the number  │
                               │ of employee hours worked, │
                               │ provided that the other   │
                               │ threshold criteria are    │
                               │ met.                      │
                               └──────────────────────────┘
```

5. Overview of this Guide

The facilities covered in this guide comprise of establishments engaged in non metallic minerals and non carboniferous production such as pits and quarries. Many operations and processes are common to pits and quarries. The processing of solid rock, sand and gravel of variable nature requires similar equipment and sometimes identical operations. The processing in general requires at first the removal of material covering the deposit (overburden). This removal may involve power shovels, loading trucks, bulldozers, drag lines and dredged pumps. When the source of crushed stone is solid

rock, drilling and blasting may be required to loosen the solid rock. Further operations taking place may include material size reduction (crushing), separation of the raw material into size classes (screening and sometimes washing). All this material needs to be transferred from one unit operation to the other using trucks and conveyor belts. Throughout this entire process, crushed material of various sizes is also stockpiled, usually in the open air and subject to wind erosion, waiting further processing or prior to shipment. Drying the material is sometimes necessary. All of these operations are the source of NPRI substance emissions. Vehicular traffic on unpaved roads within the person's contiguous facility is also a major source of dust emission that is to be taken into account when reporting to the NPRI if vehicles travelled more that 10 000 vehicle kilometres (VKT).

The emission factors for NPRI substances used in this document are the most recent factors published in the United States Environmental Protection Agency (US EPA), AP 42, Fifth Edition Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources. Note that emission factors for NPRI substances from the crushing, screening, handling and transfer operations associated with stone crushing presented in US EPA, AP-42, Chapter 11, Mineral Products Industry, section 11.19.2 'Crushed Stone Processing'

can be used to estimate emissions from corresponding sand and gravel processing sources (US EPA, AP-42, section 11.19.1 'Sand and Gravel Processing' http://www.epa.gov/ttn/chief/ap42/ch11/index.html).

Release estimates are also presented for NPRI emission substances originating from the combustion of fuels in external combustion equipment and from heavy stationary equipment used to generate power in remote locations.

This guidance document presents methodologies and appropriate links to estimate NPRI substances emissions from the most of possible operations related to pits and quarries production:

1. Emissions from Overburden Removal
2. Emissions from Boring / Blast Hole Drilling
3. Emissions from Blasting
4. Emissions from Blasting Explosives
5. Emissions from the Crushing Process
6. Emissions from the Screening Process
7. Emissions from Pulverizing
8. Emissions from Material Handling
9. Emissions due to Wind Erosion of Stockpile Surfaces
10. Emission from the Drying Process (Sand and Gravel Processing)

11. Emissions from Generators Equipment (Power Output Up to 600 Hp)

12. Emissions from Generators Equipment (Power Output> 600 Hp)

13. Emissions from the Combustion of Fuels in External Combustion Equipment

14. Emissions from Unpaved Roads ('Road dust' Emissions)

15. Emissions from Grading Activities

16. Other releases of NPRI Substances from Pits and Quarries Processes

To assist reporters, Environment Canada has developed easy-to-use excel spreadsheets that are used to estimate air emissions for some of the processes mentioned in this guide. The spreadsheets developed are based on published default emission factors or emission factor equations for Part 1 through Part 5 substances. These spreadsheets may be accessed through links in this guidance document.

For a full listing of NPRI substances, please refer to the Canada Gazette Part I Notice or the Guide for Reporting to the National Pollutant Release Inventory for the year being reported.
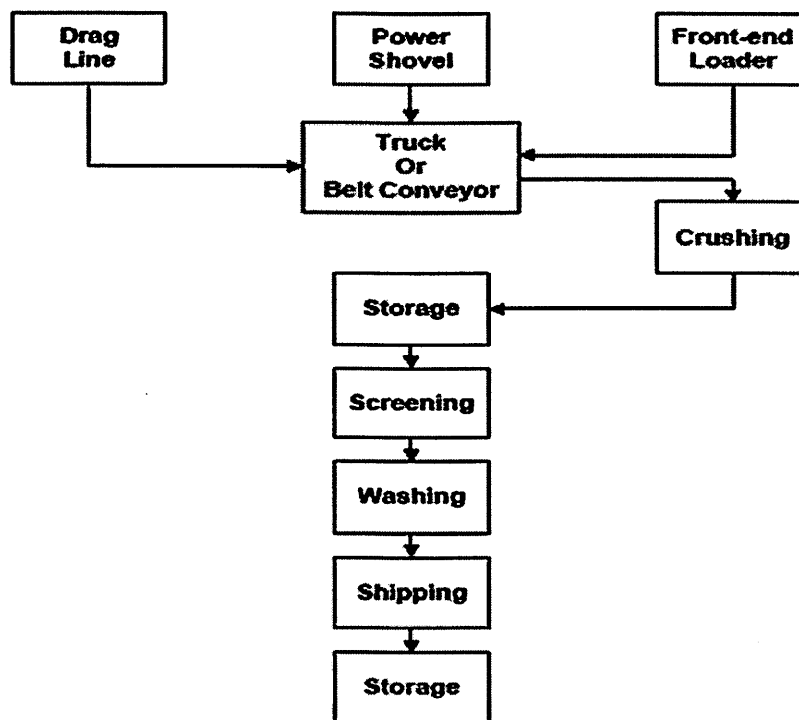
Note that the methodologies proposed in this document do not constitute endorsement of preferred methods for estimating emissions. The purpose of this document is to

provide the user with some of the available methods for estimating emissions from pits and quarries operations. Facilities may use their own site specific emission factors and other estimation methods. However, it is important to document and keep copies of the required information, together with any calculations, measurements and other data on which the information is based as required in the Gazette Notice.

