20.2.74 NMAC AIR QUALITY PERMIT APPLICATION FOR THE PROPOSED INTERCONTINENTAL POTASH CORP. (USA) OCHOA MINE PROJECT Lea County, New Mexico

PREPARED FOR

Submitted November 6, 2013
Resubmitted December 5, 2013

Prepared by

Paul Wade, Class One Technical Services, Inc.

Mail Application To:		**For Department use only:**
New Mexico Environment Department Air Quality Bureau Permits Section 525 Camino de los Marquez, Suite 1 Santa Fe, New Mexico, 87505 Phone: (505) 476-4300 Fax: (505) 476-4375 www.nmenv.state.nm.us/aqb		AIRS No.:

Universal Air Quality Permit Application

Use this application for NOI, NSR, or Title V sources.

Use this application for: the initial application, modifications, technical revisions, and renewals. For technical revisions, complete Sections, 1-A, 1-B, 2-E, 3, 9 and any other sections that are relevant to the requested action; coordination with the Air Quality Bureau permit staff prior to submittal is encouraged to clarify submittal requirements and to determine if more or less than these sections of the application are needed. Use this application for streamline permits as well. For NOI applications, submit the entire UA1, UA2, and UA3 applications on a single CD (no copies are needed). For NOIs, hard copies of UA1, Tables 2A, 2D & 2F, Section 3 and the signed Certification Page are required.

This application is being submitted as (check all that apply): ☐ Request for a No Permit Required Determination (no fee)
☐ **Updating** an application currently under NMED review. Include this page and all pages that are being updated (no fee required).
Construction Status: ☒ Not Constructed ☐ Existing Permitted (or NOI) Facility ☐ Existing Non-permitted (or NOI) Facility
Minor Source: ☐ a NOI 20.2.73 NMAC ☐ 20.2.72 NMAC application/revision ☐ 20.2.72.300 NMAC Streamline application
Title V Source: ☐ Title V (new) ☐ Title V renewal ☐ TV minor mod. ☐ TV significant mod. TV Acid Rain: ☐ New ☐ Renewal
PSD Major Source: ☒ PSD major source (new) ☐ minor modification to a PSD source ☐ a PSD major modification

Acknowledgements: ☒ I acknowledge that a pre-application meeting is available to me upon request ☐ NPR (no fee)
☒ $500 NSR Permit Filing Fee enclosed OR ☐ The full permit fee associated with 10 fee points (required w/ streamline applications).
☒ Check No.: 1013 in the amount of $500 (Fee not required for Title V) ☐ This facility meets the applicable requirements to register as a Small Business and a check for 50% of the normal fee is enclosed (only applicable **provided** that NMED has a Small Business Certification Form from your company on file found at: http://www.nmenv.state.nm.us/aqb/permit/app_form.html).

Citation: Please provide the **low level citation** under which this application is being submitted: **20.2.74.200.A NMAC**
(i.e. an example of an application for a new minor source would be 20.2.72.200.A NMAC, one example of a low level cite for a Technical Revision could be: 20.2.72.219.B.1.b NMAC, or a Title V acid rain cite would be: 20.2.70.200.C NMAC)

Synthetic Minor Source Information: A source is synthetic minor if its uncontrolled emissions are above major source applicability thresholds, but the facility is minor because it has federally enforceable requirements (federal requirements or permit conditions) that limit controlled emissions below major source thresholds. Facilities can be synthetic minor for either Title V (20.2.70 NMAC) or PSD (20.2.74 NMAC) or both. The Department tracks synthetic minor sources that are within 20% of either TV or PSD major source thresholds, referring to these as Synthetic Minor 80 Sources (abbreviated SM80). Please check all that apply:
Prior to this permitting action this source is a ☐ TV major source, ☐ a TV synthetic minor source, ☐ a TV SM80 source.
Prior to this permitting action this source is a ☐ PSD major source, ☐ a PSD synthetic minor source, ☐ a PSD SM80 source.
This permitting action results in a ☐ TV synthetic minor source and/or ☐ PSD synthetic minor source.

Section 1 – Facility Information

Section 1-A: Company Information		AI # (if known):	Updating Permit/NOI #:
1	Facility Name: Ochoa Project	Plant primary SIC Code (4 digits): 1474	
a	Facility Street Address (If no facility street address, provide directions from a prominent landmark): **Ochoa Plant Facilities**: Head west on NM 128 from Jal, New Mexico. Turn left on Vaca Lane (past Mile Marker 31). Travel 1.1 miles south on Vaca Lane and turn west on 2-track dirt road. **Shaft:** Head west on NM 128 from Jal, New Mexico. Turn right (north) on Brininstool Road/Co Road 2-A. **Jal Load Out:** From the intersection of highways 128 & 18 travel west on highway 128 for 0.23 miles to 3rd St., Turn north on 3rd St. and travel 2.6 miles to Phillips Hill Rd. Turn west on Phillips Hill Rd. and travel 1.4 miles to turnoff to Jal Loadout. Turn north. **Groundwater Pre-Treatment Plant:** From the intersection of highways 128 & 18, head north on highway 18 towards Eunice, NM. Immediately past mile marker 14, turn left (west) on Cooper Cemetery Road/Co Road 7 and travel 7.25 miles west. Turn right (north) on un-named 2-track road and travel 1 mile. Turn left (west) on un-named 2-track road and travel 1 mile. Turn right (north) on un-named 2-track road and travel 1 mile. Pass over gate/cattle guard, and then turn west (left) on		

	un-named 2-track access road to groundwater pre-treatment.	
2	Plant Operator Company Name: Intercontinental Potash Corp. (USA)	Phone/Fax: (720) 633-9005/(720) 216-2060
a	Plant Operator Address: 1030 Johnson Road, Suite 300, Golden, CO 80401	
b	Plant Operator's New Mexico Corporate ID or Tax ID: 03-180909-00-0	
3	Plant Owner(s) name(s): Same as Operator	Phone/Fax: Same as Operator
a	Plant Owner(s) Mailing Address(s): Same as Operator	
4	Bill To (Company): Same as Operator	Phone/Fax: Same as Operator
a	Mailing Address: Same as Operator	E-mail: Same as Operator
5	☐ Preparer: ☒ Consultant: Paul Wade, Class One Technical Services, Inc.	Phone/Fax: 505-830-9680 ext 102/505-830-9678
a	Mailing Address: 3500 Comanche Rd NE, Suite G, Albuquerque, NM 87107	E-mail: pwade@classonetech.com
6	Plant Operator Contact: Tommy Cope	Phone/Fax: (575) 942-2799
a	Address: 600 West Bender Blvd., Hobbs, NM 88240	E-mail:tcope@icpotash.com
7	Air Permit Contact: Susan Serreze	Title: VP Environmental and Regulatory Affairs
a	E-mail: sserreze@icpotahs.com	Phone/Fax: (720) 633-9005
b	Mailing Address: 1030 Johnson Road, Golden, CO 80401	

Section 1-B: Current Facility Status

1.a	Has this facility already been constructed? ☐ Yes ☒ No	1.b If yes to question 1.a, is it currently operating in New Mexico? ☐ Yes ☐ No ☒ N/A
2	If yes to question 1.a, was the existing facility subject to a Notice of Intent (NOI) (20.2.73 NMAC) before submittal of this application? ☐ Yes ☐ No ☒ NA	If yes to question 1.a, was the existing facility subject to a construction permit (20.2.72 NMAC) before submittal of this application? ☐ Yes ☐ No ☒ N/A
3	Is the facility currently shut down? ☐ Yes ☐ No ☒ N/A	If yes, give month and year of shut down (MM/YY):
4	Was this facility constructed before 8/31/1972 and continuously operated since 1972? ☐ Yes ☒ No	
5	If Yes to question 3, has this facility been modified (see 20.2.72.7.P NMAC) or the capacity increased since 8/31/1972? ☐Yes ☐No ☒N/A	
6	Does this facility have a Title V operating permit (20.2.70 NMAC)? ☐ Yes ☒ No	If yes, the permit No. is: P-
7	Has this facility been issued a No Permit Required (NPR)? ☐ Yes ☒ No	If yes, the NPR No. is:
8	Has this facility been issued a Notice of Intent (NOI)? ☐ Yes ☒ No	If yes, the NOI No. is:
9	Does this facility have a construction permit (20.2.72 NMAC)? ☐ Yes ☒ No	If yes, the permit No. is:
10	Is this facility registered under a General permit (GCP-1, GCP-2, etc.)? ☐ Yes ☒ No	If yes, the register No. is:

Section 1-C: Facility Input Capacity & Production Rate

1	What is the facility's maximum input capacity, specify units (reference here and list capacities in Section 20, if more room is required)			
a	Current	Hourly: NA	Daily: NA	Annually: NA
b	Proposed	Hourly: 550.4 TPH	Daily: 13,209.6 TPD	Annually: 4,821,504 TPY
2	What is the facility's maximum production rate, specify units (reference here and list capacities in Section 20, if more room is required)			

a	Current	Hourly: NA	Daily: NA	Annually: NA
b	Proposed	Hourly: 168.2 TPH	Daily: 4036.8 TPD	Annually: 1,473,344 TPY

Section 1-D: Facility Location Information

1	Jal Loadout - Section: 25, 36	Range: 36E	Township: 24S	County: Lea	Elevation (ft): 3295
	Ochoa Plant - Section: 23, 24, 25, 26, 35	Range: 33E	Township: 24S	County: Lea	Elevation (ft): 3520
	Groundwater Pre-Treatment Plant - Section: 14	Range: 35E	Township: 24S	County: Lea	Elevation (ft): 3400
2	UTM Zone: ☐ 12 or ☒ 13		Datum: ☐ NAD 27 ☒ NAD 83 ☐ WGS 84		
a	UTM E (in meters, to nearest 10 meters):	Jal Loadout – 668,450E Ochoa Plant – 638,260E Groundwater Pre-Treatment Plant - 657,410E	UTM N (in meters, to nearest 10 meters):	Jal Loadout – 3,562,590N Ochoa Plant – 3,563,520N Groundwater Pre-Treatment Plant - 3,565,175N	
b	**AND** Latitude (deg., min., sec.):	Jal Loadout – 32°, 11', 14.1" N Ochoa Plant - 32°, 11', 59.1" N Groundwater Pre-Treatment Plant - 32°, 12', 43.8" N	Longitude (deg., min., sec.):	Jal Loadout – 103°, 12', 47.2" W Ochoa Plant - 103°, 31', 59.2" W Groundwater Pre-Treatment Plant - 103°, 19', 47.1" W	
3	Name and zip code of nearest New Mexico town: Jal, NM - 88252				
4	Detailed Driving Instructions from nearest NM town (attach a road map if necessary): Jal Loadout – From the intersection of highways 128 & 18 travel west on highway 128 for 0.23 miles to 3rd St., Turn north on 3rd St. and travel 2.6 miles to Phillips Hill Rd. Turn west on Phillips Hill Rd. and travel 1.4 miles to turnoff to Jal Loadout. Turn north. Ochoa Plant – Head west on NM 128 from Jal, New Mexico. Turn left on Vaca Lane (past Mile Marker 31). Travel 1.1 miles south on Vaca Lane and turn west on 2-track dirt road. Water Pre-treatment - From the intersection of highways 128 & 18, head north on highway 18 towards Eunice, NM. Immediately past mile marker 14, turn left (west) on Cooper Cemetery Road/Co Road 7 and travel 7.25 miles west. Turn right (north) on un-named 2-track road and travel 1 mile. Turn left (west) on un-named 2-track road and travel 1 mile. Turn right (north) on un-named 2-track road and travel 1 mile. Pass over gate/cattle guard, and then turn west (left) on un-named 2-track access road to groundwater pre-treatment.				
5	The Jal Loadout is 4.7 miles, North-Northwest (340 degrees) from the intersection of Highways 128 and 18 in Jal, NM. The Ochoa Polyhalite Plant is 20.7 miles West-Northwest (285 degrees) from the intersection of Highways 128 and 18 in Jal, NM. The Groundwater Pre-Treatment Plant is 10.4 miles, Northwest (320 degrees) from the intersection of Highways 128 and 18 in Jal, NM.				
6	Status of land at facility (check one): ☒ Private ☐ Indian/Pueblo ☒ Federal BLM ☐ Federal Forest Service ☐ Other (specify)				
7	List all municipalities, Indian tribes, and counties within a ten (10) mile radius (20.2.72.203.B.2 NMAC) of the property on which the facility is proposed to be constructed or operated: Jal Loadout – Jal, NM; Lea County, NM; Andrews County, TX: Ochoa Plant – Lea County, NM; Eddy County, NM				
8	**20.2.72** NMAC applications **only**: Will the property on which the facility is proposed to be constructed or operated be closer than 50 km (31 miles) to other states, Bernalillo County, or a Class I area (see www.nmenv.state.nm.us/aqb/modeling/class1areas.html)? ☒ Yes ☐ No (20.2.72.206.A.7 NMAC) If yes, list all with corresponding distances in kilometers: 14 km - Jal Loadout to Texas, 18.5 km – Ochoa Polyhalite Plant to Texas, 23.4 km – Groundwater Pre-Treatment Plant to Texas				
9	Name nearest Class I area: Carlsbad Caverns National Park				
10	Shortest distance (in km) from facility boundary to the boundary of the nearest Class I area (to the nearest 10 meters): 77.35 km				
11	Distance (meters) from the perimeter of the Area of Operations (AO is defined as the plant site inclusive of all disturbed lands, including mining overburden removal areas) to nearest residence, school or occupied structure: Jal Loadout – 2,110 meters; Ochoa Plant – 2,150 meters; Groundwater Pre-Treatment Plant – 6,500 meters				
12	Method(s) used to delineate the Restricted Area: Fencing and Gates Sufficient fencing, gates, and signage to insure the public is noticed and restricted. "**Restricted Area**" is an area to which public entry is effectively precluded. Effective barriers include continuous fencing, continuous walls, or other continuous barriers approved by the Department, such as rugged physical terrain with steep grade that would require special equipment to traverse. If a large property is completely enclosed by fencing, a restricted area within the property may be indentified with signage only. Public roads cannot be part of a Restricted Area.				
13	Does the owner/operator intend to operate this source as a portable stationary source as defined in 20.2.72.7.X NMAC? ☐ Yes ☒ No				

	A portable stationary source is not a mobile source, such as an automobile, but a source that can be installed permanently at one location or that can be re-installed at various locations, such as a hot mix asphalt plant that is moved to different job sites.
14	Will this facility operate in conjunction with other air regulated parties on the same property? ☒ No ☐ Yes If yes, what is the name and permit number (if known) of the other facility?

Section 1-E: Proposed Operating Schedule (The 1-E.1 & 1-E.2 operating schedules may become conditions in the permit.)

1	Facility **maximum** operating ($\frac{hours}{day}$): 24	($\frac{days}{week}$): 7	($\frac{weeks}{year}$): 52	($\frac{hours}{year}$): 8760		
2	Facility's maximum daily operating schedule (if less than 24 $\frac{hours}{day}$)? Start: NA	☐AM ☐PM	End: NA	☐AM ☐PM		
3	Month and year of anticipated start of construction: June 2014					
4	Month and year of anticipated construction completion: September 2016					
5	Month and year of anticipated startup of new or modified facility: December 2016					
6	Will this facility operate at this site for more than one year? ☒ Yes ☐ No					

Section 1-F: Other Facility Information

1	Are there any current Notice of Violations (NOV), compliance orders, or any other compliance or enforcement issues related to this facility? ☐ Yes ☒ No If yes, specify:		
a	If yes, NOV date or description of issue: NA	NOV Tracking No:	
b	Is this application in response to any issue listed in 1-F, 1 or 1a above? ☐ Yes ☒ No If Yes, provide the 1c & 1d info below:		
c	Document Title: NA	Date: NA	Requirement # (or page # and paragraph #): NA
d	Provide the required text to be inserted in this permit:NA		
2	Is air quality dispersion modeling being submitted with this application? ☒ Yes ☐ No		
3	Does this facility require an "Air Toxics" permit under 20.2.72.400 NMAC & 20.2.72.502, Tables A and/or B? ☐ Yes ☒ No		
4	Will this facility be a source of federal Hazardous Air Pollutants (HAP)? ☒ Yes ☐ No		
a	If Yes, what type of source? ☐ **Major** (☐ ≥10 tpy of any single HAP **OR** ☐ ≥25 tpy of any combination of HAPS) **OR** ☒ **Minor** (☒ <10 tpy of any single HAP **AND** ☒ <25 tpy of any combination of HAPS)		
b	If 4.a is Yes, indentify the subparts in 40 CFR 61 & 40 CFR 63 that apply to this facility (If no subparts apply, enter "N/A."): N/A		

Section 1-G: Streamline Application (This section applies to 20.2.72.300 NMAC Streamline applications only)

1	☐ I have filled out Section 18, "Addendum for Streamline Applications." ☒ N/A (This is not a Streamline application.)

Section 1-H: Title V Specific Information (Fill this section out only if this is a Title V application.)

1	Responsible Official (20.2.70.300.D.2 NMAC):	Phone:
a	R.O. Title:	R.O. e-mail:
b	R. O. Address:	
2	Alternate Responsible Official (20.2.70.300.D.2 NMAC):	Phone:
a	A. R.O. Title:	A. R.O. e-mail:
b	A. R. O. Address:	
3	Company's Corporate or Partnership Relationship to any other Air Quality Permittee (List the names of any companies that have operating (20.2.70 NMAC) permits and with whom the applicant for this permit has a corporate or partnership relationship):	

4	Name of Parent Company ("Parent Company" means the primary name of the organization that owns the company to be permitted wholly or in part.):
a	Address of Parent Company:
5	Names of Subsidiary Companies ("Subsidiary Companies" means organizations, branches, divisions or subsidiaries, which are owned, wholly or in part, by the company to be permitted.):
6	Telephone numbers & names of the owners' agents and site contacts familiar with plant operations:
7	Affected Programs to include Other States, local air pollution control programs (i.e. Bernalillo) and Indian tribes: Will the property on which the facility is proposed to be constructed or operated be closer than 80 km (50 miles) from other states, local pollution control programs, and Indian tribes and pueblos (20.2.70.402.A.2 and 20.2.70.7.B)? If yes, state which ones and provide the distances in kilometers:

Section 1-I – Submittal Requirements

Each 20.2.73 NMAC (**NOI**), a 20.2.70 NMAC (**Title V**), a 20.2.72 NMAC (**NSR** minor source), or 20.2.74 NMAC (**PSD**) application package shall consist of the following:

Hard Copy Submittal Requirements:

1) One hard copy **original signed and notarized application package printed double sided 'head-to-toe' 2-hole punched** as we bind the document on top, not on the side; except Section 2 (landscape tables), which should be head-to-head. If 'head-to-toe printing' is not possible, print single sided. Please use **numbered tab separators** in the hard copy submittal(s) as this facilitates the review process. For NOI submittals only, hard copies of UA1, Tables 2A, 2D & 2F, Section 3 and the signed Certification Page are required.

2) If the application is for a NSR or Title V permitting action, include one working hard **copy** for Department use. This copy does not need to be 2-hole punched. Technical revisions only need to fill out Section 1-A, 1-B, 3, and should fill out those portions of other Section(s) relevant to the technical revision. TV Minor Modifications need only fill out Section 1-A, 1-B, 1-H, 3, and those portions of other Section(s) relevant to the minor modification. NMED may require additional portions of the application to be submitted, as needed.

3) The entire NOI or Permit application package, including the full modeling study, should be submitted electronically on compact disk(s) (CD). For permit application submittals, **two** CD copies are required (in sleeves, not crystal cases, please), with additional CD copies as specified below. NOI applications require only a single CD submittal.

4) If **air dispersion modeling** is required by the application type, include the **NMED Modeling Waiver OR** one additional electronic copy of the air dispersion modeling including the input and output files. The dispersion modeling ***summary report only*** should be submitted as hard copy(ies) unless otherwise indicated by the Bureau. The complete dispersion modeling study, including all input/output files, should be submitted electronically as part of the electronic submittal.

5) If subject to PSD review under 20.2.74 NMAC (PSD) include,
   a. one additional hard copy and one additional CD copy for US EPA,
   b. one additional hard copy and one additional CD copy for each federal land manager affected (NPS, USFS, FWS, USDI) and,
   c. one additional hard copy and one additional CD copy for each affected regulatory agency other than the Air Quality Bureau.

Electronic Submittal Requirements [in addition to the required hard copy(ies)]:

1) All required electronic documents shall be submitted in duplicate (2 separate CDs). A single PDF document of the entire application as submitted and the individual documents comprising the application.

2) The documents should also be submitted in Microsoft Office compatible file format (Word, Excel, etc.) allowing us to access the text in the documents (copy & paste). Any documents that cannot be submitted in a Microsoft Office compatible format shall be saved as a PDF file from within the electronic document that created the file. If you are unable to provide Microsoft office compatible electronic files or internally generated PDF files of files (items that were not created electronically: i.e. brochures, maps, graphics, etc,), submit these items in hard copy format with the number of additional hard copies corresponding to the number of CD copies required. We must be able to review the formulas and inputs that calculated the emissions.

3) It is preferred that this application form be submitted as 3 electronic files (2 MSWord docs: Universal Application section 1 and Universal Application section 3-19) and 1 Excel file of the tables (Universal Application section 2) on the CD(s). Please include as many of the 3-19 Sections as practical in a single MS Word electronic document. Create separate electronic file(s) if a single file becomes too large or if portions must be saved in a file format other than MS Word.

4) The electronic file names shall be a maximum of 25 characters long (including spaces, if any). The format of the electronic

Universal Application shall be in the format: "A-3423-FacilityName". The "A" distinguishes the file as an application submittal, as opposed to other documents the Department itself puts into the database. Thus, all electronic application submittals should begin with "A-". Modifications to existing facilities should use the core permit number (i.e. '3423') the Department assigned to the facility as the next 4 digits. Use 'XXXX' for new facility applications. The format of any separate electronic submittals (additional submittals such as non-Word attachments, re-submittals, application updates) and Section document shall be in the format: "A-3423-9-description", where "9" stands for the section # (in this case Section 9-Public Notice). Please refrain, as much as possible, from submitting any scanned documents as this file format is extremely large, which uses up too much storage capacity in our database. Please take the time to fill out the header information throughout all submittals as this will identify any loose pages, including the Application Date (date submitted) & Revision # (0 for original, 1, 2, etc.; which will help keep track of subsequent partial update(s) to the original submittal. The footer information should not be modified by the applicant.

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Table 2-A: Regulated Emission Sources

Unit and stack numbering must correspond throughout the application package. If applying for a NOI under 20.2.73 NMAC, equipment exemptions under 2.72.202 NMAC do not apply.

Unit Number[1]	Source Description	Manufacturer	Model #	Serial #	Maximum or Rated Capacity[3] (Specify Units)	Requested Permitted Capacity[3] (Specify Units)	Date of Manufacture or Reconstruction[2] / Date of Installation /Construction[2]	Controlled by Unit # / Emissions vented to Stack #	Source Classi-fication Code (SCC)	For Each Piece of Equipment, Check One	Applicable State & Federal Regulation(s) (i.e. 20.2.X, JJJJ, …)	Replacing Unit No.
S1	Belt Conveyor From U/G #1	TBD	TBD	TBD	550.4 tph	4821592 tpy	TBD TBD	SC1 NA	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.74	
S2	Belt Conveyor From U/G #2	TBD	TBD	TBD	550.4 tph	4821592 tpy	TBD TBD	SC1 NA	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.74	
S3	Ore Storage Bypass Diverter Gate	TBD	TBD	TBD	550.4 tph	4821592 tpy	TBD TBD	SC2 STK1	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S4	Ore Storage Feed Drag Conveyor	TBD	TBD	TBD	550.4 tph	4821592 tpy	TBD TBD	SC2 STK1	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S5A,B	Raw Ore Bin #1 and #2	TBD	TBD	TBD	550.4 tph	4821592 tpy	TBD TBD	SC2 STK1	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S6A,B	Ore Storage Drag Conveyor #1 and #2	TBD	TBD	TBD	550.4 tph	4821592 tpy	TBD TBD	SC2 STK1	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S7	ROM Baghouse Fines Screw Conveyor	TBD	TBD	TBD	1 tph	8760 tpy	TBD TBD	SC2 STK1	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S8	Belt Conveyor from Raw Ore Storage	TBD	TBD	TBD	550.4 tph	4821592 tpy	TBD TBD	SC3 STK2	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S9	Raw Ore Surge Bin	TBD	TBD	TBD	550.4 tph	4821592 tpy	TBD TBD	SC3 STK2	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S10	VFD Belt Feeder	TBD	TBD	TBD	550.4 tph	4821592 tpy	TBD TBD	SC3 STK2	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S11	Raw Ore Roll Crusher	TBD	TBD	TBD	550.4 tph	4821592 tpy	TBD TBD	SC3 STK2	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S12	Wet Sizing Screen Feed Pump Box	TBD	TBD	TBD	550.4 tph	4821592 tpy	TBD TBD	SC3 STK2	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
	Wet Sizing Screen Feed Pump	TBD	TBD	TBD			TBD TBD	SC3 STK2	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
	Wet Sizing Screens	TBD	TBD	TBD			TBD TBD	SC3 STK2	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
	Wet O/S Cage Mill	TBD	TBD	TBD			TBD TBD	SC3 STK2	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
	Wet Sizing Screens	TBD	TBD	TBD			TBD TBD	SC3 STK2	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	

Unit Number[1]	Source Description	Manufacturer	Model #	Serial #	Maximum or Rated Capacity[3] (Specify Units)	Requested Permitted Capacity[3] (Specify Units)	Date of Manufacture or Reconstruction[2] / Date of Installation /Construction[2]	Controlled by Unit # / Emissions vented to Stack #	Source Classi-fication Code (SCC)	For Each Piece of Equipment, Check One	Applicable State & Federal Regulation(s) (i.e. 20.2.X, JJJJ, …)	Replacing Unit No.
S13	Crusher Baghouse Fines Screw Conveyor	TBD	TBD	TBD	1 tph	8760 tpy	TBD TBD	SC3 STK2	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S14A,B	Sodium Chloride Wash Belt Filter #1 and #2	TBD	TBD	TBD	555.1 tph	4862676 tpy	TBD TBD	SC3 STK2	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S15A,B	Calciner Feed Surge Bin #1 and #2	TBD	TBD	TBD	555.1 tph	4862676 tpy	TBD TBD	SC3 STK2	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S16A,B	Calciner Feed Live Bottom Screw Conveyor #1 and #2	TBD	TBD	TBD	555.1 tph	4862676 tpy	TBD TBD	SC7 STK5	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S17A,B	Calciner Feed Live Bottom Screw Conveyor #3 and #4	TBD	TBD	TBD	555.1 tph	4862676 tpy	TBD TBD	SC7 STK5	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S18A,B,C	Polyhalite Dryer/Calciner (3)	TBD	TBD	TBD	214.23 mmBtu/Hr (Each)	214.23 mmBtu/Hr (Each)	TBD TBD	SC4,5,6 STK3A,3B,3C	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S19A,B,C	Polyhalite Dryer/Calciner Cyclone (3)	TBD	TBD	TBD	20 tph	175200 tpy	TBD TBD	SC4,5,6 STK3A,3B,3C	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S20A,B	Cooler Feed Bucket Elevator #1 and #2	TBD	TBD	TBD	458.89 tph	4019877 tpy	TBD TBD	SC7 STK5	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S21A,B,C	Polyhalite Coolers (3)	TBD	TBD	TBD	474.58 tph	4157321 tpy	TBD TBD	SC4,5,6 STK3A,3B,3C	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S22A,B,C	Polyhalite Coolers Cyclones (3)	TBD	TBD	TBD	4.31 tph	37755.6 tpy	TBD TBD	SC4,5,6 STK3A,3B,3C	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S23	Calcined Polyhalite Screw Conveyor #1	TBD	TBD	TBD	473.87 tph	4151101 tpy	TBD TBD	SC7 STK5	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S24	Calcined Polyhalite Bucket Elevator	TBD	TBD	TBD	473.87 tph	4151101 tpy	TBD TBD	SC7 STK5	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S25	Calcined Polyhalite Surge Bin	TBD	TBD	TBD	473.87 tph	4151101 tpy	TBD TBD	SC7 STK5	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	

Unit Number[1]	Source Description	Manufacturer	Model #	Serial #	Maximum or Rated Capacity[3] (Specify Units)	Requested Permitted Capacity[3] (Specify Units)	Date of Manufacture or Reconstruction[2] / Date of Installation /Construction[2]	Controlled by Unit # / Emissions vented to Stack #	Source Classi-fication Code (SCC)	For Each Piece of Equipment, Check One	Applicable State & Federal Regulation(s) (i.e. 20.2.X, JJJJ, …)	Replacing Unit No.
S26	Calcined Polyhalite Screw Conveyor #3	TBD	TBD	TBD	473.87 tph	4151101 tpy	TBD TBD	SC7 STK5	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S27	Calcined Polyhalite Belt Conveyor	TBD	TBD	TBD	473.87 tph	4151101 tpy	TBD TBD	SC7 STK5	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S28	Stage 1 Leach Pug Mixer	TBD	TBD	TBD	473.87 tph	4151101 tpy	TBD TBD	SC7 STK5	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S30A,B,C	Calcined Baghouse Screw Conveyor #1-3	TBD	TBD	TBD	2.15 tph	18834 tpy	TBD TBD	SC4,5,6 STK3A,3B,3C	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S32	SOP Centrifuge	TBD	TBD	TBD	111.3 tph	974988 tpy	TBD TBD	SC8 STK4	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S33	Screw Feeder	TBD	TBD	TBD	111.3 tph	974988 tpy	TBD TBD	SC8 STK4	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S34	SOP Product Dryer	TBD	TBD	TBD	18.74 mmBtu/Hr	18.74 mmBtu/Hr	TBD TBD	SC8 STK4	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S35	SOP Product Dryer Cyclone	TBD	TBD	TBD	9.69 tph	84884.4 tpy	TBD TBD	SC8 STK4	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S36	SOP Bucket Elevator #1	TBD	TBD	TBD	106.87 tph	936181 tpy	TBD TBD	SC7 STK5	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S37	SOP Product Column Cooler	TBD	TBD	TBD	106.87 tph	936181 tpy	TBD TBD	SC7 STK5	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S38	SOP Product Surge Bin	TBD	TBD	TBD	111.38 tph	975689 tpy	TBD TBD	SC7 STK5	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S39	SOP Product Surge Bin Screw Feeder	TBD	TBD	TBD	111.38 tph	975689 tpy	TBD TBD	SC7 STK5	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S40	SOP Bucket Elevator #2	TBD	TBD	TBD	109.16 tph	956342 tpy	TBD TBD	SC7 STK5	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S41	Standard SOP Multi-Deck Sizing Screen	TBD	TBD	TBD	109.16 tph	956342 tpy	TBD TBD	SC7 STK5	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S42	Standard SOP Single Stage Roller Crusher	TBD	TBD	TBD	10 tph	87600 tpy	TBD TBD	SC7 STK5	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S43	SOP O/S Crusher Recycle Screw Conveyor	TBD	TBD	TBD	10 tph	87600 tpy	TBD TBD	SC7 STK5	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	

Unit Number[1]	Source Description	Manufacturer	Model #	Serial #	Maximum or Rated Capacity[3] (Specify Units)	Requested Permitted Capacity[3] (Specify Units)	Date of Manufacture or Reconstruction[2] / Date of Installation /Construction[2]	Controlled by Unit # / Emissions vented to Stack #	Source Classi-fication Code (SCC)	For Each Piece of Equipment, Check One	Applicable State & Federal Regulation(s) (i.e. 20.2.X, JJJJ, …)	Replacing Unit No.
S44	SOP Bucket Elevator #3	TBD	TBD	TBD	12.53 tph	109763 tpy	TBD TBD	SC7 STK5	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S45	Soluble SOP Multi-Deck Sizing Screen	TBD	TBD	TBD	12.53 tph	109763 tpy	TBD TBD	SC7 STK5	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S46	Soluble SOP Transfer Belt Conveyor	TBD	TBD	TBD	12.37 tph	108361 tpy	TBD TBD	SC7 STK5	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S47	Soluble SOP Splitter Gate	TBD	TBD	TBD	12.37 tph	108361 tpy	TBD TBD	SC7 STK5	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S48	Soluble SOP Dedusting Screw Conveyor	TBD	TBD	TBD	12.35 tph	108186 tpy	TBD TBD	SC7 STK5	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S49	SOP Bucket Elevator #5	TBD	TBD	TBD	12.35 tph	108186 tpy	TBD TBD	SC7 STK5	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S50	SOP Standard Splitter Gate #1	TBD	TBD	TBD	95.54 tph	836930 tpy	TBD TBD	SC7 STK5	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S51	Standard SOP Screw Conveyor	TBD	TBD	TBD	46.40 tph	406464 tpy	TBD TBD	SC7 STK5	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S52	SOP Standard Splitter Gate #2	TBD	TBD	TBD	68.33 tph	598571 tpy	TBD TBD	SC7 STK5	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S53	Standard SOP Single Stage Roll Crusher	TBD	TBD	TBD	4.52 tph	39595 tpy	TBD TBD	SC7 STK5	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S54	Standard SOP Dedusting Screw Conveyor	TBD	TBD	TBD	63.82 tph	559063 tpy	TBD TBD	SC7 STK5	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S55	SOP Bucket Elevator #4	TBD	TBD	TBD	63.82 tph	559063 tpy	TBD TBD	SC7 STK5	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S56	Truck Unload SOP Fines Return from Jal	NA	NA	NA	0.3 tph	2628 tpy	TBD TBD	SC9 NA	30502299	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S57	SOP Fines Return Dump Hopper	TBD	TBD	TBD	0.3 tph	2628 tpy	TBD TBD	SC10 NA	30502299	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S58	SOP Fines Return Belt Feeder	TBD	TBD	TBD	0.3 tph	2628 tpy	TBD TBD	SC7 STK5	30502299	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S59	SOP Fines Return Belt Conveyor	TBD	TBD	TBD	0.3 tph	2628 tpy	TBD TBD	SC7 STK5	30502299	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S60	SOP Fines Belt Conveyor	TBD	TBD	TBD	48.58 tph	425561 tpy	TBD TBD	SC7 STK5	30502299	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	

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S61	SOP Granulation Feed Bucket Elevator #1	TBD	TBD	TBD	48.58 tph	425561 tpy	TBD TBD	SC7 STK5	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S62	SOP Recycle Bin #1	TBD	TBD	TBD	48.58 tph	425561 tpy	TBD TBD	SC7 STK5	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S63	SOP Granulation Splitter Gate	TBD	TBD	TBD	48.58 tph	425561 tpy	TBD TBD	SC7 STK5	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S64	SOP Fine Grinding Mill Feed Screw Conveyor	TBD	TBD	TBD	14.57 tph	127633 tpy	TBD TBD	SC7 STK5	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S65	SOP Vertical Fine Grinding Mill	TBD	TBD	TBD	14.57 tph	127633 tpy	TBD TBD	SC7 STK5	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S66	SOP Fine Grinding Mill Dry Cyclone	TBD	TBD	TBD	14.57 tph	127633 tpy	TBD TBD	SC7 STK5	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S67	SOP Recycle Bin #4	TBD	TBD	TBD	14.57 tph	127633 tpy	TBD TBD	SC7 STK5	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S68	SOP Granulation Feed Bucket Elevator #2	TBD	TBD	TBD	144.38 tph	1264769 tpy	TBD TBD	SC7 STK5	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S69A,B	SOP Granulation Feed Screw Conveyor	TBD	TBD	TBD	144.38 tph	1264769 tpy	TBD TBD	SC7 STK5	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S70A,B	SOP Granulation Pin Mixer #1 and #2	TBD	TBD	TBD	144.38 tph	1264769 tpy	TBD TBD	SC7 STK5	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S71A,B	SOP Disc Granulator #1 and #2	TBD	TBD	TBD	147.53 tph	1292363 tpy	TBD TBD	SC7 STK5	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S72	SOP Granulator Product Belt Conveyor	TBD	TBD	TBD	147.53 tph	1292363 tpy	TBD TBD	SC11 STK6	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S73A,B	SOP Granulation Dryers	TBD	TBD	TBD	16.54 mmBtu/Hr each	16.54 mmBtu/Hr each	TBD TBD	SC11 STK6	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S74	SOP Granulation Dryer Bucket Elevator	TBD	TBD	TBD	143.28 tph	1255133 tpy	TBD TBD	SC7 STK5	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S75	SOP Granulation Cooler Unit	TBD	TBD	TBD	143.28 tph	1255133 tpy	TBD TBD	SC7 STK5	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S76	SOP Granulation Cooler Bucket Elevator	TBD	TBD	TBD	141.85 tph	1242606 tpy	TBD TBD	SC7 STK5	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S77	SOP Granulation Splitter Gate	TBD	TBD	TBD	141.85 tph	1242606 tpy	TBD TBD	SC7 STK5	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	

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S78A,B	SOP Granulation Sizing Screens #1 and #2	TBD	TBD	TBD	141.85 tph	1242606 tpy	TBD TBD	SC7 STK5	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S79A,B	SOP Single Stage Roll Crusher #1 and #2	TBD	TBD	TBD	26.64 tph	233366.4 tpy	TBD TBD	SC7 STK5	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S80	SOP Product Screening Belt Conveyor	TBD	TBD	TBD	95.8 tph	839208 tpy	TBD TBD	SC7 STK5	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S81	SOP Recycle Bin #5	TBD	TBD	TBD	95.8 tph	839208 tpy	TBD TBD	SC7 STK5	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S82	SOP Granular Product Screw Conveyor	TBD	TBD	TBD	49.44 tph	433094 tpy	TBD TBD	SC7 STK5	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S83	SOP Granular Product Bucket Elevator	TBD	TBD	TBD	49.44 tph	433094 tpy	TBD TBD	SC7 STK5	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S84	SOP Product Dryer Dust Collector Fines Screw Conveyor	TBD	TBD	TBD	1.07 tph	9373.2 tpy	TBD TBD	SC7 STK5	30502299	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S85	SOP Granulation Dryer Dust Collector Fines Screw Conveyor	TBD	TBD	TBD	1.23 tph	10775 tpy	TBD TBD	SC11 STK6	30502299	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S86	SOP Area Dust Collector Fines Screw Conveyor	TBD	TBD	TBD	3.27 tph	28645 tpy	TBD TBD	SC7 STK5	30502299	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S87	SOP Dust Screw Conveyor	TBD	TBD	TBD	5.57 tph	48739 tpy	TBD TBD	SC7 STK5	30502299	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S88	Langbeinite Crystallization	TBD	TBD	TBD	44.08 tph	386141 tpy	TBD TBD	SC12 STK7	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S89	Screw Feeder	TBD	TBD	TBD	44.08 tph	386141 tpy	TBD TBD	SC12 STK7	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S90	Langbeinite Product Dryer	TBD	TBD	TBD	10.34 mmBtu/Hr	10.34 mmBtu/Hr	TBD TBD	SC12 STK7	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S91	Langbeinite Screw Conveyor	TBD	TBD	TBD	41.91 tph	367132 tpy	TBD TBD	SC13 STK8	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S92	Truck Unload Langbeinite Returns from Jal	NA	NA	NA	0.3 tph	2628 tpy	TBD TBD	SC9 NA	30502299	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S93	Langbeinite Fines Return Dump Hopper	TBD	TBD	TBD	0.3 tph	2628 tpy	TBD TBD	SC10 NA	30502299	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S94	Langbeinite Fines Return Belt Feeder	TBD	TBD	TBD	0.3 tph	2628 tpy	TBD TBD	SC13 STK8	30502299	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	

Unit Number[1]	Source Description	Manufacturer	Model #	Serial #	Maximum or Rated Capacity[3] (Specify Units)	Requested Permitted Capacity[3] (Specify Units)	Date of Manufacture or Reconstruction[2] / Date of Installation /Construction[2]	Controlled by Unit # / Emissions vented to Stack #	Source Classi-fication Code (SCC)	For Each Piece of Equipment, Check One	Applicable State & Federal Regulation(s) (i.e. 20.2.X, JJJJ, …)	Replacing Unit No.
S95	Langbeinite Fines Return Belt Conveyor	TBD	TBD	TBD	0.3 tph	2628 tpy	TBD TBD	SC13 STK8	30502299	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S96	Langbeinite Compaction Pug Mixer	TBD	TBD	TBD	167.35 tph	1465986 tpy	TBD TBD	SC13 STK8	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S97	Langbeinite Compaction Feed Bucket Elevator	TBD	TBD	TBD	167.35 tph	1465986 tpy	TBD TBD	SC13 STK8	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S98	Langbeinite Compactor Feed Surge Bin	TBD	TBD	TBD	167.35 tph	1465986 tpy	TBD TBD	SC13 STK8	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S99	Langbeinite Compactor	TBD	TBD	TBD	167.35 tph	1465986 tpy	TBD TBD	SC13 STK8	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S100	Langbeinite Flake Breaker	TBD	TBD	TBD	167.35 tph	1465986 tpy	TBD TBD	SC13 STK8	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S101	Langbeinite Compactor Outlet Belt Conveyor	TBD	TBD	TBD	607.03 tph	5317583 tpy	TBD TBD	SC13 STK8	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S102	Langbeinite Compactor Outlet Bucket Elevator	TBD	TBD	TBD	607.03 tph	5317583 tpy	TBD TBD	SC13 STK8	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S103	Langbeinte Compaction Splitter Gate	TBD	TBD	TBD	607.03 tph	5317583 tpy	TBD TBD	SC13 STK8	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S104A,B	Langbeinite Compaction Sizing Screen #1 and #2	TBD	TBD	TBD	607.03 tph	5317583 tpy	TBD TBD	SC13 STK8	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S105	Langbeinite Compaction Drag Conveyor	TBD	TBD	TBD	114.06 tph	999166 tpy	TBD TBD	SC14 STK9	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S106	Langbeinite Compaction Screw Conveyor #2	TBD	TBD	TBD	439.68 tph	3851597 tpy	TBD TBD	SC14 STK9	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S107A,B	Langbeinite Cage Pactor #1 and #2	TBD	TBD	TBD	439.68 tph	3851597 tpy	TBD TBD	SC14 STK9	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S108	Langbeinite Conditioning Drum Feed Belt Conveyor	TBD	TBD	TBD	143 tph	1252680 tpy	TBD TBD	SC14 STK9	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S109	Langbeinite Product Conditioning Drum Bucket Elevator	TBD	TBD	TBD	143 tph	1252680 tpy	TBD TBD	SC14 STK9	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S110	Langbeinite Conditioning Surge Bin	TBD	TBD	TBD	143 tph	1252680 tpy	TBD TBD	SC14 STK9	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S111	Langbeinite Conditioning Drum Screw Feeder	TBD	TBD	TBD	143 tph	1252680 tpy	TBD TBD	SC15 STK10	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	