6. Industrial Process Description

Figure 2 is a typical process schematic for a sand and gravel operation. This flow diagram may be similar to that of a stone quarrying.

Figure 2: Flow diagram for a sand and gravel processing operation (Source: California EPA and the National Association Stone Association, Aggregate Plants Compliance Assistance Program).

```
┌──────────┐        ┌──────────┐        ┌──────────┐
│  Drag    │        │  Power   │        │ Front-end│
│  Line    │        │  Shovel  │        │  Loader  │
└────┬─────┘        └────┬─────┘        └────┬─────┘
     │              ┌────▼─────────────┐     │
     └─────────────►│     Truck        │◄────┘
                    │      Or          │
                    │  Belt Conveyor   ├──────────┐
                    └────────┬─────────┘          │
                             │              ┌─────▼─────┐
                             │              │  Crushing │
                             │              └─────┬─────┘
                    ┌────────▼─────┐               │
                    │   Storage    │◄──────────────┘
                    └────────┬─────┘
                    ┌────────▼─────┐
                    │  Screening   │
                    └────────┬─────┘
                    ┌────────▼─────┐
                    │   Washing    │
                    └────────┬─────┘
                    ┌────────▼─────┐
                    │   Shipping   │
                    └────────┬─────┘
                    ┌────────▼─────┐
                    │   Storage    │
                    └──────────────┘
```

7. Emission Source Identification

The emission sources are activities related to pits and quarries including, overburden operations, boring, drilling, blasting, crushing, screening, pulverizing, conveying, washing, drying, hauling, loading and unloading stockpiles. The emission sources may be subdivided into six broad categories:

- Emissions of particulate matter (PM) produced during soil removal (overburden removal), from excavation, open conveyors, transfer points in conveyors systems, screens, crushers, stockpiles and wind-blown dust from storage piles.
- Emissions of PM from road dust due to vehicular traffic on unpaved roads.

- Emissions from external fixed combustion equipment.
- Emissions from generators (below 600 horsepower).
- Emissions from large stationary internal combustion engines. These engines operate at more than 600 horsepower and may be used to generate power for stationary equipment such as crushers and screens, especially in remote areas.
- Other releases of NPRI substances

A comprehensive source of information on this industry and related emission sources may be found in "U.S. EPA Fifth Edition, Volume I Chapter 11, section 11.19: Introduction to Construction and Aggregate Processing" and "U.S. EPA Fifth Edition, Volume I Chapter 13, Miscellaneous Sources".

8. Estimate Emissions from Processing Sources

This section may be used to estimate emissions from some of the already mentioned pits and quarries processing sources.

8.1 Emissions from Overburden Removal

It is often necessary to remove vegetation, soil and loose or solid rock soil in order to establish a production face where drilling and/or blasting can take place. The only NPRI

substances emitted from this operation are particulate matter (PM). The following Emission Factor equations(*) may be used to estimate the PM emissions from the overburden removal through the use of heavy equipment such as bulldozers, prior to other operations.

The method requires inputs for the silt content and moisture content of material being moved:

(8.1)

$$\text{TPM Emission (kg/hr)} = EF_{(TPM)} = 2.6\,(s)^{1.2} / (M)^{1.3}$$

(8.2)

$$PM_{10}\ \text{Emission (kg/hr)} = EF_{(PM10)} = (0.45\,(s)^{1.5} / (M)^{1.4}) \times 0.75$$

(8.3)

$$PM_{2.5}\ \text{Emission (kg/hr)} = EF_{(PM2.5)} = (2.6\,(s)^{1.2} / (M)^{1.3}) \times 0.105$$

Where,

M: average material moisture content (%)
s: material silt content (%)
EF : Emission factor for corresponding PM (kg/hr)

* Source: U.S. EPA Fifth Edition, Volume I Chapter 11, Mineral Products Industry, section 11.9: Western Surface Coal Mining, table 11.9-2.

Release Estimate

The general equation for estimating emissions is:

PM Released (tonnes/yr) = PM Emission Factor (kg/hr) x annual activity (hr/yr) x (1 tonne/1 000 kg)

NOTE: users should use these factors with caution and be aware of their limitations as they have been developed through field sampling of various western surface coal mine types. Further more, emission factors for these activities can be highly variable depending on assumptions of type of material, moisture and control efficiency.

Overburden Emission Control Techniques

Particulate emissions can be reduced by means of wind screens, enclosures or water sprays. However, no quantifiable recognised reduction efficiencies are yet available. The reporter may use its own data if available. Control techniques reduce PM emissions and in such cases, percentage emission reduction efficiencies are applied to the above equations (see section 9).

8.2 Emissions from Boring / Blast Hole Drilling

The following Emission Factors(*) may be used to estimate the PM emissions from boring activities in general or drilling of charge holes in particular. Portable internal combustion

engine powered drills are often used for holes drilling; the method does not account for the exhaust emissions from this equipment:

(8.4)

TPM Emission Factor (kg/hole) = $EF_{(TPM)}$ = 0.59 kg/hole

(8.5)

PM_{10} Emission Factor (kg/hole) = $EF_{(PM10)}$ = 0.31 kg/hole

(8.6)

$PM_{2.5}$ Emission Factor (kg/hole) = $EF_{(PM2.5)}$ = 0.31kg/hole

NOTE: the Emission Factors are based on wet drilling operations.

* Source: U.S. EPA Fifth Edition, Volume I Chapter 11, Mineral Products Industry, section 11.9: Western Surface Coal Mining, table 11.9-4". Mojave Desert Air Quality Management District, Antelope Valley Air Pollution Control District, Emissions Inventory Guidance, <u>Mineral Handling Handbook and Processing Industries</u> April 10, 2000 [doc 252kb]

Release Estimate

- The method requires an estimate of the number of holes drilled on an annual basis.

The general equation for estimating emissions is:

PM Released (tonnes/yr) = PM Emission Factor (kg /hole) x number of holes drilled per year x (1 tonne/1 000 kg)

Drilling Emission Control Techniques

Enclosures, air return or other control techniques may be used; however, no quantifiable recognised reduction efficiencies are yet available. The reporter may use its own data if available. Control techniques reduce PM emissions and in such cases, percentage emission reduction efficiencies are applied to the above equations (see section 9).

8.3 Emissions from Blasting

The following Emission Factors(*) may be used to estimate PM emissions from the displacement (fracturing, loosening or shifted) of solid rock through the use of explosives.
An estimate of emissions from the horizontal area displaced by blasting (A) is required:

(8.7)

TPM Emission Factor (kg/blast) = $EF_{(TPM)}$ = $0.00022 \, (A)^{1.5}$

(8.8)

PM_{10} Emission Factor (kg/blast) = $EF_{(PM10)}$ = $(0.00022 \, (A)^{1.5})$ x 0.52

(8.9)

$PM_{2.5}$ Emission Factor (kg/blast) = $EF_{(PM2.5)}$ = $(0.00022 \, (A)^{1.5})$ x 0.03

Where,

A: horizontal area (m2), with blasting ≤ depth 21 m.
EF : Emission factor for corresponding PM (kg/blast)

NOTE: Users should use these factors only if blasting depth does not exceed 21 meters.
NOTE: The Emission factors have been developed at western surface coal mines (US EPA).

* Source: U.S. EPA Fifth Edition, Volume I Chapter 11, Mineral Products Industry, section 11.9: Western Surface Coal Mining, table 11.9-2"

Release Estimate

- The method requires an estimate of the number of blasts per year.

The general equation for estimating emissions is:

PM Released (tonnes/yr) = PM Emission Factor (kg /blast) x number of blasts per year x (1 tonne/1 000 kg)

Drilling Emission Control Techniques

Blast blankets may be used; however, no quantifiable recognised reduction efficiencies are yet available. The reporter may use its own data if available. Control techniques reduce PM emissions and in such cases, percentage emission reduction efficiencies are applied to the above equations (see section 9).

8.4 Emissions from Blasting Explosives

Table 13.3.1 of the US EPA document - AP 42, Fifth Edition, Volume I, Chapter 13: Miscellaneous Sources - provides Emission factors according to the type of explosives and their uses. The emission factors for NOx, H_2S and SO_2 are available but no EFs for particulates are given. Some of the data is reproduced in the following table(*):

Type	Composition	Uses	CO (kg/tonne)	NOx (kg/tonne)
Dynamite, ammonia	20-60% Nitroglycerine /	Quarry work, stump	32	ND

Type	Composition	Uses	CO (kg/tonne)	NOx (kg/tonne)
	ammonium nitrate/sodium nitrate/wood pulp	blasting		
Dynamite, gelatine	20-100% Nitroglycerine	Demolition, construction work, blasting in mines	52	26
ANFO	Ammonium nitrate with 5.8-8% fuel oil	Construction work, blasting in mines	34	8

* Source: U.S. EPA Fifth Edition, Volume I Chapter 13, section 13.3: 'Explosive detonations, table 11.3-1'

The entire US EPA document may be accessed here[pdf 68kb]

Release Estimate

- The method requires an estimate of the weight of the explosives used.

The general equation for estimating emissions is:

Substance Released (tonnes/yr) = Substance Emission Factor (kg /tonne) x Weight of explosives used (tonne/yr) x (1 tonne/1 000 kg)

NOTE: VOC emissions are considered negligible for all explosives.

NOTE: Particulates are produced as well, but the quantity of particulates from the explosive charge cannot be distinguished from the ones generated from the shattering of the rock.

8.5 Emissions from the crushing process

Crushing emissions are estimated by applying emission factors published in section 11.19.2, table 11.19.2-1 of the U.S. EPA Fifth Edition, Volume I Chapter 11, Mineral Products Industry, section 11.19.2, Crushed Stone Processing and Pulverized Mineral Processing.