Unit Number[1]	Source Description	Manufacturer	Model #	Serial #	Maximum or Rated Capacity[3] (Specify Units)	Requested Permitted Capacity[3] (Specify Units)	Date of Manufacture or Reconstruction[2] / Date of Installation /Construction[2]	Controlled by Unit # / Emissions vented to Stack #	Source Classi-fication Code (SCC)	For Each Piece of Equipment, Check One	Applicable State & Federal Regulation(s) (i.e. 20.2.X, JJJJ, …)	Replacing Unit No.
S112	Conditioning Drum	TBD	TBD	TBD	145.14 tph	1271426 tpy	TBD TBD	SC15 STK10	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S113	Langbeinite Glazing/Conditioning Dryer	TBD	TBD	TBD	2 mmBtu/Hr	2 mmBtu/Hr	TBD TBD	SC15 STK10	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S114	Langbeinite Glazing/Conditioning Dryer Cyclone	TBD	TBD	TBD	1.49 tph	13052.4 tpy	TBD TBD	SC15 STK10	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S115	Langbeinite Compaction Dryer Outlet Belt Conveyor	TBD	TBD	TBD	143.08 tph	1253381 tpy	TBD TBD	SC14 STK9	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S116	Langbeinite Compaction Product Bucket Elevator	TBD	TBD	TBD	143.08 tph	1253381 tpy	TBD TBD	SC14 STK9	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S117	Langbeinite Compaction Product Screen	TBD	TBD	TBD	143.08 tph	1253381 tpy	TBD TBD	SC14 STK9	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S118	Langbeinite Product De-Dusting Screw Conveyor	TBD	TBD	TBD	42.58 tph	373001 tpy	TBD TBD	SC14 STK9	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S119	Langbeinite Product Bucket Elevator	TBD	TBD	TBD	42.58 tph	373001 tpy	TBD TBD	SC14 STK9	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S120	Langbeinite Product Dryer Dust Collector Fines Screw Conveyor	TBD	TBD	TBD	0.04 tph	350.4 tpy	TBD TBD	SC14 STK9	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S121	Langbeinite Area Dust Collector Fines Screw Conveyor	TBD	TBD	TBD	0.41 tph	3591.6 tpy	TBD TBD	SC14 STK9	30502299	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S122	Langbeinite Compaction Dust Collector Fines Screw Conveyor	TBD	TBD	TBD	6 tph	52560 tpy	TBD TBD	SC14 STK9	30502299	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S123	Langbeinite Glazing/Conditioning Dust Collector Fines Screw Conveyor	TBD	TBD	TBD	0.01 tph	87.6 tpy	TBD TBD	SC14 STK9	30502299	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S124	Granular SOP Belt Conveyor	TBD	TBD	TBD	49.44 tph	433094.4 tpy	TBD TBD	SC7 STK5	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S125	Granular SOP Loading Bin	TBD	TBD	TBD	49.44 tph	433094.4 tpy	TBD TBD	SC7 STK5	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S126	Granular SOP Loading Bulk Weigher	TBD	TBD	TBD	250.96 tph	433094.4 tpy	TBD TBD	SC10 NA	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S127	Standard SOP Belt Conveyor	TBD	TBD	TBD	63.82 tph	559063.2 tpy	TBD TBD	SC7 STK5	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	

Unit Number[1]	Source Description	Manufacturer	Model #	Serial #	Maximum or Rated Capacity[3] (Specify Units)	Requested Permitted Capacity[3] (Specify Units)	Date of Manufacture or Reconstruction[2] / Date of Installation /Construction[2]	Controlled by Unit # / Emissions vented to Stack #	Source Classification Code (SCC)	For Each Piece of Equipment, Check One	Applicable State & Federal Regulation(s) (i.e. 20.2.X, JJJJ, …)	Replacing Unit No.
S128	Standard SOP Loading Bin	TBD	TBD	TBD	63.82 tph	559063.2 tpy	TBD TBD	SC7 STK5	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S129	Standard SOP Loading Bulk Weigher	TBD	TBD	TBD	250.96 tph	559063.2 tpy	TBD TBD	SC10 NA	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S130	Soluable SOP Belt Conveyor	TBD	TBD	TBD	12.35 tph	108186 tpy	TBD TBD	SC7 STK5	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S131	Soluable SOP Loading Bin	TBD	TBD	TBD	12.35 tph	108186 tpy	TBD TBD	SC7 STK5	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S132	Soluable SOP Loading Bulk Weigher	TBD	TBD	TBD	250.96 tph	108186 tpy	TBD TBD	SC10 NA	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S133	Granular Langbeinite Belt Conveyor	TBD	TBD	TBD	42.58 tph	373001 tpy	TBD TBD	SC7 STK5	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S134	Granular Langbeinite Loading Bin	TBD	TBD	TBD	42.58 tph	373001 tpy	TBD TBD	SC7 STK5	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S135	Granular Langbeinite Loading Bulk Weigher	TBD	TBD	TBD	250.96 tph	373001 tpy	TBD TBD	SC10 NA	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S136	SOP Product Truck Unload	NA	NA	NA	300.02 tph	1100344 tpy	TBD TBD	SC16 NA	30502299	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S137	SOP Dump Hopper	TBD	TBD	TBD	300.02 tph	1100344 tpy	TBD TBD	SC17 NA	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S138	SOP Storage Belt Feeder	TBD	TBD	TBD	300.02 tph	1100344 tpy	TBD TBD	SC18 NA	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S139	SOP Storage Belt Conveyor	TBD	TBD	TBD	300.02 tph	1100344 tpy	TBD TBD	SC19 NA	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S140	SOP Storage Bucket Elevator	TBD	TBD	TBD	300.02 tph	1100344 tpy	TBD TBD	SC20 NA	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S141	SOP Storage Belt Tripper Conveyor	TBD	TBD	TBD	300.02 tph	1100344 tpy	TBD TBD	SC21 NA	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S142	SOP Storage Bin Building	TBD	TBD	TBD	361.21 tph	1100344 tpy	TBD TBD	SC22 NA	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S143	SOP Feed Hoppers	TBD	TBD	TBD	361.21 tph	1100344 tpy	TBD TBD	SC23 NA	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	

Unit Number[1]	Source Description	Manufacturer	Model #	Serial #	Maximum or Rated Capacity[3] (Specify Units)	Requested Permitted Capacity[3] (Specify Units)	Date of Manufacture or Reconstruction[2] / Date of Installation /Construction[2]	Controlled by Unit # / Emissions vented to Stack #	Source Classi-fication Code (SCC)	For Each Piece of Equipment, Check One	Applicable State & Federal Regulation(s) (i.e. 20.2.X, JJJJ, …)	Replacing Unit No.
S144A	Soluable SOP Reclaim Belt Feeder	TBD	TBD	TBD	361.21 tph	1100344 tpy	TBD TBD	SC24 NA	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S144B	Granular SOP Reclaim Belt Feeder	TBD	TBD	TBD			TBD TBD	SC24 NA	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S145A	SOP Reclaim Belt Conveyor	TBD	TBD	TBD	361.21 tph	1100344 tpy	TBD TBD	SC25 NA	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S145B	Standard SOP Reclaim Belt Conveyor	TBD	TBD	TBD	361.21 tph	1100344 tpy	TBD TBD	SC25 NA	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S146	Reclaim Bucket Elevator	TBD	TBD	TBD	361.21 tph	1100344 tpy	TBD TBD	SC26 STK11	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S147	SOP Reclaim Drag Conveyor	TBD	TBD	TBD	361.21 tph	1100344 tpy	TBD TBD	SC26 STK11	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S148	Soluable SOP Reclaim Scalping Screen	TBD	TBD	TBD	350.38 tph	1100344 tpy	TBD TBD	SC26 STK11	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S149	Standard SOP Reclaim Multi-deck Screen	TBD	TBD	TBD	350.38 tph	1100344 tpy	TBD TBD	SC26 STK11	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S150	Granular SOP Reclaim Multi-deck Screen	TBD	TBD	TBD	350.38 tph	1100344 tpy	TBD TBD	SC26 STK11	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S151	SOP Reclaim Loading Bin	TBD	TBD	TBD	602.18 tph	1100344 tpy	TBD TBD	SC26 STK11	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S152	SOP Drag Conveyor	TBD	TBD	TBD	602.18 tph	1100344 tpy	TBD TBD	SC26 STK11	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S153	SOP Bucket Elevator	TBD	TBD	TBD	602.18 tph	1100344 tpy	TBD TBD	SC26 STK11	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S154	SOP Loading Bulk Weigher	TBD	TBD	TBD	602.18 tph	1100344 tpy	TBD TBD	SC27 NA	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S155	SOP Screw Conveyor	TBD	TBD	TBD	27.1 tph	344737 tpy	TBD TBD	SC26 STK11	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S156	SOP Reclaim Off-Size Bin	TBD	TBD	TBD	27.1 tph	344737 tpy	TBD TBD	SC27 NA	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S157	Granular Langbeinite Product Truck Unload	NA	NA	NA	302.18 tph	373001 tpy	TBD TBD	SC16 NA	30502299	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S158	Granular Langbeinite Dump Hopper	TBD	TBD	TBD	302.18 tph	373001 tpy	TBD TBD	SC17 NA	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	

Unit Number[1]	Source Description	Manufacturer	Model #	Serial #	Maximum or Rated Capacity[3] (Specify Units)	Requested Permitted Capacity[3] (Specify Units)	Date of Manufacture or Reconstruction[2] / Date of Installation /Construction[2]	Controlled by Unit # / Emissions vented to Stack #	Source Classi-fication Code (SCC)	For Each Piece of Equipment, Check One	Applicable State & Federal Regulation(s) (i.e. 20.2.X, JJJJ, …)	Replacing Unit No.
S159	Granular Langbeinite Storage Belt Feeder	TBD	TBD	TBD	302.18 tph	373001 tpy	TBD TBD	SC18 NA	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S160	Granular Langbeinite Storage Belt Conveyor	TBD	TBD	TBD	302.18 tph	373001 tpy	TBD TBD	SC19 NA	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S161	Granular Langbeinite Storage Bucket Elevator	TBD	TBD	TBD	302.18 tph	373001 tpy	TBD TBD	SC20 NA	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S162	Granular Langbeinite Storage Belt Conveyor with Plough	TBD	TBD	TBD	302.18 tph	373001 tpy	TBD TBD	SC21 NA	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S163	Granular Langbeinite Storage Bin Building	TBD	TBD	TBD	361.21 tph	373001 tpy	TBD TBD	SC22 NA	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S164	Granular Langbeinite Feed Hoppers	TBD	TBD	TBD	361.21 tph	373001 tpy	TBD TBD	SC23 NA	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S165	Granular Langbeinite Reclaim Belt Conveyor #1	TBD	TBD	TBD	361.21 tph	373001 tpy	TBD TBD	SC24 NA	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S166A	Granular Langbeinite Reclaim Belt Conveyor #2	TBD	TBD	TBD	361.21 tph	373001 tpy	TBD TBD	SC25 NA	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S166B	Granular Langbeinite Reclaim Belt Conveyor #3	TBD	TBD	TBD			TBD TBD	SC25 NA	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S167	Granular Langbeinite Reclaim Bucket Elevator	TBD	TBD	TBD	361.21 tph	373001 tpy	TBD TBD	SC26 STK11	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S168	Granular Langbeinite Reclaim Multi-deck Screen	TBD	TBD	TBD	350.83 tph	373001 tpy	TBD TBD	SC26 STK11	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S169	Granular Langbeinite Loading Bin	TBD	TBD	TBD	602.9 tph	373001 tpy	TBD TBD	SC26 STK11	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S170	Granular Langbeinite Drag Conveyor	TBD	TBD	TBD	602.9 tph	373001 tpy	TBD TBD	SC26 STK11	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S171	Granular Langbeinite Bucket Elevator	TBD	TBD	TBD	602.9 tph	373001 tpy	TBD TBD	SC26 STK11	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S172	Granular Langbeinite Loading Bulk Weigher	TBD	TBD	TBD	602.9 tph	373001 tpy	TBD TBD	SC27 NA	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S173	Granular Langbeinite Reclaim Off-Size Bin	TBD	TBD	TBD	301.45 tph	11190 tpy	TBD TBD	SC27 NA	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S174	Jal Loadout Dust Collector Fines Screw Conveyor	TBD	TBD	TBD	0.5 tph	4380 tpy	TBD TBD	SC26 STK11	30502299	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	

Unit Number[1]	Source Description	Manufacturer	Model #	Serial #	Maximum or Rated Capacity[3] (Specify Units)	Requested Permitted Capacity[3] (Specify Units)	Date of Manufacture or Reconstruction[2] / Date of Installation /Construction[2]	Controlled by Unit # / Emissions vented to Stack #	Source Classi-fication Code (SCC)	For Each Piece of Equipment, Check One	Applicable State & Federal Regulation(s) (i.e. 20.2.X, JJJJ, …)	Replacing Unit No.
S175	Stage 2 Leach Belt Conveyor	TBD	TBD	TBD	338.69 tph	2966924.4 tpy	TBD TBD	SC1 NA	30502299	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S176	Gypsum Surge Bin	TBD	TBD	TBD	338.69 tph	2966924.4 tpy	TBD TBD	SC1 NA	30502299	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.74	
S177	Gypsum Screw Conveyor	TBD	TBD	TBD	338.69 tph	2966924.4 tpy	TBD TBD	NA NA	30502299	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.74	
S178	Gypsum Haul Trucks Unload	NA	NA	NA	338.69 tph	2966924.4 tpy	TBD TBD	NA NA	30502299	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.74	
S179	Gypsum Stockpile - Bulldozer	NA	NA	NA	24 Hours/Day	24 Hours/Day	TBD TBD	NA NA	30502299	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.74	
S180	Gypsum Stockpile Wind Erosion	NA	NA	NA	337 Acres	337 Acres	TBD TBD	NA NA	30502299	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.74	
S181	SOP Binder Bulk Bags Load	NA	NA	NA	0.62 tph	5431.2 tpy	TBD TBD	SC1 NA	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S182	SOP Binder Feed Hopper	TBD	TBD	TBD	0.62 tph	5431.2 tpy	TBD TBD	SC1 NA	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S183	Langbeinite Binder Bulk Bags Load	NA	NA	NA	0.62 tph	5431.2 tpy	TBD TBD	SC1 NA	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S184	Langbeinite Binder Feed Hopper	TBD	TBD	TBD	0.62 tph	5431.2 tpy	TBD TBD	SC1 NA	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S185	Flocculant Bulk Bags Load	NA	NA	NA	0.62 tph	5431.2 tpy	TBD TBD	SC1 NA	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S186	Leaching Circuit Flocculent Feed Hopper	TBD	TBD	TBD	0.62 tph	5431.2 tpy	TBD TBD	SC1 NA	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S187	Sodium Chloride Wash Flocculant Bulk Bags Load	NA	NA	NA	0.62 tph	5431.2 tpy	TBD TBD	SC1 NA	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S188	Sodium Chloride Wash Flocculant Feed Hopper	TBD	TBD	TBD	0.62 tph	5431.2 tpy	TBD TBD	SC1 NA	30502201	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.19, 20.2.74	
S189	Product Truck Traffic Ochoa Plant	NA	NA	NA	202 trip/day	73667 trips/year	TBD TBD	NA NA	30502299	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.74	
S190	Recycle Truck Traffic Ochoa Plant	NA	NA	NA	6 trip/day	2210 trips/year	TBD TBD	NA NA	30502299	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.74	
S191	Additive Truck Traffic	NA	NA	NA	2 trip/day	815 trips/year	TBD TBD	NA NA	30502299	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.74	

Unit Number[1]	Source Description	Manufacturer	Model #	Serial #	Maximum or Rated Capacity[3] (Specify Units)	Requested Permitted Capacity[3] (Specify Units)	Date of Manufacture or Reconstruction[2] / Date of Installation /Construction[2]	Controlled by Unit # / Emissions vented to Stack #	Source Classi-fication Code (SCC)	For Each Piece of Equipment, Check One	Applicable State & Federal Regulation(s) (i.e. 20.2.X, JJJJ, …)	Replacing Unit No.
S192	Equipment Truck Traffic	NA	NA	NA	5 trip/day	1825 trips/year	TBD TBD	SC28 NA	30502299	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.74	
S193	De-Duster Truck Traffic	NA	NA	NA	5 trip/day	1825 trips/year	TBD TBD	SC28 NA	30502299	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.74	
S194	Waste (Gypsum) Haul Trucks Traffic	NA	NA	NA	186 trip/day	64498 trips/year	TBD TBD	SC28 NA	30502299	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.74	
S195	Jal Loadout Truck Traffic	NA	NA	NA	185 trip/day	78432 trips/year	TBD TBD	SC28 NA	30502299	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.74	
S196	Boiler 1	TBD	TBD	TBD	155.9 mmBtu/Hr	155.9 mmBtu/Hr	TBD TBD	NA STK12	30502299	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.74, NSPS Subpart Db	
S197	Boiler 2	TBD	TBD	TBD	155.9 mmBtu/Hr	155.9 mmBtu/Hr	TBD TBD	NA STK13	30502299	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.74, NSPS Subpart Db	
S198	Temporary Polyhalite Stockpile Wind Erosion	NA	NA	NA	2 Acres	2 Acres	TBD TBD	NA NA	30502299	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.74	
S199	Waste Stockpile Wind Erosion	NA	NA	NA	4 Acres	4 Acres	TBD TBD	NA NA	30502299	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.74	
S200A,B	Water Treatment Air Strippers	TBD	TBD	TBD	160,000 ACFM	160,000 ACFM	TBD TBD	SC29 STK14	30502299	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced	20.2.74	

[1] Unit numbers must correspond to unit numbers in the previous permit unless a complete cross reference table of all units in both permits is provided.

[2] Specify dates required to determine regulatory applicability.

[3] To properly account for power conversion efficiencies, generator set rated capacity shall be reported as the rated capacity of the engine in horsepower, not the kilowatt capacity of the generator set.

Table 2-B: Insignificant Activities[1] (20.2.70 NMAC) OR Exempted Equipment (20.2.72 NMAC)

All 20.2.70 NMAC (Title V) applications must list all Insignificant Activities in this table. All 20.2.72 NMAC applications must list Exempted Equipment in this table. If equipment listed on this table is exempt under 20.2.72.202.B.5, include emissions calculations and emissions totals for 202.B.5 "similar functions" units, operations, and activities in Section 6, Calculations. Equipment and activities exempted under 20.2.72.202 NMAC may not necessarily be Insignificant under 20.2.70 NMAC (and vice versa). Unit & stack numbering must be consistent throughout the application package. Per Exemptions Policy 02-012.00 (see http://www.nmenv.state.nm.us/aqb/permit/aqb_pol.html), 20.2.72.202.B NMAC Exemptions do not apply, but 20.2.72.202.A NMAC exemptions do apply to NOI facilities under 20.2.73 NMAC. List 20.2.72.301.D.4 NMAC Auxiliary Equipment for Streamline applications in Table 2-A. The List of Insignificant Activities (for TV) can be found online at http://www.nmenv.state.nm.us/aqb/forms/InsignificantListTitleV.pdf . TV sources may elect to enter both TV Insignificant Activities and Part 72 Exemptions on this form.

Unit Number	Source Description	Manufacturer	Model No. / Serial No.	Max Capacity / Capacity Units	List Specific 20.2.72.202 NMAC Exemption (e.g. 20.2.72.202.B.5) / Insignificant Activity citation (e.g. IA List Item #1.a)	Date of Manufacture /Reconstruction[2] / Date of Installation /Construction[2]	For Each Piece of Equipment, Check Onc
EG1	Diesel-fired Emergency Generator	Caterpillar	TBD	2937 BHP	20.2.72.202.B.3	TBD	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced
			TBD	2937 BHP	NA	TBD	
FP1	Diesel-Fired Fire Pump	John Deere	TBD	144 BHP	20.2.72.202.B.3	TBD	☐ Existing (unchanged) ☐ To be Removed X New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced
			TBD	144 BHP	NA	TBD	
							☐ Existing (unchanged) ☐ To be Removed ☐ New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced
							☐ Existing (unchanged) ☐ To be Removed ☐ New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced
							☐ Existing (unchanged) ☐ To be Removed ☐ New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced
							☐ Existing (unchanged) ☐ To be Removed ☐ New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced
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							☐ Existing (unchanged) ☐ To be Removed ☐ New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced
							☐ Existing (unchanged) ☐ To be Removed ☐ New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced
							☐ Existing (unchanged) ☐ To be Removed ☐ New/Additional ☐ Replacement Unit ☐ To Be Modified ☐ To be Replaced

[1] Insignificant activities exempted due to size or production rate are defined in 20.2.70.300.D.6, 20.2.70.7.Q NMAC, and the NMED/AQB List of Insignificant Activities, dated September 15, 2008. Emissions from these insignificant activities do not need to be reported, unless specifically requested.

[2] Specify date(s) required to determine regulatory applicability.

Table 2-C: Emissions Control Equipment

Unit and stack numbering must correspond throughout the application package. Only list control equipment for TAPs if the TAP's maximum uncontrolled emissions rate is over its respective threshold as listed in 20.2.72 NMAC, Subpart V, Tables A and B. In accordance with 20.2.72.203.A(3) and (8) NMAC, 20.2.70.300.D(5)(b) and (e) NMAC, and 20.2.73.200.B(7) NMAC, the permittee shall report all control devices and list each pollutant controlled by the control device regardless if the applicant takes credit for the reduction in emissions.

Control Equipment Unit No.	Control Equipment Description	Date Installed	Controlled Pollutant(s)	Controlling Emissions for Unit Number(s)[1]	Efficiency (% Control by Weight)	Method used to Estimate Efficiency
SC1	Full Enclosure	TBD	PM	S1, S2, S175, S176, S181, S182, S183, S184, S185, S186, S187, S188	85%	see Note (1)
SC2	ROM Fabric Filter Dust Control Baghouse	TBD	PM	S3, S4, S5A,B, S6A,B, S7	99.9+%	Manufacturer
SC3	Crusher Area Fabric Filter Dust Control Baghouse	TBD	PM	S8, S9, S10, S11, S12, S13, S14A,B, S15A,B	99.9+%	Manufacturer
SC4	Calciner Fabric Filter Dust Control Baghouse	TBD	PM	S18A S19A S21A S22A S30A	99.9+%	Manufacturer
SC5	Calciner Fabric Filter Dust Control Baghouse	TBD	PM	S18B, S19B, S21B, S22B, S30B	99.9+%	Manufacturer
SC6	Calciner Fabric Filter Dust Control Baghouse	TBD	PM	S18C, S19C, S21C, S22C, S30C	99.9+%	Manufacturer
SC7	SOP Area Fabric Filter Dust Control Baghouse	TBD	PM	S16A,B, S17A,B, S20A,B, S23, S24, S25, S26, S27, S28, S36, S37, S38, S39, S40, S41, S42, S43, S44, S45, S46, S47, S48, S49, S50, S51, S52, S53, S54, S55, S58, S59, S60, S61, S62, S63, S64, S65, S66, S67, S68, S69A,B, S70A,B, S71A,B, S74, S75, S76, S77, S78A,B, S79A,B, S80, S81, S82, S83, S84, S86, S87, S124, S125, S127, S128, S130, S131, S133, S134	99.9+%	Manufacturer
SC8	SOP Product Dryer Fabric Filter Dust Control Baghouse	TBD	PM	S32 S33, S34, S35	99.9+%	Manufacturer
SC9	1/2 Enclosure + Control Method Oil Additive -2 Transfer Points from Application	TBD	PM	S56, S92	50% + 75% = Combined 87.5%	see Note (1)
SC10	1/2 Enclosure + Control Method Oil Additive -3 Transfer Points from Application	TBD	PM	S57, S93, S126, S129, S132, S135	50% + 70% = Combined 85%	see Note (1)
SC11	SOP Granulator Dryers Fabric Filter Dust Control Baghouse	TBD	PM	S72, S73A,B, S85	99.9+%	Manufacturer
SC12	Langbeinite Product Dryer Fabric Filter Dust Control Baghouse	TBD	PM	S88, S89, S90	99.9+%	Manufacturer
SC13	Langbeinite Area Fabric Filter Dust Control Baghouse	TBD	PM	S91, S94, S95, S96, S97, S98, S99, S100, S101, S102, S103, S104A,B	99.9+%	Manufacturer
SC14	Langbeinite Compaction Fabric Filter Dust Control Baghouse	TBD	PM	S105, S106, S107A,B, S108, S109, S110, S115, S116, S117, S118, S119, S120, S121, S122, S123	99.9+%	Manufacturer

Control Equipment Unit No.	Control Equipment Description	Date Installed	Controlled Pollutant(s)	Controlling Emissions for Unit Number(s)[1]	Efficiency (% Control by Weight)	Method used to Estimate Efficiency
SC15	Langbeinite Glazing/Conditioning Fabric Filter Dust Control Baghouse	TBD	PM	S111, S112, S113, S114	99.9+%	Manufacturer
SC16	1/2 Enclosure + Control Method Oil Additive -5 Transfer Points from Application	TBD	PM	S136, S157	50% + 60% = Combined 80%	see Note (1)
SC17	1/2 Enclosure + Control Method Oil Additive -6 Transfer Points from Application	TBD	PM	S137, S158	50% + 55% = Combined 77.5%	see Note (1)
SC18	1/2 Enclosure + Control Method Oil Additive -7 Transfer Points from Application	TBD	PM	S138, S159	50% + 50% = Combined 75%	see Note (1)
SC19	3/4 Enclosure + Control Method Oil Additive -8 Transfer Points from Application	TBD	PM	S139, S160	70% + 45% = Combined 83.5%	see Note (1)
SC20	3/4 Enclosure + Control Method Oil Additive -9 Transfer Points from Application	TBD	PM	S140, S161	70% + 40% = Combined 82%	see Note (1)
SC21	3/4 Enclosure + Control Method Oil Additive -10 Transfer Points from Application	TBD	PM	S141, S162	70% + 35% = Combined 80.5%	see Note (1)
SC22	3/4 Enclosure + Control Method Oil Additive -11 Transfer Points from Application	TBD	PM	S142, S163	70% + 30% = Combined 79%	see Note (1)
SC23	3/4 Enclosure + Control Method Oil Additive -12 Transfer Points from Application	TBD	PM	S143, S164	70% + 25% = Combined 77.5%	see Note (1)
SC24	3/4 Enclosure + Control Method Oil Additive -13 Transfer Points from Application	TBD	PM	S144, S165A,B	70% + 25% = Combined 76%	see Note (1)
SC25	3/4 Enclosure + Control Method Oil Additive -14 Transfer Points from Application	TBD	PM	S145, S166A,B	70% + 15% = Combined 74.5%	see Note (1)
SC26	Jal Loadout Fabric Filter Dust Control Baghouse	TBD	PM	S146, S147, S148, S149, S150, S151, S152, S153, S155, S167, S168, S169, S170, S171, S174	99.9+%	Manufacturer
SC27	Control Method Oil Additive -1 Transfer Point from Application	TBD	PM	S154, S156, S172, S173	80%	see Note (1)
SC28	Surfactants - Unpaved Roads	TBD	PM	S192, S193, S194, S195	90%	NMED Policy
SC29	Bio Filter - H_2S Control	TBD	H_2S	200A,B	99%	Manufacturer

[1] List each control device on a separate line. For each control device, list all emission units controlled by the control device.

Table 2-D: Maximum Emissions (under normal operating conditions)

☐ **This Table was intentionally left blank because it would be identical to Table 2-E.**

Maximum Emissions are the emissions at maximum capacity and prior to (in the absence of) pollution control, emission-reducing process equipment, or any other emission reduction. Calculate the hourly emissions using the worst case hourly emissions for each pollutant. For each pollutant, calculate the annual emissions as if the facility were operating at maximum plant capacity without pollution controls for 8760 hours per year, unless otherwise approved by the Department. List Hazardous Air Pollutants (HAP) & Toxic Air Pollutants (TAPs) in Table 2-I. Unit & stack numbering must be consistent throughout the application package. For each unit with flashing, list tank-flashing emissions estimates as a separate line item (20.2.70.300.D.5 NMAC, 20.2.72.203.A.3 NMAC, 20.2.73.200.B.6, & 20.2.74.301 NMAC). Fill all cells in this tablewith the emission numbers or a "-" symbol. A "-" symbol indicates that emissions of this pollutant are not expected. Numbers shall be expressed with a minimum of two significant figures[1]. If there are any significant figures to the left of a decimal point, there shall be no more than one significant figure to the right of the decimal point.

Unit No.	NOx		CO		VOC		SOx		TSP[2]		PM10[2]		PM2.5[2]		H_2S		Lead	
	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr
S1	0	0	0	0	0	0	0	0	2.1	4.3	0.97	2.0	0.15	0.31	0	0	0	0
S2	0	0	0	0	0	0	0	0	2.1	4.3	0.97	2.0	0.15	0.31	0	0	0	0
S3	0	0	0	0	0	0	0	0	2.1	4.3	0.97	2.0	0.15	0.31	0	0	0	0
S4	0	0	0	0	0	0	0	0	2.1	4.3	0.97	2.0	0.15	0.31	0	0	0	0
S5A,B	0	0	0	0	0	0	0	0	2.1	4.3	0.97	2.0	0.15	0.31	0	0	0	0
S6A,B	0	0	0	0	0	0	0	0	2.1	4.3	0.97	2.0	0.15	0.31	0	0	0	0
S7	Equipment part of control system and not a uncontrolled source																	
S8	0	0	0	0	0	0	0	0	2.1	4.3	0.97	2.0	0.15	0.31	0	0	0	0
S9	0	0	0	0	0	0	0	0	2.1	4.3	0.97	2.0	0.15	0.31	0	0	0	0
S10	0	0	0	0	0	0	0	0	2.1	4.3	0.97	2.0	0.15	0.31	0	0	0	0
S11	0	0	0	0	0	0	0	0	3.0	13	1.3	5.8	0.20	0.87	0	0	0	0
S12	0	0	0	0	0	0	0	0	No PM Emissions Expect - Wet Processing of Crushed Ore						0	0	0	0
S13	Equipment part of control system and not a uncontrolled source																	
S14A,B	0	0	0	0	0	0	0	0	0.38	0.80	0.18	0.38	0.028	0.057	0	0	0	0
S15A,B	0	0	0	0	0	0	0	0	0.38	0.80	0.18	0.38	0.028	0.057	0	0	0	0
S16A,B	0	0	0	0	0	0	0	0	0.38	0.80	0.18	0.38	0.028	0.057	0	0	0	0
S17A,B	0	0	0	0	0	0	0	0	243	505	115	239	17	36	0	0	0	0
S18A,B,C	27	118	24	104	3.7	16	0.41	1.8	12900	56502	12900	56502	12900	56502	0	0	0.00034	0.0015
	0	0	0	0	0	0	0	0	909	3980	147	643	55	241	0	0	0	0
S19A,B,C	0	0	0	0	0	0	0	0	40	173	6.4	28	2.4	11	0	0	0	0
S20A,B	0	0	0	0	0	0	0	0	909	3980	147	643	55	241	0	0	0	0
S21A,B,C	0	0	0	0	0	0	0	0	940	4116	152	665	57	249	0	0	0	0
S22A,B,C	0	0	0	0	0	0	0	0	8.5	37	1.4	6.0	0.52	2.3	0	0	0	0
S23	0	0	0	0	0	0	0	0	938	4110	152	664	57	249	0	0	0	0
S24	0	0	0	0	0	0	0	0	938	4110	152	664	57	249	0	0	0	0
S25	0	0	0	0	0	0	0	0	938	4110	152	664	57	249	0	0	0	0
S26	0	0	0	0	0	0	0	0	938	4110	152	664	57	249	0	0	0	0
S27	0	0	0	0	0	0	0	0	938	4110	152	664	57	249	0	0	0	0
S28	0	0	0	0	0	0	0	0	938	4110	152	664	57	249	0	0	0	0
S30A,B,C	Equipment part of control system and not a uncontrolled source																	
S32	0	0	0	0	0	0	0	0	0.20	0.42	0.096	0.20	0.015	0.030	0	0	0	0
S33	0	0	0	0	0	0	0	0	0.20	0.42	0.096	0.20	0.015	0.030	0	0	0	0

Unit No.	NOx		CO		VOC		SOx		TSP[2]		PM10[2]		PM2.5[2]		H_2S		Lead	
	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr
S34	0.79	3.4	0.69	3.0	0.11	0.48	0.012	0.052	2160	9461	2160	9461	2160	9461	0	0	9.9E-06	4.3E-05
	0	0	0	0	0	0	0	0	192	843	31	136.0	12	51	0	0	0	0
S35	0	0	0	0	0	0	0	0	19	84	3.1	14.00	1.2	5.1	0	0	0	0
S36	0	0	0	0	0	0	0	0	10	21	4.8	9.9	0.72	1.5	0	0	0	0
S37	0	0	0	0	0	0	0	0	10	21	4.8	9.9	0.72	1.5	0	0	0	0
S38	0	0	0	0	0	0	0	0	10	22	5.0	10	0.75	1.6	0	0	0	0
S39	0	0	0	0	0	0	0	0	10	22	5.0	10	0.75	1.6	0	0	0	0
S40	0	0	0	0	0	0	0	0	33	143	7.9	34	0.53	2.3	0	0	0	0
S41	0	0	0	0	0	0	0	0	0.39	1.7	0.15	0.66	0.0088	0.039	0	0	0	0
	0	0	0	0	0	0	0	0	1.2	2.4	0.56	1.2	0.084	0.18	0	0	0	0
	0	0	0	0	0	0	0	0	9.0	19	4.2	8.8	0.64	1.3	0	0	0	0
S42	0	0	0	0	0	0	0	0	0.90	2.0	0.40	0.90	0.10	0.10	0	0	0	0
S43	0	0	0	0	0	0	0	0	0.90	2.0	0.40	0.90	0.10	0.10	0	0	0	0
S44	0	0	0	0	0	0	0	0	3.8	16	0.90	4.0	0.061	0.27	0	0	0	0
S45	0	0	0	0	0	0	0	0	0.016	0.033	0.0076	0.016	0.0011	0.0024	0	0	0	0
	0	0	0	0	0	0	0	0	1.2	2.4	0.55	1.1	0.083	0.17	0	0	0	0
S46	0	0	0	0	0	0	0	0	1.2	2.4	0.55	1.1	0.083	0.17	0	0	0	0
S47	0	0	0	0	0	0	0	0	0.00094	0.00020	0.00044	0.000092	0.000067	0.000014	0	0	0	0
	0	0	0	0	0	0	0	0	1.2	2.4	0.55	1.1	0.083	0.17	0	0	0	0
S48	0	0	0	0	0	0	0	0	1.2	2.4	0.55	1.1	0.083	0.17	0	0	0	0
S49	0	0	0	0	0	0	0	0	1.2	2.4	0.55	1.1	0.083	0.17	0	0	0	0
S50	0	0	0	0	0	0	0	0	4.5	9.5	2.2	4.5	0.33	0.68	0	0	0	0
	0	0	0	0	0	0	0	0	6.4	13	3.0	6.3	0.46	0.96	0	0	0	0
S51	0	0	0	0	0	0	0	0	4.5	9.5	2.2	4.5	0.33	0.68	0	0	0	0
S52	0	0	0	0	0	0	0	0	1.4	5.9	0.33	1.4	0.022	0.10	0	0	0	0
	0	0	0	0	0	0	0	0	6.0	12	2.8	5.9	0.43	0.89	0	0	0	0
S53	0	0	0	0	0	0	0	0	0.42	0.88	0.2	0.42	0.03	0.063	0	0	0	0
S54	0	0	0	0	0	0	0	0	6.0	12	2.8	5.9	0.43	0.89	0	0	0	0
S55	0	0	0	0	0	0	0	0	6.0	12	2.8	5.9	0.43	0.89	0	0	0	0
S56	0	0	0	0	0	0	0	0	0.028	0.059	0.013	0.028	0.0020	0.0042	0	0	0	0
S57	0	0	0	0	0	0	0	0	0.028	0.059	0.013	0.028	0.0020	0.0042	0	0	0	0
S58	0	0	0	0	0	0	0	0	0.028	0.059	0.013	0.028	0.0020	0.0042	0	0	0	0
S59	0	0	0	0	0	0	0	0	0.028	0.059	0.013	0.028	0.0020	0.0042	0	0	0	0
S60	0	0	0	0	0	0	0	0	4.6	9.5	2.2	4.5	0.33	0.68	0	0	0	0
S61	0	0	0	0	0	0	0	0	4.6	9.5	2.2	4.5	0.33	0.68	0	0	0	0
S62	0	0	0	0	0	0	0	0	4.6	9.5	2.2	4.5	0.33	0.68	0	0	0	0
S63	0	0	0	0	0	0	0	0	1.4	2.8	0.65	1.3	0.10	0.20	0	0	0	0
	0	0	0	0	0	0	0	0	3.2	6.6	1.5	3.1	0.23	0.48	0	0	0	0
S64	0	0	0	0	0	0	0	0	29	126	4.7	20	1.7	7.7	0	0	0	0

Unit No.	NOx		CO		VOC		SOx		TSP[2]		PM10[2]		PM2.5[2]		H_2S		Lead	
	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr
S65	0	0	0	0	0	0	0	0	118	516	99	433	35	154	0	0	0	0
S66	0	0	0	0	0	0	0	0	29	126	4.7	20	1.7	7.7	0	0	0	0
	0	0	0	0	0	0	0	0	29	126	4.7	20	1.7	7.7	0	0	0	0
S67	0	0	0	0	0	0	0	0	29	126	4.7	20	1.7	7.7	0	0	0	0
S68	0	0	0	0	0	0	0	0	14	28	6.4	13	0.97	2.0	0	0	0	0
S69A,B	0	0	0	0	0	0	0	0	0.70	1.4	0.33	0.69	0.050	0.10	0	0	0	0
S70A,B	0	0	0	0	0	0	0	0	0.71	1.5	0.34	0.70	0.051	0.11	0	0	0	0
S71A,B	0	0	0	0	0	0	0	0	0.71	1.5	0.34	0.70	0.051	0.11	0	0	0	0
S72	0	0	0	0	0	0	0	0	0.71	1.5	0.34	0.70	0.051	0.11	0	0	0	0
S73A,B	1.4	6.1	1.2	5.4	0.19	0.84	0.021	0.092	4960	21725	4960	21725	4960	21725	0	0	1.7E-05	7.7E-05
	0	0	0	0	0	0	0	0	284	1243	46	201	17	75	0	0	0	0
S74	0	0	0	0	0	0	0	0	13	28	6.4	13	0.96	2.0	0	0	0	0
S75	0	0	0	0	0	0	0	0	13	28	6.4	13	0.96	2.0	0	0	0	0
S76	0	0	0	0	0	0	0	0	13	28	6.3	13	0.95	2.0	0	0	0	0
S77	0	0	0	0	0	0	0	0	43	186	10	45	0.70	3.0	0	0	0	0
S78A,B	0	0	0	0	0	0	0	0	1.8	3.8	0.87	1.8	0.13	0.27	0	0	0	0
	0	0	0	0	0	0	0	0	8.0	35	1.9	8.4	0.13	0.57	0	0	0	0
	0	0	0	0	0	0	0	0	4.6	9.7	2.2	4.6	0.33	0.69	0	0	0	0
S79A,B	0	0	0	0	0	0	0	0	2.5	5.2	1.2	2.5	0.18	0.37	0	0	0	0
S80	0	0	0	0	0	0	0	0	9.0	19	4.3	8.9	0.64	1.3	0	0	0	0
S81	0	0	0	0	0	0	0	0	9.0	19	4.3	8.9	0.64	1.3	0	0	0	0
S82	0	0	0	0	0	0	0	0	4.6	9.7	2.2	4.6	0.33	0.69	0	0	0	0
S83	0	0	0	0	0	0	0	0	4.6	9.7	2.2	4.6	0.33	0.69	0	0	0	0
S84	Equipment part of control system and not a uncontrolled source																	
S85	Equipment part of control system and not a uncontrolled source																	
S86	Equipment part of control system and not a uncontrolled source																	
S87	Equipment part of control system and not a uncontrolled source																	
S88	0	0	0	0	0	0	0	0	0.081	0.17	0.038	0.079	0.0058	0.012	0	0	0	0
S89	0	0	0	0	0	0	0	0	0.081	0.17	0.038	0.079	0.0058	0.012	0	0	0	0
S90	0.43	1.9	0.38	1.7	0.060	0.26	0.0066	0.029	80	350	80	350	80	350	0	0	5.5E-06	2.4E-05
	0	0	0	0	0	0	0	0	83	363	13	59	5.0	22	0	0	0	0
S91	0	0	0	0	0	0	0	0	3.9	8.2	1.9	3.9	0.28	0.59	0	0	0	0
S92	0	0	0	0	0	0	0	0	0.028	0.059	0.013	0.028	0.0020	0.0042	0	0	0	0
S93	0	0	0	0	0	0	0	0	0.028	0.059	0.013	0.028	0.0020	0.0042	0	0	0	0
S94	0	0	0	0	0	0	0	0	0.028	0.059	0.013	0.028	0.0020	0.0042	0	0	0	0
S95	0	0	0	0	0	0	0	0	0.028	0.059	0.013	0.028	0.0020	0.0042	0	0	0	0
S96	0	0	0	0	0	0	0	0	16	33	7.4	15	1.1	2.3	0	0	0	0
S97	0	0	0	0	0	0	0	0	16	33	7.4	15	1.1	2.3	0	0	0	0
S98	0	0	0	0	0	0	0	0	16	33	7.4	15	1.1	2.3	0	0	0	0

Unit No.	NOx		CO		VOC		SOx		TSP[2]		PM10[2]		PM2.5[2]		H_2S		Lead	
	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr
S99	0	0	0	0	0	0	0	0	16	33	7.4	15	1.1	2.3	0	0	0	0
S100	0	0	0	0	0	0	0	0	16	33	7.4	15	1.1	2.3	0	0	0	0
S101	0	0	0	0	0	0	0	0	57	119	27	56	4.1	8.5	0	0	0	0
S102	0	0	0	0	0	0	0	0	57	119	27	56	4.1	8.5	0	0	0	0
S103	0	0	0	0	0	0	0	0	182	798	44	191	3.0	13	0	0	0	0
S104A,B	0	0	0	0	0	0	0	0	11	22	5.1	11	0.77	1.6	0	0	0	0
	0	0	0	0	0	0	0	0	32	6.7	15	3.2	2.3	0.48	0	0	0	0
	0	0	0	0	0	0	0	0	13	28	6.4	13	0.96	2.0	0	0	0	0
S105	0	0	0	0	0	0	0	0	11	22	5.1	11	0.77	1.6	0	0	0	0
S106A,B	0	0	0	0	0	0	0	0	41	86	20	41	3.0	6.2	0	0	0	0
S107A,B	0	0	0	0	0	0	0	0	41	86	20	41	3.0	6.2	0	0	0	0
S108	0	0	0	0	0	0	0	0	13	28	6.4	13	0.96	2.0	0	0	0	0
S109	0	0	0	0	0	0	0	0	13	28	6.4	13	0.96	2.0	0	0	0	0
S110	0	0	0	0	0	0	0	0	13	28	6.4	13	0.96	2.0	0	0	0	0
S111	0	0	0	0	0	0	0	0	13	28	6.4	13	0.96	2.0	0	0	0	0
S112	0	0	0	0	0	0	0	0	1.3	2.7	0.62	1.3	0.094	0.19	0	0	0	0
S113	0.084	0.37	0.074	0.32	0.011	0.048	0.0012	0.0053	40	175	40	175	40	175	0	0	1E-06	4.4E-06
	0	0	0	0	0	0	0	0	280	1228	45	198	17	74	0	0	0	0
S114	0	0	0	0	0	0	0	0	0.14	0.29	0.066	0.14	0.010	0.021	0	0	0	0
S115	0	0	0	0	0	0	0	0	13	28	6.4	13	0.96	2.0	0	0	0	0
S116	0	0	0	0	0	0	0	0	43	188	10	45	0.70	3.1	0	0	0	0
S117	0	0	0	0	0	0	0	0	9.0	19	4.3	8.8	0.64	1.3	0	0	0	0
	0	0	0	0	0	0	0	0	0.44	0.92	0.21	0.44	0.032	0.066	0	0	0	0
	0	0	0	0	0	0	0	0	4.0	8.3	1.9	3.9	0.29	0.60	0	0	0	0
S118	0	0	0	0	0	0	0	0	4.0	8.3	1.9	3.9	0.29	0.60	0	0	0	0
S119	0	0	0	0	0	0	0	0	4.0	8.3	1.9	3.9	0.29	0.60	0	0	0	0
S120	Equipment part of control system and not a uncontrolled source																	
S121	Equipment part of control system and not a uncontrolled source																	
S122	Equipment part of control system and not a uncontrolled source																	
S123	Equipment part of control system and not a uncontrolled source																	
S124	0	0	0	0	0	0	0	0	4.6	9.7	2.2	4.6	0.33	0.69	0	0	0	0
S125	0	0	0	0	0	0	0	0	4.6	9.7	2.2	4.6	0.33	0.69	0	0	0	0
S126	0	0	0	0	0	0	0	0	24	9.7	11	4.6	1.7	0.69	0	0	0	0
S127	0	0	0	0	0	0	0	0	6.0	12	2.8	5.9	0.43	0.89	0	0	0	0
S128	0	0	0	0	0	0	0	0	6.0	12	2.8	5.9	0.43	0.89	0	0	0	0
S129	0	0	0	0	0	0	0	0	24	12	11	5.9	1.7	0.89	0	0	0	0
S130	0	0	0	0	0	0	0	0	1.2	2.4	0.55	1.1	0.083	0.17	0	0	0	0
S131	0	0	0	0	0	0	0	0	1.2	2.4	0.55	1.1	0.083	0.17	0	0	0	0
S132	0	0	0	0	0	0	0	0	24	2.4	11	1.1	1.7	0.17	0	0	0	0