Emission source	EF TPM (kg/tonne)	EF PM_{10} (kg/tonne)	EF $PM_{2.5}$ (kg/tonne)
Primary crushing ** (3-05-020-01), Secondary ** crushing (3-05-020-02), and Tertiary crushing (3-05-020-03) Uncontrolled *	0.0027	0.0012	0.0006 ***

Emission source	EF TPM (kg/tonne)	EF PM$_{10}$ (kg/tonne)	EF PM$_{2.5}$ (kg/tonne)
Primary crushing ** (3-05-020-01), Secondary ** crushing (3-05-020-02), and Tertiary crushing (3-05-020-03) Controlled *	0.0006	0.00027	0.00005
Fines crushing (3-05-020-05) Uncontrolled *	0.0195	0.0075	ND
Fines crushing (3-05-020-05) Controlled *	0.0015	0.0006	0.000035

Source: U.S. EPA Fifth Edition, Volume I Chapter 11, section 11.19. 2, Crushed Stone Processing and Pulverized Mineral Processing, table 11.19-2-1

* Controlled emission source employs wet suppression method. Uncontrolled moisture content (0.21-1.3%) and controlled moisture content (0.55-2.88%).

** The revised AP-42 section does not include emission factors for primary and secondary crushing of stone. However, the emission factors for tertiary stone crushing can be used as an upper limit to primary and secondary crushing (Source: background document, p.14, U.S. EPA Fifth Edition,

Volume I Chapter 11, section 11.19.2, Crushed Stone Processing and Pulverized Mineral Processing, table 11.19-2-1).

*** The development of methodology, activity data and emission factors for estimating fugitive particulates from the aggregate mining and rock quarrying sector - Final Report. Submitted to Environment Canada by: AMEC Earth & Environmental, A division of AMEC Americas Limited, 505 Woodward Avenue, Unit 1, Hamilton, Ontario, L8H 6N6, May 31, 2007, TB71005 (Environment Canada Internal report).

* Background document, pp.14-17, U.S. EPA Fifth Edition, Volume I Chapter 11, section 11.19.2, Crushed Stone Processing and Pulverized Mineral Processing, Figure 2 and Figure 5.**

Release Estimate

- The method requires an estimate of the annual quantity of material processed through each crusher in the plant.

The general equation for estimating emissions is:

PM Released (tonnes/yr) = PM Emission Factor (kg /tonne) x Annual throughput (tonne/yr) x (1 tonne/1 000 kg)

Crusher Emission Control Techniques

The following table(*) presents the efficiency factor (1-ER) that may be applied to the estimated uncontrolled emission based on the type of control method employed at the facility for reducing crushing emissions (see section 9).

Control Method	Control factor (1-ER)
No Control (TCEQ)	1
Wet Material (TCEQ)	0.5
Water Spray (MDAQMD)	0.5
Surfactant (TCEQ)	0.2
Water Spray and Surfactant (MDAQMD)	0.25
Partial Enclosure (TCEQ)	0.15
Full Enclosure (TCEQ)	0.1
Enclosed by Building (TCEQ)	0.1
Central Baghouse (MDAQMD)	0.05
Fabric Filter (MDAQMD)	0.025
Building under negative pressure (TCEQ)	0.0

* The development of methodology, activity data and emission factors for estimating fugitive particulates from the aggregate mining and rock quarrying sector - Final Report. Submitted to Environment Canada by: AMEC Earth &

Environmental, A division of AMEC Americas Limited, 505 Woodward Avenue, Unit 1, Hamilton, Ontario, L8H 6N6, May 31, 2007, TB71005 (Environment Canada Internal Report)

- (MDAQMD): Mojave Desert Air Quality Management District, Antelope Valley Air Pollution Control District, Emissions Inventory Guidance, Mineral Handling Handbook and Processing Industries, April 10, 2000
- TCEQ: (Texas Commission on Environmental Quality). 2002. Rock Crushing Plants: Technical Guidance for Rock Crushing Plants. Air Permits Division, Austin TX.

NOTE: A spreadsheet may be used online to estimate the release of Criteria Air Contaminants (Part 4 substances) from crushing operations. The spreadsheet entitled 'Crushed Stone Processing' contains emission factors for the following processes: crushing (primary, secondary and tertiary), fines crushing, screening, fines screening and conveyor transfer point. The spreadsheet can be accessed in the NPRI Toolbox [xls 61ko]

8.6 Emissions from the screening process

Screening emissions are estimated by applying emission factors published in section 11.19.2, table 11.19.2-1 of the U.S. EPA Fifth Edition, Volume I Chapter 11, Mineral Products

Industry, section 11.19.2, Crushed Stone Processing and Pulverized Mineral Processing.

Emission source	EF TPM (kg/tonne)	EF PM$_{10}$ (kg/tonne)	EF PM$_{2.5}$ (kg/tonne)
Emission source Screening (3-05-020-02, 03) Uncontrolled**	0.0125	0.0043	ND
Emission source Screening (3-05-020-02, 03) Controlled **	0.0011	0.00037	0.000025
Emission source Fines Screening (3-05-020-21) Uncontrolled**	0.15	0.036	ND
Emission source Fines Screening (3-05-020-21) Controlled **	0.0018	0.0011	ND

*Source: U.S. EPA Fifth Edition, Volume I Chapter 11, section 11.19.2, Crushed Stone Processing and Pulverized Mineral Processing, table 11.19-2-1

** Controlled emission source employs wet suppression

method. Uncontrolled moisture content (0.21-1.3%) and controlled moisture content (0.55-2.88%).

ND: No data

Release Estimate

- The method requires an estimate of the annual quantity of material processed through each screen.