Unit No.	NOx		CO		VOC		SOx		TSP[2]		PM10[2]		PM2.5[2]		H_2S		Lead	
	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr
S133	0	0	0	0	0	0	0	0	4.0	8.3	1.9	3.9	0.29	0.60	0	0	0	0
S134	0	0	0	0	0	0	0	0	4.0	8.3	1.9	3.9	0.29	0.60	0	0	0	0
S135	0	0	0	0	0	0	0	0	24	8.3	11	3.9	1.7	0.60	0	0	0	0
S136	0	0	0	0	0	0	0	0	28	25	13	12	2.0	1.8	0	0	0	0
S137	0	0	0	0	0	0	0	0	0.90	1.7	0.33	0.61	0.051	0.094	0	0	0	0
S138	0	0	0	0	0	0	0	0	0.90	1.7	0.33	0.61	0.051	0.094	0	0	0	0
S139	0	0	0	0	0	0	0	0	0.90	1.7	0.33	0.61	0.051	0.094	0	0	0	0
S140	0	0	0	0	0	0	0	0	0.90	1.7	0.33	0.61	0.051	0.094	0	0	0	0
S141	0	0	0	0	0	0	0	0	28	25	13	12	2.0	1.8	0	0	0	0
S142	0	0	0	0	0	0	0	0	34	25	16	12	2.4	1.8	0	0	0	0
S143	0	0	0	0	0	0	0	0	1.1	4.7	0.40	1.7	0.061	0.27	0	0	0	0
S144A,B	0	0	0	0	0	0	0	0	1.1	1.7	0.40	0.61	0.061	0.094	0	0	0	0
S145A,B	0	0	0	0	0	0	0	0	1.1	1.7	0.40	0.61	0.061	0.094	0	0	0	0
S146	0	0	0	0	0	0	0	0	1.1	1.7	0.40	0.61	0.061	0.094	0	0	0	0
S147	0	0	0	0	0	0	0	0	108	165	26	40	3.9	6.0	0	0	0	0
S148	0	0	0	0	0	0	0	0	33	25	16	12	2.4	1.8	0	0	0	0
S149	0	0	0	0	0	0	0	0	35	25	17	12	2.5	1.8	0	0	0	0
S150	0	0	0	0	0	0	0	0							0	0	0	0
S151	0	0	0	0	0	0	0	0	57	25	27	12	4.1	1.8	0	0	0	0
S152	0	0	0	0	0	0	0	0	1.8	1.7	0.66	0.61	0.10	0.094	0	0	0	0
S153	0	0	0	0	0	0	0	0	57	25	27	12	4.1	1.8	0	0	0	0
S154	0	0	0	0	0	0	0	0	57	25	27	12	4.1	1.8	0	0	0	0
S155	0	0	0	0	0	0	0	0	2.5	0.74	1.2	0.35	0.18	0.053	0	0	0	0
S156	0	0	0	0	0	0	0	0	28	0.74	13	0.35	2.0	0.053	0	0	0	0
S157	0	0	0	0	0	0	0	0	28	8.3	13	3.9	2.0	0.596	0	0	0	0
S158	0	0	0	0	0	0	0	0	0.90	0.56	0.33	0.21	0.051	0.032	0	0	0	0
S159	0	0	0	0	0	0	0	0	0.90	0.56	0.33	0.21	0.051	0.032	0	0	0	0
S160	0	0	0	0	0	0	0	0	0.90	0.56	0.33	0.21	0.051	0.032	0	0	0	0
S161	0	0	0	0	0	0	0	0	0.90	0.56	0.33	0.21	0.051	0.032	0	0	0	0
S162	0	0	0	0	0	0	0	0	28	8.3	13	3.9	2.0	0.60	0	0	0	0
S163	0	0	0	0	0	0	0	0	34	8.3	16	3.9	2.4	0.60	0	0	0	0
S164	0	0	0	0	0	0	0	0	1.1	0.56	0.40	0.21	0.061	0.032	0	0	0	0
S165	0	0	0	0	0	0	0	0	1.1	0.56	0.40	0.21	0.061	0.032	0	0	0	0
S166A,B	0	0	0	0	0	0	0	0	1.1	0.56	0.40	0.21	0.061	0.032	0	0	0	0
S167	0	0	0	0	0	0	0	0	108	56	26	13	3.9	2.0	0	0	0	0
S168	0	0	0	0	0	0	0	0	34	8.6	16	4.1	2.4	0.61	0	0	0	0
S169	0	0	0	0	0	0	0	0	57	8.3	27	3.9	4.1	0.60	0	0	0	0
S170	0	0	0	0	0	0	0	0	1.8	0.56	0.66	0.21	0.10	0.032	0	0	0	0
S171	0	0	0	0	0	0	0	0	57	8.3	27	3.9	4.1	0.60	0	0	0	0

Unit No.	NOx		CO		VOC		SOx		TSP[2]		PM10[2]		PM2.5[2]		H_2S		Lead	
	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr
S172	0	0	0	0	0	0	0	0	57	8.3	27	3.9	4.1	0.60	0	0	0	0
S173	0	0	0	0	0	0	0	0	28	0.25	13	0.12	2.0	0.018	0	0	0	0
S174	Equipment part of control system and not a uncontrolled source																	
S175	0	0	0	0	0	0	0	0	0.089	0.18	0.042	0.087	0.0064	0.013	0	0	0	0
S176	0	0	0	0	0	0	0	0	0.089	0.18	0.042	0.087	0.0064	0.013	0	0	0	0
S177	0	0	0	0	0	0	0	0	0.089	0.18	0.042	0.087	0.0064	0.013	0	0	0	0
S178	0	0	0	0	0	0	0	0	0.089	0.18	0.042	0.087	0.0064	0.013	0	0	0	0
S179	0	0	0	0	0	0	0	0	4.3	9.5	0.98	2.2	0.46	1.0	0	0	0	0
S180	0	0	0	0	0	0	0	0	2.0	8.9	1.0	4.4	0.15	0.67	0	0	0	0
S181	0	0	0	0	0	0	0	0	0.058	0.12	0.028	0.057	0.0042	0.0087	0	0	0	0
S182	0	0	0	0	0	0	0	0	0.058	0.12	0.028	0.057	0.0042	0.0087	0	0	0	0
S183	0	0	0	0	0	0	0	0	0.058	0.12	0.028	0.057	0.0042	0.0087	0	0	0	0
S184	0	0	0	0	0	0	0	0	0.058	0.12	0.028	0.057	0.0042	0.0087	0	0	0	0
S185	0	0	0	0	0	0	0	0	0.058	0.12	0.028	0.057	0.0042	0.0087	0	0	0	0
S186	0	0	0	0	0	0	0	0	0.058	0.12	0.028	0.057	0.0042	0.0087	0	0	0	0
S187	0	0	0	0	0	0	0	0	0.058	0.12	0.028	0.057	0.0042	0.0087	0	0	0	0
S188	0	0	0	0	0	0	0	0	0.058	0.12	0.028	0.057	0.0042	0.0087	0	0	0	0
S189	0	0	0	0	0	0	0	0	2.5	10	0.50	2.1	0.12	0.52	0	0	0	0
S190	0	0	0	0	0	0	0	0	0.075	0.31	0.015	0.063	0.0037	0.015	0	0	0	0
S191	0	0	0	0	0	0	0	0	0.031	0.13	0.0061	0.025	0.0015	0.0063	0	0	0	0
S192	0	0	0	0	0	0	0	0	3.3	12	0.84	3.1	0.084	0.31	0	0	0	0
S193	0	0	0	0	0	0	0	0	3.3	12	0.84	3.1	0.084	0.31	0	0	0	0
S194	0	0	0	0	0	0	0	0	198	723	50	184	5.0	18	0	0	0	0
S195	0	0	0	0	0	0	0	0	173	633	44	161	4.4	16	0	0	0	0
S196	3.1	14	5.8	25	0.91	4	0.099	0.43	0.81	3.6	0.81	3.6	0.81	3.6	0	0	8.2E-05	0.00036
S197	3.1	14	5.8	25	0.91	4	0.099	0.43	0.81	3.6	0.81	3.6	0.81	3.6	0	0	8.2E-05	0.00036
S198	0	0	0	0	0	0	0	0	0.039	0.17	0.019	0.085	0.0029	0.013	0	0	0	0
S199	0	0	0	0	0	0	0	0	0.082	0.36	0.041	0.18	0.0061	0.027	0	0	0	0
S200A,B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	162	710	0	0
Totals	36	157	38	165	5.9	26	0.65	2.8	32319	135162	22805	97100	20894	91098	162	710	0.00054	0.0024

[1] **Significant Figures Examples:** One significant figure – 0.03, 3, 0.3. Two significant figures – 0.34, 34, 3400, 3.4

[2] **Condensables:** Include condensable particulate matter emissions in particulate matter calculations.

Table 2-E: Requested Allowable Emissions

Unit & stack numbering must be consistent throughout the application package. For each unit with flashing, list tank-flashing emissions estimates as a separate line item (20.2.70.300.D.5 NMAC, 20.2.72.203.A.3 NMAC, 20.2.73.200.B.6, & 20.2.74.301 NMAC). Fill all cells in this table with the emission numbers or a "-" symbol. A "-" symbol indicates that emissions of this pollutant are not expected. Numbers shall be expressed with a minimum of two significant figures[1]. If there are any significant figures to the left of a decimal point, there shall be no more than one significant figure to the right of the decimal point. Please do not change the column widths on this table.

Unit No.	NOx		CO		VOC		SOx		TSP[2]		PM10[2]		PM2.5[2]		H_2S		Lead	
	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr
S1	0	0	0	0	0	0	0	0	0.31	0.64	0.15	0.30	0.022	0.046	0	0	0	0
S2	0	0	0	0	0	0	0	0	0.31	0.64	0.15	0.30	0.022	0.046	0	0	0	0
STK1	0	0	0	0	0	0	0	0	0.21	0.94	0.21	0.94	0.21	0.94	0	0	0	0
STK2	0	0	0	0	0	0	0	0	0.60	2.6	0.60	2.6	0.60	2.6	0	0	0	0
STK3A,B,C	27	118	24	104	3.7	16	0.41	1.8	19	81	19	81	19	81	0	0	0.00034	0.0015
STK4	0.79	3.4	0.69	3.0	0.11	0.48	0.012	0.052	0.64	2.8	0.64	2.8	0.64	2.8	0	0	0.00001	4.3E-05
STK5	0	0	0	0	0	0	0	0	1.8	8.0	1.8	8.0	1.8	8.0	0	0	0	0
S56	0	0	0	0	0	0	0	0	0.0035	0.0073	0.0017	0.0035	0.00025	0.00052	0	0	0	0
S57	0	0	0	0	0	0	0	0	0.0042	0.0088	0.0020	0.0042	0.00030	0.00063	0	0	0	0
STK6	1.4	6.1	1.2	5.4	0.19	0.84	0.021	0.092	1.1	4.6	1.1	4.6	1.1	4.6	0	0	1.7E-05	7.7E-05
STK7	0.43	1.9	0.38	1.7	0.060	0.26	0.0066	0.029	0.40	1.8	0.40	1.8	0.40	1.8	0	0	5.5E-06	2.4E-05
STK8	0	0	0	0	0	0	0	0	0.76	3.3	0.76	3.3	0.76	3.3	0	0	0	0
S92	0	0	0	0	0	0	0	0	0.0035	0.0073	0.0017	0.0035	0.00025	0.00052	0	0	0	0
S93	0	0	0	0	0	0	0	0	0.0042	0.0088	0.0020	0.0042	0.00030	0.00063	0	0	0	0
SC9	0	0	0	0	0	0	0	0	0.69	3.0	0.69	3.0	0.69	3.0	0	0	0	0
STK10	0.084	0.37	0.074	0.32	0.012	0.051	0.0013	0.0056	0.62	2.7	0.62	2.7	0.62	2.7	0	0	1E-06	4.4E-06
S126	0	0	0	0	0	0	0	0	3.5	1.4	1.7	0.69	0.25	0.10	0	0	0	0
S129	0	0	0	0	0	0	0	0	3.5	1.9	1.7	0.88	0.25	0.13	0	0	0	0
S132	0	0	0	0	0	0	0	0	3.5	0.36	1.7	0.17	0.25	0.026	0	0	0	0
S135	0	0	0	0	0	0	0	0	3.5	1.2	1.7	0.59	0.25	0.089	0	0	0	0
S180	0	0	0	0	0	0	0	0	0.0087	0.018	0.0041	0.0086	0.00063	0.0013	0	0	0	0
S181	0	0	0	0	0	0	0	0	0.0087	0.018	0.0041	0.0086	0.00063	0.0013	0	0	0	0
S182	0	0	0	0	0	0	0	0	0.0087	0.018	0.0041	0.0086	0.00063	0.0013	0	0	0	0
S183	0	0	0	0	0	0	0	0	0.0087	0.018	0.0041	0.0086	0.00063	0.0013	0	0	0	0
S184	0	0	0	0	0	0	0	0	0.0087	0.018	0.0041	0.0086	0.00063	0.0013	0	0	0	0
S185	0	0	0	0	0	0	0	0	0.0087	0.018	0.0041	0.0086	0.00063	0.0013	0	0	0	0
S186	0	0	0	0	0	0	0	0	0.0087	0.018	0.0041	0.0086	0.00063	0.0013	0	0	0	0
S187	0	0	0	0	0	0	0	0	0.0087	0.018	0.0041	0.0086	0.00063	0.0013	0	0	0	0
S136	0	0	0	0	0	0	0	0	5.6	4.9	2.7	2.3	0.40	0.35	0	0	0	0
S137	0	0	0	0	0	0	0	0	0.20	1.7	0.074	0.61	0.011	0.094	0	0	0	0
S138	0	0	0	0	0	0	0	0	0.23	1.7	0.083	0.61	0.013	0.094	0	0	0	0
S139	0	0	0	0	0	0	0	0	0.15	1.7	0.054	0.61	0.0084	0.094	0	0	0	0
S140	0	0	0	0	0	0	0	0	0.16	1.7	0.059	0.61	0.0092	0.094	0	0	0	0
S141	0	0	0	0	0	0	0	0	5.5	4.8	2.6	2.3	0.39	0.34	0	0	0	0
S142	0	0	0	0	0	0	0	0	7.1	5.2	3.4	2.4	0.51	0.37	0	0	0	0
S143	0	0	0	0	0	0	0	0	0.24	1.7	0.089	0.61	0.014	0.094	0	0	0	0

Unit No.	NOx		CO		VOC		SOx		TSP[2]		PM10[2]		PM2.5[2]		H_2S		Lead	
	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr
S144	0	0	0	0	0	0	0	0	0.26	1.7	0.095	0.61	0.015	0.094	0	0	0	0
S145	0	0	0	0	0	0	0	0	0.28	1.7	0.10	0.61	0.016	0.094	0	0	0	0
S154	0	0	0	0	0	0	0	0	11	4.9	5.4	2.3	0.81	0.35	0	0	0	0
S156	0	0	0	0	0	0	0	0	5.7	0.15	2.7	0.070	0.41	0.011	0	0	0	0
S157	0	0	0	0	0	0	0	0	5.6	1.7	2.7	0.79	0.40	0.12	0	0	0	0
S158	0	0	0	0	0	0	0	0	0.20	0.56	0.074	0.21	0.011	0.032	0	0	0	0
S159	0	0	0	0	0	0	0	0	0.23	0.56	0.083	0.21	0.013	0.032	0	0	0	0
S160	0	0	0	0	0	0	0	0	0.15	0.56	0.054	0.21	0.0084	0.032	0	0	0	0
S161	0	0	0	0	0	0	0	0	0.16	1.7	0.059	0.61	0.0092	0.094	0	0	0	0
S162	0	0	0	0	0	0	0	0	5.5	1.6	2.6	0.77	0.39	0.12	0	0	0	0
S163	0	0	0	0	0	0	0	0	7.1	1.7	3.4	0.83	0.51	0.13	0	0	0	0
S164	0	0	0	0	0	0	0	0	0.24	0.56	0.089	0.21	0.014	0.032	0	0	0	0
S165	0	0	0	0	0	0	0	0	0.26	0.56	0.10	0.21	0.015	0.032	0	0	0	0
S166A,B	0	0	0	0	0	0	0	0	0.28	0.56	0.10	0.21	0.016	0.032	0	0	0	0
S172	0	0	0	0	0	0	0	0	11	1.7	5.4	0.79	0.81	0.12	0	0	0	0
S173	0	0	0	0	0	0	0	0	5.7	0.050	2.7	0.024	0.41	0.0036	0	0	0	0
SC11	0	0	0	0	0	0	0	0	1.5	6.8	1.5	6.8	1.5	6.8	0	0	0	0
S175	0	0	0	0	0	0	0	0	0.013	0.028	0.0063	0.013	0.0010	0.0020	0	0	0	0
S176	0	0	0	0	0	0	0	0	0.013	0.028	0.0063	0.013	0.0010	0.0020	0	0	0	0
S177	0	0	0	0	0	0	0	0	0.089	0.18	0.042	0.087	0.0064	0.013	0	0	0	0
S178	0	0	0	0	0	0	0	0	0.089	0.18	0.042	0.087	0.0064	0.013	0	0	0	0
S179	0	0	0	0	0	0	0	0	4.3	9.5	0.98	2.2	0.46	1.0	0	0	0	0
S180	0	0	0	0	0	0	0	0	2.0	8.9	1.0	4.4	0.15	0.67	0	0	0	0
S189	0	0	0	0	0	0	0	0	2.5	10	0.50	2.1	0.12	0.52	0	0	0	0
S190	0	0	0	0	0	0	0	0	0.075	0.31	0.015	0.063	0.0037	0.015	0	0	0	0
S191	0	0	0	0	0	0	0	0	0.031	0.13	0.0061	0.025	0.0015	0.0063	0	0	0	0
S192	0	0	0	0	0	0	0	0	0.33	1.2	0.084	0.31	0.0084	0.031	0	0	0	0
S193	0	0	0	0	0	0	0	0	0.33	1.2	0.084	0.31	0.0084	0.031	0	0	0	0
S194	0	0	0	0	0	0	0	0	20	72	5.0	18	0.50	1.8	0	0	0	0
S195	0	0	0	0	0	0	0	0	17	63	4.4	16	0.44	1.6	0	0	0	0
STK11 S196	3.1	14	5.8	25	0.91	4.0	0.099	0.43	0.81	3.6	0.81	3.6	0.81	3.6	0	0	8.2E-05	0.00036
STK12 S197	3.1	14	5.8	25	0.91	4.0	0.099	0.43	0.81	3.6	0.81	3.6	0.81	3.6	0	0	8.2E-05	0.00036
S198	0	0	0	0	0	0	0	0	0.039	0.17	0.019	0.085	0.0029	0.013	0	0	0	0
S199	0	0	0	0	0	0	0	0	0.082	0.36	0.041	0.18	0.0061	0.027	0	0	0	0
STK13 S200A,B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.6	7.1	0	0
Totals	36	157	38	165	5.9	26	0.65	2.8	164	342	82	191	37	134	1.6	7.1	0.00054	0.0024

[1] **Significant Figures Examples**: One significant figure – 0.03, 3, 0.3. Two significant figures – 0.34, 34, 3400, 3.4

[2] **Condensables:** Include condensable particulate matter emissions in particulate matter calculations.

Table 2-F: Additional Emissions during Startup, Shutdown, and Routine Maintenance (SSM)

X This table is intentionally left blank as all SSM emissions at this facility do not require an increase in Requested Allowables greater than those listed in Table 2-E. If you are required to report GHG emissions as described in Section 21, include any GHG emissions due Startup, Shutdown, and/or Scheduled Maintenance in Table 2-P. Provide explanation in Section 6.

All applications, including NOI applications, must fill out this table, reporting Maximum Emissions during Startup, Shutdown and Scheduled Maintenance (20.2.7 NMAC, 20.2.72.203.A.3 NMAC, 20.2.73.200.D.2 NMAC). Only report SSM emissions greater than the cooresponding Table 2-E emissions[1]. Not providing emissions for a unit indicates that SSM emissions for this unit are less than the Requested Allowables for that unit in Table 2-E. In Section 6, provide emissions calculations for any emissions listed in this table. Refer to "Guidance for Submittal of Startup, Shutdown, Maintenance Emissions in Permit Applications (http://www.nmenv.state.nm.us/aqb/permit/app_form.html) for more detailed instructions. For each unit with flashing, list tank-flashing emissions estimates as a separate line item (20.2.72.203.A.3 and 20.2.70.300.D.5 NMAC). List all units and SSM fugitives, except GHGs, in this table. Refer to Table 2-E for instructions on use of the "-" symbol and on significant figures.

Unit No.	NOx		CO		VOC		SOx		TSP[2]		PM10[2]		PM2.5[2]		H_2S		Lead	
	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr
Totals																		

[1] **For instance**, if the short term steady-state Table 2-E emissions are 5 lb/hr and the SSM rate is 12 lb/hr, enter 7 lb/hr in the table below. If the annual steady-state Table 2-E emissions are 21.9 TPY, and the number of scheduled SSM events result in annual emissions of 31.9 TPY, enter 10.0 TPY in the table below.

[2] **Condensables**: Include condensable particulate matter emissions in particulate matter calculations.

Table 2-G: Stack Exit and Fugitive Emission Rates for Special Stacks

X I have elected to leave this table blank because this facility does not have any stacks/vents that split emissions from a single source or combine emissions from more than one source listed in table 2-A. Additionally, the emission rates of all stacks match the Requested allowable emission rates stated in Table 2-E.

Use this table to list stack emissions (requested allowable) from split and combined stacks. List Toxic Air Pollutants (TAPs) and Hazardous Air Pollutants (HAPs) in Table 2-I. List all fugitives that are associated with the normal, routine, and non-emergency operation of the facility. List tank-flashing emissions estimates as a separate line item. Unit and stack numbering must correspond throughout the application package. Refer to Table 2-E for instructions on use of the "-" symbol and on significant figures.

Stack No.	Serving Unit Number(s) from Table 2-A	NOx		CO		VOC		SOx		TSP		PM10		PM2.5		☐ H_2S or ☐ Lead	
		lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr
Totals:																	

Table 2-H: Stack Exit Conditions

Unit and stack numbering must correspond throughout the application package.

Stack Number	Serving Unit Number(s) from Table 2-A	Orientation (H-Horizontal V=Vertical)	Rain Caps (Yes or No)	Height Above Ground (ft)	Temp. (F)	Flow Rate (acfs)	Flow Rate (dscfs)	Moisture by Volume (%)	Velocity (ft/sec)	Inside Diameter or L x W (ft)
STK1	S3,S4,S5A,S5B,S6A,S6B,S7	V	No	101	75	5000			52.87	1.42
STK2	S8,S9,S10,S11,S13,S14A,S14B,S15A,S15B	V	No	212	75	14000			50.87	2.42
STK3A	S18A, S19A, S21A, S22A, S30A	V	No	252	475	286000	138778		62.81	9.83
STK3B	S18B, S19B, S21B, S22B, S30B	V	No	252	475	286000	138778		62.81	9.83
STK3C	S18C, S19C, S21C, S22C, S30C			252	475	286000	138778		62.81	9.83
STK4	S32 S33, S34, S35	V	No	212	300	24000	14327		63.44	2.83
STK5	S16A, S16B, S17A, S17B, S20A, S20B, S23, S24, S25, S26, S27, S28, S36, S37, S38, S39, S40, S41, S42, S43, S44, S45, S46, S47, S48, S49, S50, S51, S52, S53, S54, S55, S58, S59, S60, S61, S62, S63, S64, S65, S66, S67, S68, S69A, S69B, S70A, S70B, S71A, S71B, S74, S75, S76, S77, S78A, S78B, S79A, S79B, S80, S81, S82, S83, S84, S86, S87, S124, S125, S127, S128, S130, S131, S133, S134	V	No	232	75	50000	42401.6		61.12	4.17
STK6	S72, S73A,B, S85	V	No	212	250	37000	23643.00		64.10	3.50
STK7	S88, S89, S90	V	No	212	350	16700	6314		56.70	2.50
STK8	S91, S94, S95, S96, S97, S98, S99, S100, S101, S102, S103, S104A,B	V	No	212	75	21000	17808.7		52.38	2.92
STK9	S105, S106, S107A,B, S108, S109, S110, S115, S116, S117, S118, S119, S120, S121, S122, S123	V	No	212	220	24000	16012.8		56.59	3.00
STK10	S111, S112, S113, S114	V	No	212	180	19500	13832		58.19	2.67

Stack Number	Serving Unit Number(s) from Table 2-A	Orientation (H-Horizontal V=Vertical)	Rain Caps (Yes or No)	Height Above Ground (ft)	Temp. (F)	Flow Rate (acfs)	Flow Rate (dscfs)	Moisture by Volume (%)	Velocity (ft/sec)	Inside Diameter or L x W (ft)
STK11	S146, S147, S148, S149, S150, S151, S152, S153, S155, S167, S168, S169, S170, S171, S174	V	No	125	75	36000			50.00	3.91
STK12	S196	V	No	50	360	62307	34474		82.64	4.00
STK13	S197	V	No	50	360	62307	34474		82.64	4.00
STK14	S200A, S200B	V	No	37	59	160000			53.05	8.00

Table 2-I: Stack Exit and Fugitive Emission Rates for HAPs and TAPs

In the table below, report the Potential to Emit for each HAP from each regulated emission unit listed in Table 2-A, only if the entire facility emits the HAP at a rate greater than or equal to one (1) ton per year For each such emission unit, HAPs shall be reported to the nearest 0.1 tpy. Each facility-wide Individual HAP total and the facility-wide Total HAPs shall be the sum of all HAP sources calculated to the nearest 0.1 ton per year. Per 20.2.72.403.A.1 NMAC, facilities not exempt [see 20.2.72.402.C NMAC] from TAP permitting shall report each TAP that has an uncontrolled emission rate in excess of its pounds per hour screening level specified in 20.2.72.502 NMAC. TAPs shall be reported using one more significant figure than the number of significant figures shown in the pound per hour threshold corresponding to the substance. Use the HAP nomenclature as it appears in Section 112 (b) of the 1990 CAAA and the TAP nomenclature as it listed in 20.2.72.502 NMAC. Include tank-flashing emissions estimates of HAPs in this table. For each HAP or TAP listed, fill all cells in this table with the emission numbers or a "-" symbol. A "-" symbol indicates that emissions of this pollutant are not expected or the pollutant is emitted in a quantity less than the threshold amounts described above.

Stack No.	Unit No.(s)	Total HAPs		Provide Pollutant Name Here ☐ HAP or ☐ TAP		Provide Pollutant Name Here ☐ HAP or ☐ TAP		Provide Pollutant Name Here ☐ HAP or ☐ TAP		Provide Pollutant Name Here ☐ HAP or ☐ TAP		Provide Pollutant Name Here ☐ HAP or ☐ TAP		Provide Pollutant Name Here ☐ HAP or ☐ TAP		Provide Pollutant Name Here ☐ HAP or ☐ TAP		Provide Pollutant Name Here ☐ HAP or ☐ TAP	
		lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr	lb/hr	ton/yr
Totals:																			

Table 2-J: Fuel

Specify fuel characteristics and usage. Unit and stack numbering must correspond throughout the application package.

Unit No.	Fuel Type (No. 2 Diesel, Natural Gas, Coal, …)	Specify Units				
		Lower Heating Value	Hourly Usage	Annual Usage	% Sulfur	% Ash
S18A	Natural Gas	946 BTU/scf	214.23 MMBTU/hr	1983.8 MMSCF	0.75 grains/scf	0.00
S18B	Natural Gas	946 BTU/scf	214.23 MMBTU/hr	1983.8 MMSCF	0.75 grains/scf	0.00
S18C	Natural Gas	946 BTU/scf	214.23 MMBTU/hr	1983.8 MMSCF	0.75 grains/scf	0.00
S34	Natural Gas	946 BTU/scf	18.74 MMBTU/hr	173.5 MMSCF	0.75 grains/scf	0.00
S73A	Natural Gas	946 BTU/scf	16.54 MMBTU/hr	153.2 MMSCF	0.75 grains/scf	0.00
S73B	Natural Gas	946 BTU/scf	16.54 MMBTU/hr	153.2 MMSCF	0.75 grains/scf	0.00
S90	Natural Gas	946 BTU/scf	10.35 MMBTU/hr	95.84 MMSCF	0.75 grains/scf	0.00
S113	Natural Gas	946 BTU/scf	2.0 MMBTU/hr	17.52 MMSCF	0.75 grains/scf	0.00
S196	Natural Gas	946 BTU/scf	155.9 MMBTU/hr	1443.6 MMSCF	0.75 grains/scf	0.00
S197	Natural Gas	946 BTU/scf	155.9 MMBTU/hr	1443.6 MMSCF	0.75 grains/scf	0.00

Table 2-K: Liquid Data for Tanks Listed in Table 2-L

For each tank, list the liquid(s) to be stored in each tank. If it is expected that a tank may store a variety of hydrocarbon liquids, enter "mixed hydrocarbons" in the Composition column for that tank and enter the corresponding data of the most volatile liquid to be stored in the tank. If tank is to be used for storage of different materials, list all the materials in the "All Calculations" attachment, run the newest version of TANKS on each, and use the material with the highest emission rate to determine maximum uncontrolled and requested allowable emissions rate. The permit will specify the most volatile category of liquids that may be stored in each tank. Include appropriate tank-flashing modeling input data. Use additional sheets if necessary. Unit and stack numbering must correspond throughout the application package.

Tank No.	SCC Code	Material Name	Composition	Liquid Density (lb/gal)	Vapor Molecular Weight (lb/lb*mol)	Average Storage Conditions		Max Storage Conditions	
						Temperature (°F)	True Vapor Pressure (psia)	Temperature (°F)	True Vapor Pressure (psia)

Table 2-L: Tank Data

Include appropriate tank-flashing modeling input data. Use an addendum to this table for unlisted data categories. Unit and stack numbering must correspond throughout the application package. Use additional sheets if necessary. See reference Table 2-L2. Note: 1.00 bbl = 10.159 M3 = 42.0 gal

Tank No.	Date Installed	Materials Stored	Seal Type (refer to Table 2-LR below)	Roof Type (refer to Table 2-LR below)	Capacity		Diameter (M)	Vapor Space (M)	Color (from Table VI-C)		Paint Condition (from Table VI-C)	Annual Throughput (gal/yr)	Turn-overs (per year)
					(bbl)	(M^3)			Roof	Shell			

Table 2-L2: Liquid Storage Tank Data Codes Reference Table

Roof Type	Seal Type, Welded Tank Seal Type		Seal Type, Riveted Tank Seal Type		Roof, Shell Color	Paint Condition
FX: Fixed Roof	**Mechanical Shoe Seal**	**Liquid-mounted resilient seal**	**Vapor-mounted resilient seal**	**Seal Type**	**WH**: White	Good
IF: Internal Floating Roof	**A**: Primary only	**A**: Primary only	**A**: Primary only	**A**: Mechanical shoe, primary only	**AS**: Aluminum (specular)	Poor
EF: External Floating Roof	**B**: Shoe-mounted secondary	**B**: Weather shield	**B**: Weather shield	**B**: Shoe-mounted secondary	**AD**: Aluminum (diffuse)	
P: Pressure	**C**: Rim-mounted secondary	**C**: Rim-mounted secondary	**C**: Rim-mounted secondary	**C**: Rim-mounted secondary	**LG**: Light Gray	
					MG: Medium Gray	
					BL: Black	
					OT: Other (specify)	

Note: 1.00 bbl = 0.159 M^3 = 42.0 gal

Table 2-M: Materials Processed and Produced (Use additional sheets as necessary.)

Material Processed				Material Produced			
Description	**Chemical Composition**	**Phase (Gas, Liquid, or Solid)**	**Quantity (specify units)**	**Description**	**Chemical Composition**	**Phase**	**Quantity (specify units)**
Raw Ore (Polyhalite)	$K_2Ca2Mg(SO_4)4{\bullet}2(H_2O)$,	Solid	4,821,592 tons/year	Sulphate of Potash	K_2SO_4	Solid	1,100,344 tons/yr
				Langbeinite	$2Mg(SO_4){\bullet}K_2SO_4$	Solid	373,001 tons/yr
				Gypsum (Waste)	$CaSO_4$	Solid	2,966,924 tons/yr

Table 2-N: CEM Equipment

Enter Continuous Emissions Measurement (CEM) Data in this table. If CEM data will be used as part of a federally enforceable permit condition, or used to satisfy the requirements of a state or federal regulation, include a copy of the CEM's manufacturer specification sheet in the Information Used to Determine Emissions attachment. Unit and stack numbering must correspond throughout the application package. Use additional sheets if necessary.

Stack No.	Pollutant(s)	Manufacturer	Model No.	Serial No.	Sample Frequency	Averaging Time	Range	Sensitivity	Accuracy

Table 2-O: Parametric Emissions Measurement Equipment

Unit and stack numbering must correspond throughout the application package. Use additional sheets if necessary.

Unit No.	Parameter/Pollutant Measured	Location of Measurement	Unit of Measure	Acceptable Range	Frequency of Maintenance	Nature of Maintenance	Method of Recording	Averaging Time
S18A	Natural Gas Usage	Prior to Burner Inlet	cubic feet	TBD	TBD	TBD	TBD	TBD
S18B	Natural Gas Usage	Prior to Burner Inlet	cubic feet	TBD	TBD	TBD	TBD	TBD
S18C	Natural Gas Usage	Prior to Burner Inlet	cubic feet	TBD	TBD	TBD	TBD	TBD
S34	Natural Gas Usage	Prior to Burner Inlet	cubic feet	TBD	TBD	TBD	TBD	TBD
S73A	Natural Gas Usage	Prior to Burner Inlet	cubic feet	TBD	TBD	TBD	TBD	TBD
S73B	Natural Gas Usage	Prior to Burner Inlet	cubic feet	TBD	TBD	TBD	TBD	TBD
S90	Natural Gas Usage	Prior to Burner Inlet	cubic feet	TBD	TBD	TBD	TBD	TBD
S113	Natural Gas Usage	Prior to Burner Inlet	cubic feet	TBD	TBD	TBD	TBD	TBD
S196	Natural Gas Usage	Prior to Burner Inlet	cubic feet	TBD	TBD	TBD	TBD	TBD
S197	Natural Gas Usage	Prior to Burner Inlet	cubic feet	TBD	TBD	TBD	TBD	TBD
SC2	PM	Differenctial pressure across bags	PSI	TBD	TBD	TBD	TBD	TBD
SC3	PM	Differenctial pressure across bags	PSI	TBD	TBD	TBD	TBD	TBD
SC4	PM	Differenctial pressure across bags	PSI	TBD	TBD	TBD	TBD	TBD
SC5	PM	Differenctial pressure across bags	PSI	TBD	TBD	TBD	TBD	TBD
SC6	PM	Differenctial pressure across bags	PSI	TBD	TBD	TBD	TBD	TBD
SC7	PM	Differenctial pressure across bags	PSI	TBD	TBD	TBD	TBD	TBD
SC8	PM	Differenctial pressure across bags	PSI	TBD	TBD	TBD	TBD	TBD
SC11	PM	Differenctial pressure across bags	PSI	TBD	TBD	TBD	TBD	TBD
SC12	PM	Differenctial pressure across bags	PSI	TBD	TBD	TBD	TBD	TBD
SC13	PM	Differenctial pressure across bags	PSI	TBD	TBD	TBD	TBD	TBD
SC14	PM	Differenctial pressure across bags	PSI	TBD	TBD	TBD	TBD	TBD
SC15	PM	Differenctial pressure across bags	PSI	TBD	TBD	TBD	TBD	TBD

Unit No.	Parameter/Pollutant Measured	Location of Measurement	Unit of Measure	Acceptable Range	Frequency of Maintenance	Nature of Maintenance	Method of Recording	Averaging Time
SC26	PM	Differenctial pressure across bags	PSI	TBD	TBD	TBD	TBD	TBD

Table 2-P: Green House Gas Emissions

Applications submitted under 20.2.70, 20.2.72, & 20.2.74 NMAC that are Major for GHGs as determined in Section 22 of this application are required to complete this Table if so directed in Section 22 or are major for GHGs and have an existing GHG BACT. Applicants must report potential emission rates in short tons per year. Include GHG emissions during Startup, Shutdown, and Scheduled Maintenance in this table.

		CO_2 ton/yr	N_2O ton/yr	CH_4 ton/yr	SF_6 ton/yr	PFC/HFC ton/yr[2]									Total GHG Mass Basis ton/yr[4]	Total CO_2e ton/yr[5]
Unit No.	**GWPs [1]**	**1**	**310**	**21**	**23,900**	**footnote 3**									**521586**	**522041**
S18A	**mass GHG**	109690	0.19	1.9											109693	
	CO_2e	109690	58	39												109788
S18B	**mass GHG**	109690	0.19	1.9											109693	
	CO_2e	109690	58	39												109788
S18C	**mass GHG**	109690	0.19	1.9											109693	
	CO_2e	109690	58	39												109788
S34	**mass GHG**	9595	0.016	0.16											9595	
	CO_2e	9595	5.0	3.4												9604
S73A	**mass GHG**	8469	0.014	0.14											8469	
	CO_2e	8469	4.3	2.9												8476
S73B	**mass GHG**	8469	0.014	0.14											8469	
	CO_2e	8469	4.3	2.9												8476
S90	**mass GHG**	5299	0.0091	0.091											5300	
	CO_2e	5299	2.8	1.9												5304
S113	**mass GHG**	1024	0.0018	0.018											1024	
	CO_2e	1024	0.56	0.38												1025
S196	**mass GHG**	79824	0.137	1.37											79826	
	CO_2e	79824	42.5	28.8												79895
S197	**mass GHG**	79824	0.137	1.37											79826	
	CO_2e	79824	42.5	28.8												79895
	mass GHG															
	CO_2e															
	mass GHG															
	CO_2e															
	mass GHG															
	CO_2e															
	mass GHG															
	CO_2e															
	mass GHG															
	CO2e															
	mass GHG															
	CO_2e															
	mass GHG															
	CO_2e															

[1] **GWP** (Global Warming Potential): Applicants must use the most current GWPs codified in Table A-1 of 40 CFR part 98. GWPs are subject to change, therefore, applicants need to check 40 CFR 98 to confirm GWP values.

[2] For **HFCs** or **PFCs** describe the specific HFC or PFC compound and use a separate column for each individual compound.

[3] For each new compound, enter the appropriate GWP for each HFC or PFC compound from Table A-1 in 40 CFR 98.

[4] Green house gas emissions on a **mass basis** is the ton per year green house gas emission before adjustment with its GWP.

[5] **CO_2e** means Carbon Dioxide Equivalent and is calculated by multiplying the TPY mass emissions of the green house gas by its GWP.