The general equation for estimating emissions is:

PM Released (tonnes/yr) = PM Emission Factor (kg /tonne) x Annual throughput (tonne/yr) x (1 tonne/1 000 kg)

Screen Emission Control Techniques

The following table(*) presents the efficiency factor (1-ER) that may be applied to the estimated uncontrolled emission based on the type of control method employed at the facility for reducing screening emissions (see section 9).

Control Method	Control factor (1-ER)
Covered Screen	0.5
Covered Screen with Water Spray	0.25
Covered Screen with Water Spray and Surfactant	0.10
Covered Screen with Control Fabric Filter	0.05

Control Method	Control factor (1-ER)
Covered Screen with Insertable Filter	0.025

* The development of methodology, activity data and emission factors for estimating fugitive particulates from the aggregate mining and rock quarrying sector - Final Report. Submitted to Environment Canada by: AMEC Earth & Environmental, A division of AMEC Americas Limited, 505 Woodward Avenue, Unit 1, Hamilton, Ontario, L8H 6N6, May 31, 2007, TB71005 (Environment Canada Internal report)

Particulate emissions can be reduced by means of screens and water sprays. Control techniques reduce PM emissions and in such cases, percentage emission reduction efficiencies are applied to the above equations (see section 9).

NOTE: A spreadsheet may be used online to estimate the release of Criteria Air Contaminants (Part 4 substances) from screening operations. The spreadsheet entitled 'Crushed Stone Processing' contains emission factors for the following processes: crushing (primary, secondary and tertiary), fines crushing, screening, fines screening and conveyor transfer point. The spreadsheet can be accessed in the NPRI Toolbox. [xls 61ko]

8.7 Emissions from Pulverizing

The pulverization process uses material from tertiary screening and produces an end product with diameters ranging from 1 µm to 75 µm. The dry and wet pulverization modes may be used. However, application of the wet mode processing may be limited in Canada.

The process description emission sources for the dry mode together with the corresponding emission factors are presented in the following table(*):

Process description and control technique (Source)	Standard Classification Code (SCC)	EF TPM (kg/tonne)	EF PM$_{10}$ (kg/tonne)	EF PM$_{2.5}$ (kg/tonne)
Grinding (Dry) with Fabric Filter Control	3-05-038-11	0.0202	0.0169	0.006
Classifiers (Dry) with Fabric Filter Control	3-05-038-12	0.0112	0.0052	0.002
Flash Drying with Fabric Filter Control	3-05-038-35	0.0134	0.0073	0.0042

Process description and control technique (Source)	Standard Classification Code (SCC)	EF TPM (kg/tonne)	EF PM_{10} (kg/tonne)	EF $PM_{2.5}$ (kg/tonne)
Product Storage with Fabric Filter Control	3-05-038-13	0.0055	0.0008	0.0003

* Source: U.S. EPA Fifth Edition, Volume I Chapter 11, section 11.19. 2, Crushed Stone Processing and Pulverized Mineral Processing, table 11.19-2-3".

Release Estimate

- The method requires an estimate of the annual quantity of material processed through the process equipment involved in the plant.

The general equation for estimating emissions is:

PM Released (tonnes/yr) = PM Emission Factor (kg /tonne) x Annual throughput (tonne/yr) x (1 tonne/1 000 kg)

Pulverizing Emission Control Techniques

- Emission controls have already been incorporated into the emission factors presented in the previous table.

8.8 Emissions from Material Handling

PM emissions occur during the handling and transfer operations of material from one process to another within the facility:

- **Open storage piles** of raw material and products are generated at various points throughout the operational area. Emissions of particulate matter (PM) occur during material loading onto the pile and load out from the pile. The operation may be batch (e.g. Truck dumping, front end loaders) or continuous (e.g. adding material to the pile by a conveyor belt);

- Conveyor belt **transfer points** are sometimes necessary to make the stream of material change direction or carry it to another elevation. Emissions of particulate matter (PM) occur during material transfer from one conveyor belt to another (discharge chutes).

(i) Open storage piles

Either adding aggregate material to a storage pile or removing it usually involves dropping the material onto a receiving surface. Truck dumping on the pile or loading out

from the pile to a truck with a front-end loader are examples of batch drop operations. Adding material to the pile by a conveyor is an example of a continuous drop operation.

Open area storage piles are subject to numerous points of dust emission such as

- pile loading of material (batch or continuous)
- wind erosion (see section 8.9), and
- truck or equipment movement around the stockpile (see section 8.14).
- load out of material from pile for shipment or return to the process stream (batch or continuous)

However, only emissions from the material handling (material loading and unloading) are discussed in this section. For emission from wind erosion, the method described in section 8.9 may be used.

A spreadsheet was developed to assist with estimating the release of Criteria Air Contaminants (Part 4 substances) from aggregate handling operations in general. The primary variables affecting particulate matter (PM) emissions from stockpiles are wind and material moisture. These two variables are included in the spreadsheet entitled 'Material Handling Operations'. This spreadsheet can be accessed in the NPRI Toolbox.

The method employs a predictive emission factor equation(*).

(8.10)

$$EF = k * 0.0016 * (U/2.2)^{13} / (M/2)^{1.4}$$

Where,

EF: Emission factor (kg/tonne)

U: mean wind speed (m/s)

M: material moisture content (%)

k: particle size multiplier

$k_{(TPM)} = 0.74$

$k_{(PM10)} = 0.35$

$k_{(PM2.5)} = 0.053$

Release Estimate

- The input information needed to estimate emissions is the mean wind speed, material moisture content and total quantity of material processed for each storage pile.