Material Drop from Conveyor Belt from U/G #1 to Conveyor Belt from U/G #2 (S1)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.00374	lbs/ton	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton			
E(PM10) =	0.00177	lbs/ton	Max tph	550.4	tph	
E(PM2.5) =	0.00027	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.00178	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.00084	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00013	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	550.4	tph	M	3	%	
	4821592	tpy				

%Control Efficiency 85 % Full Enclosed Transfer

	lb/hr	tons/yr	model lb/hr
E(tsp) Uncontrolled	2.06	4.28	
E(pm10) Uncontrolled	0.97	2.02	
E(pm2.5) Uncontrolled	0.15	0.31	
E(tsp) Controlled	0.31	0.64	0.14658
E(pm10) Controlled	0.15	0.30	0.06933
E(pm2.5) Controlled	0.02	0.05	0.01050

Material Drop from Conveyor Belt from U/G #2 to Ore Storage Bypass Diverter Gate (S2)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.00374	lbs/ton	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton			
E(PM10) =	0.00177	lbs/ton	Max tph	550.4	tph	
E(PM2.5) =	0.00027	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.00178	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.00084	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00013	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	550.4	tph	M	3	%	
	4821592	tpy				

%Control Efficiency 85 % Full Enclosed Transfer

	lb/hr	tons/yr	model lb/hr
E(tsp) Uncontrolled	2.06	4.28	
E(pm10) Uncontrolled	0.97	2.02	
E(pm2.5) Uncontrolled	0.15	0.31	
E(tsp) Controlled	0.31	0.64	0.14658
E(pm10) Controlled	0.15	0.30	0.06933
E(pm2.5) Controlled	0.02	0.05	0.01050

Material Drop from Ore Storage Bypass Diverter Gate to Ore Storage Feed Drag

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.00374	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.00177	lbs/ton	Max tph	550.4	tph	
E(PM2.5) =	0.00027	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.00178	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.00084	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00013	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	550.4	tph	M	3	%	
	4821592	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	2.05912	4.28
E(pm10) Uncontrolled	0.97391	2.02
E(pm2.5) Uncontrolled	0.14748	0.31

E(tsp) Controlled	PM Emissions Controlled with ROM Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with ROM Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with ROM Area Dust Collector

Material Drop from Ore Storage Feed Drag Conveyor to Raw ore Bins #1 and #2 (S4)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.00374	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.00177	lbs/ton	Max tph	550.4	tph	
E(PM2.5) =	0.00027	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.00178	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.00084	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00013	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	550.4	tph	M	3	%	
	4821592	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	2.05912	4.28
E(pm10) Uncontrolled	0.97391	2.02
E(pm2.5) Uncontrolled	0.14748	0.31

E(tsp) Controlled	PM Emissions Controlled with ROM Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with ROM Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with ROM Area Dust Collector

Material Drop from Raw ore Bins #1 and #2 to Storage Bin Unload Drag Conveyors #1 and #2

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.00374	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.00177	lbs/ton	Max tph	550.4	tph	
E(PM2.5) =	0.00027	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.00178	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.00084	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00013	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	550.4	tph	M	3	%	
	4821592	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	2.05912	4.28
E(pm10) Uncontrolled	0.97391	2.02
E(pm2.5) Uncontrolled	0.14748	0.31

E(tsp) Controlled	PM Emissions Controlled with ROM Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with ROM Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with ROM Area Dust Collector

Material Drop from Ore Storage Bypass Diverter Gate or Storage Bin Unload Drag Conveyors #1

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.00374	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.00177	lbs/ton	Max tph	550.4	tph	
E(PM2.5) =	0.00027	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.00178	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.00084	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00013	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	550.4	tph	M	3	%	
	4821592	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	2.05912	4.28
E(pm10) Uncontrolled	0.97391	2.02
E(pm2.5) Uncontrolled	0.14748	0.31

E(tsp) Controlled	PM Emissions Controlled with ROM Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with ROM Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with ROM Area Dust Collector

Material Drop from ROM Baghouse Fines Screw Conveyor to Belt Conveyor from Raw Ore Storage

AP-42 Section 11.19.2-4 "Crushed Stone Processing and Pulverized Mineral Processing"
Ver 08/2004
Uncontrolled emission rates derived from "Product Storage with Fabric Filter" controlled emission rate and

	Controlled		Uncontrolled	
E(TSP) =	0.00990	lbs/ton	1.98000	lbs/ton
E(PM10) =	0.00160	lbs/ton	0.32000	lbs/ton
E(PM2.5) =	0.00060	lbs/ton	0.12000	lbs/ton

1	tph
8760	tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	1.98000	8.67
E(pm10) Uncontrolled	0.32000	1.40
E(pm2.5) Uncontrolled	0.12000	0.53

E(tsp) Controlled	PM Emissions Controlled with ROM Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with ROM Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with ROM Area Dust Collector

ROM Area Baghouse (STK1)

BACT **PM (Total)**

PM (Total) Controlled 0.005 gr/DSCF BACT

Exhaust Flowrate

5000 DSCFM

5000 ACFM

Uncontrolled Hours of Operation

8760 hr/yr

Controlled Hours of Operation

8760 hr/yr

	Uncontolled		Controlled	
Pollutant	**PPH**	**TPY**	**PPH**	**TPY**
PM (Total)			0.214	0.939

Material Drop from Conveyor Belt from Raw Ore Storage to Ore Surge Bin (S8)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.00374	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.00177	lbs/ton	Max tph	550.4	tph	
E(PM2.5) =	0.00027	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.00178	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.00084	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00013	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	550.4	tph	M	3	%	
	4821592	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	2.05912	4.28
E(pm10) Uncontrolled	0.97391	2.02
E(pm2.5) Uncontrolled	0.14748	0.31

E(tsp) Controlled	PM Emissions Controlled with Crusher Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Crusher Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Crusher Area Dust Collector

Material Drop from Ore Surge Bin to VFD Belt Feeder (S9)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.00374	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.00177	lbs/ton	Max tph	550.4	tph	
E(PM2.5) =	0.00027	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.00178	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.00084	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00013	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	550.4	tph	M	3	%	
	4821592	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	2.05912	4.28
E(pm10) Uncontrolled	0.97391	2.02
E(pm2.5) Uncontrolled	0.14748	0.31

E(tsp) Controlled	PM Emissions Controlled with Crusher Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Crusher Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Crusher Area Dust Collector

Material Drop from VFD Belt Feeder to Raw Ore Roll Crusher (S10)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.00374	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.00177	lbs/ton	Max tph	550.4	tph	
E(PM2.5) =	0.00027	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.00178	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.00084	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00013	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	550.4	tph	M	3	%	
	4821592	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	2.05912	4.28
E(pm10) Uncontrolled	0.97391	2.02
E(pm2.5) Uncontrolled	0.14748	0.31

E(tsp) Controlled	PM Emissions Controlled with Crusher Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Crusher Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Crusher Area Dust Collector

Material Drop from Raw Ore Roll Crusher to Wet Sizing Screen Feed Pump Box (S11)

AP-42 Table 11.19.2-2 "Tertiary Crusher Uncontrolled"
Ver 8/2004

E(TSP) =	0.00540	lbs/ton
E(PM10) =	0.00240	lbs/ton
E(PM2.5) =	0.00036	lbs/ton

Throughput	550.4	tph
	4821592	tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	2.97216	13.01806
E(pm10) Uncontrolled	1.32096	5.78580
E(pm2.5) Uncontrolled	0.19814	0.86787

E(tsp) Controlled	PM Emissions Controlled with Crusher Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Crusher Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Crusher Area Dust Collector

Material Drop from Crusher Baghouse Fines Screw Conveyor to Wet Sizing Screen Feed Pump Box

AP-42 Section 11.19.2-4 "Crushed Stone Processing and Pulverized Mineral Processing"
Ver 08/2004
Uncontrolled emission rates derived from "Product Storage with Fabric Filter" controlled emission rate and

	Controlled		Uncontrolled	
E(TSP) =	0.00990	lbs/ton	1.98000	lbs/ton
E(PM10) =	0.00160	lbs/ton	0.32000	lbs/ton
E(PM2.5) =	0.00060	lbs/ton	0.12000	lbs/ton

1	tph
8760	tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	1.98000	8.67
E(pm10) Uncontrolled	0.32000	1.40
E(pm2.5) Uncontrolled	0.12000	0.53

E(tsp) Controlled	PM Emissions Controlled with Crusher Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Crusher Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Crusher Area Dust Collector

Crusher Area Baghouse (STK2)

BACT **PM (Total)**

PM (Total) Controlled 0.005 gr/DSCF BACT

Exhaust Flowrate

14000 DSCFM

14000 ACFM

Uncontrolled Hours of Operation

8760 hr/yr

Controlled Hours of Operation

8760 hr/yr

	Uncontolled		Controlled	
Pollutant	**PPH**	**TPY**	**PPH**	**TPY**
PM (Total)			0.600	2.63

Material Drop from Sodium Chloride Wash Belt Filter to Calciner Feed Surge Bin #1 and #2 - Total for 2 lines (S14A,B)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.00069	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.00033	lbs/ton	Max tph	555.1	tph	
E(PM2.5) =	0.00005	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.00033	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.00016	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00002	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
			M	10	%	
	555.1	tph				
	4862676	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	0.38490	0.80
E(pm10) Uncontrolled	0.18205	0.38
E(pm2.5) Uncontrolled	0.02757	0.06

E(tsp) Controlled	PM Emissions Controlled with Crusher Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Crusher Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Crusher Area Dust Collector

Material Drop from Calciner Feed Surge Bin #1 and #2 to Calciner Feed Live Bottom Screw Conveyor #1 and #2 - Total for 2 lines (S15A,B)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.00069	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.00033	lbs/ton	Max tph	555.1	tph	
E(PM2.5) =	0.00005	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.00033	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.00016	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00002	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
			M	10	%	
	555.1	tph				
	4862676	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	0.38490	0.80
E(pm10) Uncontrolled	0.18205	0.38
E(pm2.5) Uncontrolled	0.02757	0.06

E(tsp) Controlled	PM Emissions Controlled with Crusher Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Crusher Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Crusher Area Dust Collector

Material Drop from Calciner Feed Live Bottom Screw Conveyor #1 and #2 to Calciner Feed Live Bottom Screw Conveyor #3 and #4 - Total for 2 lines (16A,B)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.00069	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.00033	lbs/ton	Max tph	555.1	tph	
E(PM2.5) =	0.00005	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.00033	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.00016	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00002	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
			M	10	%	
	555.1	tph				
	4862676	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	0.38490	0.80
E(pm10) Uncontrolled	0.18205	0.38
E(pm2.5) Uncontrolled	0.02757	0.06

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from Calciner Feed Live Bottom Screw Conveyor #3 and #4 to Polyhalite Dryer/Calciner - Total for 4 lines (S17A,B)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.43750	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.20692	lbs/ton	Max tph	555.1	tph	
E(PM2.5) =	0.03133	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.20762	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.09820	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.01487	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
			M	0.1	%	
	555.1	tph				
	4862676	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	242.85352	504.80
E(pm10) Uncontrolled	114.86315	238.76
E(pm2.5) Uncontrolled	17.39356	36.15

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from Polyhalite Dryer/Calciner to Cooler Feed Bucket Elevator #1 and #2 - Total for 2 lines (S18A,B,C

AP-42 Section 11.19.2-4 "Crushed Stone Processing and Pulverized Mineral Processing"
Ver 08/2004
Uncontrolled emission rates derived from "Product Storage with Fabric Filter" controlled emission rate and a

	Controlled		Uncontrolled	
E(TSP) =	0.00990	lbs/ton	1.98000	lbs/ton
E(PM10) =	0.00160	lbs/ton	0.32000	lbs/ton
E(PM2.5) =	0.00060	lbs/ton	0.12000	lbs/ton

458.89 tph
4019876.4 tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	908.60220	3979.68
E(pm10) Uncontrolled	146.84480	643.18
E(pm2.5) Uncontrolled	55.06680	241.19

E(tsp) Controlled	PM Emissions Controlled with Calciner Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Calciner Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Calciner Dust Collector

Material Drop from Polyhalite Dryer/Calciners Cyclones to Polyhalite Coolers - Entrance - Total for 4 lines (S19A,B,C)

AP-42 Section 11.19.2-4 "Crushed Stone Processing and Pulverized Mineral Processing"
Ver 08/2004
Uncontrolled emission rates derived from "Product Storage with Fabric Filter" controlled emission rate and a

	Controlled		Uncontrolled	
E(TSP) =	0.00990	lbs/ton	1.98000	lbs/ton
E(PM10) =	0.00160	lbs/ton	0.32000	lbs/ton
E(PM2.5) =	0.00060	lbs/ton	0.12000	lbs/ton

20.0 tph
175200 tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	39.60000	173.45
E(pm10) Uncontrolled	6.40000	28.03
E(pm2.5) Uncontrolled	2.40000	10.51

E(tsp) Controlled	PM Emissions Controlled with Calciner Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Calciner Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Calciner Dust Collector

Material Drop from Cooler Feed Bucket Elevator #1 and #2 -Exit to Polyhalite Coolers - Total for 4 lines (S20A,B)

AP-42 Section 11.19.2-4 "Crushed Stone Processing and Pulverized Mineral Processing"
Ver 08/2004
Uncontrolled emission rates derived from "Product Storage with Fabric Filter" controlled emission rate and a

	Controlled		Uncontrolled	
E(TSP) =	0.00990	lbs/ton	1.98000	lbs/ton
E(PM10) =	0.00160	lbs/ton	0.32000	lbs/ton
E(PM2.5) =	0.00060	lbs/ton	0.12000	lbs/ton

458.89 tph
4019876.4 tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	908.60220	3979.68
E(pm10) Uncontrolled	146.84480	643.18
E(pm2.5) Uncontrolled	55.06680	241.19

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from Polyhalite Coolers to Calcined Polyhalite Screw Conveyor #1 - Entrance - Total for 4 lines (S21A,B,C)

AP-42 Section 11.19.2-4 "Crushed Stone Processing and Pulverized Mineral Processing"
Ver 08/2004
Uncontrolled emission rates derived from "Product Storage with Fabric Filter" controlled emission rate and a

	Controlled		Uncontrolled	
E(TSP) =	0.00990	lbs/ton	1.98000	lbs/ton
E(PM10) =	0.00160	lbs/ton	0.32000	lbs/ton
E(PM2.5) =	0.00060	lbs/ton	0.12000	lbs/ton

474.58 tph
4157320.8 tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	939.66840	4115.75
E(pm10) Uncontrolled	151.86560	665.17
E(pm2.5) Uncontrolled	56.94960	249.44

E(tsp) Controlled	PM Emissions Controlled with Calciner Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Calciner Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Calciner Dust Collector

Material Drop from Polyhalite Coolers Cyclones to Calcined Polyhalite Screw Conveyor #1 - Entrance - Total for 4 lines (S22A,B,C)

AP-42 Section 11.19.2-4 "Crushed Stone Processing and Pulverized Mineral Processing"
Ver 08/2004
Uncontrolled emission rates derived from "Product Storage with Fabric Filter" controlled emission rate and a

	Controlled		Uncontrolled	
E(TSP) =	0.00990	lbs/ton	1.98000	lbs/ton
E(PM10) =	0.00160	lbs/ton	0.32000	lbs/ton
E(PM2.5) =	0.00060	lbs/ton	0.12000	lbs/ton

4.31 tph
37755.6 tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	8.53380	37.38
E(pm10) Uncontrolled	1.37920	6.04
E(pm2.5) Uncontrolled	0.51720	2.27

E(tsp) Controlled	PM Emissions Controlled with Calciner Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Calciner Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Calciner Dust Collector

Material Drop from Calcined Polyhalite Screw Conveyor #1 - Exit to Calcined Polyhalite Bucket Elevator - Entrance - Total for 1 lines (S23)

AP-42 Section 11.19.2-4 "Crushed Stone Processing and Pulverized Mineral Processing"
Ver 08/2004
Uncontrolled emission rates derived from "Product Storage with Fabric Filter" controlled emission rate and a

	Controlled		Uncontrolled	
E(TSP) =	0.00990	lbs/ton	1.98000	lbs/ton
E(PM10) =	0.00160	lbs/ton	0.32000	lbs/ton
E(PM2.5) =	0.00060	lbs/ton	0.12000	lbs/ton

473.87 tph
4151101.2 tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	938.26260	4109.59
E(pm10) Uncontrolled	151.63840	664.18
E(pm2.5) Uncontrolled	56.86440	249.07

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from Calcined Polyhalite Bucket Elevator - Exit to Calcined Polyhalite Surge Bin - Total for 1 lines (S24)

AP-42 Section 11.19.2-4 "Crushed Stone Processing and Pulverized Mineral Processing"
Ver 08/2004
Uncontrolled emission rates derived from "Product Storage with Fabric Filter" controlled emission rate and a

	Controlled		Uncontrolled	
E(TSP) =	0.00990	lbs/ton	1.98000	lbs/ton
E(PM10) =	0.00160	lbs/ton	0.32000	lbs/ton
E(PM2.5) =	0.00060	lbs/ton	0.12000	lbs/ton

473.87 tph
4151101.2 tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	938.26260	4109.59
E(pm10) Uncontrolled	151.63840	664.18
E(pm2.5) Uncontrolled	56.86440	249.07

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from Calcined Polyhalite Surge Bin to Calcined Polyhalite Screw Conveyor #3 - Entrance - Total for 1 lines (S25)

AP-42 Section 11.19.2-4 "Crushed Stone Processing and Pulverized Mineral Processing"
Ver 08/2004
Uncontrolled emission rates derived from "Product Storage with Fabric Filter" controlled emission rate and a

	Controlled		Uncontrolled	
E(TSP) =	0.00990	lbs/ton	1.98000	lbs/ton
E(PM10) =	0.00160	lbs/ton	0.32000	lbs/ton
E(PM2.5) =	0.00060	lbs/ton	0.12000	lbs/ton

473.87 tph
4151101.2 tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	938.26260	4109.59
E(pm10) Uncontrolled	151.63840	664.18
E(pm2.5) Uncontrolled	56.86440	249.07

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from Calcined Polyhalite Screw Conveyor #3 - Exit to Calcined Polyhalite Belt Conveyor - Entrance - Total for 1 lines (S26)

AP-42 Section 11.19.2-4 "Crushed Stone Processing and Pulverized Mineral Processing"
Ver 08/2004
Uncontrolled emission rates derived from "Product Storage with Fabric Filter" controlled emission rate and a

	Controlled		Uncontrolled	
E(TSP) =	0.00990	lbs/ton	1.98000	lbs/ton
E(PM10) =	0.00160	lbs/ton	0.32000	lbs/ton
E(PM2.5) =	0.00060	lbs/ton	0.12000	lbs/ton

473.87 tph
4151101.2 tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	938.26260	4109.59
E(pm10) Uncontrolled	151.63840	664.18
E(pm2.5) Uncontrolled	56.86440	249.07

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from Calcined Polyhalite Belt Conveyor - Exit to Stage 1 Leach Pug Mixer - Total for 1 lines (S27)

AP-42 Section 11.19.2-4 "Crushed Stone Processing and Pulverized Mineral Processing"
Ver 08/2004
Uncontrolled emission rates derived from "Product Storage with Fabric Filter" controlled emission rate and a

	Controlled		Uncontrolled	
E(TSP) =	0.00990	lbs/ton	1.98000	lbs/ton
E(PM10) =	0.00160	lbs/ton	0.32000	lbs/ton
E(PM2.5) =	0.00060	lbs/ton	0.12000	lbs/ton

473.87 tph
4151101.2 tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	938.26260	4109.59
E(pm10) Uncontrolled	151.63840	664.18
E(pm2.5) Uncontrolled	56.86440	249.07

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from Stage 1 Leach Pug Mixer to Leach Tanks - Total for 1 lines (S28)

AP-42 Section 11.19.2-4 "Crushed Stone Processing and Pulverized Mineral Processing"
Ver 08/2004
Uncontrolled emission rates derived from "Product Storage with Fabric Filter" controlled emission rate and a

	Controlled		Uncontrolled	
E(TSP) =	0.00990	lbs/ton	1.98000	lbs/ton
E(PM10) =	0.00160	lbs/ton	0.32000	lbs/ton
E(PM2.5) =	0.00060	lbs/ton	0.12000	lbs/ton

473.87 tph
4151101.2 tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	938.26260	4109.59
E(pm10) Uncontrolled	151.63840	664.18
E(pm2.5) Uncontrolled	56.86440	249.07

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from Calcined Baghouse Screw Conveyor #1 - #4 - Exit to Polyhalite Coolers (4) (S30A,B,C)

AP-42 Section 11.19.2-4 "Crushed Stone Processing and Pulverized Mineral Processing"
Ver 08/2004
Uncontrolled emission rates derived from "Product Storage with Fabric Filter" controlled emission rate and a

	Controlled		Uncontrolled	
E(TSP) =	0.00990	lbs/ton	1.98000	lbs/ton
E(PM10) =	0.00160	lbs/ton	0.32000	lbs/ton
E(PM2.5) =	0.00060	lbs/ton	0.12000	lbs/ton

2.15 tph
18834 tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	4.25700	18.65
E(pm10) Uncontrolled	0.68800	3.01
E(pm2.5) Uncontrolled	0.25800	1.13

E(tsp) Controlled	PM Emissions Controlled with Calciner Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Calciner Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Calciner Dust Collector

Facility will Permit Three Idential Polyhalite Dryer/Dehydrator/Calciners (S18A,B,C) (STK3A,B,C)
AP-42 Section 1.4 "Natural Gas Combustion"
BACT
3 Units Total

SO2, CO2, Lead, Formaldehyde, Methane, N2O
NOx, CO, PM (Total)

Burner Maximum Rated Capacity
214.23 mBTU/Hr (each)

Natural Gas LHV
946 Btu/standard cubic feet

Maximum Natural Gas Usage (each)
226458.7738 cubic feet/hr
0.226458774 million scf/hr 1983.778858 million scf/yr

Exhaust Flowrate
138777.8 DSCFM
286000 ACFM

Uncontrolled Hours of Operation
8760 hr/yr

Controlled Hours of Operation
8760 hr/yr

NOx	0.042	lbs/MMBtu	BACT
CO	0.037	lbs/MMBtu	BACT
SO2	0.6	lbs/MMSCF	AP-42 Section 1.4
VOC	5.5	lbs/MMSCF	AP-42 Section 1.4
PM Uncontrolled	4300	lbs/hr	Mass Balance
PM Controlled	0.0052	grains/DSCF	BACT
CO2	116.9	lbs/MMBtu	BACT
Methane	0.002	lbs/MMBtu	BACT
N2O	0.0002	lbs/MMBtu	BACT
CO2e	117.004	lbs/MMBtu	BACT
Lead	0.0005	lbs/MMSCF	AP-42 Section 1.4

	Uncontolled		Controlled	
Pollutant	**PPH**	**TPY**	**PPH**	**TPY**
NOx	9.00	39.41	9.00	39.41
CO	7.93	34.72	7.93	34.72
SO2	0.14	0.60	0.14	0.60
VOC	1.25	5.46	1.25	5.46
PM	4300.00	18834.00	6.19	27.09
CO2	25043.49	109690.47	25043.49	109690.47
Methane	0.43	1.88	0.43	1.88
N2O	0.04	0.19	0.04	0.19
CO2e	25065.77	109788.06	25065.77	109788.06
Lead	0.000113	0.000496	0.000113	0.000496

4 Units Combined

	Uncontolled		Controlled	
Pollutant	**PPH**	**TPY**	**PPH**	**TPY**
NOx	26.99298	118.2292524	26.99298	118.2293
CO	23.77953	104.1543414	23.77953	104.1543
SO2	0.407626	1.785400973	0.407626	1.785401
VOC	3.73657	16.36617558	3.73657	16.36618
PM	12900	56502	18.55658	81.27781
CO2	75130.46	329071.4192	75130.46	329071.4
Methane	1.28538	5.6299644	1.28538	5.629964
N2O	0.128538	0.56299644	0.128538	0.562996
CO2e	75197.3	329364.1773	75197.3	329364.2
Lead	0.00034	0.001487834	0.00034	0.001488

Calciners

AP-42 Section 1.4 "Natural Gas Combustion" Tables 1.4-3 and -4

Federal HAPs

Speciated Organic Compounds	Case #	Emission Factor (lbs/MMSCF)	Emission Rate (lbs/hr)	Emission Rate (tpy)	Total 3 Units Emission Rate (lbs/hr)	Total 3 Units Emission Rate (tpy)
Benzene	71-43-2	2.10E-03	4.76E-04	2.08E-03	1.43E-03	6.25E-03
Formaldehyde	50-00-0	7.50E-02	1.70E-02	7.44E-02	5.10E-02	2.23E-01
Naphthalene	91-20-3	6.10E-04	1.38E-04	6.05E-04	4.14E-04	1.82E-03
Toluene	108-88-3	3.40E-03	7.70E-04	3.37E-03	2.31E-03	1.01E-02

Metals	Case #	Emission Factor (lbs/MMSCF)	Emission Rate (lbs/hr)	Emission Rate (tpy)	Emission Rate (lbs/hr)	Emission Rate (tpy)
Arsenic	7440-38-2	2.00E-04	4.53E-05	1.98E-04	1.36E-04	5.95E-04
Beryllium	7440-41-7	1.20E-05	2.72E-06	1.19E-05	8.15E-06	3.57E-05
Cadmium	7440-43-9	1.10E-03	2.49E-04	1.09E-03	7.47E-04	3.27E-03
Chromium	7440-47-3	1.40E-03	3.17E-04	1.39E-03	9.51E-04	4.17E-03
Cobalt	7440-48-4	8.40E-05	1.90E-05	8.33E-05	5.71E-05	2.50E-04
Manganese	7439-96-5	3.80E-04	8.61E-05	3.77E-04	2.58E-04	1.13E-03
Mercury	7439-97-6	2.60E-04	5.89E-05	2.58E-04	1.77E-04	7.74E-04
Nickel	7440-02-0	2.10E-03	4.76E-04	2.08E-03	1.43E-03	6.25E-03
Selenium	7782-49-2	2.40E-05	5.44E-06	2.38E-05	1.63E-05	7.14E-05
		Total 1 Unit	**0.020**	**0.086**		
		Total 2 Units			**0.059**	**0.258**

State TAPs

Metals	Case #	Emission Factor (lbs/MMSCF)	Emission Rate (lbs/hr)	Emission Rate (tpy)	Emission Rate (lbs/hr)	Emission Rate (tpy)
Barium	7440-39-3	4.40E-03	9.96E-04	4.36E-03	2.99E-03	1.31E-02
Copper	7440-50-8	8.50E-04	1.92E-04	8.43E-04	5.77E-04	2.53E-03
Molybdenum	7439-98-7	1.10E-03	2.49E-04	1.09E-03	7.47E-04	3.27E-03
Vanadium	7440-62-2	2.30E-03	5.21E-04	2.28E-03	1.56E-03	6.84E-03
Zinc	7440-66-6	2.90E-02	6.57E-03	2.88E-02	1.97E-02	8.63E-02
		Total 1 Unit	**0.0085**	**0.037**		
		Total 3 Units			**0.026**	**0.112**

Material Drop from SOP Centrifuge to Screw Feeder (S32)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.00183	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.00087	lbs/ton	Max tph	111.3	tph	
E(PM2.5) =	0.00013	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.00087	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.00041	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00006	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	111.3	tph	M	5	%	
	974988	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	0.20366	0.42
E(pm10) Uncontrolled	0.09633	0.20
E(pm2.5) Uncontrolled	0.01459	0.03

E(tsp) Controlled	PM Emissions Controlled with SOP Product Dryer Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Product Dryer Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Product Dryer Dust Collector

Material Drop from Screw Feeder to SOP Product Dryer (S33)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.00183	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.00087	lbs/ton	Max tph	111.3	tph	
E(PM2.5) =	0.00013	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.00087	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.00041	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00006	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	111.3	tph	M	5	%	
	974988	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	0.20366	0.42
E(pm10) Uncontrolled	0.09633	0.20
E(pm2.5) Uncontrolled	0.01459	0.03

E(tsp) Controlled	PM Emissions Controlled with SOP Product Dryer Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Product Dryer Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Product Dryer Dust Collector

Material Drop from SOP Product Dryer to SOP Bucket Elevator #1 - Entrance (S34)

AP-42 Section 11.19.2-4 "Crushed Stone Processing and Pulverized Mineral Processing"
Ver 08/2004
Uncontrolled emission rates derived from "Product Storage with Fabric Filter" controlled emission rate and a

	Controlled		Uncontrolled	
E(TSP) =	0.00990	lbs/ton	1.98000	lbs/ton
E(PM10) =	0.00160	lbs/ton	0.32000	lbs/ton
E(PM2.5) =	0.00060	lbs/ton	0.12000	lbs/ton

97.18 tph
851297 tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	192.41640	842.78
E(pm10) Uncontrolled	31.09760	136.21
E(pm2.5) Uncontrolled	11.66160	51.08

E(tsp) Controlled	PM Emissions Controlled with SOP Product Dryer Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Product Dryer Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Product Dryer Dust Collector

Material Drop from SOP Product Dryer Cyclone to SOP Bucket Elevator #1 - Entrance (S35)

AP-42 Section 11.19.2-4 "Crushed Stone Processing and Pulverized Mineral Processing"
Ver 08/2004
Uncontrolled emission rates derived from "Product Storage with Fabric Filter" controlled emission rate and a

	Controlled		Uncontrolled	
E(TSP) =	0.00990	lbs/ton	1.98000	lbs/ton
E(PM10) =	0.00160	lbs/ton	0.32000	lbs/ton
E(PM2.5) =	0.00060	lbs/ton	0.12000	lbs/ton

9.69 tph
84884.4 tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	19.18620	84.04
E(pm10) Uncontrolled	3.10080	13.58
E(pm2.5) Uncontrolled	1.16280	5.09

E(tsp) Controlled	PM Emissions Controlled with SOP Product Dryer Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Product Dryer Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Product Dryer Dust Collector

Material Drop from SOP Bucket Elevator #1 - Exit to SOP Product Column Cooler (S36)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	106.9	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	106.87	tph	M	0.3	%	
	936181.2	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	10.04290	20.88
E(pm10) Uncontrolled	4.75002	9.87
E(pm2.5) Uncontrolled	0.71929	1.50

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from SOP Product Column Cooler to SOP Product Surge Bin (S37)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	106.9	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	106.87	tph	M	0.3	%	
	936181.2	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	10.04290	20.88
E(pm10) Uncontrolled	4.75002	9.87
E(pm2.5) Uncontrolled	0.71929	1.50

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from SOP Product Surge Bin to SOP Product Surge Bin Screw Feeder - Entrance (S38)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	111.4	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	111.38	tph	M	0.3	%	
	975688.8	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	10.46672	21.76
E(pm10) Uncontrolled	4.95048	10.29
E(pm2.5) Uncontrolled	0.74964	1.56

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from SOP Product Surge Bin Screw Feeder - Exit to SOP Bucket Elevator #2 -Entrance (S39)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	111.4	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	111.38	tph	M	0.3	%	
	975688.8	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	10.46672	21.76
E(pm10) Uncontrolled	4.95048	10.29
E(pm2.5) Uncontrolled	0.74964	1.56

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from SOP Bucket Elevator #2 - to SOP Standard Multi-Deck Sizing Screen - Entrance (S40)

AP-42 Table 11.19.2-2 "Fines Screening Uncontrolled"
Ver 8/2004

E(TSP) =	0.30000	lbs/ton
E(PM10) =	0.07200	lbs/ton
E(PM2.5) =	0.00490	lbs/ton

Throughput	109.16	tph
	956341.6	tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	32.74800	143.43624
E(pm10) Uncontrolled	7.85952	34.42470
E(pm2.5) Uncontrolled	0.53488	2.34279

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from SOP Standard Multi-Deck Sizing Screen O/S - Exit to Standard SOP Single Stage Roller Crusher - Entrance (S41)

AP-42 Table 11.19.2-2 "Fines Crusher Uncontrolled"
Ver 8/2004

E(TSP) =	0.03900	lbs/ton
E(PM10) =	0.01500	lbs/ton
E(PM2.5) =	0.00088	lbs/ton

Throughput	10	tph
	87600	tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	0.39000	1.70820
E(pm10) Uncontrolled	0.15000	0.65700
E(pm2.5) Uncontrolled	0.00880	0.03854

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from Standard SOP Single Stage Roller Crusher to SOP O/S Crusher Recycle Screw Conveyor - Entrance (S42)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	10.0	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	10	tph	M	0.3	%	
	87600	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	0.93973	1.95
E(pm10) Uncontrolled	0.44447	0.92
E(pm2.5) Uncontrolled	0.06731	0.14

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from SOP O/S Crusher Recycle Screw Conveyor - Exit to SOP Product Surge Bin (S43)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	10.0	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	10	tph	M	0.3	%	
	87600	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	0.93973	1.95
E(pm10) Uncontrolled	0.44447	0.92
E(pm2.5) Uncontrolled	0.06731	0.14

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from SOP Standard Multi-Deck Sizing Screen U/S to SOP Bucket Elevator #3 - Entrance (S41)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	12.5	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	12.53	tph	M	0.3	%	
	109762.8	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	1.17748	2.45
E(pm10) Uncontrolled	0.55692	1.16
E(pm2.5) Uncontrolled	0.08433	0.18

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from SOP Bucket Elevator #3 - Exit to Soluble SOP Multi-Deck Sizing Screen (S44)

AP-42 Table 11.19.2-2 "Fines ScreeningUncontrolled"
Ver 8/2004

E(TSP) =	0.30000	lbs/ton
E(PM10) =	0.07200	lbs/ton
E(PM2.5) =	0.00490	lbs/ton

Throughput	12.53	tph
	109762.8	tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	3.75900	16.46442
E(pm10) Uncontrolled	0.90216	3.95146
E(pm2.5) Uncontrolled	0.06140	0.26892

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from Soluble SOP Multi-Deck Sizing Screen O/S and U/S to SOP Fines Belt Conveyor - Entrance (S45)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	0.2	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	0.17	tph	M	0.3	%	
	1489.2	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	0.01598	0.03
E(pm10) Uncontrolled	0.00756	0.02
E(pm2.5) Uncontrolled	0.00114	0.00

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from Soluble SOP Multi-Deck Sizing Screen to Soluble SOP Transfer Belt Conveyor - Entrance (S45)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	12.4	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	12.37	tph	M	0.3	%	
	108361.2	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	1.16245	2.42
E(pm10) Uncontrolled	0.54981	1.14
E(pm2.5) Uncontrolled	0.08326	0.17

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from Soluble SOP Transfer Belt Conveyor - Exit to Soluble SOP Splitter Gate - Entrance (S46)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	12.4	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	12.37	tph	M	0.3	%	
	108361.2	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	1.16245	2.42
E(pm10) Uncontrolled	0.54981	1.14
E(pm2.5) Uncontrolled	0.08326	0.17

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from Soluble SOP Splitter Gate - Exit to Soluble SOP Transfer Belt Conveyor - Entrance (S47)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	0.0	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	0.01	tph	M	0.3	%	
	8.76	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	0.00094	0.00
E(pm10) Uncontrolled	0.00044	0.00
E(pm2.5) Uncontrolled	0.00007	0.00

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from Soluble SOP Splitter Gate - Exit to Soluble SOP Dedusting Screw Conveyor - Entrance (S47)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	12.4	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	12.35	tph	M	0.3	%	
	108186	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	1.16057	2.41
E(pm10) Uncontrolled	0.54892	1.14
E(pm2.5) Uncontrolled	0.08312	0.17

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from Soluble SOP Dedusting Screw Conveyor - Exit to SOP Bucket Elevator #5 - Entrance (S48)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	12.4	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	12.35	tph	M	0.3	%	
	108186	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	1.16057	2.41
E(pm10) Uncontrolled	0.54892	1.14
E(pm2.5) Uncontrolled	0.08312	0.17

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from SOP Bucket Elevator #5 - Exit to Soluable SOP Belt Conveyor - Entrance (S49)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	12.4	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	12.35	tph	M	0.3	%	
	108186	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	1.16057	2.41
E(pm10) Uncontrolled	0.54892	1.14
E(pm2.5) Uncontrolled	0.08312	0.17

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from SOP Standard Multi-Deck Sizing Screen to SOP Standard Splitter Gate #1 - Entrance (S41)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	95.5	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	95.54	tph	M	0.3	%	
	836930.4	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	8.97819	18.66
E(pm10) Uncontrolled	4.24644	8.83
E(pm2.5) Uncontrolled	0.64303	1.34

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from SOP Standard Splitter Gate #1 - Exit to Standard SOP Screw Conveyor - Entrance (S50)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	48.4	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	48.4	tph	M	0.3	%	
	423984	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	4.54830	9.45
E(pm10) Uncontrolled	2.15122	4.47
E(pm2.5) Uncontrolled	0.32576	0.68

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from Standard SOP Screw Conveyor - Exit to SOP Fines Belt Conveyor (S51)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	48.4	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	48.4	tph	M	0.3	%	
	423984	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	4.54830	9.45
E(pm10) Uncontrolled	2.15122	4.47
E(pm2.5) Uncontrolled	0.32576	0.68

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from SOP Standard Splitter Gate #1 - Exit to SOP Standard Splitter Gate #2 - Entrance (S50)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	68.3	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	68.33	tph	M	0.3	%	
	598570.8	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	6.42118	13.35
E(pm10) Uncontrolled	3.03704	6.31
E(pm2.5) Uncontrolled	0.45990	0.96

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from SOP Standard Splitter Gate #2 - Exit to Standard SOP Single Stage Roll Crusher (S52)

AP-42 Table 11.19.2-2 "Fines Crusher Uncontrolled"
Ver 8/2004

E(TSP) =	0.30000	lbs/ton
E(PM10) =	0.07200	lbs/ton
E(PM2.5) =	0.00490	lbs/ton

Throughput	4.52	tph
	39595.2	tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	1.35600	5.93928
E(pm10) Uncontrolled	0.32544	1.42543
E(pm2.5) Uncontrolled	0.02215	0.09701

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from Standard SOP Single Stage Roll Crusher to SOP Bucket Elevator #2 - Entrance (S53)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	4.5	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	4.52	tph	M	0.3	%	
	39595.2	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	0.42476	0.88
E(pm10) Uncontrolled	0.20090	0.42
E(pm2.5) Uncontrolled	0.03042	0.06

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from SOP Standard Splitter Gate #2 - Exit to Standard SOP Dedusting Screw Conveyor - Entrance (S52)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	63.8	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	63.82	tph	M	0.3	%	
	559063.2	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	5.99736	12.47
E(pm10) Uncontrolled	2.83659	5.90
E(pm2.5) Uncontrolled	0.42954	0.89

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from Standard SOP Dedusting Screw Conveyor - Exit to SOP Bucket Elevator #4 - Entrance (S54)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	63.8	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	63.82	tph	M	0.3	%	
	559063.2	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	5.99736	12.47
E(pm10) Uncontrolled	2.83659	5.90
E(pm2.5) Uncontrolled	0.42954	0.89

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from SOP Bucket Elevator #4 - Exit to Standard SOP Belt Conveyor - Entrance (S55)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	63.8	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	63.82	tph	M	0.3	%	
	559063.2	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	5.99736	12.47
E(pm10) Uncontrolled	2.83659	5.90
E(pm2.5) Uncontrolled	0.42954	0.89

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from Truck Unload SOP Fines Return to SOP Fines Return Dump Hopper (S56)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	0.3	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	0.3	tph	M	0.3	%	
	2628	tpy				
			Control for 1/2 Enclosure =	50	% CE	
			Control Method Oil Additive -2 =	75	% CE	
				87.5	% total control	

	lb/hr	tons/yr	
E(tsp) Uncontrolled	0.02819	0.06	
E(pm10) Uncontrolled	0.01333	0.03	
E(pm2.5) Uncontrolled	0.00202	0.00	
E(tsp) Controlled	0.00352	0.00732	0.00167
E(pm10) Controlled	0.00167	0.00346	0.00079
E(pm2.5) Controlled	0.00025	0.00052	0.00012

Material Drop from SOP Fines Return Dump Hopper to SOP Fines Return Belt Feeder (S57)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	0.3	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	0.3	tph	M	0.3	%	
	2628	tpy				

Control for 1/2 Enclosure =	50	% CE
Control Method Oil Additive -3 =	70	% CE
	85	% total control

	lb/hr	tons/yr	Model lbs/hr
E(tsp) Uncontrolled	0.02819	0.05860	
E(pm10) Uncontrolled	0.01333	0.02772	
E(pm2.5) Uncontrolled	0.00202	0.00420	
E(tsp) Controlled	0.00423	0.00879	0.00201
E(pm10) Controlled	0.00200	0.00416	0.00095
E(pm2.5) Controlled	0.00030	0.00063	0.00014

Material Drop from SOP Fines Return Belt Feeder to SOP Fines Return Belt Conveyor (S58)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	0.3	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	0.3	tph	M	0.3	%	
	2628	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	0.02819	0.06
E(pm10) Uncontrolled	0.01333	0.03
E(pm2.5) Uncontrolled	0.00202	0.00

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from SOP Fines Return Belt Conveyor to SOP Fines Belt Conveyor (S59)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	0.3	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	0.3	tph	M	0.3	%	
	2628	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	0.02819	0.06
E(pm10) Uncontrolled	0.01333	0.03
E(pm2.5) Uncontrolled	0.00202	0.00

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from SOP Fines Belt Conveyor - Exit to SOP Granulation Feed Bucket Elevator #1 - Entrance (S60)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	48.6	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	48.58	tph	M	0.3	%	
	425560.8	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	4.56521	9.49
E(pm10) Uncontrolled	2.15922	4.49
E(pm2.5) Uncontrolled	0.32697	0.68

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

SOP Product Dryer (S34) (STK4)
AP-42 Section 1.4 "Natural Gas Combustion"
BACT

SO2, CO2, Lead, Formaldehyde, Methane, N2O
NOx, CO, PM (Total)

Burner Maximum Rated Capacity
18.74 mmBTU/Hr

Natural Gas LHV
946 Btu/standard cubic feet

Maximum Natural Gas Usage
19809.72516 cubic feet/hr
0.019809725 million scf/hr 173.5331924 million scf/yr

Exhaust Flowrate
14327.3 DSCFM
24000 ACFM

Uncontrolled Hours of Operation
8760 hr/yr

Controlled Hours of Operation
8760 hr/yr

NOx	0.042	lbs/MMBtu	BACT
CO	0.037	lbs/MMBtu	BACT
SO2	0.6	lbs/MMSCF	AP-42 Section 1.4
VOC	5.5	lbs/MMSCF	AP-42 Section 1.4
PM Uncontrolled	2160	lbs/hr	Mass Balance
PM Controlled	0.0052	grains/DSCF	BACT
CO2	116.9	lbs/MMBtu	BACT
Methane	0.002	lbs/MMBtu	BACT
N2O	0.0002	lbs/MMBtu	BACT
CO2e	117.004	lbs/MMBtu	BACT
Lead	0.0005	lbs/MMSCF	AP-42 Section 1.4

	Uncontolled		Controlled	
Pollutant	**PPH**	**TPY**	**PPH**	**TPY**
NOx	0.79	3.45	0.79	3.45
CO	0.69	3.04	0.69	3.04
SO2	0.01	0.05	0.01	0.05
VOC	0.11	0.48	0.11	0.48
PM	2160.00	9460.80	0.64	2.80
CO2	2190.71	9595.29	2190.71	9595.29
Methane	0.04	0.16	0.04	0.16
N2O	0.00	0.02	0.00	0.02
CO2e	2192.65	9603.83	2192.65	9603.83
Lead	0.000010	0.000043	0.000010	0.000043

SOP Product Dryer

AP-42 Section 1.4 "Natural Gas Combustion" Tables 1.4-3 and -4

Federal HAPs

Speciated Organic Compounds	Case #	Emission Factor (lbs/MMSCF)	Emission Rate (lbs/hr)	Emission Rate (tpy)
Benzene	71-43-2	2.10E-03	4.16E-05	1.82E-04
Formaldehyde	50-00-0	7.50E-02	1.49E-03	6.51E-03
Naphthalene	91-20-3	6.10E-04	1.21E-05	5.29E-05
Toluene	108-88-3	3.40E-03	6.74E-05	2.95E-04

Metals	Case #	Emission Factor (lbs/MMSCF)	Emission Rate (lbs/hr)	Emission Rate (tpy)
Arsenic	7440-38-2	2.00E-04	3.96E-06	1.74E-05
Beryllium	7440-41-7	1.20E-05	2.38E-07	1.04E-06
Cadmium	7440-43-9	1.10E-03	2.18E-05	9.54E-05
Chromium	7440-47-3	1.40E-03	2.77E-05	1.21E-04
Cobalt	7440-48-4	8.40E-05	1.66E-06	7.29E-06
Manganese	7439-96-5	3.80E-04	7.53E-06	3.30E-05
Mercury	7439-97-6	2.60E-04	5.15E-06	2.26E-05
Nickel	7440-02-0	2.10E-03	4.16E-05	1.82E-04
Selenium	7782-49-2	2.40E-05	4.75E-07	2.08E-06
		Total	**0.0017**	**0.0075**

State TAPs

Metals	Case #	Emission Factor (lbs/MMSCF)	Emission Rate (lbs/hr)	Emission Rate (tpy)
Barium	7440-39-3	4.40E-03	8.72E-05	3.82E-04
Copper	7440-50-8	8.50E-04	1.68E-05	7.38E-05
Molybdenum	7439-98-7	1.10E-03	2.18E-05	9.54E-05
Vanadium	7440-62-2	2.30E-03	4.56E-05	2.00E-04
Zinc	7440-66-6	2.90E-02	5.74E-04	2.52E-03
		Total	**0.00075**	**0.0033**

SOP Area Dust Collector (STK5)

BACT PM (Total)

PM (Total) Controlled 0.005 gr/DSCF BACT

Exhaust Flowrate

42401.6 DSCFM

50000 ACFM

Uncontrolled Hours of Operation

8760 hr/yr

Controlled Hours of Operation

8760 hr/yr

	Uncontolled		Controlled	
Pollutant	**PPH**	**TPY**	**PPH**	**TPY**
PM (Total)			1.817	7.96

Material Drop from SOP Granulation Feed Bucket Elevator #1 - Exit to SOP Recycle Bin #1 (S61)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	48.6	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	48.58	tph	M	0.3	%	
	425560.8	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	4.56521	9.49
E(pm10) Uncontrolled	2.15922	4.49
E(pm2.5) Uncontrolled	0.32697	0.68

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from SOP Recycle Bin #1 to SOP Granulation Splitter Gate - Entrance (S62)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	48.6	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	48.58	tph	M	0.3	%	
	425560.8	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	4.56521	9.49
E(pm10) Uncontrolled	2.15922	4.49
E(pm2.5) Uncontrolled	0.32697	0.68

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from SOP Granulation Splitter Gate - Exit to SOP Fine Grinding Mill Feed Screw Conveyor -Entrance (S63)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	14.6	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	14.57	tph	M	0.3	%	
	127633.2	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	1.36919	2.85
E(pm10) Uncontrolled	0.64759	1.35
E(pm2.5) Uncontrolled	0.09806	0.20

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop fromSOP Fine Grinding Mill Feed Screw Conveyor - Exit to SOP Vertical Fine Grinding Mill (S64)

AP-42 Section 11.19.2-4 "Grinding (Dry) with Fabric Filter Control"
Ver 08/2004
Uncontrolled emission rates derived from "Product Storage with Fabric Filter" controlled emission rate and a

	Controlled		Uncontrolled	
E(TSP) =	0.02020	lbs/ton	4.04000	lbs/ton
E(PM10) =	0.01690	lbs/ton	3.38000	lbs/ton
E(PM2.5) =	0.00600	lbs/ton	1.20000	lbs/ton

14.57	tph
127633.2	tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	58.863	257.82
E(pm10) Uncontrolled	49.247	215.70
E(pm2.5) Uncontrolled	17.484	76.58

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from SOP Vertical Fine Grinding Mill - Exit to SOP Fine Grinding Mill Dry Cyclone (S65)

AP-42 Section 11.19.2-4 "Classifiers (Dry) with Fabric Filter Control"
Ver 08/2004
Uncontrolled emission rates derived from "Product Storage with Fabric Filter" controlled emission rate and a

	Controlled		Uncontrolled	
E(TSP) =	0.01120	lbs/ton	2.24000	lbs/ton
E(PM10) =	0.00520	lbs/ton	1.04000	lbs/ton
E(PM2.5) =	0.00200	lbs/ton	0.40000	lbs/ton

14.57 tph
127633.2 tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	32.63680	142.95
E(pm10) Uncontrolled	15.15280	66.37
E(pm2.5) Uncontrolled	5.82800	25.53

E(tsp) Controlled	PM Emissions Controlled with Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Dust Collector

Material Drop from SOP Fine Grinding Mill Dry Cyclone to SOP Recycle Bin #4 (S66)

AP-42 Section 11.19.2-4 "Crushed Stone Processing and Pulverized Mineral Processing"
Ver 08/2004
Uncontrolled emission rates derived from "Product Storage with Fabric Filter" controlled emission rate and a

	Controlled		Uncontrolled	
E(TSP) =	0.00990	lbs/ton	1.98000	lbs/ton
E(PM10) =	0.00160	lbs/ton	0.32000	lbs/ton
E(PM2.5) =	0.00060	lbs/ton	0.12000	lbs/ton

14.57 tph
127633.2 tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	28.84860	126.36
E(pm10) Uncontrolled	4.66240	20.42
E(pm2.5) Uncontrolled	1.74840	7.66

E(tsp) Controlled	PM Emissions Controlled with Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Dust Collector

Material Drop from SOP Fine Grinding Mill Dry Cyclone to SOP Vertical Fine Grinding Mill (S66)

AP-42 Section 11.19.2-4 "Crushed Stone Processing and Pulverized Mineral Processing"
Ver 08/2004
Uncontrolled emission rates derived from "Product Storage with Fabric Filter" controlled emission rate and a