The general equation for estimating emissions is:

PM Released (tonnes/yr) = PM Emission Factor (kg /tonne) x Quantity of material handled per year (tonne/yr) x (1 tonne/1 000 kg)

* Source: U.S. EPA Fifth Edition, Volume I Chapter 13, Miscellaneous Sources, section 13.2.4, Aggregate Handling And Storage Piles

Storage Pile Emission Control Techniques

- The emission factors used in this spreadsheet are based on uncontrolled emissions. If you are using an emission control device you will have to adjust the emissions calculated by this spreadsheet accordingly (see section 9).

(ii) Conveyor belt Transfer points

The emission factors employed for Particulate Matter emission from conveyor belt transfer points (where a stream of material makes an abrupt change in direction or elevation) are presented in table 11.19.2-1, U.S. EPA Fifth Edition, Volume I Chapter 11, Mineral Products Industry, section 11.19.2, Crushed Stone Processing and Pulverized Mineral Processing:

Process description and control technique (Source)	Standard Classification Code (SCC)	EF TPM (kg/tonne)	EF PM$_{10}$ (kg/tonne)	EF PM$_{2.5}$ (kg/tonne)
Conveyor Transfer Point (Uncontrolled)	3-05-020-06	0.0015	0.00055	ND

Process description and control technique (Source)	Standard Classification Code (SCC)	EF TPM (kg/tonne)	EF PM$_{10}$ (kg/tonne)	EF PM$_{2.5}$ (kg/tonne)
Conveyor Transfer Point (Controlled)**	3-05-020-06	0.00007	2.3×10^{-5}	6.5×10^{-6}

*Source: U.S. EPA Fifth Edition, Volume I Chapter 11, section 11.19. 2, Crushed Stone Processing and Pulverized Mineral Processing, table 11.19-2-1

** Controlled emission source employs wet suppression method. Uncontrolled moisture content (0.21-1.3%) and controlled moisture content (0.55-2.88%).

NOTE: A spreadsheet may be used online to estimate the release of Criteria Air Contaminants (Part 4 substances) from Transfer Points operations. The spreadsheet entitled 'Crushed Stone Processing' contains emission factors for the following processes: crushing (primary, secondary and tertiary), fines crushing, screening, fines screening and conveyor transfer point. The spreadsheet can be accessed in the NPRI Toolbox. [xls 61kb]

Transfer Point Emission Control Techniques

The emission factors used in the spreadsheet are based on wet controlled and uncontrolled emissions. If you use your own emission control devices with known overall reduction

efficiency, you will have to adjust the emissions calculated by this spreadsheet accordingly (see section 9).

8.9 Emissions Due to Wind Erosion of Stockpile Surfaces

The following equation may be used to estimate PM emission factors for wind erosion of stockpile surfaces (*):

(8.11)

$$EF = 1.12 * 10^{-4} * J * 1.7 * (s/1.5) * 365 * ((365-P)/235) * (I/15)$$

Where,

EF: Emission factor in (kg/m^2)

J: Particulate aerodynamic factor

s: Average silt loading of storage pile in percent (%)

P: Average number of days during the year with at least 0.254 mm of precipitation

I: Percentage of time in the year with unobstructed wind speed >19.3 km/h in percent (%)

The particle aerodynamic factor for TPM, PM_{10} and $PM_{2.5}$ are:

$J(TPM) = 1.0$

$J(PM10) = 0.5$

$J(PM2.5) = 0.2$

Equation (9.1) requires inputs for **(a)** the silt content of the stockpiled material, **(b)** the average number of days during the year in question that experienced at least 0.254 mm of precipitation, the percentage of time during the year that the unobstructed wind speed exceeded 19.3 km/h, and **(c)** the exposed surface area of the stockpile.

(a) Average stockpile silt content

Silt contents of some stockpile material are described in the following table (*). Use specific facility value if known.

Stockpile Material	Silt Content (%)
Limestone	0.5
Crushed Limestone	1.5
Sand and Gravel	8.0
Overburden	10.0
Inorganic Minerals	30.0

* Mojave Desert Air Quality Management District, <u>Mineral Handling and Processing Industries, Table 2</u>, 2000

(b) Meteorological data (Wind speed and precipitation)

The average number of days during the year in question that experienced at least 0.254 mm of precipitation (P), and the percentage of time during the year that the unobstructed wind speed exceeded 19.3 km/h (I), may be determined using Online climate data from Environment Canada Weather <u>Web Site</u>.

To find the number of days per year with wind speed more than 19.3 km/h, you can follow these steps:

1. Go to the Online climate data from Environment Canada Weather <u>Website</u>.
2. Click on "Canadian Climate Normals".
3. Click on the Search method that you would like to use (Search by Station Name, Province or Proximity), enter the information requested and click 'Go'.
4. Click on the appropriate station from the list displayed (or the nearest one).
5. Click on the tab labelled "Normals Data".
6. Scroll down to the "Wind" table, find the "Wind: Speed (km/h)" row and then go across the month columns.
7. Find the months with "Wind: Speed (km/h)" more than 19.3 km/h
8. Divide the number of months with Wind Speed more than 19.3 km/h per 12 months and multiply by 100, you obtain

the average percentage of time 'I' during the year that wind speed exceeded 19.3 km/h.

NOTE: - This approach is based on 'Climate Normals' from 1981 to 2010 of the Climate Weather Office.

NOTE: - Should the reporter choose a more detailed method, use climate data On line on the left side of the menu of the Historical Climate Data Records.

(c) Exposed surface area of stockpile

Calculation for wind erosion emissions assumes a conically shaped stockpile. Thus the exposed surface area of the stockpile to the wind would be the one of a cone figure. The lateral surface area of the cone is given by

(8.12)

$$A = \pi * R \sqrt{(R^2 + H^2)}$$

Where,

π: Pi number = 3.1416

R : Radius of the storage pile

H: Height of the storage pile

A: Exposed surface area of stockpile (m^2)

Release Estimate

- The input information needed to estimate emissions is the exposed surface area of each storage pile generated throughout the plant.

The general equation for estimating PM emissions is:

PM Released (tonnes/yr) = PM Emission Factor (kg/m^2) x Exposed surface area of stockpile (m2) × (1 tonne/1 000 kg)

Stockpile Wind Erosion Emission Control Techniques

Particulate emissions from stockpiles may be reduced through the use of water spray. The following table presents the required minimum water application rates to achieve a given control efficiency.

Efficiency (%)	Application Rate (Litre/m^2)
50	1.591
60	2.232
70	3.172
80	4.748
85	6.077
90	8.306
95	13.337

* The development of methodology, activity data and emission factors for estimating fugitive particulates from the aggregate mining and rock quarrying sector - Final Report. Submitted to Environment Canada by: AMEC Earth & Environmental, A division of AMEC Americas Limited, 505 Woodward Avenue, Unit 1, Hamilton, Ontario, L8H 6N6, May 31, 2007, TB71005

* Mojave Desert Air Quality Management District, Mineral Handling and Processing Industries, table2, 2000 (MDAQMD, 2000)

NOTE: - Complete coverage by wind screens or enclosures on windward side to the stockpile provides a control efficiency of 75% (MDAQMD, 2000)

8.10 Emissions from the Drying Process (Sand and Gravel Processing)

Generally the material is wet and moist when handled and some of the operations involve washing, froth flotation and drainage. The material goes through driers to reduce its moisture content. The driers are generally fired with natural gas or oil. Emission factors for some of the NPRI substances are presented in the following tables (*):

Source	Total PM (kg/tonne)	NOx (kg/tonne)

Source	Total PM (kg/tonne)	NOx (kg/tonne)
Sand dryer (SCC 3-05-027-20)	0.98	0.016
Sand dryer with wet scrubber (SCC 3-05-027-20)	0.019	0.016
Sand dryer with fabric filter (SCC 3-05-027-20)	0.0053	0.016
Sand handling, transfer, and storage with wet scrubber (SCC 3-05-027-60)	0.00064	ND
Sand screening with venturi scrubber (SCC 3-05-027-13)	0.0042	ND

* Source: U.S. EPA Fifth Edition, Volume I Chapter 11, Mineral Products Industry, section 11.19.1, Sand and Gravel Processing, table 11.19.1-1

Source	CAS number	Name	EF (kg/tonne)
Diesel-fired rotary sand dryer with fabric filter (SCC 3-05-027-22)	50-00-0	Formaldehyde	0.0021
	206-44-0	Fluoranthene	3.0×10^{-6}
	91-20-3	Naphthalene	2.9×10^{-5}

Source	CAS number	Name	EF (kg/tonne)
	85-01-8	Phenanthrene	7.5×10^{-6}

* Source: U.S. EPA Fifth Edition, Volume I Chapter 11, Mineral Products Industry, section 11.19.1, Sand and Gravel Processing, tables 11.19.1-2

Release Estimate

- The input information needed to estimate emissions is the quantity of material dried.

The general equation for estimating emissions is:

Substance Released (tonnes/yr) = Substance Emission Factor (kg /tonne) x annual quantity of material processed (tonnes) x (1 tonne/1 000 kg)

8.11 Emissions from Generators Equipment (Power Output Up to 600 Horsepower)

Several spreadsheets have been designed to assist with estimating the releases of NPRI substances from generators (reciprocating engines) using gasoline and diesel fuel.

The spreadsheets can be accessed in the <u>NPRI Toolbox</u>.

The spreadsheets names together with the Standard Classification Codes (SCC) corresponding to the processes mentioned in the spreadsheets are described in the following table:

Process description (Source)	Standard Classification Codes (SCC)	Input Information	Spreadsheet Name
Distillate Oil (Diesel) / Reciprocating	2-02-001-02 2-03-001-01	Fuel usage	Diesel Fuel Generator - Fuel Usage'
		Hours of Operation	Diesel Fuel Generator - Hours of operation
Gasoline / Reciprocating	2-02-003-01 2-03-003-01	Fuel usage	Gasoline Generator - Fuel Usage'
		Hours of Operation	Gasoline Generator - Hours of operation

- For each fuel type, the input information may be either Fuel usage or Hours of operation.
- The spreadsheets for Distillate Oil (Diesel) / Reciprocating are applicable for Diesel Fuel generators up to 600

Horsepower.

- The spreadsheets were populated with default heating values for Diesel fuel and gasoline. These values may be changed if site specific values are available.