	Controlled		Uncontrolled	
E(TSP) =	0.00990	lbs/ton	1.98000	lbs/ton
E(PM10) =	0.00160	lbs/ton	0.32000	lbs/ton
E(PM2.5) =	0.00060	lbs/ton	0.12000	lbs/ton

14.57 tph
127633.2 tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	28.84860	126.36
E(pm10) Uncontrolled	4.66240	20.42
E(pm2.5) Uncontrolled	1.74840	7.66

E(tsp) Controlled	PM Emissions Controlled with Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Dust Collector

Material Drop from SOP Recycle Bin #4 to SOP Granulation Feed Bucket Elevator #2 -Entrance (S67)

AP-42 Section 11.19.2-4 "Crushed Stone Processing and Pulverized Mineral Processing"
Ver 08/2004
Uncontrolled emission rates derived from "Product Storage with Fabric Filter" controlled emission rate and a

	Controlled		Uncontrolled	
E(TSP) =	0.00990	lbs/ton	1.98000	lbs/ton
E(PM10) =	0.00160	lbs/ton	0.32000	lbs/ton
E(PM2.5) =	0.00060	lbs/ton	0.12000	lbs/ton

14.57 tph
127633.2 tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	28.84860	126.36
E(pm10) Uncontrolled	4.66240	20.42
E(pm2.5) Uncontrolled	1.74840	7.66

E(tsp) Controlled	PM Emissions Controlled with Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Dust Collector

Material Drop from SOP Granulation Splitter Gate - Exit to SOP Granulation Feed Bucket Elevator #2 -Entrance (S63)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	34.0	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	34.01	tph	M	0.3	%	
	297927.6	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	3.19602	6.64
E(pm10) Uncontrolled	1.51163	3.14
E(pm2.5) Uncontrolled	0.22890	0.48

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from SOP Granulation Feed Bucket Elevator #2 - Exit to SOP Granulation Feed Screw Conveyor - Entrance (S68)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	144.4	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	144.38	tph	M	0.3	%	
	1264768.8	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	13.56783	28.20
E(pm10) Uncontrolled	6.41722	13.34
E(pm2.5) Uncontrolled	0.97175	2.02

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from SOP Granulation Feed Screw Conveyor -Exit to SOP Granulation Pin Mixer #1 and #2 - 2 Lines (S69)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.00483	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton			
E(PM10) =	0.00228	lbs/ton	Max tph	144.4	tph		
E(PM2.5) =	0.00035	lbs/ton	k(tsp)	0.74			
			k(pm10)	0.35			
E(TSP) =	0.00229	lbs/ton	k(pm2.5)	0.053			
E(PM10) =	0.00108	lbs/ton	U Maximum	11	MPH	NMED default	
E(PM2.5) =	0.00016	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter	
	144.38	tph	M	2.5	%		
	1264768.8	tpy					

	lb/hr	tons/yr
E(tsp) Uncontrolled	0.69721	1.45
E(pm10) Uncontrolled	0.32976	0.69
E(pm2.5) Uncontrolled	0.04994	0.10

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from SOP Granulation Pin Mixer #1 and #2 to SOP Disc Granulator #1 and #2 - 2 Lines (S70A,B)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.00483	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton			
E(PM10) =	0.00228	lbs/ton	Max tph	147.5	tph		
E(PM2.5) =	0.00035	lbs/ton	k(tsp)	0.74			
			k(pm10)	0.35			
E(TSP) =	0.00229	lbs/ton	k(pm2.5)	0.053			
E(PM10) =	0.00108	lbs/ton	U Maximum	11	MPH	NMED default	
E(PM2.5) =	0.00016	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter	
	147.52	tph	M	2.5	%		
	1292275.2	tpy					

	lb/hr	tons/yr
E(tsp) Uncontrolled	0.71237	1.48
E(pm10) Uncontrolled	0.33693	0.70
E(pm2.5) Uncontrolled	0.05102	0.11

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from SOP Disc Granulator #1 and #2 to SOP Granulator Product Belt Conveyor - Entrance (S71A,B)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.00483	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton			
E(PM10) =	0.00228	lbs/ton	Max tph	147.5	tph		
E(PM2.5) =	0.00035	lbs/ton	k(tsp)	0.74			
			k(pm10)	0.35			
E(TSP) =	0.00229	lbs/ton	k(pm2.5)	0.053			
E(PM10) =	0.00108	lbs/ton	U Maximum	11	MPH	NMED default	
E(PM2.5) =	0.00016	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter	
	147.52	tph	M	2.5	%		
	1292275.2	tpy					

	lb/hr	tons/yr
E(tsp) Uncontrolled	0.71237	1.48
E(pm10) Uncontrolled	0.33693	0.70
E(pm2.5) Uncontrolled	0.05102	0.11

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from SOP Granulator Product Belt Conveyor - Exit to SOP Granulation Dryer (S72)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.00483	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton			
E(PM10) =	0.00228	lbs/ton	Max tph	147.5	tph		
E(PM2.5) =	0.00035	lbs/ton	k(tsp)	0.74			
			k(pm10)	0.35			
E(TSP) =	0.00229	lbs/ton	k(pm2.5)	0.053			
E(PM10) =	0.00108	lbs/ton	U Maximum	11	MPH	NMED default	
E(PM2.5) =	0.00016	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter	
	147.52	tph	M	2.5	%		
	1292275.2	tpy					

	lb/hr	tons/yr
E(tsp) Uncontrolled	0.71237	1.48
E(pm10) Uncontrolled	0.33693	0.70
E(pm2.5) Uncontrolled	0.05102	0.11

E(tsp) Controlled	PM Emissions Controlled with SOP Granulation Dryer Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Granulation Dryer Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Granulation Dryer Dust Collector

Material Drop from SOP Granulation Dryer to SOP Granulation Dryer Bucket Elevator -Entrance (S73A,B)

AP-42 Section 11.19.2-4 "Crushed Stone Processing and Pulverized Mineral Processing"
Ver 08/2004
Uncontrolled emission rates derived from "Product Storage with Fabric Filter" controlled emission rate and a

	Controlled		Uncontrolled	
E(TSP) =	0.00990	lbs/ton	1.98000	lbs/ton
E(PM10) =	0.00160	lbs/ton	0.32000	lbs/ton
E(PM2.5) =	0.00060	lbs/ton	0.12000	lbs/ton

143.28 tph
1255132.8 tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	283.69440	1242.58
E(pm10) Uncontrolled	45.84960	200.82
E(pm2.5) Uncontrolled	17.19360	75.31

E(tsp) Controlled PM Emissions Controlled with SOP Granulation Dryer Dust Collector
E(pm10) Controlled PM Emissions Controlled with SOP Granulation Dryer Dust Collector
E(pm2.5) Controlled PM Emissions Controlled with SOP Granulation Dryer Dust Collector

Material Drop from SOP Granulation Dryer Bucket Elevator -Exit to SOP Granulation Cooler Unit (S74A,B)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	143.3	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	143.28	tph	M	0.3	%	
	1255132.8	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	13.46446	27.99
E(pm10) Uncontrolled	6.36833	13.24
E(pm2.5) Uncontrolled	0.96435	2.00

E(tsp) Controlled PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled PM Emissions Controlled with SOP Area Dust Collector

Material Drop from SOP Granulation Cooler Unit to SOP Granulation Cooler Bucket Elevator - Entrance (S75)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	143.3	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	143.28	tph	M	0.3	%	
	1255132.8	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	13.46446	27.99
E(pm10) Uncontrolled	6.36833	13.24
E(pm2.5) Uncontrolled	0.96435	2.00

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from SOP Granulation Cooler Bucket Elevator - Exit to SOP Granulation Splitter Gate (S76)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	141.9	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	141.85	tph	M	0.3	%	
	1242606	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	13.33008	27.71
E(pm10) Uncontrolled	6.30477	13.11
E(pm2.5) Uncontrolled	0.95472	1.98

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from SOP Granulation Splitter Gate - Exit to SOP Granulation Sizing Screens #1 and #2 (S77)

AP-42 Table 11.19.2-2 "Fines ScreeningUncontrolled"
Ver 8/2004

E(TSP) =	0.30000	lbs/ton
E(PM10) =	0.07200	lbs/ton
E(PM2.5) =	0.00490	lbs/ton

Throughput	141.85	tph
	1242606	tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	42.55500	186.39090
E(pm10) Uncontrolled	10.21320	44.73382
E(pm2.5) Uncontrolled	0.69507	3.04438

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from SOP Granulation Sizing Screens #1 and #2 U/S to SOP Product Screening Belt Conveyor (S78A,B)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	19.6	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	19.56	tph	M	0.3	%	
	171345.6	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	1.83811	3.82
E(pm10) Uncontrolled	0.86938	1.81
E(pm2.5) Uncontrolled	0.13165	0.27

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from SOP Granulation Sizing Screens #1 and #2 O/S to SOP Single Stage Roll Crusher #1 and #2 (S78A,B)

AP-42 Table 11.19.2-2 "Fines Crusher Uncontrolled"
Ver 8/2004

E(TSP) =	0.30000	lbs/ton
E(PM10) =	0.07200	lbs/ton
E(PM2.5) =	0.00490	lbs/ton

Throughput	26.64	tph
	233366.4	tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	7.99200	35.00496
E(pm10) Uncontrolled	1.91808	8.40119
E(pm2.5) Uncontrolled	0.13054	0.57175

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from SOP Single Stage Roll Crusher #1 and #2 to SOP Product Screening Belt Conveyor (S79A,B)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	26.6	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	26.64	tph	M	0.3	%	
	233366.4	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	2.50344	5.20
E(pm10) Uncontrolled	1.18406	2.46
E(pm2.5) Uncontrolled	0.17930	0.37

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from SOP Product Screening Belt Conveyor to SOP Recycle Bin #5 (S80)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	95.8	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	95.8	tph	M	0.3	%	
	839208	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	9.00262	18.71
E(pm10) Uncontrolled	4.25800	8.85
E(pm2.5) Uncontrolled	0.64478	1.34

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from SOP Recycle Bin #5 to SOP Granulation Feed Bucket Elevator #2 (S81)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	95.8	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	95.8	tph	M	0.3	%	
	839208	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	9.00262	18.71
E(pm10) Uncontrolled	4.25800	8.85
E(pm2.5) Uncontrolled	0.64478	1.34

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from SOP Granulation Sizing Screens #1 and #2 to SOP Granular Prodcut Screw Conveyor - Entrance (S78A,B)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	49.4	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	49.44	tph	M	0.3	%	
	433094.4	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	4.64603	9.66
E(pm10) Uncontrolled	2.19745	4.57
E(pm2.5) Uncontrolled	0.33276	0.69

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from SOP Granular Prodcut Screw Conveyor - Exit to SOP Granular Product Bucket Elevator - Entrance (S82)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	49.4	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	49.44	tph	M	0.3	%	
	433094.4	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	4.64603	9.66
E(pm10) Uncontrolled	2.19745	4.57
E(pm2.5) Uncontrolled	0.33276	0.69

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from SOP Granular Product Bucket Elevator - Exit to Granular SOP Belt Conveyor - Entrance (S83)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	49.4	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	49.44	tph	M	0.3	%	
	433094.4	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	4.64603	9.66
E(pm10) Uncontrolled	2.19745	4.57
E(pm2.5) Uncontrolled	0.33276	0.69

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from SOP Product Dryer Dust Collector to SOP Dust Screw Conveyor (S84)

AP-42 Section 11.19.2-4 "Crushed Stone Processing and Pulverized Mineral Processing"
Ver 08/2004
Uncontrolled emission rates derived from "Product Storage with Fabric Filter" controlled emission rate and a

	Controlled		Uncontrolled	
E(TSP) =	0.00990	lbs/ton	1.98000	lbs/ton
E(PM10) =	0.00160	lbs/ton	0.32000	lbs/ton
E(PM2.5) =	0.00060	lbs/ton	0.12000	lbs/ton
	1.07	tph		
	9373.2	tpy		

	lb/hr	tons/yr
E(tsp) Uncontrolled	2.11860	9.28
E(pm10) Uncontrolled	0.34240	1.50
E(pm2.5) Uncontrolled	0.12840	0.56

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from SOP Granulation Dryer Dust Collector to SOP Dust Screw Conveyor (S85)

AP-42 Section 11.19.2-4 "Crushed Stone Processing and Pulverized Mineral Processing"
Ver 08/2004
Uncontrolled emission rates derived from "Product Storage with Fabric Filter" controlled emission rate and a

	Controlled		Uncontrolled	
E(TSP) =	0.00990	lbs/ton	1.98000	lbs/ton
E(PM10) =	0.00160	lbs/ton	0.32000	lbs/ton
E(PM2.5) =	0.00060	lbs/ton	0.12000	lbs/ton

1.23 tph
10774.8 tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	2.43540	10.67
E(pm10) Uncontrolled	0.39360	1.72
E(pm2.5) Uncontrolled	0.14760	0.65

E(tsp) Controlled PM Emissions Controlled with SOP Granulation Dryer Dust Collector
E(pm10) Controlled PM Emissions Controlled with SOP Granulation Dryer Dust Collector
E(pm2.5) Controlled PM Emissions Controlled with SOP Granulation Dryer Dust Collector

Material Drop from SOP Area Dust Collector to SOP Dust Screw Conveyor (S86)

AP-42 Section 11.19.2-4 "Crushed Stone Processing and Pulverized Mineral Processing"
Ver 08/2004
Uncontrolled emission rates derived from "Product Storage with Fabric Filter" controlled emission rate and a

	Controlled		Uncontrolled	
E(TSP) =	0.00990	lbs/ton	1.98000	lbs/ton
E(PM10) =	0.00160	lbs/ton	0.32000	lbs/ton
E(PM2.5) =	0.00060	lbs/ton	0.12000	lbs/ton

3.27 tph
28645.2 tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	6.47460	28.36
E(pm10) Uncontrolled	1.04640	4.58
E(pm2.5) Uncontrolled	0.39240	1.72

E(tsp) Controlled PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled PM Emissions Controlled with SOP Area Dust Collector

Material Drop from SOP Dust Screw Conveyor to SOP Product Screening Belt Conveyor (S87)

AP-42 Section 11.19.2-4 "Crushed Stone Processing and Pulverized Mineral Processing"
Ver 08/2004
Uncontrolled emission rates derived from "Product Storage with Fabric Filter" controlled emission rate and a

	Controlled		Uncontrolled	
E(TSP) =	0.00990	lbs/ton	1.98000	lbs/ton
E(PM10) =	0.00160	lbs/ton	0.32000	lbs/ton
E(PM2.5) =	0.00060	lbs/ton	0.12000	lbs/ton

5.57	tph
48739.2	tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	11.02860	48.25
E(pm10) Uncontrolled	1.78240	7.80
E(pm2.5) Uncontrolled	0.66840	2.92

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Facility will Permit Two Idential SOP Granulator Dryer (S73A,B) (STK6)
AP-42 Section 1.4 "Natural Gas Combustion" **SO2, CO2, Lead, Formaldehyde, Methane, N2O**
BACT (2 Units) **NOx, CO, PM (Total)**

Burner Maximum Rated Capacity
16.54 mBTU/Hr (each)

Natural Gas LHV
946 Btu/standard cubic feet

Maximum Natural Gas Usage (each)
17484.14376 cubic feet/hr
0.017484144 million scf/hr 153.1610994 million scf/yr

Exhaust Flowrate
11821.7 DSCFM
18500 ACFM

Uncontrolled Hours of Operation
8760 hr/yr

Controlled Hours of Operation
8760 hr/yr
7800 hr/yr

NOx	0.042	lbs/MMBtu	BACT
CO	0.037	lbs/MMBtu	BACT
SO2	0.6	lbs/MMSCF	AP-42 Section 1.4
VOC	5.5	lbs/MMSCF	AP-42 Section 1.4
PM Uncontrolled	2480	lbs/hr	Mass Balance
PM Controlled	0.0052	grains/DSCF	BACT
CO2	116.9	lbs/MMBtu	BACT
Methane	0.002	lbs/MMBtu	BACT
N2O	0.0002	lbs/MMBtu	BACT
CO2e	117.004	lbs/MMBtu	BACT
Lead	0.0005	lbs/MMSCF	AP-42 Section 1.4

	Uncontolled		Controlled	
Pollutant	**PPH**	**TPY**	**PPH**	**TPY**
NOx	0.69	3.04	0.69	3.04
CO	0.61	2.68	0.61	2.68
SO2	0.01	0.05	0.01	0.05
VOC	0.10	0.42	0.10	0.42
PM	2480.00	10862.40	0.53	2.31
CO2	1933.53	8468.84	1933.53	8468.84
Methane	0.033	0.14	0.033	0.14
N2O	0.0033	0.014	0.0033	0.014
CO2e	1935.25	8476.38	1935.25	8476.38
Lead	0.000009	0.000038	0.000009	0.000038

Total 2 Units

	Uncontolled		Controlled	
Pollutant	**PPH**	**TPY**	**PPH**	**TPY**
NOx	1.39	6.09	1.39	6.09
CO	1.22	5.36	1.22	5.36
SO2	0.02	0.09	0.02	0.09
VOC	0.19	0.84	0.19	0.84
PM	4960.00	21724.80	1.05	4.62
CO2	3867.05	16937.69	3867.05	16937.69
Methane	0.07	0.29	0.07	0.29
N2O	0.01	0.03	0.01	0.03
CO2e	3870.49	16952.76	3870.49	16952.76
Lead	0.00	0.00	0.00	0.00

SOP Granulator Dryer
AP-42 Section 1.4 "Natural Gas Combustion" Tables 1.4-3 and -4

Federal HAPs

Speciated Organic Compounds	Case #	Emission Factor (lbs/MMSCF)	Emission Rate (lbs/hr)	Emission Rate (tpy)	Total 2 Units Emission Rate (lbs/hr)	Total 2 Units Emission Rate (tpy)
Benzene	71-43-2	2.10E-03	3.67E-05	1.61E-04	7.34E-05	3.22E-04
Formaldehyde	50-00-0	7.50E-02	1.31E-03	5.74E-03	2.62E-03	1.15E-02
Naphthalene	91-20-3	6.10E-04	1.07E-05	4.67E-05	2.13E-05	9.34E-05
Toluene	108-88-3	3.40E-03	5.94E-05	2.60E-04	1.19E-04	5.21E-04

Metals	Case #	Emission Factor (lbs/MMSCF)	Emission Rate (lbs/hr)	Emission Rate (tpy)	Emission Rate (lbs/hr)	Emission Rate (tpy)
Arsenic	7440-38-2	2.00E-04	3.50E-06	1.53E-05	6.99E-06	3.06E-05
Beryllium	7440-41-7	1.20E-05	2.10E-07	9.19E-07	4.20E-07	1.84E-06
Cadmium	7440-43-9	1.10E-03	1.92E-05	8.42E-05	3.85E-05	1.68E-04
Chromium	7440-47-3	1.40E-03	2.45E-05	1.07E-04	4.90E-05	2.14E-04
Cobalt	7440-48-4	8.40E-05	1.47E-06	6.43E-06	2.94E-06	1.29E-05
Manganese	7439-96-5	3.80E-04	6.64E-06	2.91E-05	1.33E-05	5.82E-05
Mercury	7439-97-6	2.60E-04	4.55E-06	1.99E-05	9.09E-06	3.98E-05
Nickel	7440-02-0	2.10E-03	3.67E-05	1.61E-04	7.34E-05	3.22E-04
Selenium	7782-49-2	2.40E-05	4.20E-07	1.84E-06	8.39E-07	3.68E-06
		Total 1 Unit	**0.002**	**0.007**		
		Total 2 Units			**0.0030**	**0.013**

State TAPs

Metals	Case #	Emission Factor (lbs/MMSCF)	Emission Rate (lbs/hr)	Emission Rate (tpy)	Emission Rate (lbs/hr)	Emission Rate (tpy)
Barium	7440-39-3	4.40E-03	7.69E-05	3.37E-04	1.54E-04	6.74E-04
Copper	7440-50-8	8.50E-04	1.49E-05	6.51E-05	2.97E-05	1.30E-04
Molybdenum	7439-98-7	1.10E-03	1.92E-05	8.42E-05	3.85E-05	1.68E-04
Vanadium	7440-62-2	2.30E-03	4.02E-05	1.76E-04	8.04E-05	3.52E-04
Zinc	7440-66-6	2.90E-02	5.07E-04	2.22E-03	1.01E-03	4.44E-03
		Total 1 Unit	**0.0007**	**0.003**		
		Total 2 Units			**0.0013**	**0.0058**

Material Drop fromLangbeinite Crystallization to Screw Feeder (S88)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.00183	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.00087	lbs/ton	Max tph	44.1	tph	
E(PM2.5) =	0.00013	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.00087	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.00041	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00006	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	44.08	tph	M	5	%	
	386140.8	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	0.08066	0.17
E(pm10) Uncontrolled	0.03815	0.08
E(pm2.5) Uncontrolled	0.00578	0.01

E(tsp) Controlled	PM Emissions Controlled with Langbeinite Product Dryer Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Langbeinite Product Dryer Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Langbeinite Product Dryer Dust Collector

Material Drop from Screw Feeder to Langbeinite Product Dryer (S89)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.00183	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.00087	lbs/ton	Max tph	44.1	tph	
E(PM2.5) =	0.00013	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.00087	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.00041	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00006	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	44.08	tph	M	5	%	
	386140.8	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	0.08066	0.17
E(pm10) Uncontrolled	0.03815	0.08
E(pm2.5) Uncontrolled	0.00578	0.01

E(tsp) Controlled	PM Emissions Controlled with Langbeinite Product Dryer Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Langbeinite Product Dryer Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Langbeinite Product Dryer Dust Collector

Material Drop from Langbeinite Product Dryer to Langbeinite Screw Conveyor (S90)

AP-42 Section 11.19.2-4 "Crushed Stone Processing and Pulverized Mineral Processing"
Ver 08/2004
Uncontrolled emission rates derived from "Product Storage with Fabric Filter" controlled emission rate and a 99.5% control

	Controlled		Uncontrolled	
E(TSP) =	0.00990	lbs/ton	1.98000	lbs/ton
E(PM10) =	0.00160	lbs/ton	0.32000	lbs/ton
E(PM2.5) =	0.00060	lbs/ton	0.12000	lbs/ton

41.91 tph
367131.6 tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	82.98180	363.46
E(pm10) Uncontrolled	13.41120	58.74
E(pm2.5) Uncontrolled	5.02920	22.03

E(tsp) Controlled PM Emissions Controlled with Langbeinite Product Dryer Dust Collector
E(pm10) Controlled PM Emissions Controlled with Langbeinite Product Dryer Dust Collector
E(pm2.5) Controlled PM Emissions Controlled with Langbeinite Product Dryer Dust Collector

Material Drop from Langbeinite Screw Conveyor to Langbeinite Compaction Pug Mixer (S91)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	41.9	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	41.91	tph	M	0.3	%	
	367131.6	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	3.93841	8.19
E(pm10) Uncontrolled	1.86276	3.87
E(pm2.5) Uncontrolled	0.28208	0.59

E(tsp) Controlled PM Emissions Controlled with Langbeinite Area Dust Collector
E(pm10) Controlled PM Emissions Controlled with Langbeinite Area Dust Collector
E(pm2.5) Controlled PM Emissions Controlled with Langbeinite Area Dust Collector

Material Drop from Truck Unload Langbeinite Fines Return to Langbeinite Fines Return Dump Hopper (S92)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	0.3	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	0.3	tph	M	0.3	%	
	2628	tpy				
			Control for 1/2 Enclosure =	50	% CE	
			Control Method Oil Additive -2 =	75	% CE	
				87.5	% total control	

	lb/hr	tons/yr	Model lbs/hr
E(tsp) Uncontrolled	0.02819	0.05860	
E(pm10) Uncontrolled	0.01333	0.02772	
E(pm2.5) Uncontrolled	0.00202	0.00420	
E(tsp) Controlled	0.00352	0.00732	0.00167
E(pm10) Controlled	0.00167	0.00346	0.00079
E(pm2.5) Controlled	0.00025	0.00052	0.00012

Material Drop from Langbeinite Fines Return Dump Hopper to Lagbeinite Fines Return Belt Feeder (S93)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	0.3	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	0.3	tph	M	0.3	%	
	2628	tpy				
			Control for 1/2 Enclosure =	50	% CE	
			Control Method Oil Additive -3 =	70	% CE	
				85	% total control	

	lb/hr	tons/yr	Model lbs/hr
E(tsp) Uncontrolled	0.02819	0.05860	
E(pm10) Uncontrolled	0.01333	0.02772	
E(pm2.5) Uncontrolled	0.00202	0.00420	
E(tsp) Controlled	0.00423	0.00879	0.00201
E(pm10) Controlled	0.00200	0.00416	0.00095
E(pm2.5) Controlled	0.00030	0.00063	0.00014

Material Drop from Langbeinite Fines Return Belt Feeder to Langbeinite Fines Return Belt Conveyor (S94)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton			
E(PM10) =	0.04445	lbs/ton	Max tph		0.3	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)		0.74		
			k(pm10)		0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)		0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum		11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual		6.2	MPH	2004-2008 WIPP Site 10 Meter
	0.3	tph	M		0.3	%	
	2628	tpy					

	lb/hr	tons/yr
E(tsp) Uncontrolled	0.02819	0.06
E(pm10) Uncontrolled	0.01333	0.03
E(pm2.5) Uncontrolled	0.00202	0.00

E(tsp) Controlled	PM Emissions Controlled with Langbeinite Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Langbeinite Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Langbeinite Area Dust Collector

Material Drop from Langbeinite Fines Belt Conveyor to Langbeinite Compaction Pug Mixer (S95)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton			
E(PM10) =	0.04445	lbs/ton	Max tph		0.3	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)		0.74		
			k(pm10)		0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)		0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum		11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual		6.2	MPH	2004-2008 WIPP Site 10 Meter
	0.3	tph	M		0.3	%	
	2628	tpy					

	lb/hr	tons/yr
E(tsp) Uncontrolled	0.02819	0.06
E(pm10) Uncontrolled	0.01333	0.03
E(pm2.5) Uncontrolled	0.00202	0.00

E(tsp) Controlled	PM Emissions Controlled with Langbeinite Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Langbeinite Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Langbeinite Area Dust Collector

Material Drop from Langbeinite Compaction Pug Mixer to Langbeinite Compaction Feed Bucket Elevator - Entrance (S96)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	167.4	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	167.35	tph	M	0.3	%	
	1465986	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	15.72639	32.69
E(pm10) Uncontrolled	7.43816	15.46
E(pm2.5) Uncontrolled	1.12635	2.34

E(tsp) Controlled	PM Emissions Controlled with Langbeinite Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Langbeinite Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Langbeinite Area Dust Collector

Material Drop from Langbeinite Compaction Feed Bucket Elevator - Exit to Langbeinite Compactor Feed Surge Bin (S97)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	167.4	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	167.35	tph	M	0.3	%	
	1465986	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	15.72639	32.69
E(pm10) Uncontrolled	7.43816	15.46
E(pm2.5) Uncontrolled	1.12635	2.34

E(tsp) Controlled	PM Emissions Controlled with Langbeinite Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Langbeinite Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Langbeinite Area Dust Collector

Material Drop from Langbeinite Compactor Feed Surge Bin to Langbeinite Compactor (S98)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	167.4	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	167.35	tph	M	0.3	%	
	1465986	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	15.72639	32.69
E(pm10) Uncontrolled	7.43816	15.46
E(pm2.5) Uncontrolled	1.12635	2.34

E(tsp) Controlled	PM Emissions Controlled with Langbeinite Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Langbeinite Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Langbeinite Area Dust Collector

Material Drop from Langbeinite Compactor to Lagbeinite Flake Breaker (S99)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	167.4	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	167.35	tph	M	0.3	%	
	1465986	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	15.72639	32.69
E(pm10) Uncontrolled	7.43816	15.46
E(pm2.5) Uncontrolled	1.12635	2.34

E(tsp) Controlled	PM Emissions Controlled with Langbeinite Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Langbeinite Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Langbeinite Area Dust Collector

Material Drop from Langbeinite Flake Breaker to Langbeinite Compactor Outlet Belt Conveyor (S100)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	167.4	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	167.35	tph	M	0.3	%	
	1465986	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	15.72639	32.69
E(pm10) Uncontrolled	7.43816	15.46
E(pm2.5) Uncontrolled	1.12635	2.34

E(tsp) Controlled	PM Emissions Controlled with Langbeinite Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Langbeinite Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Langbeinite Area Dust Collector

Material Drop from Langbeinite Compactor Outlet Belt Conveyor to Langbeinite Compactor Outlet Bucket Elevator - Entrance (S101)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	607.0	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	607.03	tph	M	0.3	%	
	5317582.8	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	57.04447	118.57
E(pm10) Uncontrolled	26.98049	56.08
E(pm2.5) Uncontrolled	4.08562	8.49

E(tsp) Controlled	PM Emissions Controlled with Langbeinite Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Langbeinite Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Langbeinite Area Dust Collector

Material Drop from Langbeinite Compactor Outlet Bucket Elevator - Exit to Langbeinte Compaction Splitter Gate - Entrance (S102)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	607.0	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	607.03	tph	M	0.3	%	
	5317582.8	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	57.04447	118.57
E(pm10) Uncontrolled	26.98049	56.08
E(pm2.5) Uncontrolled	4.08562	8.49

E(tsp) Controlled	PM Emissions Controlled with Langbeinite Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Langbeinite Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Langbeinite Area Dust Collector

Material Drop from Langbeinte Compaction Splitter Gate - Exit to Langbeinite Compaction Sizing Screen #1 and #2 - Entrance (S103)

AP-42 Table 11.19.2-2 "Fines Screening Uncontrolled"
Ver 8/2004

E(TSP) =	0.30000	lbs/ton
E(PM10) =	0.07200	lbs/ton
E(PM2.5) =	0.00490	lbs/ton

Throughput	607.03	tph
	5317582.8	tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	182.10900	797.63742
E(pm10) Uncontrolled	43.70616	191.43298
E(pm2.5) Uncontrolled	2.97445	13.02808

E(tsp) Controlled	PM Emissions Controlled with Langbeinite Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Langbeinite Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Langbeinite Area Dust Collector

Material Drop from Langbeinite Compaction Sizing Screen #1 and #2 U/S to Langbeinite Compaction Drag Conveyor - Entrance - 2 Lines (S104A,B)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	114.1	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	114.06	tph	M	0.3	%	
	999165.6	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	10.71857	22.28
E(pm10) Uncontrolled	5.06959	10.54
E(pm2.5) Uncontrolled	0.76768	1.60

E(tsp) Controlled	PM Emissions Controlled with Langbeinite Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Langbeinite Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Langbeinite Area Dust Collector

Material Drop from Langbeinite Compaction Drag Conveyor - Exit to Langbeinite Compaction Pug Mixer (S105)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	114.1	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	114.06	tph	M	0.3	%	
	999165.6	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	10.71857	22.28
E(pm10) Uncontrolled	5.06959	10.54
E(pm2.5) Uncontrolled	0.76768	1.60

E(tsp) Controlled	PM Emissions Controlled with Langbeinite Compaction Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Langbeinite Compaction Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Langbeinite Compaction Dust Collector

Material Drop from Langbeinite Compaction Sizing Screen #1 and #2 O/S to Langbeinite Compaction Screw Conveyor #2 - Entrance - 2 Lines (S104A,B)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	343.9	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	343.9	tph	M	0.3	%	
	301256.4	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	32.31734	6.72
E(pm10) Uncontrolled	15.28523	3.18
E(pm2.5) Uncontrolled	2.31462	0.48

E(tsp) Controlled	PM Emissions Controlled with Langbeinite Compaction Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Langbeinite Compaction Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Langbeinite Compaction Dust Collector

Material Drop from Langbeinite Compaction Screw Conveyor #2 - Exit to Langbeinite Cage Pactor #1 and #2 - 2 Lines (S106)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	439.7	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	439.68	tph	M	0.3	%	
	3851596.8	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	41.31808	85.88
E(pm10) Uncontrolled	19.54234	40.62
E(pm2.5) Uncontrolled	2.95927	6.15

E(tsp) Controlled	PM Emissions Controlled with Langbeinite Compaction Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Langbeinite Compaction Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Langbeinite Compaction Dust Collector

Material Drop from Langbeinite Cage Pactor #1 and #2 to Langbeinite Compaction Screw Conveyor #2 - Entrance - 2 Lines (S107A,B)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	439.7	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	439.68	tph	M	0.3	%	
	3851596.8	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	41.31808	85.88
E(pm10) Uncontrolled	19.54234	40.62
E(pm2.5) Uncontrolled	2.95927	6.15

E(tsp) Controlled	PM Emissions Controlled with Langbeinite Compaction Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Langbeinite Compaction Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Langbeinite Compaction Dust Collector

Material Drop from Langbeinite Compaction Sizing Screen #1 and #2 to Langbeinite Conditioning Drum Feed Belt Conveyor - Entrance - 2 Lines (S104A,B)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	143.0	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	143	tph	M	0.3	%	
	1252680	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	13.43815	27.93
E(pm10) Uncontrolled	6.35588	13.21
E(pm2.5) Uncontrolled	0.96246	2.00

E(tsp) Controlled	PM Emissions Controlled with Langbeinite Compaction Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Langbeinite Compaction Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Langbeinite Compaction Dust Collector

Material Drop from Langbeinite Conditioning Drum Feed Belt Conveyor - Exit to Langbeinite Product Conditioning Drum Bucket Elevator - Entrance (S108)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton			
E(PM10) =	0.04445	lbs/ton	Max tph	143.0	tph		
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74			
			k(pm10)	0.35			
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053			
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default	
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter	
	143	tph	M	0.3	%		
	1252680	tpy					

	lb/hr	tons/yr
E(tsp) Uncontrolled	13.43815	27.93
E(pm10) Uncontrolled	6.35588	13.21
E(pm2.5) Uncontrolled	0.96246	2.00

E(tsp) Controlled	PM Emissions Controlled with Langbeinite Compaction Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Langbeinite Compaction Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Langbeinite Compaction Dust Collector

Material Drop from Langbeinite Product Conditioning Drum Bucket Elevator Langbeinite Conditioning Surge Bin (S109)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton			
E(PM10) =	0.04445	lbs/ton	Max tph	143.0	tph		
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74			
			k(pm10)	0.35			
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053			
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default	
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter	
	143	tph	M	0.3	%		
	1252680	tpy					

	lb/hr	tons/yr
E(tsp) Uncontrolled	13.43815	27.93
E(pm10) Uncontrolled	6.35588	13.21
E(pm2.5) Uncontrolled	0.96246	2.00

E(tsp) Controlled	PM Emissions Controlled with Langbeinite Compaction Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Langbeinite Compaction Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Langbeinite Compaction Dust Collector

Material Drop from Langbeinite Conditioning Surge Bin to Langbeinite Conditioning Drum Screw Feeder - Entrance (S110)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton			
E(PM10) =	0.04445	lbs/ton	Max tph		143.0	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)		0.74		
			k(pm10)		0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)		0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum		11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual		6.2	MPH	2004-2008 WIPP Site 10 Meter
	143	tph	M		0.3	%	
	1252680	tpy					

	lb/hr	tons/yr
E(tsp) Uncontrolled	13.43815	27.93
E(pm10) Uncontrolled	6.35588	13.21
E(pm2.5) Uncontrolled	0.96246	2.00

E(tsp) Controlled	PM Emissions Controlled with Langbeinite Compaction Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Langbeinite Compaction Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Langbeinite Compaction Dust Collector

Material Drop from Langbeinite Conditioning Drum Screw Feeder - Exit to Conditioning Drum (S111)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton			
E(PM10) =	0.04445	lbs/ton	Max tph		143.0	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)		0.74		
			k(pm10)		0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)		0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum		11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual		6.2	MPH	2004-2008 WIPP Site 10 Meter
	143	tph	M		0.3	%	
	1252680	tpy					

	lb/hr	tons/yr
E(tsp) Uncontrolled	13.43815	27.93
E(pm10) Uncontrolled	6.35588	13.21
E(pm2.5) Uncontrolled	0.96246	2.00

E(tsp) Controlled	PM Emissions Controlled with Langbeinite Langbeinite Glazing/Conditioning Cyclone/Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Langbeinite Langbeinite Glazing/Conditioning Cyclone/Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Langbeinite Langbeinite Glazing/Conditioning Cyclone/Dust Collector

Material Drop from Conditioning Drum to Langbeinite Glazing/Conditioning Dryer (S112)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.00902	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.00427	lbs/ton	Max tph	145.1	tph	
E(PM2.5) =	0.00065	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.00428	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.00202	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00031	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	145.14	tph	M	1.6	%	
	1271426.4	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	1.30916	2.72
E(pm10) Uncontrolled	0.61920	1.29
E(pm2.5) Uncontrolled	0.09376	0.19

E(tsp) Controlled	PM Emissions Controlled with Langbeinite Langbeinite Glazing/Conditioning Cyclone/Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Langbeinite Langbeinite Glazing/Conditioning Cyclone/Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Langbeinite Langbeinite Glazing/Conditioning Cyclone/Dust Collector

Material Drop from Langbeinite Glazing/Conditioning Dryer to Langbeinite Compaction Dryer Outlet Belt Conveyor (S113)

AP-42 Section 11.19.2-4 "Crushed Stone Processing and Pulverized Mineral Processing"
Ver 08/2004
Uncontrolled emission rates derived from "Product Storage with Fabric Filter" controlled emission rate and a 99.5% control

	Controlled		Uncontrolled	
E(TSP) =	0.00990	lbs/ton	1.98000	lbs/ton
E(PM10) =	0.00160	lbs/ton	0.32000	lbs/ton
E(PM2.5) =	0.00060	lbs/ton	0.12000	lbs/ton
	141.56	tph		
	1240065.6	tpy		

	lb/hr	tons/yr
E(tsp) Uncontrolled	280.28880	1227.66
E(pm10) Uncontrolled	45.29920	198.41
E(pm2.5) Uncontrolled	16.98720	74.40

E(tsp) Controlled	PM Emissions Controlled with Langbeinite Langbeinite Glazing/Conditioning Cyclone/Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Langbeinite Langbeinite Glazing/Conditioning Cyclone/Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Langbeinite Langbeinite Glazing/Conditioning Cyclone/Dust Collector

Material Drop from Langbeinite Glazing/Conditioning Dryer Cyclone to Langbeinite Compaction Dryer Outlet Belt Conveyor (S114)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	1.5	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	1.49	tph	M	0.3	%	
	13052.4	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	0.14002	0.29
E(pm10) Uncontrolled	0.06623	0.14
E(pm2.5) Uncontrolled	0.01003	0.02

E(tsp) Controlled	PM Emissions Controlled with Langbeinite Langbeinite Glazing/Conditioning Cyclone/Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Langbeinite Langbeinite Glazing/Conditioning Cyclone/Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Langbeinite Langbeinite Glazing/Conditioning Cyclone/Dust Collector

Material Drop from Langbeinite Compaction Dryer Outlet Belt Conveyor - Exit to Langbeinite Compaction Product Bucket Elevator - Entrance (S115)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	143.1	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	143.08	tph	M	0.3	%	
	1253380.8	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	13.44567	27.95
E(pm10) Uncontrolled	6.35944	13.22
E(pm2.5) Uncontrolled	0.96300	2.00

E(tsp) Controlled	PM Emissions Controlled with Langbeinite Compaction Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Langbeinite Compaction Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Langbeinite Compaction Dust Collector

Material Drop from Langbeinite Compaction Product Bucket Elevator - Exit to Langbeinite Compaction Product Screen - Entrance (S116)

AP-42 Table 11.19.2-2 "Fines Screening Uncontrolled"
Ver 8/2004

E(TSP) =	0.30000	lbs/ton
E(PM10) =	0.07200	lbs/ton
E(PM2.5) =	0.00490	lbs/ton

Throughput	143.08	tph
	1253380.8	tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	42.92400	188.00712
E(pm10) Uncontrolled	10.30176	45.12171
E(pm2.5) Uncontrolled	0.70109	3.07078

E(tsp) Controlled	PM Emissions Controlled with Langbeinite Compaction Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Langbeinite Compaction Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Langbeinite Compaction Dust Collector

Material Drop from Langbeinite Compaction Product Screen O/S to Langbeinite Compaction Screw Conveyor #2 - Entrance (S117)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	95.8	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	95.77	tph	M	0.3	%	
	838945.2	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	8.99980	18.71
E(pm10) Uncontrolled	4.25666	8.85
E(pm2.5) Uncontrolled	0.64458	1.34

E(tsp) Controlled	PM Emissions Controlled with Langbeinite Compaction Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Langbeinite Compaction Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Langbeinite Compaction Dust Collector

Material Drop from Langbeinite Compaction Product Screen U/S to Langbeinite Compaction Drag Conveyor - Entrance (S117)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	4.7	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	4.72	tph	M	0.3	%	
	41347.2	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	0.44355	0.92
E(pm10) Uncontrolled	0.20979	0.44
E(pm2.5) Uncontrolled	0.03177	0.07

E(tsp) Controlled	PM Emissions Controlled with Langbeinite Compaction Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Langbeinite Compaction Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Langbeinite Compaction Dust Collector

Material Drop from Langbeinite Compaction Product Screen to Langbeinite Product De-Dusting Screw Conveyor - Entrance (S117)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	42.6	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	42.58	tph	M	0.3	%	
	373000.8	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	4.00137	8.32
E(pm10) Uncontrolled	1.89254	3.93
E(pm2.5) Uncontrolled	0.28658	0.60

E(tsp) Controlled	PM Emissions Controlled with Langbeinite Compaction Dust Collector/De-duster
E(pm10) Controlled	PM Emissions Controlled with Langbeinite Compaction Dust Collector/De-duster
E(pm2.5) Controlled	PM Emissions Controlled with Langbeinite Compaction Dust Collector/De-duster

Material Drop from Langbeinite Product De-Dusting Screw Conveyor - Exit to Langbeinite Product Bucket Elevator - Entrance (S118)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	42.6	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	42.58	tph	M	0.3	%	
	373000.8	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	4.00137	8.32
E(pm10) Uncontrolled	1.89254	3.93
E(pm2.5) Uncontrolled	0.28658	0.60

E(tsp) Controlled	PM Emissions Controlled with Langbeinite Compaction Dust Collector/De-duster
E(pm10) Controlled	PM Emissions Controlled with Langbeinite Compaction Dust Collector/De-duster
E(pm2.5) Controlled	PM Emissions Controlled with Langbeinite Compaction Dust Collector/De-duster

Material Drop from Langbeinite Product Bucket Elevator - Exit to Granular Langbeinite Belt Conveyor -Entrance (S119)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	42.6	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	42.58	tph	M	0.3	%	
	373000.8	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	4.00137	8.32
E(pm10) Uncontrolled	1.89254	3.93
E(pm2.5) Uncontrolled	0.28658	0.60

E(tsp) Controlled	PM Emissions Controlled with Langbeinite Compaction Dust Collector/De-duster
E(pm10) Controlled	PM Emissions Controlled with Langbeinite Compaction Dust Collector/De-duster
E(pm2.5) Controlled	PM Emissions Controlled with Langbeinite Compaction Dust Collector/De-duster

Material Drop from Langbeinite Product Dryer Dust Collector Fines to Langbeinite Compaction Drag Conveyor - Entrance (S120)

AP-42 Section 11.19.2-4 "Crushed Stone Processing and Pulverized Mineral Processing"
Ver 08/2004
Uncontrolled emission rates derived from "Product Storage with Fabric Filter" controlled emission rate and a 99.5% control

	Controlled		Uncontrolled	
E(TSP) =	0.00990	lbs/ton	1.98000	lbs/ton
E(PM10) =	0.00160	lbs/ton	0.32000	lbs/ton
E(PM2.5) =	0.00060	lbs/ton	0.12000	lbs/ton

0.04 tph
350.4 tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	0.07920	0.35
E(pm10) Uncontrolled	0.01280	0.06
E(pm2.5) Uncontrolled	0.00480	0.02

E(tsp) Controlled	PM Emissions Controlled with Langbeinite Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Langbeinite Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Langbeinite Area Dust Collector

Material Drop from Langbeinite Area Dust Collector Fines to Langbeinite Compaction Drag Conveyor - Entrance (S121)

AP-42 Section 11.19.2-4 "Crushed Stone Processing and Pulverized Mineral Processing"
Ver 08/2004
Uncontrolled emission rates derived from "Product Storage with Fabric Filter" controlled emission rate and a 99.5% control

	Controlled		Uncontrolled	
E(TSP) =	0.00990	lbs/ton	1.98000	lbs/ton
E(PM10) =	0.00160	lbs/ton	0.32000	lbs/ton
E(PM2.5) =	0.00060	lbs/ton	0.12000	lbs/ton

0.41 tph
3591.6 tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	0.81180	3.56
E(pm10) Uncontrolled	0.13120	0.57
E(pm2.5) Uncontrolled	0.04920	0.22

E(tsp) Controlled	PM Emissions Controlled with Langbeinite Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Langbeinite Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Langbeinite Area Dust Collector

Material Drop from Langbeinite Compaction Dust Collector Fines to Langbeinite Compaction Drag Conveyor - Entrance (S122)

AP-42 Section 11.19.2-4 "Crushed Stone Processing and Pulverized Mineral Processing"
Ver 08/2004
Uncontrolled emission rates derived from "Product Storage with Fabric Filter" controlled emission rate and a 99.5% control

	Controlled		Uncontrolled	
E(TSP) =	0.00990	lbs/ton	1.98000	lbs/ton
E(PM10) =	0.00160	lbs/ton	0.32000	lbs/ton
E(PM2.5) =	0.00060	lbs/ton	0.12000	lbs/ton

6	tph
52560	tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	11.88000	52.03
E(pm10) Uncontrolled	1.92000	8.41
E(pm2.5) Uncontrolled	0.72000	3.15

E(tsp) Controlled	PM Emissions Controlled with Langbeinite Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Langbeinite Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Langbeinite Area Dust Collector

Material Drop from Langbeinite Glazing/Conditioning Dust Collector Fines to Langbeinite Compaction Dryer Outlet Belt Conveyor - Entrance (S123)

AP-42 Section 11.19.2-4 "Crushed Stone Processing and Pulverized Mineral Processing"
Ver 08/2004
Uncontrolled emission rates derived from "Product Storage with Fabric Filter" controlled emission rate and a 99.5% control

	Controlled		Uncontrolled	
E(TSP) =	0.00990	lbs/ton	1.98000	lbs/ton
E(PM10) =	0.00160	lbs/ton	0.32000	lbs/ton
E(PM2.5) =	0.00060	lbs/ton	0.12000	lbs/ton

0.01	tph
87.6	tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	0.01980	0.09
E(pm10) Uncontrolled	0.00320	0.01
E(pm2.5) Uncontrolled	0.00120	0.01

E(tsp) Controlled	PM Emissions Controlled with Langbeinite Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Langbeinite Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Langbeinite Area Dust Collector

Langbeinite Area Dust Collector (STK7)

BACT **PM (Total)**

PM (Total) Controlled 0.005 gr/DSCF BACT

Exhaust Flowrate

17808.7 DSCFM

21000 ACFM

Uncontrolled Hours of Operation

8760 hr/yr

Controlled Hours of Operation

8760 hr/yr

	Uncontolled		Controlled	
Pollutant	**PPH**	**TPY**	**PPH**	**TPY**
PM (Total)			0.763	3.34

Langbeinite Product Dryer (S90) (STK8)
AP-42 Section 1.4 "Natural Gas Combustion"
BACT

SO2, CO2, Lead, Formaldehyde, Methane, N2O
NOx, CO, PM (Total)

Burner Maximum Rated Capacity
10.35 mmBTU/Hr

Natural Gas LHV
946 Btu/standard cubic feet

Maximum Natural Gas Usage
10940.80338 cubic feet/hr
0.010940803 million scf/hr 95.84143763 million scf/yr

Exhaust Flowrate
9084.8 DSCFM
16700 ACFM

Uncontrolled Hours of Operation
8760 hr/yr

Controlled Hours of Operation
8760 hr/yr
7800 hr/yr

NOx	0.042	lbs/MMBtu	BACT
CO	0.037	lbs/MMBtu	BACT
SO2	0.6	lbs/MMSCF	AP-42 Section 1.4
VOC	5.5	lbs/MMSCF	AP-42 Section 1.4
PM Uncontrolled	80	lbs/hr	Mass Balance
PM Controlled	0.0052	grains/DSCF	BACT
CO2	116.9	lbs/MMBtu	BACT
Methane	0.002	lbs/MMBtu	BACT
N2O	0.0002	lbs/MMBtu	BACT
CO2e	117.004	lbs/MMBtu	BACT
Lead	0.0005	lbs/MMSCF	AP-42 Section 1.4

	Uncontolled		Controlled	
Pollutant	**PPH**	**TPY**	**PPH**	**TPY**
NOx	0.43	1.90	0.43	1.90
CO	0.38	1.68	0.38	1.68
SO2	0.01	0.03	0.01	0.03
VOC	0.06	0.26	0.06	0.26
PM	80.00	350.40	0.40	1.77
CO2	1209.92	5299.43	1209.92	5299.43
Methane	0.021	0.091	0.021	0.091
N2O	0.0021	0.0091	0.0021	0.0091
CO2e	1210.99	5304.14	1210.99	5304.14
Lead	0.000005	0.000024	0.000005	0.000024

Langbeinite Product Dryer

AP-42 Section 1.4 "Natural Gas Combustion" Tables 1.4-3 and -4

Federal HAPs

Speciated Organic Compounds	Case #	Emission Factor (lbs/MMSCF)	Emission Rate (lbs/hr)	Emission Rate (tpy)
Benzene	71-43-2	2.10E-03	2.30E-05	1.01E-04
Formaldehyde	50-00-0	7.50E-02	8.21E-04	3.59E-03
Naphthalene	91-20-3	6.10E-04	6.67E-06	2.92E-05
Toluene	108-88-3	3.40E-03	3.72E-05	1.63E-04

Metals	Case #	Emission Factor (lbs/MMSCF)	Emission Rate (lbs/hr)	Emission Rate (tpy)
Arsenic	7440-38-2	2.00E-04	2.19E-06	9.58E-06
Beryllium	7440-41-7	1.20E-05	1.31E-07	5.75E-07
Cadmium	7440-43-9	1.10E-03	1.20E-05	5.27E-05
Chromium	7440-47-3	1.40E-03	1.53E-05	6.71E-05
Cobalt	7440-48-4	8.40E-05	9.19E-07	4.03E-06
Manganese	7439-96-5	3.80E-04	4.16E-06	1.82E-05
Mercury	7439-97-6	2.60E-04	2.84E-06	1.25E-05
Nickel	7440-02-0	2.10E-03	2.30E-05	1.01E-04
Selenium	7782-49-2	2.40E-05	2.63E-07	1.15E-06
		Total	**0.00095**	**0.0042**

State TAPs

Metals	Case #	Emission Factor (lbs/MMSCF)	Emission Rate (lbs/hr)	Emission Rate (tpy)
Barium	7440-39-3	4.40E-03	4.81E-05	2.11E-04
Copper	7440-50-8	8.50E-04	9.30E-06	4.07E-05
Molybdenum	7439-98-7	1.10E-03	1.20E-05	5.27E-05
Vanadium	7440-62-2	2.30E-03	2.52E-05	1.10E-04
Zinc	7440-66-6	2.90E-02	3.17E-04	1.39E-03
		Total	**0.00041**	**0.0018**

Langbeinite Compactor Dust Collector (STK9)

BACT **PM (Total)**

PM (Total) Controlled 0.005 gr/DSCF BACT

Exhaust Flowrate

16012.8262 DSCFM

24000 ACFM

Uncontrolled Hours of Operation

8760 hr/yr

Controlled Hours of Operation

8760 hr/yr

	Uncontolled		Controlled	
Pollutant	**PPH**	**TPY**	**PPH**	**TPY**
PM (Total)			0.686	3.01

Langbeinite Glazing/Conditioning Dryer (S113) (STK10)
AP-42 Section 1.4 "Natural Gas Combustion"
BACT

SO2, CO2, Lead, Formaldehyde, Methane, N2O
NOx, CO, PM (Total)

Burner Maximum Rated Capacity
2 mmBTU/Hr

Natural Gas LHV
946 Btu/standard cubic feet

Maximum Natural Gas Usage
2114.164905 cubic feet/hr
0.002114165 million scf/hr 18.52008457 million scf/yr

Exhaust Flowrate
13832.2 DSCFM
19500 ACFM

Uncontrolled Hours of Operation
8760 hr/yr

Controlled Hours of Operation
8760 hr/yr
7800 hr/yr

NOx	0.042	lbs/MMBtu	BACT
CO	0.037	lbs/MMBtu	BACT
SO2	0.6	lbs/MMSCF	AP-42 Section 1.4
VOC	5.5	lbs/MMSCF	AP-42 Section 1.4
PM Uncontrolled	40	lbs/hr	Mass Balance
PM Controlled	0.0052	grains/DSCF	BACT
CO2	116.9	lbs/MMBtu	BACT
Methane	0.002	lbs/MMBtu	BACT
N2O	0.0002	lbs/MMBtu	BACT
CO2e	117.004	lbs/MMBtu	BACT
Lead	0.0005	lbs/MMSCF	AP-42 Section 1.4

	Uncontolled		Controlled	
Pollutant	**PPH**	**TPY**	**PPH**	**TPY**
NOx	0.08	0.37	0.08	0.37
CO	0.07	0.32	0.07	0.32
SO2	0.00	0.01	0.00	0.01
VOC	0.01	0.05	0.01	0.05
PM	40.00	175.20	0.62	2.70
CO2	233.80	1024.04	233.80	1024.04
Methane	0.004	0.018	0.004	0.018
N2O	0.00040	0.0018	0.00040	0.0018
CO2e	234.01	1024.96	234.01	1024.96
Lead	0.000001	0.000005	0.000001	0.000005

Langbeinite GlazingConditioning Dryer

AP-42 Section 1.4 "Natural Gas Combustion" Tables 1.4-3 and -4

Federal HAPs

ıted Organic Comp	Case #	Emission Factor (lbs/MMSCF)	Emission Rate (lbs/hr)	Emission Rate (tpy)
Benzene	71-43-2	2.10E-03	4.44E-06	1.94E-05
Formaldehyde	50-00-0	7.50E-02	1.59E-04	6.95E-04
Naphthalene	91-20-3	6.10E-04	1.29E-06	5.65E-06
Toluene	108-88-3	3.40E-03	7.19E-06	3.15E-05

Metals	Case #	Emission Factor (lbs/MMSCF)	Emission Rate (lbs/hr)	Emission Rate (tpy)
Arsenic	7440-38-2	2.00E-04	4.23E-07	1.85E-06
Beryllium	7440-41-7	1.20E-05	2.54E-08	1.11E-07
Cadmium	7440-43-9	1.10E-03	2.33E-06	1.02E-05
Chromium	7440-47-3	1.40E-03	2.96E-06	1.30E-05
Cobalt	7440-48-4	8.40E-05	1.78E-07	7.78E-07
Manganese	7439-96-5	3.80E-04	8.03E-07	3.52E-06
Mercury	7439-97-6	2.60E-04	5.50E-07	2.41E-06
Nickel	7440-02-0	2.10E-03	4.44E-06	1.94E-05
Selenium	7782-49-2	2.40E-05	5.07E-08	2.22E-07
		Total	**0.00018**	**0.00080**

State TAPs

Metals	Case #	Emission Factor (lbs/MMSCF)	Emission Rate (lbs/hr)	Emission Rate (tpy)
Barium	7440-39-3	4.40E-03	9.30E-06	4.07E-05
Copper	7440-50-8	8.50E-04	1.80E-06	7.87E-06
Molybdenum	7439-98-7	1.10E-03	2.33E-06	1.02E-05
Vanadium	7440-62-2	2.30E-03	4.86E-06	2.13E-05
Zinc	7440-66-6	2.90E-02	6.13E-05	2.69E-04
		Total	**0.000080**	**0.00035**

Waste Material

Material Drop from Stage 2 Leach Belt Conveyor to Gypsum Surge Bin (S175)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.00026	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.00012	lbs/ton	Max tph	338.7	tph	
E(PM2.5) =	0.00002	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.00012	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.00006	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00001	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	338.69	tph	M	20	%	
	2966924.4	tpy				
			Control for Full Enclosure =	85	% CE	

	lb/hr	tons/yr	Model lbs/hr
E(tsp) Uncontrolled	0.08899	0.18497	
E(pm10) Uncontrolled	0.04209	0.08749	
E(pm2.5) Uncontrolled	0.00637	0.01325	
E(tsp) Controlled	0.01335	0.02775	0.00633
E(pm10) Controlled	0.00631	0.01312	0.00300
E(pm2.5) Controlled	0.00096	0.00199	0.00045

Material Drop from Gypsum Surge Bin to Gypsum Screw Conveyor (S176)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.00026	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.00012	lbs/ton	Max tph	338.7	tph	
E(PM2.5) =	0.00002	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.00012	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.00006	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00001	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	338.69	tph	M	20	%	
	2966924.4	tpy				
			Control for Full Enclosure =	85	% CE	

	lb/hr	tons/yr	Model lbs/hr
E(tsp) Uncontrolled	0.08899	0.18497	
E(pm10) Uncontrolled	0.04209	0.08749	
E(pm2.5) Uncontrolled	0.00637	0.01325	
E(tsp) Controlled	0.01335	0.02775	0.00633
E(pm10) Controlled	0.00631	0.01312	0.00300
E(pm2.5) Controlled	0.00096	0.00199	0.00045

Material Drop from Gypsum Screw Conveyor to Gypsum Haul Trucks (S177)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.00026	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.00012	lbs/ton	Max tph	338.7	tph	
E(PM2.5) =	0.00002	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.00012	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.00006	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00001	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	338.69	tph	M	20	%	
	2966924.4	tpy				
			No Control =	0	% CE	

	lb/hr	tons/yr	Model lbs/hr
E(tsp) Uncontrolled	0.08899	0.18497	
E(pm10) Uncontrolled	0.04209	0.08749	
E(pm2.5) Uncontrolled	0.00637	0.01325	
E(tsp) Controlled	0.08899	0.18497	0.04223
E(pm10) Controlled	0.04209	0.08749	0.01997
E(pm2.5) Controlled	0.00637	0.01325	0.00302

Material Drop from Gypsum Haul Trucks Unload to Gypsum Stockpile (S178)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.00026	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.00012	lbs/ton	Max tph	338.7	tph	
E(PM2.5) =	0.00002	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.00012	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.00006	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00001	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	338.69	tph	M	20	%	
	2966924.4	tpy				
			No Control =	0	% CE	

	lb/hr	tons/yr	Model lbs/hr
E(tsp) Uncontrolled	0.08899	0.18497	
E(pm10) Uncontrolled	0.04209	0.08749	
E(pm2.5) Uncontrolled	0.00637	0.01325	
E(tsp) Controlled	0.08899	0.18497	0.04223
E(pm10) Controlled	0.04209	0.08749	0.01997
E(pm2.5) Controlled	0.00637	0.01325	0.00302

Bulldozing at Gypsum Stockpile (S178)

AP-42 Section 11.9 Table 11.9-1 "Bulldozing Overburden" (ver 07/98)
Bulldozer operations will occur 24 hours per day with 50% of the time material moved

TSP Emission Equation
5.7(s)^1.2/(M)^1.3 * hours

PM15 Emission Equation
1.0(s)^1.5/(M)^1.4 * hours

PM10 factor	0.75	
PM2.5 factor (TSP Equation)	0.105	
Bulldozer Hours	24	hours per day
	8760	
Material Moved Percentage	50	%

15.0 %silt (s)
15.0 %moisture (M)

	lbs/hr	lbs/day	tons/yr
Uncontrolled TSP	4.35	52.2	9.52
Uncontrolled PM10	0.98	11.8	2.15
Uncontrolled PM2.5	0.46	5.5	1.00

Granular SOP

Material Drop from Granular SOP Belt Conveyor - Exit to Granular SOP Loading Bin (S124)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	49.4	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	49.44	tph	M	0.3	%	
	433094.4	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	4.64603	9.66
E(pm10) Uncontrolled	2.19745	4.57
E(pm2.5) Uncontrolled	0.33276	0.69

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from Granular SOP Loading Bin to Granular SOP Loading Bulk Weigher (S125)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	49.4	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	49.44	tph	M	0.3	%	
	433094.4	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	4.64603	9.66
E(pm10) Uncontrolled	2.19745	4.57
E(pm2.5) Uncontrolled	0.33276	0.69

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from Granular SOP Loading Bulk Weigher to Product Truck Loading (S126)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	251.0	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	250.96	tph	M	0.3	%	
	433094.4	tpy				
			Control for 1/2 Enclosure =	50	% CE	
			Control Method Oil Additive - 3 =	70	% CE	
				85	% total control	

	lb/hr	tons/yr	Model lbs/hr
E(tsp) Uncontrolled	23.58348	9.65728	
E(pm10) Uncontrolled	11.15435	4.56763	
E(pm2.5) Uncontrolled	1.68909	0.69167	
E(tsp) Controlled	3.53752	1.44859	1.67880
E(pm10) Controlled	1.67315	0.68514	0.79403
E(pm2.5) Controlled	0.25336	0.10375	0.12024

Standard SOP

Material Drop from Standard SOP Belt Conveyor - Exit to Standard SOP Loading Bin (S127)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	63.8	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	63.82	tph	M	0.3	%	
	559063.2	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	5.99736	12.47
E(pm10) Uncontrolled	2.83659	5.90
E(pm2.5) Uncontrolled	0.42954	0.89

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from Standard SOP Loading Bin to Standard SOP Loading Bulk Weigher (S128)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	63.8	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	63.82	tph	M	0.3	%	
	559063.2	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	5.99736	12.47
E(pm10) Uncontrolled	2.83659	5.90
E(pm2.5) Uncontrolled	0.42954	0.89

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from Standard SOP Loading Bulk Weigher to Product Truck Loading (S129)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	251.0	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	250.96	tph	M	0.3	%	
	559063.2	tpy				

Control for 1/2 Enclosure =	50	% CE
Control Method Oil Additive - 3 =	70	% CE
	85	% total control

	lb/hr	tons/yr	Model lbs/hr
E(tsp) Uncontrolled	23.58348	12.46617	
E(pm10) Uncontrolled	11.15435	5.89616	
E(pm2.5) Uncontrolled	1.68909	0.89285	
E(tsp) Controlled	3.53752	1.86993	1.67880
E(pm10) Controlled	1.67315	0.88442	0.79403
E(pm2.5) Controlled	0.25336	0.13393	0.12024

Soluble SOP

Material Drop from Soluable SOP Belt Conveyor - Exit to Soluable SOP Loading Bin (S130)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	12.4	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	12.35	tph	M	0.3	%	
	108186	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	1.16057	2.41
E(pm10) Uncontrolled	0.54892	1.14
E(pm2.5) Uncontrolled	0.08312	0.17

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from Soluable SOP Loading Bin to Soluable SOP Loading Bulk Weigher (S131)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	12.4	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	12.35	tph	M	0.3	%	
	108186	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	1.16057	2.41
E(pm10) Uncontrolled	0.54892	1.14
E(pm2.5) Uncontrolled	0.08312	0.17

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from Soluable SOP Loading Bulk Weigher to Product Truck Loading (S132)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	251.0	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	250.96	tph	M	0.3	%	
	108186	tpy				
			Control for 1/2 Enclosure =	50	% CE	
			Control Method Oil Additive - 3 =	70	% CE	
				85	% total control	

	lb/hr	tons/yr	Model lbs/hr
E(tsp) Uncontrolled	23.5835	2.41237	
E(pm10) Uncontrolled	11.15435	1.14098	
E(pm2.5) Uncontrolled	1.68909	0.17278	
E(tsp) Controlled	3.53752	0.36185	1.67880
E(pm10) Controlled	1.67315	0.17115	0.79403
E(pm2.5) Controlled	0.25336	0.02592	0.12024

Granular Langbeinite

Material Drop from Granular Langbeinite Belt Conveyor - Exit to Granular Langbeinite Loading Bin (S133)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	42.6	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	42.58	tph	M	0.3	%	
	373000.8	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	4.00137	8.32
E(pm10) Uncontrolled	1.89254	3.93
E(pm2.5) Uncontrolled	0.28658	0.60

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from Granular Langbeinite Loading Bin to Granular Langbeinite Loading Bulk Weigher (S134)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	42.6	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	42.58	tph	M	0.3	%	
	373000.8	tpy				

	lb/hr	tons/yr
E(tsp) Uncontrolled	4.00137	8.32
E(pm10) Uncontrolled	1.89254	3.93
E(pm2.5) Uncontrolled	0.28658	0.60

E(tsp) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm10) Controlled	PM Emissions Controlled with SOP Area Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with SOP Area Dust Collector

Material Drop from Granular Langbeinite Loading Bulk Weigher to Product Truck Loading (S135)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	251.0	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	250.96	tph	M	0.3	%	
	373000.8	tpy				

Control for 1/2 Enclosure =	50	% CE
Control Method Oil Additive - 3 =	70	% CE
	85	% total control

	lb/hr	tons/yr	Model lbs/hr
E(tsp) Uncontrolled	23.58348	8.31729	
E(pm10) Uncontrolled	11.15435	3.93385	
E(pm2.5) Uncontrolled	1.68909	0.59570	
E(tsp) Controlled	3.53752	1.24759	1.67880
E(pm10) Controlled	1.67315	0.59008	0.79403
E(pm2.5) Controlled	0.25336	0.08935	0.12024

SOP Binder

Material Drop from SOP Binder Bulk Bags to SOP Binder Feed Hopper (S181)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	0.6	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	0.62	tph	M	0.3	%	
	5431.2	tpy				
			Control for Full Enclosure =	85	% CE	

	lb/hr	tons/yr	Model lbs/hr
E(tsp) Uncontrolled	0.05826	0.12111	
E(pm10) Uncontrolled	0.02756	0.05728	
E(pm2.5) Uncontrolled	0.00417	0.00867	
E(tsp) Controlled	0.00874	0.01817	0.00415
E(pm10) Controlled	0.00413	0.00859	0.00196
E(pm2.5) Controlled	0.00063	0.00130	0.00030

Material Drop from SOP Binder Feed Hopper to SOP Binder Metering Screw - Entrance (S182)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	0.6	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	0.62	tph	M	0.3	%	
	5431.2	tpy				
			Control for Full Enclosure =	85	% CE	

	lb/hr	tons/yr	Model lbs/hr
E(tsp) Uncontrolled	0.05826	0.12111	
E(pm10) Uncontrolled	0.02756	0.05728	
E(pm2.5) Uncontrolled	0.00417	0.00867	
E(tsp) Controlled	0.00874	0.01817	0.00415
E(pm10) Controlled	0.00413	0.00859	0.00196
E(pm2.5) Controlled	0.00063	0.00130	0.00030

Langbeinite Binder

Material Drop from Langbeinite Binder Bulk Bags to Langbeinite Binder Feed Hopper (S183)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	0.6	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	0.62	tph	M	0.3	%	
	5431.2	tpy				
			Control for Full Enclosure =	85	% CE	

	lb/hr	tons/yr	Model lbs/hr
E(tsp) Uncontrolled	0.05826	0.12111	
E(pm10) Uncontrolled	0.02756	0.05728	
E(pm2.5) Uncontrolled	0.00417	0.00867	
E(tsp) Controlled	0.00874	0.01817	0.00415
E(pm10) Controlled	0.00413	0.00859	0.00196
E(pm2.5) Controlled	0.00063	0.00130	0.00030

Material Drop from Langbeinite Binder Feed Hopper to Langbeinite Binder Metering Screw -

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	0.6	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	0.62	tph	M	0.3	%	
	5431.2	tpy				
			Control for Full Enclosure =	85	% CE	

	lb/hr	tons/yr	Model lbs/hr
E(tsp) Uncontrolled	0.05826	0.12111	
E(pm10) Uncontrolled	0.02756	0.05728	
E(pm2.5) Uncontrolled	0.00417	0.00867	
E(tsp) Controlled	0.00874	0.01817	0.00415
E(pm10) Controlled	0.00413	0.00859	0.00196
E(pm2.5) Controlled	0.00063	0.00130	0.00030

Flocculant

Material Drop from Flocculant Bulk Bags to Leaching Circuit Flocculent Feed Hopper (S185)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	0.6	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	0.62	tph	M	0.3	%	
	5431.2	tpy				
			Control for Full Enclosure =	85	% CE	

	lb/hr	tons/yr	Model lbs/hr
E(tsp) Uncontrolled	0.05826	0.12111	
E(pm10) Uncontrolled	0.02756	0.05728	
E(pm2.5) Uncontrolled	0.00417	0.00867	
E(tsp) Controlled	0.00874	0.01817	0.00415
E(pm10) Controlled	0.00413	0.00859	0.00196
E(pm2.5) Controlled	0.00063	0.00130	0.00030

Material Drop from Leaching Circuit Flocculent Feed Hopper to Leaching Circuit Flocculent

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	0.6	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	0.62	tph	M	0.3	%	
	5431.2	tpy				
			Control for Full Enclosure =	85	% CE	

	lb/hr	tons/yr	Model lbs/hr
E(tsp) Uncontrolled	0.05826	0.12111	
E(pm10) Uncontrolled	0.02756	0.05728	
E(pm2.5) Uncontrolled	0.00417	0.00867	
E(tsp) Controlled	0.00874	0.01817	0.00415
E(pm10) Controlled	0.00413	0.00859	0.00196
E(pm2.5) Controlled	0.00063	0.00130	0.00030

Sodium Chloride Wash Flocculant

Material Drop from Sodium Chloride Wash Flocculant Bulk Bags to Sodium Chloride Wash

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	0.6	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	0.62	tph	M	0.3	%	
	5431.2	tpy				
			Control for Full Enclosure =	85	% CE	

	lb/hr	tons/yr	Model lbs/hr
E(tsp) Uncontrolled	0.05826	0.12111	
E(pm10) Uncontrolled	0.02756	0.05728	
E(pm2.5) Uncontrolled	0.00417	0.00867	
E(tsp) Controlled	0.00874	0.01817	0.00415
E(pm10) Controlled	0.00413	0.00859	0.00196
E(pm2.5) Controlled	0.00063	0.00130	0.00030

Material Drop from Sodium Chloride Wash Flocculant Feed Hopper to Sodium Chloride Wash

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

E(TSP) =	0.09397	lbs/ton	AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
E(PM10) =	0.04445	lbs/ton	Max tph	0.6	tph	
E(PM2.5) =	0.00673	lbs/ton	k(tsp)	0.74		
			k(pm10)	0.35		
E(TSP) =	0.04460	lbs/ton	k(pm2.5)	0.053		
E(PM10) =	0.02109	lbs/ton	U Maximum	11	MPH	NMED default
E(PM2.5) =	0.00319	lbs/ton	U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
	0.62	tph	M	0.3	%	
	5431.2	tpy				
			Control for Full Enclosure =	85	% CE	

	lb/hr	tons/yr	Model lbs/hr
E(tsp) Uncontrolled	0.05826	0.12111	
E(pm10) Uncontrolled	0.02756	0.05728	
E(pm2.5) Uncontrolled	0.00417	0.00867	
E(tsp) Controlled	0.00874	0.01817	0.00415
E(pm10) Controlled	0.00413	0.00859	0.00196
E(pm2.5) Controlled	0.00063	0.00130	0.00030

Paved Road Equation AP-42 Section 13.2.1 (01/11)
E =[k (sL)^0.91 x (W)^1.02] x (1-P/4N) (Equation 2)

Ochoa Site

	PM2.5	PM10	PM30	
k	0.00054	0.0022	0.011	Table 13.2.1-1
sL	0.6	0.6	0.6	Limited access roadway (<500 ADT) Table 13.2.1-2
W	25.99	25.99	25.99	Average of Fleet (# of Trucks per Route x Truck Route VMT/Day / Total VMT/Day)
P	60	60	60	AP-42 Figure 13.2.1-2
N	365	365	365	
lb/VMT	0.00941	0.03834	0.19168	
lb/hr	0.13	0.52	2.62	
tpy	0.54	2.18	10.90	
annual lb/hr	0.12	0.50	2.49	

Average Weight of Vehicle

Truck Routes	Trucks/Day	Unload Weight (tons)	Load Weight (tons)	Average Weight (tons)	Round Trip (Meters)	VMT/Day	Normalize Weight	Fleet Average Weight (tons)	Percentage	TSP (lb/hr)	PM10 (lb/hr)	PM2.5 (lb/hr)	Annual Ave TSP (TPY)	Annual Ave PM10 (TPY)	Annual Ave PM2.5 (TPY)
Ochoa Product Trucks	183	15	22	26	2757.01	314.39	8174.18		0.96	2.51	0.50	0.12	10.46	2.09	0.52
Ochoa Return Trucks	6	15	22	26	2757.01	9.43	245.23		0.03	0.08	0.015	0.0037	0.31	0.063	0.015
Additives Deliveries	2	15	20	25	2757.01	3.83	95.65		0.01	0.031	0.006	0.0015	0.13	0.025	0.006
Total	**191**					**327.65**	**8515.06**	**25.99**							
Annual Trucks Per Year	**69794**				**Total Truck Traffic Mileage**	**119592.04**	**Miles/Yr**			**2.62**	**0.52**	**0.13**	**10.90**	**2.18**	**0.54**

Ochoa Plant

Unpaved Road Equation AP-42 Section 13.2.2 (11/06)

E =[k (s/12)^a x (W/3)^b] x [(365-P)/365] (Equations 1a and 2)

	PM2.5	PM10	PM30	
k	0.15	1.5	4.9	Table 13.2.2-2
a	0.9	0.9	0.7	Table 13.2.2-2
b	0.45	0.45	0.45	Table 13.2.2-2
s	4.8	4.8	4.8	Sand and Gravel
W	25.00	25.00	25.00	Average of Fleet (# of Trucks per Route x Truck Route VMT/Day / Total VMT/Day)
P	60	60	60	AP-42 Figure 13.2.1-2
lb/VMT	0.17073	1.70732	6.69895	
lb/hr	0.17	1.67	6.56	
tpy	0.61	6.12	24.03	
annual lb/hr	0.14	1.40	5.49	
%Control Efficiency	90	90	90	
Controlled Emissions				
lb/VMT	0.01707	0.17073	0.66989	
lb/hr	0.01673	0.16730	0.65643	
tpy	0.06123	0.61231	2.40252	
annual lb/hr	0.01398	0.13980	0.54852	

Waste Haul

	PM2.5	PM10	PM30	
k	0.15	1.5	4.9	Table 13.2.2-2
a	0.9	0.9	0.7	Table 13.2.2-2
b	0.45	0.45	0.45	Table 13.2.2-2
s	4.8	4.8	4.8	Sand and Gravel
W	58.50	58.50	58.50	Average of Fleet (# of Trucks per Route x Truck Route VMT/Day / Total VMT/Day)
P	60	60	60	AP-42 Figure 13.2.1-2
lb/VMT	0.25030	2.50300	9.82095	
lb/hr	5.04	50.36	197.61	
tpy	18.43	184.33	723.25	
annual lb/hr	7.79	77.93	305.78	
%Control Efficiency	90	90	90	
Controlled Emissions				
lb/VMT	0.02503	0.25030	0.98210	
lb/hr	0.50363	5.03633	19.76090	
tpy	1.84330	18.43296	72.32491	
annual lb/hr	0.77933	7.79325	30.57818	

Uncontrolled Emission Rates

Truck Routes	TSP (lb/hr)	PM10 (lb/hr)	PM2.5 (lb/hr)	Annual Ave TSP (TPY)	Annual Ave PM10 (TPY)	Annual Ave PM2.5 (TPY)
Equipment Deliveries	3.28	0.84	0.084	12.01	3.06	0.31
De-Duster Deliveries	3.28	0.84	0.084	12.01	3.06	0.31
Total	**6.56**	**1.67**	**0.17**	**24.03**	**6.12**	**0.61**
Waste Haul Trucks	197.61	50.36	5.04	723.25	184.33	18.43
	204.17	52.04	5.20	747.27	190.45	19.05

Average Weight of Vehicle / **Controlled Emission Rates**

Truck Routes	Trucks/Day	Unload Weight (tons)	Load Weight (tons)	Average Weight (tons)	Round Trip (Meters)	VMT/Day	Normalize Weight	Fleet Average Weight (tons)	Percentage	TSP (lb/hr)	PM10 (lb/hr)	PM2.5 (lb/hr)	Annual Ave TSP (TPY)	Annual Ave PM10 (TPY)	Annual Ave PM2.5 (TPY)
Equipment Deliveries	5	15	20	25	3783.96	11.76	293.97		0.50	0.33	0.084	0.0084	1.20	0.31	0.03
De-Duster Deliveries	5	15	20	25	3783.96	11.76	293.97		0.50	0.33	0.084	0.0084	1.20	0.31	0.03
Total	**10**					**23.52**	**587.94**	**25.00**		**0.66**	**0.17**	**0.017**	**2.40**	**0.61**	**0.06**
Waste Haul Trucks	100	35.5	46	58.5	7769.99	482.91				19.76	5.04	0.50	72.32	18.43	1.84
Annual Trucks Per Year	**3650**			**Total Truck Traffic Mileage**		**8583.87**	**Miles/Yr**			20.42	5.20	0.52	74.73	19.05	1.90
Annual Waste Trucks Per Year	**36500**			**Total Waste Truck Traffic Mileage**		**176261.43**	**Miles/Yr**								

Jal Loadout

Unpaved Road Equation AP-42 Section 13.2.2 (11/06)

E =[k (s/12)^a x (W/3)^b] x [(365-P)/365] (Equations 1a and 2)

	PM2.5	PM10	PM30	
k	0.15	1.5	4.9	Table 13.2.2-2
a	0.9	0.9	0.7	Table 13.2.2-2
b	0.45	0.45	0.45	Table 13.2.2-2
s	4.8	4.8	4.8	Sand and Gravel
W	25.96	25.96	25.96	Average of Fleet (# of Trucks per Route x Truck Route VMT/Day / Total VMT/Day)
P	60	60	60	AP-42 Figure 13.2.1-2
lb/VMT	0.17366	1.73664	6.81401	
lb/hr	4.41	44.05	172.85	
tpy	16.12	161.23	632.62	
annual lb/hr	3.68	36.81	144.43	
%Control Efficiency	90	90	90	
Controlled Emissions				
lb/VMT	0.01737	0.17366	0.68140	
lb/hr	0.44053	4.40526	17.28481	
tpy	1.61233	16.12326	63.26241	
annual lb/hr	0.36811	3.68111	14.44347	

Uncontrolled Emission Rates

Truck Routes	TSP (lb/hr)	PM10 (lb/hr)	PM2.5 (lb/hr)	Annual Ave TSP (TPY)	Annual Ave PM10 (TPY)	Annual Ave PM2.5 (TPY)
Jal Loadout Product Trucks	161.82	41.24	4.12	592.26	150.95	15.09
Jal Loadout Return Trucks	4.85	1.24	0.12	17.77	4.53	0.45
Additive Deliveries	1.76	0.45	0.04	6.46	1.65	0.16
De-Duster Deliveries	4.41	1.12	0.11	16.14	4.11	0.41
	172.85	**44.05**	**4.41**	**632.62**	**161.23**	**16.12**

Average Weight of Vehicle

Truck Routes	Trucks/Day	Unload Weight (tons)	Load Weight (tons)	Average Weight (tons)	Round Trip (Meters)	VMT/Day	Normalize Weight	Fleet Average Weight (tons)	Percentage	TSP (lb/hr)	PM10 (lb/hr)	PM2.5 (lb/hr)	Annual Ave TSP (TPY)	Annual Ave PM10 (TPY)	Annual Ave PM2.5 (TPY)
Jal Loadout Product Trucks	183	15	22	26	4998.13	569.95	14818.82		0.94	16.18	4.12	0.412	13.52	3.45	0.34
Jal Loadout Return Trucks	6	15	22	26	4998.13	17.10	444.56		0.03	0.49	0.12	0.012	0.41	0.10	0.01
Additive Deliveries	2	15	20	25	4998.13	6.21	155.32		0.01	0.18	0.04	0.004	0.15	0.038	0.004
De-Duster Deliveries	5	15	20	25	4998.13	15.53	388.29		0.03	0.44	0.11	0.011	0.37	0.094	0.009
Total	**196.0**					**608.80**	**15807.00**	**25.96**		**17.28**	**4.41**	**0.44**	**14.44**	**3.68**	**0.37**
Annual Trucks Per Year	**71534**														

Total Truck Traffic Mileage 222211 Miles/Yr

SOP

Material Drop from Product Trucks to SOP Dump Hopper (Granular, Standard, Soluble) (S136)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
k(tsp)	0.74		
k(pm10)	0.35		
k(pm2.5)	0.053		
U Maximum	11	MPH	NMED default
U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
M	0.3	%	

Max Hourly Emission Factors

E(TSP) =	0.09397	lbs/ton
E(PM10) =	0.04445	lbs/ton
E(PM2.5) =	0.00673	lbs/ton

Annual Emission Factors

E(TSP) =	0.04460	lbs/ton
E(PM10) =	0.02109	lbs/ton
E(PM2.5) =	0.00319	lbs/ton

Throughput	300.02	tph
	1100343.6	tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	28.19380	24.53581
E(pm10) Uncontrolled	13.33491	11.60478
E(pm2.5) Uncontrolled	2.01929	1.75729

%Control Efficiency	50	1/2 enclosed
	60	de-duster application - 5
	80	total control

	lb/hr	tons/yr	Model lbs/hr
E(tsp) Controlled	5.63876	4.90716	1.12036
E(pm10) Controlled	2.66698	2.32096	0.52990
E(pm2.5) Controlled	0.40386	0.35146	0.08024

Material Drop from SOP Dump Hopper to SOP Storage Belt Feeder (Granular, Standard, Soluble) (S137)

AP-42 Table 11.19.2-2 "Conveyor Transfer Point Uncontrolled"
Ver 8/2004

E(TSP) =	0.00300	lbs/ton
E(PM10) =	0.00110	lbs/ton
E(PM2.5) =	0.00017	lbs/ton

Throughput	300.02	tph
	1100343.6	tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	0.90006	1.65052
E(pm10) Uncontrolled	0.33002	0.60519
E(pm2.5) Uncontrolled	0.05100	0.09353

%Control Efficiency	50	1/2 enclosed
	55	de-duster application - 6
	77.5	total control

	lb/hr	tons/yr	Model lbs/hr
E(tsp) Controlled	0.20251	1.65052	0.37683
E(pm10) Controlled	0.07425	0.60519	0.13817
E(pm2.5) Controlled	0.01148	0.09353	0.02135

Material Drop from SOP Storage Belt Feeder to SOP Storage Belt Conveyor (Granular, Standard, Soluble) (S138)

AP-42 Table 11.19.2-2 "Conveyor Transfer Point Uncontrolled"
Ver 8/2004

E(TSP) =	0.00300	lbs/ton
E(PM10) =	0.00110	lbs/ton
E(PM2.5) =	0.00017	lbs/ton

Throughput	300.02	tph
	1100343.6	tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	0.90006	1.65052
E(pm10) Uncontrolled	0.33002	0.60519
E(pm2.5) Uncontrolled	0.05100	0.09353

%Control Efficiency	50	1/2 enclosed
	50	de-duster application - 7
	75	total control

	lb/hr	tons/yr	Model lbs/hr
E(tsp) Controlled	0.22502	1.65052	0.37683
E(pm10) Controlled	0.08251	0.60519	0.13817
E(pm2.5) Controlled	0.01275	0.09353	0.02135

Material Drop from SOP Storage Belt Conveyor to SOP Storage Bucket Elevator (Granular, Standard, Soluble) (S139)

AP-42 Table 11.19.2-2 "Conveyor Transfer Point Uncontrolled"
Ver 8/2004

E(TSP) =	0.00300	lbs/ton
E(PM10) =	0.00110	lbs/ton
E(PM2.5) =	0.00017	lbs/ton

Throughput	300.02	tph
	1100343.6	tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	0.90006	1.65052
E(pm10) Uncontrolled	0.33002	0.60519
E(pm2.5) Uncontrolled	0.05100	0.09353

%Control Efficiency	70	3/4 enclosed
	45	de-duster application - 8
	83.5	total control

	lb/hr	tons/yr	Model lbs/hr
E(tsp) Controlled	0.14851	1.65052	0.37683
E(pm10) Controlled	0.05445	0.60519	0.13817
E(pm2.5) Controlled	0.00842	0.09353	0.02135

Material Drop from SOP Storage Bucket Elevator to SOP Storage Belt Tripper Conveyor (Granular, Standard, Soluble) (S140)

AP-42 Table 11.19.2-2 "Conveyor Transfer Point Uncontrolled"
Ver 8/2004

E(TSP) =	0.00300	lbs/ton
E(PM10) =	0.00110	lbs/ton
E(PM2.5) =	0.00017	lbs/ton

Throughput	300.02	tph
	1100343.6	tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	0.90006	1.65052
E(pm10) Uncontrolled	0.33002	0.60519
E(pm2.5) Uncontrolled	0.05100	0.09353

%Control Efficiency	70	3/4 enclosed
	40	de-duster application - 9
	82	total control

	lb/hr	tons/yr	Model lbs/hr
E(tsp) Controlled	0.16201	1.65052	0.37683
E(pm10) Controlled	0.05940	0.60519	0.13817
E(pm2.5) Controlled	0.00918	0.09353	0.02135

Material Drop from SOP Storage Belt Tripper Conveyor to SOP Storage Bin (Granular, Standard, Soluble) (S141)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

AP-42 13.2.4 (11/06) E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton

k(tsp)	0.74		
k(pm10)	0.35		
k(pm2.5)	0.053		
U Maximum	11	MPH	NMED default
U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
M	0.3	%	

Max Hourly Emission Factors

E(TSP) =	0.09397	lbs/ton
E(PM10) =	0.04445	lbs/ton
E(PM2.5) =	0.00673	lbs/ton

Annual Emission Factors

E(TSP) =	0.04460	lbs/ton
E(PM10) =	0.02109	lbs/ton
E(PM2.5) =	0.00319	lbs/ton

Throughput	300.02	tph
	1100343.6	tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	28.19380	24.53581
E(pm10) Uncontrolled	13.33491	11.60478
E(pm2.5) Uncontrolled	2.01929	1.75729

%Control Efficiency	70	3/4 enclosed
	35	de-duster application - 10
	80.5	total control

	lb/hr	tons/yr	Model lbs/hr
E(tsp) Controlled	5.49779	4.78448	1.09235
E(pm10) Controlled	2.60031	2.26293	0.51665
E(pm2.5) Controlled	0.39376	0.34267	0.07824

Material Drop from SOP Storage Bin to SOP Reclaim Feeder (Granular, Standard, Soluble) (Front-end Loader) (S142)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
k(tsp)	0.74		
k(pm10)	0.35		
k(pm2.5)	0.053		
U Maximum	11	MPH	NMED default
U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
M	0.3	%	

Max Hourly Emission Factors

E(TSP) =	0.09397	lbs/ton
E(PM10) =	0.04445	lbs/ton
E(PM2.5) =	0.00673	lbs/ton

Annual Emission Factors

E(TSP) =	0.04460	lbs/ton
E(PM10) =	0.02109	lbs/ton
E(PM2.5) =	0.00319	lbs/ton

Throughput	361.21	tph
	1100343.6	tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	33.94401	24.53581
E(pm10) Uncontrolled	16.05460	11.60478
E(pm2.5) Uncontrolled	2.43113	1.75729

%Control Efficiency	70	3/4 enclosed
	30	de-duster application - 11
	79	total control

	lb/hr	tons/yr	Model lbs/hr
E(tsp) Controlled	7.12824	5.15252	1.17637
E(pm10) Controlled	3.37147	2.43700	0.55639
E(pm2.5) Controlled	0.51054	0.36903	0.08425

Material Drop from SOP Reclaim Feeder to SOP Reclaim Belt Conveyor (Granular, Standard, Soluble) (S143)

AP-42 Table 11.19.2-2 "Conveyor Transfer Point Uncontrolled"
Ver 8/2004

E(TSP) =	0.00300	lbs/ton
E(PM10) =	0.00110	lbs/ton
E(PM2.5) =	0.00017	lbs/ton

Throughput	361.21	tph
	1100343.6	tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	1.08363	4.74630
E(pm10) Uncontrolled	0.39733	1.74031
E(pm2.5) Uncontrolled	0.06141	0.26896

%Control Efficiency	70	3/4 enclosed
	25	de-duster application - 12
	77.5	total control

	lb/hr	tons/yr	Model lbs/hr
E(tsp) Controlled	0.24382	1.65052	0.37683
E(pm10) Controlled	0.08940	0.60519	0.13817
E(pm2.5) Controlled	0.01382	0.09353	0.02135