8.12 Emissions from Large Stationary Equipment Exhaust (Power Output > 600 Horsepower)

Large stationary internal combustion engine may operate at more than 600 horsepower and can be used to generate power to equipment such as crushers and screens, especially in remote areas.

A spreadsheet has been designed to assist with estimating the releases of NPRI substances from the diesel fuel combustion in a large stationary diesel engine (greater than 600 horse power). Only the NPRI substances the emission factors of which are available are considered. The spreadsheets can be accessed in the NPRI Toolbox. [xls 78kb]

The spreadsheet name together with the Standard Classification Codes (SCC) corresponding to the process mentioned in the spreadsheet is described in the following table:

Process description (Source)	Standard Classification Codes (SCC)	Input Information	Spreadsheet Name

Process description (Source)	Standard Classification Codes (SCC)	Input Information	Spreadsheet Name
Diesel	2-02-004-01	Fuel usage	Large Stationary Diesel Engine (> 600Hp)

8.13 Emissions from the Combustion of Fuels in External Combustion Equipment

The Toolbox section provides excel spreadsheets for estimating releases from external combustion equipment using various fuel types. They include available AP-42 and WebFIRE emission factors for Part 1 through Part 5 substances for those covered processes. For example, the spreadsheets for anthracite, Natural gas, Fuel oil (no 6) and Distillate Fuel oil can be accessed in the NPRI Toolbox.

8.14 Emissions from Unpaved Roads ('Road dust' Emissions)

This is a new requirement of the 2007 Gazette Notice and the emissions concern only unpaved roads. Gravel surfaced roads and thin membrane bituminous surface treatments and bituminous cold mix surfaces are referred as unpaved roads. If a dust suppressant is applied to an unpaved road, this

segment of road is still considered unpaved road surface. The reporting threshold for including PM, PM_{10} and $PM_{2.5}$ emissions from road dust is more than 10 000 Vehicle Kilometres travelled (VKT) on unpaved surfaces within the contiguous facility in a given year.

- A <u>guidance document</u>to assist facilities on how to report road dust emissions from unpaved surfaces to the National Pollutant Release Inventory (NPRI).
- A calculator has also been developed to estimate dust emissions due to vehicular traffic on unpaved roads within the facility. This spreadsheet can be accessed in the <u>NPRI Toolbox</u>.

8.15 Emissions from Grading Activities

This procedure applies to the removal or leveling of loose unpaved road material by scraping and planning. The emission for grading (kg/VKT) is calculated using the mean vehicle speed of the grader based on section 11.9, Western Surface Coal Mining from AP-42. The use of any emission control techniques utilized by a facility is also factored into the final point source emission.

(8.13)

$$EF_{(TPM)} = 0.0034 \times (S)^{2.5}$$

(8.14)

$$EF_{(PM10)} = 0.60 \times (0.0056 \times (S)^{2.0})$$

(8.15)

$$EF_{(PM2.5)} = 0.031 \times (0.0034 \times (S)^{2.5})$$

Where,

$EF_{(TPM)}$: emission for particulate matter ≤ 100 μm (kg/VKT)

$EF_{(PM10)}$: emission for particulate matter ≤ 10 μm (kg/VKT)

$EF_{(PM2.5)}$: emission for particulate matter ≤ 2.5 μm (kg/VKT)

S: mean vehicle operational speed (km/h)

Release Estimate

- The method requires an estimate of the annual vehicle kilometres travelled VKT.

The general equation for estimating emissions is:

PM Released (tonnes/yr) = PM Emission Factor (kg /VKT) x VKT (km travelled) x (1 tonne/1 000 kg)

8.16 Other releases of NPRI Substances from Pits and Quarries Processes

Some of the processes may involve the use of chemical substances (chemical wetting agents) that may end up in the environment. These processes may also release other NPRI

substances. It is therefore important to ensure if those NPRI substances meet the required thresholds, and if they do, report them accordingly.

9. Controlled Emissions

Particulate emissions can be reduced by means of equipment. Emission Control techniques and in such cases, percentage emission reduction efficiencies are applied to the uncontrolled emission estimates:

(9.1)

$$E_c = E \times (1-ER/100)$$

Where,

E_c: Controlled emissions

E: Uncontrolled emissions

ER: overall emission reduction efficiency, %

References

- US Environmental Protection Agency, Emissions Factors & AP 42, Fifth Edition Compilation of Air Pollutant Emission

Factors, Volume 1: Stationary Point and Area Sources

- US Environmental Protection Agency, Factor Information REtrieval (FIRE) Software (Webfire, December 2005)
- US Environmental Protection Agency, List of Source Classification Codes (SCC)
- Statistics Canada, North American Industry Classification (NAICS) 2007
- The development of methodology, activity data and emission factors for estimating fugitive particulates from the aggregate mining and rock quarrying sector - Final Report. Submitted to Environment Canada by: AMEC Earth & Environmental, A division of AMEC Americas Limited, 505 Woodward Avenue, Unit 1, Hamilton, Ontario, L8H 6N6, May, 2007, TB71005 (Environment Canada Internal Report)
- Mojave Desert Air Quality Management District, Antelope Valley Air Pollution Control District, Emissions Inventory Guidance, Mineral Handling Handbook and Processing Industries, April, 2000

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