Material Drop from SOP (Granular, Standard, Soluble) Reclaim Belt Conveyor to SOP Reclaim Belt Conveyor (S144)

AP-42 Table 11.19.2-2 "Conveyor Transfer Point Uncontrolled"
Ver 8/2004

	E(TSP) =	0.00300	lbs/ton
	E(PM10) =	0.00110	lbs/ton
	E(PM2.5) =	0.00017	lbs/ton

Throughput	361.21	tph
	1100343.6	tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	1.08363	1.65052
E(pm10) Uncontrolled	0.39733	0.60519
E(pm2.5) Uncontrolled	0.06141	0.09353

%Control Efficiency	70	3/4 enclosed
	20	de-duster application - 13
	76	total control

	lb/hr	tons/yr	Model lbs/hr
E(tsp) Controlled	0.26007	1.65052	0.37683
E(pm10) Controlled	0.09536	0.60519	0.13817
E(pm2.5) Controlled	0.01474	0.09353	0.02135

Material Drop from SOP Reclaim Belt Conveyor to SOP Reclaim Bucket Elevator (Granular, Standard, Soluble) (S145)

AP-42 Table 11.19.2-2 "Conveyor Transfer Point Uncontrolled"
Ver 8/2004

	E(TSP) =	0.00300	lbs/ton
	E(PM10) =	0.00110	lbs/ton
	E(PM2.5) =	0.00017	lbs/ton

Throughput	361.21	tph
	1100343.6	tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	1.08363	1.65052
E(pm10) Uncontrolled	0.39733	0.60519
E(pm2.5) Uncontrolled	0.06141	0.09353

%Control Efficiency	70	3/4 enclosed
	15	de-duster application - 14
	74.5	total control

	lb/hr	tons/yr	Model lbs/hr
E(tsp) Controlled	0.27633	1.65052	0.37683
E(pm10) Controlled	0.10132	0.60519	0.13817
E(pm2.5) Controlled	0.01566	0.09353	0.02135

Material Drop from SOP Reclaim Bucket Elevator to SOP Reclaim Drag Conveyor(Granular, Standard, Soluble) (S146)

AP-42 Table 11.19.2-2 "Conveyor Transfer Point Uncontrolled"
Ver 8/2004

E(TSP) =	0.00300	lbs/ton
E(PM10) =	0.00110	lbs/ton
E(PM2.5) =	0.00017	lbs/ton

Throughput	361.21	tph
	1100343.6	tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	1.08363	1.65052
E(pm10) Uncontrolled	0.39733	0.60519
E(pm2.5) Uncontrolled	0.06141	0.09353

E(tsp) Controlled	PM Emissions Controlled with Jal Loadout Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Jal Loadout Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Jal Loadout Dust Collector

Material Drop from SOP Reclaim Drag Conveyor to Screens (Granular, Standard, Soluble) (S147)

AP-42 Table 11.19.2-2 "Fine Screening Uncontrolled"
Ver 8/2004

E(TSP) =	0.30000	lbs/ton
E(PM10) =	0.07200	lbs/ton
E(PM2.5) =	0.01091	lbs/ton

Throughput	361.21	tph
	1100343.6	tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	108.36300	165.05154
E(pm10) Uncontrolled	26.00712	39.61237
E(pm2.5) Uncontrolled	3.94047	6.00187

E(tsp) Controlled	PM Emissions Controlled with Jal Loadout Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Jal Loadout Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Jal Loadout Dust Collector

Material Drop from Screens (Granular, Standard, Soluble) to SOP Reclaim Loading Bin (S148, S149, S150)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
k(tsp)	0.74		
k(pm10)	0.35		
k(pm2.5)	0.053		
U Maximum	11	MPH	NMED default
U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
M	0.3	%	

Max Hourly Emission Factors

E(TSP) =	0.09397	lbs/ton
E(PM10) =	0.04445	lbs/ton
E(PM2.5) =	0.00673	lbs/ton

Annual Emission Factors

E(TSP) =	0.04460	lbs/ton
E(PM10) =	0.02109	lbs/ton
E(PM2.5) =	0.00319	lbs/ton

Throughput	350.38	tph
	1100343.6	tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	32.92628	24.53581
E(pm10) Uncontrolled	15.57324	11.60478
E(pm2.5) Uncontrolled	2.35823	1.75729

E(tsp) Controlled	PM Emissions Controlled with Jal Loadout Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Jal Loadout Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Jal Loadout Dust Collector

Material Drop from SOP Reclaim Loading Bin to SOP Drag Conveyor (S151)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
k(tsp)	0.74		
k(pm10)	0.35		
k(pm2.5)	0.053		
U Maximum	11	MPH	NMED default
U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
M	0.3	%	

Max Hourly Emission Factors

E(TSP) =	0.09397	lbs/ton
E(PM10) =	0.04445	lbs/ton
E(PM2.5) =	0.00673	lbs/ton

Annual Emission Factors

E(TSP) =	0.04460	lbs/ton
E(PM10) =	0.02109	lbs/ton
E(PM2.5) =	0.00319	lbs/ton

Throughput	602.18	tph
	1100343.6	tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	56.58870	24.53581
E(pm10) Uncontrolled	26.76493	11.60478
E(pm2.5) Uncontrolled	4.05297	1.75729

E(tsp) Controlled	PM Emissions Controlled with Jal Loadout Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Jal Loadout Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Jal Loadout Dust Collector

Material Drop from SOP Drag Conveyor to SOP Bucket Elevator (S152)

AP-42 Table 11.19.2-2 "Conveyor Transfer Point Uncontrolled"
Ver 8/2004

E(TSP) =	0.00300	lbs/ton
E(PM10) =	0.00110	lbs/ton
E(PM2.5) =	0.00017	lbs/ton

Throughput	602.18	tph
	1100343.6	tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	1.80654	1.65052
E(pm10) Uncontrolled	0.66240	0.60519
E(pm2.5) Uncontrolled	0.10237	0.09353

E(tsp) Controlled	PM Emissions Controlled with Jal Loadout Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Jal Loadout Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Jal Loadout Dust Collector

Material Drop from SOP Bucket Elevator to SOP Loading Bulk Weigher (S153)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
k(tsp)	0.74		
k(pm10)	0.35		
k(pm2.5)	0.053		
U Maximum	11	MPH	NMED default
U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
M	0.3	%	

Max Hourly Emission Factors

E(TSP) =	0.09397	lbs/ton
E(PM10) =	0.04445	lbs/ton
E(PM2.5) =	0.00673	lbs/ton

Annual Emission Factors

E(TSP) =	0.04460	lbs/ton
E(PM10) =	0.02109	lbs/ton
E(PM2.5) =	0.00319	lbs/ton

Throughput	602.18	tph
	1100343.6	tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	56.58870	24.53581
E(pm10) Uncontrolled	26.76493	11.60478
E(pm2.5) Uncontrolled	4.05297	1.75729

E(tsp) Controlled	PM Emissions Controlled with Jal Loadout Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Jal Loadout Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Jal Loadout Dust Collector

Material Drop from SOP Loading Bulk Weigher to SOP Rail Car (S154)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
k(tsp)	0.74		
k(pm10)	0.35		
k(pm2.5)	0.053		
U Maximum	11	MPH	NMED default
U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
M	0.3	%	

Max Hourly Emission Factors

E(TSP) =	0.09397	lbs/ton
E(PM10) =	0.04445	lbs/ton
E(PM2.5) =	0.00673	lbs/ton

Annual Emission Factors

E(TSP) =	0.04460	lbs/ton
E(PM10) =	0.02109	lbs/ton
E(PM2.5) =	0.00319	lbs/ton

Throughput	602.18	tph
	1100343.6	tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	56.58870	24.53581
E(pm10) Uncontrolled	26.76493	11.60478
E(pm2.5) Uncontrolled	4.05297	1.75729

Control Method Oil Additive -1 = 80.0 % CE

	lb/hr	tons/yr	Model lbs/hr
E(tsp) Controlled	11.31774	4.90716	1.12036
E(pm10) Controlled	5.35299	2.32096	0.52990
E(pm2.5) Controlled	0.81059	0.35146	0.08024

Material Drop from Screens (Granular, Standard, Soluble) to SOP Screw Conveyor (S148, S149, S150)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
k(tsp)	0.74		
k(pm10)	0.35		
k(pm2.5)	0.053		
U Maximum	11	MPH	NMED default
U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
M	0.3	%	

Max Hourly Emission Factors

E(TSP) =	0.09397	lbs/ton
E(PM10) =	0.04445	lbs/ton
E(PM2.5) =	0.00673	lbs/ton

Annual Emission Factors

E(TSP) =	0.04460	lbs/ton
E(PM10) =	0.02109	lbs/ton
E(PM2.5) =	0.00319	lbs/ton

Throughput	27.1	tph
	34473.6	tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	2.54667	0.76870
E(pm10) Uncontrolled	1.20451	0.36358
E(pm2.5) Uncontrolled	0.18240	0.05506

E(tsp) Controlled	PM Emissions Controlled with Jal Loadout Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Jal Loadout Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Jal Loadout Dust Collector

Material Drop from SOP Screw Conveyor to SOP Reclaim Off-size Bin (S155)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
k(tsp)	0.74		
k(pm10)	0.35		
k(pm2.5)	0.053		
U Maximum	11	MPH	NMED default
U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
M	0.3	%	

Max Hourly Emission Factors

E(TSP) =	0.09397	lbs/ton
E(PM10) =	0.04445	lbs/ton
E(PM2.5) =	0.00673	lbs/ton

Annual Emission Factors

E(TSP) =	0.04460	lbs/ton
E(PM10) =	0.02109	lbs/ton
E(PM2.5) =	0.00319	lbs/ton

Throughput	27.1	tph
	33010.308	tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	2.54667	0.73607
E(pm10) Uncontrolled	1.20451	0.34814
E(pm2.5) Uncontrolled	0.18240	0.05272

E(tsp) Controlled	PM Emissions Controlled with Jal Loadout Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Jal Loadout Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Jal Loadout Dust Collector

Material Drop from SOP Reclaim Off-size Bin to SOP Recycle Truck Return (S156)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
k(tsp)	0.74		
k(pm10)	0.35		
k(pm2.5)	0.053		
U Maximum	11	MPH	NMED default
U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
M	0.3	%	

Max Hourly Emission Factors

E(TSP) =	0.09397	lbs/ton
E(PM10) =	0.04445	lbs/ton
E(PM2.5) =	0.00673	lbs/ton

Annual Emission Factors

E(TSP) =	0.04460	lbs/ton
E(PM10) =	0.02109	lbs/ton
E(PM2.5) =	0.00319	lbs/ton

Throughput	301.09	tph
	33010.308	tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	28.29435	0.73607
E(pm10) Uncontrolled	13.38246	0.34814
E(pm2.5) Uncontrolled	2.02649	0.05272

Control Method Oil Additive -1 = 80.0 % CE

	lb/hr	tons/yr	Model lbs/hr
E(tsp) Controlled	5.65887	0.14721	0.03361
E(pm10) Controlled	2.67649	0.06963	0.01590
E(pm2.5) Controlled	0.40530	0.01054	0.00241

Langbeinite

Material Drop from Product Trucks to Granular Langbeinite Dump Hopper (S157)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
k(tsp)	0.74		
k(pm10)	0.35		
k(pm2.5)	0.053		
U Maximum	11	MPH	NMED default
U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
M	0.3	%	

Max Hourly Emission Factors

E(TSP) =	0.09397	lbs/ton
E(PM10) =	0.04445	lbs/ton
E(PM2.5) =	0.00673	lbs/ton

Annual Emission Factors

E(TSP) =	0.04460	lbs/ton
E(PM10) =	0.02109	lbs/ton
E(PM2.5) =	0.00319	lbs/ton

Throughput	300.02	tph
	373000.8	tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	28.19380	8.31729
E(pm10) Uncontrolled	13.33491	3.93385
E(pm2.5) Uncontrolled	2.01929	0.59570

%Control Efficiency	50	1/2 enclosed
	60	de-duster application - 5
	80	total control

	lb/hr	tons/yr	Model lbs/hr
E(tsp) Controlled	5.63876	1.66346	0.37978
E(pm10) Controlled	2.66698	0.78677	0.17963
E(pm2.5) Controlled	0.40386	0.11914	0.02720

Material Drop from Granular Langbeinite Dump Hopper to Granular Langbeinite Storage Belt Feeder (S158)

AP-42 Table 11.19.2-2 "Conveyor Transfer Point Uncontrolled"
Ver 8/2004

E(TSP) =	0.00300	lbs/ton
E(PM10) =	0.00110	lbs/ton
E(PM2.5) =	0.00017	lbs/ton

Throughput	300.02	tph
	373000.8	tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	0.90006	0.55950
E(pm10) Uncontrolled	0.33002	0.20515
E(pm2.5) Uncontrolled	0.05100	0.03171

%Control Efficiency	50	1/2 enclosed
	55	de-duster application - 6
	77.5	total control

	lb/hr	tons/yr	Model lbs/hr
E(tsp) Controlled	0.20251	0.55950	0.12774
E(pm10) Controlled	0.07425	0.20515	0.04684
E(pm2.5) Controlled	0.01148	0.03171	0.00724

Material Drop from Granular Langbeinite Storage Belt Feeder to Granular Langbeinite Storage Belt Conveyor (S159)

AP-42 Table 11.19.2-2 "Conveyor Transfer Point Uncontrolled"
Ver 8/2004

E(TSP) =	0.00300	lbs/ton
E(PM10) =	0.00110	lbs/ton
E(PM2.5) =	0.00017	lbs/ton

Throughput	300.02	tph
	373000.8	tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	0.90006	0.55950
E(pm10) Uncontrolled	0.33002	0.20515
E(pm2.5) Uncontrolled	0.05100	0.03171

%Control Efficiency	50	1/2 enclosed
	50	de-duster application - 7
	75	total control

	lb/hr	tons/yr	Model lbs/hr
E(tsp) Controlled	0.22502	0.55950	0.12774
E(pm10) Controlled	0.08251	0.20515	0.04684
E(pm2.5) Controlled	0.01275	0.03171	0.00724

Material Drop from Granular Langbeinite Storage Belt Conveyor to Granular Langbeinite Storage Bucket Elevator (S160)

AP-42 Table 11.19.2-2 "Conveyor Transfer Point Uncontrolled"
Ver 8/2004

E(TSP) =	0.00300	lbs/ton
E(PM10) =	0.00110	lbs/ton
E(PM2.5) =	0.00017	lbs/ton

Throughput	300.02	tph
	373000.8	tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	0.90006	0.55950
E(pm10) Uncontrolled	0.33002	0.20515
E(pm2.5) Uncontrolled	0.05100	0.03171

%Control Efficiency	70	3/4 enclosed
	45	de-duster application - 8
	83.5	total control

	lb/hr	tons/yr	Model lbs/hr
E(tsp) Controlled	0.14851	0.55950	0.12774
E(pm10) Controlled	0.05445	0.20515	0.04684
E(pm2.5) Controlled	0.00842	0.03171	0.00724

Material Drop from Granular Langbeinite Storage Bucket Elevator to Granular Langbeinite Storage Belt Conveyor with Plough (S161)

AP-42 Table 11.19.2-2 "Conveyor Transfer Point Uncontrolled"
Ver 8/2004

E(TSP) =	0.00300	lbs/ton
E(PM10) =	0.00110	lbs/ton
E(PM2.5) =	0.00017	lbs/ton

Throughput	300.02	tph
	373000.8	tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	0.90006	0.55950
E(pm10) Uncontrolled	0.33002	0.20515
E(pm2.5) Uncontrolled	0.05100	0.03171

%Control Efficiency	70	3/4 enclosed
	40	de-duster application - 9
	82	total control

	lb/hr	tons/yr	Model lbs/hr
E(tsp) Controlled	0.16201	0.55950	0.12774
E(pm10) Controlled	0.05940	0.20515	0.04684
E(pm2.5) Controlled	0.00918	0.03171	0.00724

Material Drop from Granular Granular Langbeinite Storage Belt Conveyor with Plough to Granular Langbeinite Storage Bin (S162)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

AP-42 13.2.4 (11/06) E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton

k(tsp)	0.74		
k(pm10)	0.35		
k(pm2.5)	0.053		
U Maximum	11	MPH	NMED default
U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
M	0.3	%	

Max Hourly Emission Factors

E(TSP) =	0.09397	lbs/ton
E(PM10) =	0.04445	lbs/ton
E(PM2.5) =	0.00673	lbs/ton

Annual Emission Factors

E(TSP) =	0.04460	lbs/ton
E(PM10) =	0.02109	lbs/ton
E(PM2.5) =	0.00319	lbs/ton

Throughput	300.02	tph
	373000.8	tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	28.19380	8.31729
E(pm10) Uncontrolled	13.33491	3.93385
E(pm2.5) Uncontrolled	2.01929	0.59570

%Control Efficiency	70	3/4 enclosed
	35	de-duster application - 10
	80.5	total control

	lb/hr	tons/yr	Model lbs/hr
E(tsp) Controlled	5.49779	1.62187	0.37029
E(pm10) Controlled	2.60031	0.76710	0.17514
E(pm2.5) Controlled	0.39376	0.11616	0.02652

Material Drop from Granular Langbeinite Storage Bin to Granular Langbeinite Reclaim Feeder (Front-end Loader) (S163)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
k(tsp)	0.74		
k(pm10)	0.35		
k(pm2.5)	0.053		
U Maximum	11	MPH	NMED default
U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
M	0.3	%	

Max Hourly Emission Factors

E(TSP) =	0.09397	lbs/ton
E(PM10) =	0.04445	lbs/ton
E(PM2.5) =	0.00673	lbs/ton

Annual Emission Factors

E(TSP) =	0.04460	lbs/ton
E(PM10) =	0.02109	lbs/ton
E(PM2.5) =	0.00319	lbs/ton

Throughput	361.21	tph
	373000.8	tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	33.94401	8.31729
E(pm10) Uncontrolled	16.05460	3.93385
E(pm2.5) Uncontrolled	2.43113	0.59570

%Control Efficiency	70	3/4 enclosed
	30	de-duster application - 11
	79	total control

	lb/hr	tons/yr	Model lbs/hr
E(tsp) Controlled	7.12824	1.74663	0.39877
E(pm10) Controlled	3.37147	0.82611	0.18861
E(pm2.5) Controlled	0.51054	0.12510	0.02856

Material Drop from Granular Langbeinite Reclaim Feeder to Granular Langbeinite Reclaim Belt Conveyor #1 or #2 (S164)

AP-42 Table 11.19.2-2 "Conveyor Transfer Point Uncontrolled"
Ver 8/2004

E(TSP) =	0.00300	lbs/ton
E(PM10) =	0.00110	lbs/ton
E(PM2.5) =	0.00017	lbs/ton

Throughput	361.21	tph
	373000.8	tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	1.08363	0.55950
E(pm10) Uncontrolled	0.39733	0.20515
E(pm2.5) Uncontrolled	0.06141	0.03171

%Control Efficiency	70	3/4 enclosed
	25	de-duster application - 12
	77.5	total control

	lb/hr	tons/yr	Model lbs/hr
E(tsp) Controlled	0.24382	0.55950	0.12774
E(pm10) Controlled	0.08940	0.20515	0.04684
E(pm2.5) Controlled	0.01382	0.03171	0.00724

Material Drop from Granular Langbeinite Reclaim Belt Conveyor #1 to Granular Langbeinite Reclaim Belt Conveyor #3 (S165)

AP-42 Table 11.19.2-2 "Conveyor Transfer Point Uncontrolled"
Ver 8/2004

E(TSP) =	0.00300	lbs/ton
E(PM10) =	0.00110	lbs/ton
E(PM2.5) =	0.00017	lbs/ton

Throughput	361.21	tph
	373000.8	tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	1.08363	0.55950
E(pm10) Uncontrolled	0.39733	0.20515
E(pm2.5) Uncontrolled	0.06141	0.03171

%Control Efficiency	70	3/4 enclosed
	20	de-duster application - 13
	76	total control

	lb/hr	tons/yr	Model lbs/hr
E(tsp) Controlled	0.26007	0.55950	0.12774
E(pm10) Controlled	0.09536	0.20515	0.04684
E(pm2.5) Controlled	0.01474	0.03171	0.00724

Material Drop from Granular Langbeinite Reclaim Belt Conveyor #2 or #3 to Granular Langbeinite Reclaim Bucket Elevator (S166A,B)

AP-42 Table 11.19.2-2 "Conveyor Transfer Point Uncontrolled"
Ver 8/2004

E(TSP) =	0.00300	lbs/ton
E(PM10) =	0.00110	lbs/ton
E(PM2.5) =	0.00017	lbs/ton

Throughput	361.21	tph
	373000.8	tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	1.08363	0.55950
E(pm10) Uncontrolled	0.39733	0.20515
E(pm2.5) Uncontrolled	0.06141	0.03171

%Control Efficiency	70	3/4 enclosed
	15	de-duster application - 14
	74.5	total control

	lb/hr	tons/yr	Model lbs/hr
E(tsp) Controlled	0.27633	0.55950	0.12774
E(pm10) Controlled	0.10132	0.20515	0.04684
E(pm2.5) Controlled	0.01566	0.03171	0.00724

Material Drop from Granular Langbeinite Reclaim Bucket Elevator to Granular Langbeinite Reclaim Multi-Deck Screen (S167)

AP-42 Table 11.19.2-2 "Fine Screening Uncontrolled"			lbs/ton
Ver 8/2004			lbs/ton
	E(TSP) =	0.30000	lbs/ton
	E(PM10) =	0.07200	
	E(PM2.5) =	0.01091	tph
			tpy
Throughput		361.21	
		373000.8	

	lb/hr	tons/yr
E(tsp) Uncontrolled	108.36300	55.95012
E(pm10) Uncontrolled	26.00712	13.42803
E(pm2.5) Uncontrolled	3.94047	2.03455

E(tsp) Controlled	PM Emissions Controlled with Jal Loadout Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Jal Loadout Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Jal Loadout Dust Collector

Material Drop from Granular Langbeinite Reclaim Multi-Deck Screen to Granular Langbeinite Reclaim Loading Bin (S168)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
k(tsp)	0.74		
k(pm10)	0.35		NMED default
k(pm2.5)	0.053		2004-2008 WIPP Site 10 Meter
U Maximum	11	MPH	
U Annual	6.2	MPH	
M	0.3	%	

Max Hourly Emission Factors

E(TSP) =	0.09397	lbs/ton
E(PM10) =	0.04445	lbs/ton
E(PM2.5) =	0.00673	lbs/ton

Annual Emission Factors

E(TSP) =	0.04460	lbs/ton
E(PM10) =	0.02109	lbs/ton
E(PM2.5) =	0.00319	lbs/ton

Throughput	350.83	tph
	373000.8	tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	32.96857	8.31729
E(pm10) Uncontrolled	15.59324	3.93385
E(pm2.5) Uncontrolled	2.36126	0.59570

E(tsp) Controlled	PM Emissions Controlled with Jal Loadout Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Jal Loadout Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Jal Loadout Dust Collector

Material Drop from Granular Langbeinite Reclaim Loading Bin to Granular Langbeinite Drag Conveyor (S169)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
k(tsp)	0.74		
k(pm10)	0.35		
k(pm2.5)	0.053		
U Maximum	11	MPH	NMED default
U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
M	0.3	%	

Max Hourly Emission Factors

E(TSP) =	0.09397	lbs/ton
E(PM10) =	0.04445	lbs/ton
E(PM2.5) =	0.00673	lbs/ton

Annual Emission Factors

E(TSP) =	0.04460	lbs/ton
E(PM10) =	0.02109	lbs/ton
E(PM2.5) =	0.00319	lbs/ton

Throughput	602.9	tph
	373000.8	tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	56.65636	8.31729
E(pm10) Uncontrolled	26.79693	3.93385
E(pm2.5) Uncontrolled	4.05782	0.59570

E(tsp) Controlled	PM Emissions Controlled with Jal Loadout Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Jal Loadout Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Jal Loadout Dust Collector

Material Drop from Granular Langbeinite Drag Conveyor to Granular Langbeinite Bucket Elevator (S170)

AP-42 Table 11.19.2-2 "Conveyor Transfer Point Uncontrolled"
Ver 8/2004

E(TSP) =	0.00300	lbs/ton
E(PM10) =	0.00110	lbs/ton
E(PM2.5) =	0.00017	lbs/ton

Throughput	602.9	tph
	373000.8	tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	1.80870	0.55950
E(pm10) Uncontrolled	0.66319	0.20515
E(pm2.5) Uncontrolled	0.10249	0.03171

E(tsp) Controlled	PM Emissions Controlled with Jal Loadout Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Jal Loadout Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Jal Loadout Dust Collector

<u>Material Drop from Granular Langbeinite Bucket Elevator to Granular Langbeinite Loading Bulk Weigher (S171)</u>

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
k(tsp)	0.74		
k(pm10)	0.35		
k(pm2.5)	0.053		
U Maximum	11	MPH	NMED default
U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
M	0.3	%	

Max Hourly Emission Factors

E(TSP) =	0.09397	lbs/ton
E(PM10) =	0.04445	lbs/ton
E(PM2.5) =	0.00673	lbs/ton

Annual Emission Factors

E(TSP) =	0.04460	lbs/ton
E(PM10) =	0.02109	lbs/ton
E(PM2.5) =	0.00319	lbs/ton

Throughput	602.9	tph
	373000.8	tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	56.65636	8.31729
E(pm10) Uncontrolled	26.79693	3.93385
E(pm2.5) Uncontrolled	4.05782	0.59570

E(tsp) Controlled	PM Emissions Controlled with Jal Loadout Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Jal Loadout Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Jal Loadout Dust Collector

Material Drop from Granular Langbeinite Loading Bulk Weigher to Granular Langbeinite Rail Car (S172)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
k(tsp)	0.74		
k(pm10)	0.35		
k(pm2.5)	0.053		
U Maximum	11	MPH	NMED default
U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
M	0.3	%	

Max Hourly Emission Factors

E(TSP) =	0.09397	lbs/ton
E(PM10) =	0.04445	lbs/ton
E(PM2.5) =	0.00673	lbs/ton

Annual Emission Factors

E(TSP) =	0.04460	lbs/ton
E(PM10) =	0.02109	lbs/ton
E(PM2.5) =	0.00319	lbs/ton

Throughput	602.9	tph
	373000.8	tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	56.65636	8.31729
E(pm10) Uncontrolled	26.79693	3.93385
E(pm2.5) Uncontrolled	4.05782	0.59570

Control Method Oil Additive -1 = 80.0

	lb/hr	tons/yr	Model lbs/hr
E(tsp) Controlled	11.33127	1.66346	0.37978
E(pm10) Controlled	5.35939	0.78677	0.17963
E(pm2.5) Controlled	0.81156	0.11914	0.02720

Material Drop from Granular Langbeinite Reclaim Multi-Deck Screen to Granular Langbeinite Reclaim Off-size Bin (S168)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
k(tsp)	0.74		
k(pm10)	0.35		NMED default
k(pm2.5)	0.053		2004-2008 WIPP Site 10 Meter
U Maximum	11	MPH	
U Annual	6.2	MPH	
M	0.3	%	

Max Hourly Emission Factors

E(TSP) =	0.09397	lbs/ton
E(PM10) =	0.04445	lbs/ton
E(PM2.5) =	0.00673	lbs/ton

Annual Emission Factors

E(TSP) =	0.04460	lbs/ton
E(PM10) =	0.02109	lbs/ton
E(PM2.5) =	0.00319	lbs/ton

Throughput	10.86	tph
	11190.024	tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	1.02055	0.24952
E(pm10) Uncontrolled	0.48269	0.11802
E(pm2.5) Uncontrolled	0.07309	0.01787

E(tsp) Controlled	PM Emissions Controlled with Jal Loadout Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Jal Loadout Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Jal Loadout Dust Collector

Material Drop from Granular Langbeinite Reclaim Off-size Bin to Granular Langbeinite Recycle Truck Return (S173)

AP-42 Section 13.2.4 "Aggregate Handling"
Ver 11/2006

AP-42 13.2.4 (11/06)	E = k x (0.0032) x (U/5)^1.3 / (M/2)^1.4 lbs/ton		
k(tsp)	0.74		
k(pm10)	0.35		
k(pm2.5)	0.053		
U Maximum	11	MPH	NMED default
U Annual	6.2	MPH	2004-2008 WIPP Site 10 Meter
M	0.3	%	

Max Hourly Emission Factors

E(TSP) =	0.09397	lbs/ton
E(PM10) =	0.04445	lbs/ton
E(PM2.5) =	0.00673	lbs/ton

Annual Emission Factors

E(TSP) =	0.04460	lbs/ton
E(PM10) =	0.02109	lbs/ton
E(PM2.5) =	0.00319	lbs/ton

Throughput	301.45	tph
	11190.024	tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	28.32818	0.24952
E(pm10) Uncontrolled	13.39846	0.11802
E(pm2.5) Uncontrolled	2.02891	0.01787

Control Method Oil Additive -1 = 80.0

	lb/hr	tons/yr	Model lbs/hr
E(tsp) Controlled	5.66564	0.04990	0.01139
E(pm10) Controlled	2.67969	0.02360	0.00539
E(pm2.5) Controlled	0.40578	0.00357	0.00082

Material Drop from Jal Loadout Area Dust Collector Fines to Granular Langbeinite Reclaim Off-size Bin (S174)

AP-42 Section 11.19.2-4 "Crushed Stone Processing and Pulverized Mineral Processing"
Ver 08/2004
Uncontrolled emission rates derived from "Product Storage with Fabric Filter" controlled emission rate and a 99.5% control efficiency from the

	Controlled		Uncontrolled	
E(TSP) =	0.00990	lbs/ton	1.98000	lbs/ton
E(PM10) =	0.00160	lbs/ton	0.32000	lbs/ton
E(PM2.5) =	0.00060	lbs/ton	0.12000	lbs/ton

	0.5	tph
	4380	tpy

	lb/hr	tons/yr
E(tsp) Uncontrolled	0.99000	4.34
E(pm10) Uncontrolled	0.16000	0.70
E(pm2.5) Uncontrolled	0.06000	0.26

E(tsp) Controlled	PM Emissions Controlled with Jal Loadout Dust Collector
E(pm10) Controlled	PM Emissions Controlled with Jal Loadout Dust Collector
E(pm2.5) Controlled	PM Emissions Controlled with Jal Loadout Dust Collector

Jal Loadout Dust Collector (STK11)

BACT **PM (Total)**

PM (Total) Controlled 0.005 gr/DSCF BACT

Exhaust Flowrate

36000 DSCFM

36000 ACFM

Uncontrolled Hours of Operation

8760 hr/yr

Controlled Hours of Operation

8760 hr/yr

	Uncontolled		Controlled	
Pollutant	**PPH**	**TPY**	**PPH**	**TPY**
PM (Total)			1.543	6.76

ICP Ochoa Polyhalite Plant - Wind Erosion Calculation Totals
EPA AP-42 Section 13.2.5

				TSP		PM10		PM2.5	
Emission Unit ID	**Source Description**	**Rated Capacity**	**Emission Calculation Method**	**(lbs/hr)**	**TPY**	**(lbs/hr)**	**TPY**	**(lbs/hr)**	**TPY**
S198	Temporary Polyhalite Stockpile Wind Erosion	8,330 sqmeters	AP42-13.2.5-2	0.039	0.17	0.019	0.085	0.0029	0.013
S199	Waste Stockpile Wind Erosion	17,569 sqmeters	AP42-13.2.5-2	0.082	0.36	0.041	0.18	0.0061	0.027
S180	Tailings Area Wind Erosion	1,364,145 sqmeters	AP42-13.2.5-2	2.0	8.9	1.0	4.4	0.15	0.67
				2.1	**9.4**	**1.1**	**4.7**	**0.16**	**0.71**

Facility will Permit Two Idential Steam Boilers (S196, S197) (STK12, STK13)
Boiler Burner
AP-42 Section 1.4 "Natural Gas Combustion" **SO2, CO2, Lead, Formaldehyde, Methane, N2O**
BACT **NOx, CO, PM (Total)**

Burner Maximum Rated Capacity
155.9 mmBTU/Hr (each)

Natural Gas LHV
946 Btu/standard cubic feet

Maximum Natural Gas Usage (each)
164799.1543 cubic feet/hr
0.164799154 million scf/hr 1443.640592 million scf/yr

Exhaust Flowrate
34474 DSCFM
62307 ACFM

Uncontrolled Hours of Operation
8760 hr/yr

Controlled Hours of Operation
8760 hr/yr

NOx	0.02	lbs/MMBtu	BACT
CO	0.037	lbs/MMBtu	BACT
SO2	0.6	lbs/MMSCF	AP-42 Section 1.4
VOC	5.5	lbs/MMSCF	AP-42 Section 1.4
PM	0.0052	lbs/MMBtu	BACT
CO2	116.9	lbs/MMBtu	BACT
Methane	0.002	lbs/MMBtu	BACT
N2O	0.0002	lbs/MMBtu	BACT
CO2e	117.004	lbs/MMBtu	BACT
Lead	0.0005	lbs/MMSCF	AP-42 Section 1.4

1 Unit

	Uncontolled		Controlled	
Pollutant	**PPH**	**TPY**	**PPH**	**TPY**
NOx	3.12	13.66	3.12	13.66
CO	5.77	25.27	5.77	25.27
SO2	0.10	0.43	0.10	0.43
VOC	0.91	3.97	0.91	3.97
PM	0.81	3.55	0.81	3.55
CO2	18224.71	79824.23	18224.71	79824.23
Methane	0.31	1.37	0.31	1.37
N2O	0.031	0.14	0.03	0.14
CO2e	18240.92	79895.25	18240.92	79895.25
Lead	0.000082	0.000361	0.000082	0.000361

Combined Boilers (2)

	Uncontolled		Controlled	
Pollutant	**PPH**	**TPY**	**PPH**	**TPY**
NOx	6.24	27.31	6.24	27.31
CO	11.54	50.53	11.54	50.53
SO2	0.20	0.87	0.20	0.87
VOC	1.81	7.94	1.81	7.94
PM	1.62	7.10	1.62	7.10
CO2	36449.42	159648.46	36449.42	159648.46
Methane	0.62	2.73	0.62	2.73
N2O	0.06	0.27	0.06	0.27
CO2e	36481.85	159790.49	36481.85	159790.49
Lead	0.00016	0.00072	0.00016	0.00072

Boiler Burner

AP-42 Section 1.4 "Natural Gas Combustion" Tables 1.4-3 and -4

Federal HAPs

ciated Organic Compo	Case #	Emission Factor (lbs/MMSCF)	Emission Rate (lbs/hr)	Emission Rate (tpy)	Total 2 Units Emission Rate (lbs/hr)	Total 2 Units Emission Rate (tpy)
Benzene	71-43-2	2.10E-03	3.46E-04	1.52E-03	6.92E-04	3.03E-03
Formaldehyde	50-00-0	7.50E-02	1.24E-02	5.41E-02	2.47E-02	1.08E-01
Naphthalene	91-20-3	6.10E-04	1.01E-04	4.40E-04	2.01E-04	8.81E-04
Toluene	108-88-3	3.40E-03	5.60E-04	2.45E-03	1.12E-03	4.91E-03

Metals	Case #	Emission Factor (lbs/MMSCF)	Emission Rate (lbs/hr)	Emission Rate (tpy)	Emission Rate (lbs/hr)	Emission Rate (tpy)
Arsenic	7440-38-2	2.00E-04	3.30E-05	1.44E-04	6.59E-05	2.89E-04
Beryllium	7440-41-7	1.20E-05	1.98E-06	8.66E-06	3.96E-06	1.73E-05
Cadmium	7440-43-9	1.10E-03	1.81E-04	7.94E-04	3.63E-04	1.59E-03
Chromium	7440-47-3	1.40E-03	2.31E-04	1.01E-03	4.61E-04	2.02E-03
Cobalt	7440-48-4	8.40E-05	1.38E-05	6.06E-05	2.77E-05	1.21E-04
Manganese	7439-96-5	3.80E-04	6.26E-05	2.74E-04	1.25E-04	5.49E-04
Mercury	7439-97-6	2.60E-04	4.28E-05	1.88E-04	8.57E-05	3.75E-04
Nickel	7440-02-0	2.10E-03	3.46E-04	1.52E-03	6.92E-04	3.03E-03
Selenium	7782-49-2	2.40E-05	3.96E-06	1.73E-05	7.91E-06	3.46E-05
		Total 1 Unit	**0.014**	**0.063**		
		Total 2 Units			**0.029**	**0.125**

State TAPs

Metals	Case #	Emission Factor (lbs/MMSCF)	Emission Rate (lbs/hr)	Emission Rate (tpy)	Emission Rate (lbs/hr)	Emission Rate (tpy)
Barium	7440-39-3	4.40E-03	7.25E-04	3.18E-03	1.45E-03	6.35E-03
Copper	7440-50-8	8.50E-04	1.40E-04	6.14E-04	2.80E-04	1.23E-03
Molybdenum	7439-98-7	1.10E-03	1.81E-04	7.94E-04	3.63E-04	1.59E-03
Vanadium	7440-62-2	2.30E-03	3.79E-04	1.66E-03	7.58E-04	3.32E-03
Zinc	7440-66-6	2.90E-02	4.78E-03	2.09E-02	9.56E-03	4.19E-02
		Total 1 Unit	**0.0062**	**0.027**		
		Total 2 Units			**0.012**	**0.054**

Air Stripper Bio-Trickling Filter (S200A,B) (STK14)
Mass Balance

H2S Concentration out of Air Stripper	=	2.7	lbs/min H2S
H2S Flowrate out of BioTrickling Filter	=	160000	ACFM
BioTrickling Filter Control	=	99	% removal

Mass Balance Calculations

lbs/hr = lbs/min * 60 min/hr

Uncontrolled Emission
lbs/hr = 162
ton/year = 710

Controlled Emission
lbs/hr = 1.620
ton/year = 7.10

Uncontrolled Facility Regulated Emission Rates

		NOx		CO		SO2		VOC		Lead		H2S		TSP		PM10		PM2.5		CO2		Methane		N2O		CO2e	
Unit ID	Unit Description	lbs/hr	tons/yr	lbs/hr	tons/yr	lbs/hr	tons/yr	lbs/hr	tons/yr	lbs/hr	tons/yr	lbs/hr	tons/yr	lbs/hr	tons/yr	lbs/hr	tons/yr	lbs/hr	tons/yr	lbs/hr	tons/yr	lbs/hr	tons/yr	lbs/hr	tons/yr	lbs/hr	tons/yr
S1	Belt Conveyor From U/G #1 drop to Belt Conveyor From U/G #2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.1	4.3	0.97	2.0	0.15	0.31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S2	Belt Conveyor From U/G #2 drop to Ore Storage Bypass Diverter Gate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.1	4.3	0.97	2.0	0.15	0.31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S3	Ore Storage Bypass Diverter Gate to Ore Storage Feed Drag Conveyor	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.1	4.3	0.97	2.0	0.15	0.31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S4	Ore Storage Feed Drag Conveyor Exit to Raw Ore Bin #1 and #2 Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.1	4.3	0.97	2.0	0.15	0.31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S5A,B	Raw Ore Bin #1 and #2 Exit to Storage Bin Unload Drag Conveyor	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.1	4.3	0.97	2.0	0.15	0.31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S6A,B	Ore Storage Drag Conveyor #1 and #2 to Belt Conveyor from Raw Ore Storage	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.1	4.3	0.97	2.0	0.15	0.31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S2	Belt Conveyor From U/G #2 drop to Ore Storage Bypass Diverter Gate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Emission rate calculated above						0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S3	Ore Storage Bypass Diverter Gate to Belt Conveyor from Raw Ore Storage	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Emission rate calculated above						0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S7	ROM Baghouse Fines Screw Conveyor to Belt Conveyor from Raw Ore Storage	Equipment part of control system and not a uncontrolled source																									
	Crushing Circuit																										
S8	Belt Conveyor from Raw Ore Storage to Ore Surge Bin	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.1	4.3	0.97	2.0	0.15	0.31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S9	Raw Ore Surge Bin to VFD Belt Feeder- Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.1	4.3	0.97	2.0	0.15	0.31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S10	VFD Belt Feeder- Exit to Raw Ore Roll Crusher	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.1	4.3	0.97	2.0	0.15	0.31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S11	Raw Ore Roll Crusher drop to Wet Sizing Screen Feed Pump Box	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	13	1.3	5.8	0.20	0.87	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S12	Wet Sizing Screen Feed Pump Box to Wet Sizing Screen Feed Pump Wet Sizing Screen Feed Pump to Wet Sizing Screen Wet Sizing Screens to Wet O/S Cage Mill Wet O/S Cage Mill to Wet Sizing Screen Feed Pump Box Wet Sizing Screens to Sodium Chloride Leach Tank	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	No PM Emissions Expect - Wet Processing of Crushed Ore						0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S13	Crusher Baghouse Fines Screw Conveyor to Wet Sizing Screen Feed Pump Box	Equipment part of control system and not a uncontrolled source																									
	Polyhalite Calcining Circuit																										
S14A,B	Sodium Chloride Wash Belt Filter #1 and #2 to Calciner Feed Surge Bin #1 and #2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.38	0.80	0.18	0.38	0.028	0.057	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S15A,B	Calciner Feed Surge Bin #1 and #2 to Calciner Feed Live Bottom Screw Conveyor #1 and #2 -Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.38	0.80	0.18	0.38	0.028	0.057	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S16A,B	Calciner Feed Live Bottom Screw Conveyor #1 and #2 - Exit to Calciner Feed Live Bottom Screw Conveyor #3 and #4 - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.38	0.80	0.18	0.38	0.028	0.057	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S17A,B	Calciner Feed Live Bottom Screw Conveyor #3 and #4 - Exit to Polyhalite Dryer/Calciner	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	243	505	115	239	17	36	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S18A,B,C	Polyhalite Dryer/Calciner/Cooler - 3 Units Total	27	118	24	104	0.41	1.8	3.7	16	0.00034	0.0015	0.0	0.0	12900	56502	12900	56502	12900	56502	75130	329071	1.3	5.6	0.13	0.56	75197	329364
S18A,B,C	Polyhalite Dryer/Calciner to Cooler Feed Bucket Elevator #1 and #2 -Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	909	3980	147	643	55	241	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S19A,B,C	Polyhalite Dryer/Calciner Cyclone (4) - Exit to Polyhalite Coolers (4)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	40	173	6.4	28	2.4	11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S20A, B	Cooler Feed Bucket Elevator #1 and #2 -Exit to Polyhalite Coolers (4)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	909	3980	147	643	55	241	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S21A,B,C	Polyhalite Coolers (4) to Calcined Polyhalite Screw Conveyor #1 - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	940	4116	152	665	57	249	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S22A,B,C	Polyhalite Coolers Cyclones (4) to Calcined Polyhalite Screw Conveyor #1 - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.5	37	1.4	6.0	0.52	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S23	Calcined Polyhalite Screw Conveyor #1 - Exit to Calcined Polyhalite Bucket Elevator - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	938	4110	152	664	57	249	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S24	Calcined Polyhalite Bucket Elevator - Exit to Calcined Polyhalite Surge Bin	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	938	4110	152	664	57	249	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S25	Calcined Polyhalite Surge Bin to Calcined Polyhalite Screw Conveyor #3 - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	938	4110	152	664	57	249	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S26	Calcined Polyhalite Screw Conveyor #3 - Exit to Calcined Polyhalite Belt Conveyor - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	938	4110	152	664	57	249	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S27	Calcined Polyhalite Belt Conveyor - Exit to Stage 1 Leach Pug Mixer	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	938	4110	152	664	57	249	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S28	Stage 1 Leach Pug Mixer to Leach Tanks	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	938	4110	152	664	57	249	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S30A,B,C	Calcined Baghouse Fines Screw Conveyor #1 - #4 - Exit to Polyhalite Coolers (4)	Equipment part of control system and not a uncontrolled source																									
	SOP Drying and Sizing Circuit																										
S32	SOP Centrifuge to Screw Feeder	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.20	0.42	0.096	0.20	0.015	0.030	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S33	Screw Feeder to SOP Product Dryer	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.20	0.42	0.096	0.20	0.015	0.030	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S34	SOP Product Dryer	0.79	3.4	0.69	3.0	0.012	0.052	0.11	0.48	0.0000099	0.000043	0.0	0.0	2160	9461	2160	9461	2160	9461	2191	9595	0.037	0.16	0.0037	0.016	2193	9604
S34	SOP Product Dryer to SOP Bucket Elevator #1 - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	192	843	31	136	12	51	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S35	SOP Product Dryer Cyclone to SOP Bucket Elevator #1 - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19	84	3.1	14	1.2	5.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S36	SOP Bucket Elevator #1 - Exit to SOP Product Column Cooler	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10	21	4.8	9.9	0.72	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S37	SOP Product Column Cooler to SOP Product Surge Bin	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10	21	4.8	9.9	0.72	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S38	SOP Product Surge Bin to SOP Product Surge Bin Screw Feeder - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10	22	5.0	10	0.75	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S39	SOP Product Surge Bin Screw Feeder - Exit to SOP Bucket Elevator #2 -Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10	22	5.0	10	0.75	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S40	SOP Bucket Elevator #2 - Exit to SOP Standard Multi-Deck Sizing Screen	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33	143	7.9	34	0.53	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S41	SOP Standard Multi-Deck Sizing Screen O/S to Standard SOP Single Stage Roller Crusher	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.39	1.7	0.15	0.66	0.0088	0.039	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S42	Standard SOP Single Stage Roller Crusher to SOP O/S Crusher Recycle Screw Conveyor -Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	2.0	0.4	0.9	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S43	SOP O/S Crusher Recycle Screw Conveyor - Exit to SOP Product Surge Bin	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	2.0	0.4	0.9	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S41	SOP Standard Multi-Deck Sizing Screen U/S to SOP Bucket Elevator #3 - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	2.4	0.56	1.2	0.084	0.18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S44	SOP Bucket Elevator #3 -Exit to Soluble SOP Multi-Deck Sizing Screen	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.8	16	0.90	4.0	0.061	0.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S45	Soluble SOP Multi-Deck Sizing Screen O/S and U/S to SOP Fines Belt Conveyor - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.016	0.033	0.0076	0.016	0.0011	0.0024	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S45	Soluble SOP Multi-Deck Sizing Screen to Soluble SOP Transfer Belt Conveyor - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	2.4	0.55	1.1	0.083	0.17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

S46	Soluble SOP Transfer Belt Conveyor - Exit to Soluble SOP Splitter Gate - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	2.4	0.55	1.1	0.083	0.17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S47	Soluble SOP Splitter Gate - Exit to Soluble SOP Transfer Belt Conveyor - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00094	0.00020	0.00044	0.000092	0.000067	0.000014	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S47	Soluble SOP Splitter Gate - Exit to Soluble SOP Dedusting Screw Conveyor - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	2.4	0.55	1.1	0.083	0.17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S48	Soluble SOP Dedusting Screw Conveyor - Exit to SOP Bucket Elevator #5 - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	2.4	0.55	1.1	0.083	0.17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S49	SOP Bucket Elevator #5 - Exit to Soluable SOP Belt Conveyor - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	2.4	0.55	1.1	0.083	0.17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S41	SOP Standard Multi-Deck Sizing Screen to SOP Standard Splitter Gate #1 - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.0	19	4.2	8.8	0.64	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S50	SOP Standard Splitter Gate #1 - Exit to Standard SOP Screw Conveyor - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.5	9.5	2.2	4.5	0.33	0.68	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S51	Standard SOP Screw Conveyor - Exit to SOP Fines Belt Conveyor	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.5	9.5	2.2	4.5	0.33	0.68	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S50	SOP Standard Splitter Gate #1 - Exit to SOP Standard Splitter Gate #2 - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.4	13	3.0	6.3	0.46	0.96	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S52	SOP Standard Splitter Gate #2 - Exit to Standard SOP Single Stage Roll Crusher	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	5.9	0.33	1.4	0.022	0.10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S53	Standard SOP Single Stage Roll Crusher to SOP Bucket Elevator #2 - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.42	0.88	0.20	0.42	0.030	0.063	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S52	SOP Standard Splitter Gate #2 - Exit to Standard SOP Dedusting Screw Conveyor - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.0	12	2.8	5.9	0.43	0.89	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S54	Standard SOP Dedusting Screw Conveyor - Exit to SOP Bucket Elevator #4 - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.0	12	2.8	5.9	0.43	0.89	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S55	SOP Bucket Elevator #4 - Exit to Standard SOP Belt Conveyor - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.0	12	2.8	5.9	0.43	0.89	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S56	Truck Unload SOP Fines Return from Jal to SOP Fines Return Dump Hopper	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.028	0.059	0.013	0.028	0.0020	0.0042	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S57	SOP Fines Return Dump Hopper to SOP Fines Return Belt Feeder	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.028	0.059	0.013	0.028	0.0020	0.0042	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S58	SOP Fines Return Belt Feeder to SOP Fines Return Belt Conveyor	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.028	0.059	0.013	0.028	0.0020	0.0042	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S59	SOP Fines Return Belt Conveyor to SOP Fines Belt Conveyor	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.028	0.059	0.013	0.028	0.0020	0.0042	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S60	SOP Fines Belt Conveyor - Exit to SOP Granulation Feed Bucket Elevator #1 - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.6	9.5	2.2	4.5	0.33	0.68	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	SOP Granulation Circuit																										
S61	SOP Granulation Feed Bucket Elevator #1 - Exit to SOP Recycle Bin #1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.6	9.5	2.2	4.5	0.33	0.68	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S62	SOP Recycle Bin #1 to SOP Granulation Splitter Gate - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.6	9.5	2.2	4.5	0.33	0.68	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S63	SOP Granulation Splitter Gate - Exit to SOP Fine Grinding Mill Feed Screw Conveyor -Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	2.8	0.65	1.3	0.10	0.20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S64	SOP Fine Grinding Mill Feed Screw Conveyor -Exit to SOP Vertical Fine Grinding Mill	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	29	126	4.7	20	1.7	7.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S65	SOP Vertical Fine Grinding Mill to SOP Fine Grinding Mill Dry Cyclone	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	118	516	99	433	35.3	154	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S66	SOP Fine Grinding Mill Dry Cyclone to SOP Recycle Bin #4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	29	126	4.7	20	1.7	7.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S66	SOP Fine Grinding Mill Dry Cyclone to SOP Fine Grinding Mill	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	29	126	4.7	20	1.7	7.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S67	SOP Recycle Bin #4 to SOP Granulation Feed Bucket Elevator #2 -Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	29	126	4.7	20	1.7	7.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S63	SOP Granulation Splitter Gate - Exit to SOP Granulation Feed Bucket Elevator #2 -Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.2	6.6	1.5	3.1	0.23	0.48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S68	SOP Granulation Feed Bucket Elevator #2 -Exit to SOP Granulation Feed Screw Conveyor -Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14	28	6.4	13	0.97	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S69A,B	SOP Granulation Feed Screw Conveyor -Exit to SOP Granulation Pin Mixer #1 and #2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.70	1.4	0.33	0.69	0.050	0.10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Binder to SOP Granulation Pin Mixer #1 and #2	Not a source of emissions. Equipment adds binder in the form of a solution to the SOP granulation material.																									
S70A,B	SOP Granulation Pin Mixer #1 and #2 to SOP Disc Granulator #1 and #2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.71	1.5	0.34	0.70	0.051	0.11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S71A,B	SOP Disc Granulator #1 and #2 to SOP Granulator Product Belt Conveyor - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.71	1.5	0.34	0.70	0.051	0.11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S72	SOP Granulator Product Belt Conveyor - Exit to SOP Granulation Dryer	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.71	1.5	0.34	0.70	0.051	0.11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S73A,B	SOP Granulation Dryer	1.4	6.1	1.2	5.4	0.021	0.092	0.19	0.84	0.000017	0.000077	0.0	0.0	4960	21725	4960	21725	4960	21725	3867	16938	0.066	0.29	0.0066	0.029	3870	16953
S73A,B	SOP Granulation Dryer to SOP Granulation Dryer Bucket Elevator -Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	284	1243	46	201	17	75	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S74	SOP Granulation Dryer Bucket Elevator -Exit to SOP Granulation Cooler Unit	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13	28	6.4	13	0.96	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S75	SOP Granulation Cooler Unit to SOP Granulation Cooler Bucket Elevator - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13	28	6.4	13	0.96	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S76	SOP Granulation Cooler Bucket Elevator - Exit to SOP Granulation Splitter Gate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13	28	6.3	13	0.95	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S77	SOP Granulation Splitter Gate to SOP Granulation Sizing Screens #1 and #2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	43	186	10	45	0.70	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S78A,B	SOP Granulation Sizing Screens #1 and #2 U/S to SOP Product Screening Belt Conveyor	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8	3.8	0.87	1.8	0.13	0.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S78A,B	SOP Granulation Sizing Screens #1 and #2 O/S to SOP Single Stage Roll Crusher #1 and #2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.0	35	1.9	8.4	0.13	0.57	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S79A,B	SOP Single Stage Roll Crusher #1 and #2 to SOP Product Screening Belt Conveyor	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	5.2	1.2	2.5	0.18	0.37	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S80	SOP Product Screening Belt Conveyor to SOP Recycle Bin #5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.0	19	4.3	8.9	0.64	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S81	SOP Recycle Bin #5 to SOP Granulation Feed Bucket Elevator #2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.0	19	4.3	8.9	0.64	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S78A,B	SOP Granulation Sizing Screens #1 and #2 to SOP Granular Product Screw Conveyor - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.6	9.7	2.2	4.6	0.33	0.69	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S82	SOP Granular Product Screw Conveyor - Exit to SOP Granular Product Bucket Elevator - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.6	9.7	2.2	4.6	0.33	0.69	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S83	SOP Granular Product Bucket Elevator - Exit to Granular SOP Belt Conveyor -Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.6	9.7	2.2	4.6	0.33	0.69	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S84	SOP Product Dryer Dust Collector Fines Screw Conveyor to SOP Dust Screw Conveyor	Equipment part of control system and not a uncontrolled source																									
S85	SOP Granulation Dryer Dust Collector Fines Screw Conveyor to SOP Dust Screw Conveyor	Equipment part of control system and not a uncontrolled source																									
S86	SOP Area Dust Collector Fines Screw Conveyor to SOP Dust Screw Conveyor	Equipment part of control system and not a uncontrolled source																									
S87	SOP Dust Screw Conveyor to SOP Product Screening Belt Conveyor	Equipment part of control system and not a uncontrolled source																									

	Lang Drying and Sizing Circuit																										
S88	Langbeinite Crystallization to Screw Feeder	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.081	0.17	0.038	0.079	0.0058	0.012	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S89	Screw Feeder to Langbeinite Product Dryer	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.081	0.17	0.038	0.079	0.0058	0.012	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S90	Langbeinite Product Dryer	0.43	1.9	0.38	1.7	0.0066	0.029	0.060	0.26	0.0000055	0.000024	0.0	0.0	80	350	80	350	80	350	1210	5299	0.021	0.091	0.0021	0.0091	1211	5304
S90	Langbeinite Product Dryer to Langbeinite Screw Conveyor	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	83	363	13	59	5.0	22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S91	Langbeinite Screw Conveyor to Langbeinite Compaction Pug Mixer	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.9	8.2	1.9	3.9	0.28	0.59	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Binder to Langbeinite Compaction Pug Mixer	Not a source of emissions. Equipment adds binder in the form of a solution to the Langbeinite material.																									
S92	Truck Unload Langbeinite Returns from Jal to Langbeinite Fines Return Dump Hopper	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.028	0.059	0.013	0.028	0.0020	0.0042	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S93	Langbeinite Fines Return Dump Hopper to Langbeinite Fines Return Belt Feeder	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.028	0.059	0.013	0.028	0.0020	0.0042	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S94	Langbeinite Fines Return Belt Feeder to Langbeinite Fines Return Belt Conveyor	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.028	0.059	0.013	0.028	0.0020	0.0042	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S95	Langbeinite Fines Return Belt Conveyor to Langbeinite Compaction Pug Mixer	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.028	0.059	0.013	0.028	0.0020	0.0042	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S96	Langbeinite Compaction Pug Mixer to Langbeinite Compaction Feed Bucket Elevator - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16	33	7.4	15	1.1	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S97	Langbeinite Compaction Feed Bucket Elevator - Exit to Langbeinite Compactor Feed Surge Bin	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16	33	7.4	15	1.1	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S98	Langbeinite Compactor Feed Surge Bin to Langbeinite Compactor	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16	33	7.4	15	1.1	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S99	Langbeinite Compactor to Lagbeinite Flake Breaker	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16	33	7.4	15	1.1	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S100	Langbeinite Flake Breaker to Langbeinite Compactor Outlet Belt Conveyor	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16	33	7.4	15	1.1	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S101	Langbeinite Compactor Outlet Belt Conveyor to Langbeinite Compactor Outlet Bucket Elevator - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	57	119	27	56	4.1	8.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S102	Langbeinite Compactor Outlet Bucket Elevator - Exit to Langbeinte Compaction Splitter Gate - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	57	119	27	56	4.1	8.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S103	Langbeinte Compaction Splitter Gate - Exit to Langbeinite Compaction Sizing Screen #1 and #2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	182	798	44	191	3.0	13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S104A,B	Langbeinite Compaction Sizing Screen #1 and #2 U/S to Langbeinite Compaction Drag Conveyor - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11	22	5.1	11	0.77	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S105	Langbeinite Compaction Drag Conveyor - Exit to Langbeinite Compaction Pug Mixer	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11	22	5.1	11	0.77	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S104A,B	Langbeinite Compaction Sizing Screen #1 and #2 O/S to Langbeinite Compaction Screw Conveyor #2 - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	32	6.7	15	3.2	2.3	0.48	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S106A,B	Langbeinite Compaction Screw Conveyor #2 - Exit to Langbeinite Cage Pactor #1 and #2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	41	86	20	41	3.0	6.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S107A,B	Langbeinite Cage Pactor #1 and #2 to Langbeinite Compaction Outlet Belt Conveyor - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	41	86	20	41	3.0	6.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S104A,B	Langbeinite Compaction Sizing Screen #1 and #2 to Langbeinite Conditioning Drum Feed Belt Conveyor - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13	28	6.4	13	0.96	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S108	Langbeinite Conditioning Drum Feed Belt Conveyor - Exit to Langbeinite Product Conditioning Drum Bucket Elevator - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13	28	6.4	13	0.96	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S109	Langbeinite Product Conditioning Drum Bucket Elevator - Exit to Langbeinite Conditioning Surge Bin	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13	28	6.4	13	0.96	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S110	Langbeinite Conditioning Surge Bin to Langbeinite Conditioning Drum Screw Feeder - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13	28	6.4	13	0.96	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S111	Langbeinite Conditioning Drum Screw Feeder - Exit to Conditioning Drum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13	28	6.4	13	0.96	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Conditioning Solution to Conditioning Drum	Not a source of emissions. Equipment adds solution to the Langbeinite material.																									
S112	Conditioning Drum to Langbeinite Glazing/Conditioning Dryer	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	2.7	0.62	1.3	0.094	0.19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S113	Langbeinite Glazing/Conditioning Dryer	0.084	0.37	0.074	0.32	0.0013	0.0056	0.012	0.051	0.0000011	0.0000046	0.0	0.0	40	175	40	175	40	175	234	1024	0.0040	0.018	0.00040	0.0018	234	1025
S113	Langbeinite Glazing/Conditioning Dryer to Langbeinite Compaction Dryer Outlet Belt Conveyor	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	280	1228	45	198	17	74	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S114	Langbeinite Glazing/Conditioning Dryer Cyclone to Langbeinite Compaction Dryer Outlet Belt Conveyor	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.14	0.29	0.066	0.14	0.010	0.021	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S115	Langbeinite Compaction Dryer Outlet Belt Conveyor - Exit to Langbeinite Compaction Product Bucket Elevator - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	13	28	6.4	13	0.96	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S116	Langbeinite Compaction Product Bucket Elevator - Exit to Langbeinite Compaction Product Screen	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	43	188	10	45	0.70	3.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S117	Langbeinite Compaction Product Screen O/S to Langbeinite Compaction Screw Conveyor #2 - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.0	19	4.3	8.8	0.64	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S117	Langbeinite Compaction Product Screen U/S to Langbeinite Compaction Drag Conveyor - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.44	0.92	0.21	0.44	0.032	0.066	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S117	Langbeinite Compaction Product Screen to Langbeinite Product De-Dusting Screw Conveyor - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	8.3	1.9	3.9	0.29	0.60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S118	Langbeinite Product De-Dusting Screw Conveyor - Exit to Langbeinite Product Bucket Elevator - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	8.3	1.9	3.9	0.29	0.60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S119	Langbeinite Product Bucket Elevator - Exit to Granular Langbeinite Belt Conveyor -Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	8.3	1.9	3.9	0.29	0.60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S120	Langbeinite Product Dryer Dust Collector Fines Screw Conveyor to Langbeinite Compaction Drag Conveyor - Entrance	Equipment part of control system and not a uncontrolled source																									
S121	Langbeinite Area Dust Collector Fines Screw Conveyor to Langbeinite Compaction Drag Conveyor - Entrance	Equipment part of control system and not a uncontrolled source																									
S122	Langbeinite Compaction Dust Collector Fines Screw Conveyor to Langbeinite Compaction Drag Conveyor - Entrance	Equipment part of control system and not a uncontrolled source																									
S123	Langbeinite Glazing/Conditioning Dust Collector Fines Screw Conveyor to Langbeinite Compaction Dryer Outlet Belt Conveyor - Entrance	Equipment part of control system and not a uncontrolled source																									

	Product Loading Circuit																										
S124	Granular SOP Belt Conveyor - Exit to Granular SOP Loading Bin	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.6	9.7	2.2	4.6	0.33	0.69	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S125	Granular SOP Loading Bin to Granular SOP Loading Bulk Weigher	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.6	9.7	2.2	4.6	0.33	0.69	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S126	Granular SOP Loading Bulk Weigher to Product Truck Loading	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24	9.7	11	4.6	1.7	0.69	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S127	Standard SOP Belt Conveyor - Exit to Standard SOP Loading Bin	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.0	12	2.8	5.9	0.43	0.89	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S128	Standard SOP Loading Bin to Standard SOP Loading Bulk Weigher	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.0	12	2.8	5.9	0.43	0.89	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S129	Standard SOP Loading Bulk Weigher to Product Truck Loading	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24	12	11	5.9	1.7	0.89	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S130	Soluable SOP Belt Conveyor - Exit to Soluable SOP Loading Bin	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	2.4	0.55	1.1	0.083	0.17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S131	Soluable SOP Loading Bin to Soluable SOP Loading Bulk Weigher	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	2.4	0.55	1.1	0.083	0.17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S132	Soluable SOP Loading Bulk Weigher to Product Truck Loading	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24	2.4	11	1.1	1.7	0.17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S133	Granular Langbeinite Belt Conveyor - Exit to Granular Langbeinite Loading Bin	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	8.3	1.9	3.9	0.29	0.60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S134	Granular Langbeinite Loading Bin to Granular Langbeinite Loading Bulk Weigher	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	8.3	1.9	3.9	0.29	0.60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S135	Granular Langbeinite Loading Bulk Weigher to Product Truck Loading	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24	8.3	11	3.9	1.7	0.60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Jal Loadout SOP Circuit																										
S136	SOP Product Truck Unload to SOP Dump Hopper	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	28	25	13	12	2.0	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S137	SOP Dump Hopper to SOP Storage Belt Feeder - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.90	1.7	0.33	0.61	0.051	0.094	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S138	SOP Storage Belt Feeder - Exit to SOP Storage Belt Conveyor - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.90	1.7	0.33	0.61	0.051	0.094	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S139	SOP Storage Belt Conveyor - Exit to SOP Storage Bucket Elevator - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.90	1.7	0.33	0.61	0.051	0.094	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S140	SOP Storage Bucket Elevator - Exit to SOP Storage Belt Tripper Conveyor	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.90	1.7	0.33	0.61	0.051	0.094	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S141	SOP Storage Belt Tripper Conveyor to SOP Storage Bin Building	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	28	25	13	12	2.0	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S142	SOP Storage Bin Building to SOP Feed Hoppers (Front-end Loader)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	34	25	16	12	2.4	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S143	SOP Feed Hoppers to Soluable SOP Reclaim Belt Feeder - Entrance or SOP Feed Hoppers to Granular SOP Reclaim Belt Feeder - Entrance or SOP Feed Hoppers to Standard SOP Reclaim Belt Feeder - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	4.7	0.40	1.7	0.061	0.27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S144A,B	Soluable SOP Reclaim Belt Feeder - Exit to SOP Reclaim Belt Conveyor - Entrance or Granular SOP Reclaim Belt Feeder - Exit to SOP Reclaim Belt Conveyor - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	1.7	0.40	0.61	0.061	0.094	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	and																										
S145A,B	SOP Reclaim Belt Conveyor - Exit to Reclaim Bucket Elevator - Entrance or Standard SOP Reclaim Belt Conveyor to Reclaim Bucket Elevator - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	1.7	0.40	0.61	0.061	0.094	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S146	Reclaim Bucket Elevator - Exit to SOP Reclaim Drag Conveyor - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	1.7	0.40	0.61	0.061	0.094	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S147	SOP Reclaim Drag Conveyor - Exit to Soluable SOP Reclaim Scalping Screen SOP Reclaim Drag Conveyor - Exit to Standard SOP Reclaim Multi-deck Screen SOP Reclaim Drag Conveyor - Exit to Granular SOP Reclaim Multi-deck Screen	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	108	165	26	40	3.9	6.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S148	Soluable SOP Reclaim Scalping Screen to SOP Reclaim Loading Bin	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33	25	16	12	2.4	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S149	Soluable SOP Reclaim Scalping Screen O/S to SOP Screw Conveyor - Entrance Standard SOP Reclaim Multi-deck Screen to SOP Reclaim Loading Bin Standard SOP Reclaim Multi-deck Screen O/S to SOP Screw Conveyor - Entrance Standard SOP Reclaim Multi-deck Screen U/S to SOP Screw Conveyor - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35	25	17	12	2.5	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S150	Granular SOP Reclaim Multi-deck Screen to SOP Reclaim Loading Bin Granular SOP Reclaim Multi-deck Screen O/S to SOP Screw Conveyor - Entrance Granular SOP Reclaim Multi-deck Screen U/S to SOP Screw Conveyor - Entrance																										
S151	SOP Reclaim Loading Bin to SOP Drag Conveyor - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	57	25	27	12	4.1	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S152	SOP Drag Conveyor - Exit to SOP Bucket Elevator - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8	1.7	0.66	0.61	0.10	0.094	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S153	SOP Bucket Elevator - Exit to SOP Loading Bulk Weigher	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	57	25	27	12	4.1	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S154	SOP Loading Bulk Weigher to Railcar Loading	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	57	25	27	12	4.1	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S155	SOP Screw Conveyor - Exit to SOP Reclaim Off-Size Bin	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	0.74	1.2	0.35	0.18	0.053	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S156	SOP Reclaim Off-Size Bin to Recycle Trucks Return to Ochoa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	28	0.74	13	0.35	2.0	0.053	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

		NOx		CO		SO2		VOC		Lead		H2S		TSP		PM10		PM2.5		CO2		Methane		N2O		CO2e	
	Langbeinite Circuit																										
S157	Granular Langbeinite Product Truck Unload to Langbeinite Dump Hopper	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	28	8.3	13	3.9	2.0	0.596	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S158	Granular Langbeinite Dump Hopper to Granular Langbeinite Storage Belt Feeder	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.90	0.56	0.33	0.21	0.051	0.032	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S159	Granular Langbeinite Storage Belt Feeder to Granular Langbeinite Storage Belt Conveyor - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.90	0.56	0.33	0.21	0.051	0.032	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S160	Granular Langbeinite Storage Belt Conveyor - Exit to Granular Langbeinite Storage Bucket Elevator	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.90	0.56	0.33	0.21	0.051	0.032	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S161	Granular Langbeinite Storage Bucket Elevator - Exit to Granular Langbeinite Storage Belt Conveyor with Plough - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.90	0.56	0.33	0.21	0.051	0.032	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S162	Granular Langbeinite Storage Belt Conveyor with Plough to Granular Langbeinite Storage Bin Building	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	28	8.3	13	3.9	2.0	0.60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S163	Granular Langbeinite Storage Bin Building to Granular Langbeinite Feed Hoppers (Front-end Loader)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	34	8.3	16	3.9	2.4	0.60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S164	Granular Langbeinite Feed Hoppers to Granular Langbeinite Reclaim Belt Conveyor #1 - Entrance Granular Langbeinite Feed Hoppers to Granular Langbeinite Reclaim Belt Conveyor #2 - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.56	0.40	0.21	0.061	0.032	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S165	Granular Langbeinite Reclaim Belt Conveyor #1 - Exit to Granular Langbeinite Reclaim Belt Conveyor #3 - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.56	0.40	0.21	0.061	0.032	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S166A,B	Granular Langbeinite Reclaim Belt Conveyor #2 - Exit to Granular Langbeinite Reclaim Storage Bucket Elevator - Entrance Granular Langbeinite Reclaim Belt Conveyor #3 - Exit to Granular Langbeinite Reclaim Storage Bucket Elevator - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.56	0.40	0.21	0.061	0.032	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S167	Granular Langbeinite Reclaim Bucket Elevator - Exit to Granular Langbeinite Reclaim Multi-deck Screen	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	108	56	26	13	3.9	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S168	Granular Langbeinite Reclaim Multi-deck Screen O/S to Granular Langbeinite Reclaim Off-Size Bin Granular Langbeinite Reclaim Multi-deck Screen U/S to Granular Langbeinite Reclaim Off-Size Bin Granular Langbeinite Reclaim Multi-deck Screen to Granular Langbeinite Reclaim Loading Bin	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	34	8.6	16	4.1	2.4	0.61	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S169	Granular Langbeinite Loading Bin to Granular Langbeinite Drag Conveyor - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	57	8.3	27	3.9	4.1	0.60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S170	Granular Langbeinite Drag Conveyor - Exit to Granular Langbeinite Bucket Elevator - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8	0.56	0.66	0.21	0.10	0.032	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S171	Granular Langbeinite Bucket Elevator - Exit to Granular Langbeinite Loading Bulk Weigher	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	57	8.3	27	3.9	4.1	0.60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S172	Granular Langbeinite Loading Bulk Weigher to Railcar Loading	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	57	8.3	27	3.9	4.1	0.60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S173	Granular Langbeinite Reclaim Off-Size Bin to Recycle Trucks Return to Ochoa	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	28	0.25	13	0.12	2.0	0.018	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S174	Jal Loadout Dust Collector Fines Screw Conveyor to Granular Langbeinite Reclaim Off-Size Bin	Equipment part of control system and not a uncontrolled source																									
	Gypsum Waste and Tailing Circuit																										
S175	Stage 2 Leach Belt Conveyor to Gypsum Surge Bin	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.089	0.18	0.042	0.087	0.0064	0.013	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S176	Gypsum Surge Bin to Gypsum Screw Conveyor	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.089	0.18	0.042	0.087	0.0064	0.013	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S177	Gypsum Screw Conveyor to Gypsum Haul Trucks	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.089	0.18	0.042	0.087	0.0064	0.013	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S178	Gypsum Haul Trucks Unload to Gypsum Stockpile	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.089	0.18	0.042	0.087	0.0064	0.013	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S179	Gypsum Stockpile - Bulldozer	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.3	9.5	0.98	2.2	0.46	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S180	Gypsum Stockpile Wind Erosion	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	8.9	1.0	4.4	0.15	0.67	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Additives																										
	SOP Binder																										
S181	SOP Binder Bulk Bags to SOP Binder Feed Hopper	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.058	0.12	0.028	0.057	0.0042	0.0087	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S182	SOP Binder Feed Hopper to SOP Binder Metering Screw - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.058	0.12	0.028	0.057	0.0042	0.0087	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Langbeinite Binder																										
S183	Langbeinite Binder Bulk Bags to Langbeinite Binder Feed Hopper	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.058	0.12	0.028	0.057	0.0042	0.0087	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S184	Langbeinite Binder Feed Hopper to Langbeinite Binder Metering Screw - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.058	0.12	0.028	0.057	0.0042	0.0087	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Flocculant																										
S185	Flocculant Bulk Bags to Leaching Circuit Flocculent Feed Hopper	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.058	0.12	0.028	0.057	0.0042	0.0087	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S186	Leaching Circuit Flocculent Feed Hopper to Leaching Circuit Flocculent Metering Screw - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.058	0.12	0.028	0.057	0.0042	0.0087	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Sodium Chloride Wash Flocculant																										
S187	Sodium Chloride Wash Flocculant Bulk Bags to Sodium Chloride Wash Flocculant Feed Hopper	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.058	0.12	0.028	0.057	0.0042	0.0087	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S188	Sodium Chloride Wash Flocculant Feed Hopper to Sodium Chloride Wash Flocculant Metering Screw - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.058	0.12	0.028	0.057	0.0042	0.0087	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Truck Traffic																										
S189	Product Truck Traffic Ochoa Plant to Jal Loadout	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	10.5	0.50	2.1	0.12	0.52	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S190	Recycle Truck Traffic Ochoa Plant from Jal Loadout	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.075	0.31	0.015	0.063	0.0037	0.015	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S191	Additive Truck Traffic to Ochoa Plant	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.031	0.13	0.0061	0.025	0.0015	0.0063	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S192	Equipment Truck Traffic to Ochoa Plant	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	12	0.84	3.1	0.084	0.31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S193	De-Duster Truck Traffic to Ochoa Plant	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	12	0.84	3.1	0.084	0.31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S194	Gypsum Haul Trucks to Gypsum Stockpile	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	198	723	50	184	5.0	18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S195	Truck Traffic at Jal Loadout	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	173	633	44	161	4.4	16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Boilers																										
S196	Boiler 1	3.1	14	5.8	25	0.099	0.43	0.91	4.0	0.000082	0.00036	0.0	0.0	0.81	3.6	0.81	3.6	0.81	3.6	18225	79824	0.31	1.4	0.031	0.14	18241	79895
S197	Boiler 2	3.1	14	5.8	25	0.099	0.43	0.91	4.0	0.000082	0.00036	0.0	0.0	0.81	3.6	0.81	3.6	0.81	3.6	18225	79824	0.31	1.4	0.031	0.14	18241	79895
	Wind Erosion Storage Piles																										
S198	Temporary Polyhalite Stockpile Wind Erosion	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.039	0.17	0.019	0.085	0.0029	0.013	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S199	Waste Stockpile Wind Erosion	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.082	0.36	0.041	0.18	0.0061	0.027	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Water Treatment																										
S200A,B	Air Stripper	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	162	710	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Total	**36**	**157**	**38**	**165**	**0.65**	**2.8**	**5.9**	**26**	**0.00054**	**0.0024**	**162**	**710**	**32319**	**135162**	**22805**	**97100**	**20894**	**91098**	**119081**	**521576**	**2.0**	**8.9**	**0.20**	**0.89**	**119187**	**522040**

Controlled Facility Regulated Emission Rates

		NOx		CO		SO2		VOC		Lead		H2S		TSP		PM10		PM2.5		CO2		Methane		N2O		CO2e	
Unit ID	Unit Description	lbs/hr	tons/yr	lbs/hr	tons/yr	lbs/hr	tons/yr	lbs/hr	tons/yr	lbs/hr	tons/yr	lbs/hr	tons/yr	lbs/hr	tons/yr	lbs/hr	tons/yr	lbs/hr	tons/yr	lbs/hr	tons/yr	lbs/hr	tons/yr	lbs/hr	tons/yr	lbs/hr	tons/yr
	Raw Ore Handling Circuit																										
S1	Belt Conveyor From U/G #1 drop to Belt Conveyor From U/G #2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.31	0.64	0.15	0.30	0.022	0.046	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S2	Belt Conveyor From U/G #2 drop to Ore Storage Bypass Diverter Gate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.31	0.64	0.15	0.30	0.022	0.046	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STK1	ROM Area Dust Collector	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.21	0.94	0.21	0.94	0.21	0.94	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Crushing Circuit																										
STK2	Crusher Area Dust Collector	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.60	2.6	0.60	2.6	0.60	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Polyhalite Circuit																										
STK3A,B,C	Polyhalite Dryer/Calciner/Cooler with Dust Collector - 3 Units Total	27	118	24	104	0.41	1.8	3.7	16	0.00034	0.0015	0.0	0.0	19	81	19	81	19	81	75130	329071	1.3	5.6	0.13	0.56	75197	329364
	SOP Product Circuit																										
STK4	SOP Product Dryer and Dust Collector	0.79	3.4	0.69	3.0	0.012	0.052	0.11	0.48	0.000010	0.000043	0.0	0.0	0.64	2.8	0.64	2.8	0.64	2.8	2191	9595	0.037	0.16	0.0037	0.016	2193	9604
STK5	SOP Area Dust Collector	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.8	8.0	1.8	8.0	1.8	8.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S56	Truck Unload SOP Fines Return from Jal to SOP Fines Return Dump Hopper	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0035	0.0073	0.0017	0.0035	0.00025	0.00052	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S57	SOP Fines Return Dump Hopper to SOP Fines Belt Feeder	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0042	0.0088	0.0020	0.0042	0.00030	0.00063	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STK6	SOP Granulator Dryer with Dust Collector	1.4	6.1	1.2	5.4	0.021	0.092	0.19	0.84	0.000017	0.000077	0.0	0.0	1.1	4.6	1.1	4.6	1.1	4.6	3867	16938	0.066	0.29	0.0066	0.029	3870	16953
	Langbeinite Product Circuit																										
STK7	Langbeinite Product Dryer with Dust Collector	0.43	1.9	0.38	1.7	0.0066	0.029	0.060	0.26	0.0000055	0.000024	0.0	0.0	0.40	1.8	0.40	1.8	0.40	1.8	1210	5299	0.021	0.09	0.0021	0.0091	1211	5304
STK8	Langbeinite Area Dust Collector	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.76	3.3	0.76	3.3	0.76	3.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S92	Truck Unload Langbeinite Returns from Jal to Langbeinite Fines Return Dump Hopper	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0035	0.0073	0.0017	0.0035	0.00025	0.00052	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S93	Langbeinite Fines Return Dump Hopper to Langbeinite Fines Returns Belt Feeder	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0042	0.0088	0.0020	0.0042	0.00030	0.00063	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STK9	Lang Compactor Dust Collector	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.69	3.0	0.69	3.0	0.69	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STK10	Lang Granulator Glazer/Conditioner Unit with Dust Collector	0.084	0.37	0.074	0.32	0.0013	0.0056	0.012	0.051	0.0000011	0.0000046	0.0	0.0	0.62	2.7	0.62	2.7	0.62	2.7	234	1024	0.00040	0.0018	0.00040	0.0018	234	1025
	Product Loading Circuit																										
S126	Granular SOP Loading Bulk Weigher to Product Truck Loading	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.5	1.4	1.7	0.69	0.25	0.10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S129	Standard SOP Loading Bulk Weigher to Product Truck Loading	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.5	1.9	1.7	0.88	0.25	0.13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S132	Soluable SOP Loading Bulk Weigher to Product Truck Loading	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.5	0.36	1.7	0.17	0.25	0.026	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S135	Granular Langbeinite Loading Bulk Weigher to Product Truck Loading	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.5	1.2	1.7	0.59	0.25	0.089	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Additives																										
S181	SOP Binder Bulk Bags to SOP Binder Feed Hopper	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0087	0.018	0.0041	0.0086	0.00063	0.0013	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S182	SOP Binder Feed Hopper to SOP Binder Metering Screw - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0087	0.018	0.0041	0.0086	0.00063	0.0013	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S183	Langbeinite Binder to Langbeinite Binder Feed Hopper	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0087	0.018	0.0041	0.0086	0.00063	0.0013	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S184	Langbeinite Binder Feed Hopper to Langbeinite Binder Metering Screw	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0087	0.018	0.0041	0.0086	0.00063	0.0013	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S185	Flocculant Bulk Bags to Leaching Circuit Flocculent Feed Hopper	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0087	0.018	0.0041	0.0086	0.00063	0.0013	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S186	Leaching Circuit Flocculent Feed Hopper to Leaching Circuit Flocculent Metering Screw - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0087	0.018	0.0041	0.0086	0.00063	0.0013	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S187	Sodium Chloride Wash Flocculant Bulk Bags to Sodium Chloride Wash Flocculant Feed Hopper	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0087	0.018	0.0041	0.0086	0.00063	0.0013	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S188	Sodium Chloride Wash Flocculant Feed Hopper to Sodium Chloride Wash Flocculant Metering Screw - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0087	0.018	0.0041	0.0086	0.00063	0.0013	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	SOP Jal Loading Circuit																										
S136	SOP Product Truck Traffic to SOP Dump Hopper	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.6	4.9	2.7	2.3	0.40	0.35	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S137	SOP Dump Hopper to SOP Storage Belt Feeder - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.20	1.7	0.074	0.61	0.011	0.094	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S138	SOP Storage Belt Feeder - Exit to SOP Storage Belt Conveyor - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.23	1.7	0.083	0.61	0.013	0.094	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S139	SOP Storage Belt Conveyor - Exit to SOP Storage Bucket Elevator - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.15	1.7	0.054	0.61	0.0084	0.094	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S140	SOP Storage Bucket Elevator - Exit to SOP Storage Belt Tripper Conveyor	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.16	1.7	0.059	0.61	0.0092	0.094	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S141	SOP Storage Belt Tripper Conveyor to SOP Storage Bin Building	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.5	4.8	2.6	2.3	0.39	0.34	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S142	SOP Storage Bin Building to SOP Feed Hoppers (Front-end Loader)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.1	5.2	3.4	2.4	0.51	0.37	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S143	SOP Feed Hoppers to Soluable SOP Reclaim Belt Feeder - Entrance or SOP Feed Hoppers to Granular SOP Reclaim Belt Feeder - Entrance or SOP Feed Hoppers to Standard SOP Reclaim Belt Feeder - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.24	1.7	0.089	0.61	0.014	0.094	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S144	Soluable SOP Reclaim Belt Feeder - Exit to SOP Reclaim Belt Conveyor - Entrance or Granular SOP Reclaim Belt Feeder - Exit to SOP Reclaim Belt Conveyor - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.26	1.7	0.095	0.61	0.015	0.094	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	and																										
S145	SOP Reclaim Belt Conveyor - Exit to Reclaim Bucket Elevator - Entrance or Standard SOP Reclaim Belt Conveyor to Reclaim Bucket Elevator - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.28	1.7	0.10	0.61	0.016	0.094	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S154	SOP Loading Bulk Weigher to Railcar Loading	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11	4.9	5.4	2.3	0.81	0.35	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S156	SOP Reclaim Off-size Bin to SOP Recycle Truck Return	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.7	0.15	2.7	0.070	0.41	0.011	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

		NOx	CO	SO2	VOC	Lead	H2S	TSP	PM10	PM2.5	CO2	Methane	N2O	CO2e
	Langbeinite Jal Loading Circuit													
S157	Granular Langbeinite Product Truck Unload to Langbeinite Dump Hopper	0.0	0.0	0.0	0.0	0.0	0.0	5.6	1.7	2.7	0.79	0.40	0.12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S158	Granular Langbeinite Dump Hopper to Granular Langbeinite Storage Belt Feeder	0.0	0.0	0.0	0.0	0.0	0.0	0.20	0.56	0.074	0.21	0.011	0.032	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S159	Granular Langbeinite Storage Belt Feeder to Granular Langbeinite Storage Belt Conveyor - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.23	0.56	0.083	0.21	0.013	0.032	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S160	Granular Langbeinite Storage Belt Conveyor - Exit to Granular Langbeinite Storage Bucket Elevator	0.0	0.0	0.0	0.0	0.0	0.0	0.15	0.56	0.054	0.21	0.0084	0.032	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S161	Granular Langbeinite Storage Bucket Elevator - Exit to Granular Langbeinite Storage Belt Conveyor with Plough - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.16	0.56	0.059	0.21	0.0092	0.032	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S162	Granular Langbeinite Storage Belt Conveyor with Plough to Granular Langbeinite Storage Bin Building	0.0	0.0	0.0	0.0	0.0	0.0	5.5	1.6	2.6	0.77	0.39	0.12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S163	Granular Langbeinite Storage Bin Building to Granular Langbeinite Feed Hoppers (Front-end Loader)	0.0	0.0	0.0	0.0	0.0	0.0	7.1	1.7	3.4	0.83	0.51	0.13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S164	Granular Langbeinite Feed Hoppers to Granular Langbeinite Reclaim Belt Conveyor #1 - Entrance Granular Langbeinite Feed Hoppers to Granular Langbeinite Reclaim Belt Conveyor #2 - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.24	0.56	0.089	0.21	0.014	0.032	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S165	Granular Langbeinite Reclaim Belt Conveyor #1 - Exit to Granular Langbeinite Reclaim Belt Conveyor #3 - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.26	0.56	0.10	0.21	0.015	0.032	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S166A,B	Granular Langbeinite Reclaim Belt Conveyor #2 - Exit to Granular Langbeinite Reclaim Storage Bucket Elevator - Entrance Granular Langbeinite Reclaim Belt Conveyor #3 - Exit to Granular Langbeinite Reclaim Storage Bucket Elevator - Entrance	0.0	0.0	0.0	0.0	0.0	0.0	0.28	0.56	0.10	0.21	0.016	0.032	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S172	Granular Langbeinite Loading Bulk Weigher to Railcar Loading	0.0	0.0	0.0	0.0	0.0	0.0	11	1.7	5.4	0.79	0.81	0.12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S173	Granular Langbeinite Reclaim Off-Size Bin to Recycle Trucks Return to Ochoa	0.0	0.0	0.0	0.0	0.0	0.0	5.7	0.050	2.7	0.024	0.41	0.0036	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STK11	Jal Loadout Area Dust Collector	0.0	0.0	0.0	0.0	0.0	0.0	1.5	6.8	1.5	6.8	1.5	6.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Ochoa Waste Handling Circuit													
S175	Stage 2 Leach Belt Conveyor to Gypsum Surge Bin	0.0	0.0	0.0	0.0	0.0	0.0	0.013	0.028	0.0063	0.013	0.0010	0.0020	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S176	Gypsum Surge Bin to Gypsum Screw Conveyor	0.0	0.0	0.0	0.0	0.0	0.0	0.013	0.028	0.0063	0.013	0.0010	0.0020	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S177	Gypsum Screw Conveyor to Gypsum Haul Trucks	0.0	0.0	0.0	0.0	0.0	0.0	0.089	0.18	0.042	0.087	0.0064	0.013	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S178	Gypsum Haul Trucks Unload to Gypsum Stockpile	0.0	0.0	0.0	0.0	0.0	0.0	0.089	0.18	0.042	0.087	0.0064	0.013	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S179	Gypsum Stockpile - Bulldozer	0.0	0.0	0.0	0.0	0.0	0.0	4.3	9.5	0.98	2.2	0.46	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S180	Gypsum Stockpile Wind Erosion	0.0	0.0	0.0	0.0	0.0	0.0	2.0	8.9	1.0	4.4	0.15	0.67	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Truck Traffic													
S189	Product Truck Traffic Ochoa Plant to Jal Loadout	0.0	0.0	0.0	0.0	0.0	0.0	2.5	10	0.50	2.1	0.12	0.52	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S190	Recycle Truck Traffic Ochoa Plant from Jal Loadout	0.0	0.0	0.0	0.0	0.0	0.0	0.075	0.31	0.015	0.063	0.0037	0.015	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S191	Additive Truck Traffic to Ochoa Plant	0.0	0.0	0.0	0.0	0.0	0.0	0.031	0.13	0.0061	0.025	0.0015	0.0063	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S192	Equipment Truck Traffic to Ochoa Plant	0.0	0.0	0.0	0.0	0.0	0.0	0.33	1.2	0.084	0.31	0.0084	0.031	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S193	De-Duster Truck Traffic to Ochoa Plant	0.0	0.0	0.0	0.0	0.0	0.0	0.33	1.2	0.084	0.31	0.0084	0.031	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S194	Gypsum Haul Trucks to Gypsum Stockpile	0.0	0.0	0.0	0.0	0.0	0.0	20	72	5.0	18	0.50	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S195	Truck Traffic at Jal Loadout	0.0	0.0	0.0	0.0	0.0	0.0	17	63	4.4	16	0.44	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Boilers													
STK12 (S196)	Boiler 1	3.1	14	5.8	25	0.099	0.43	0.91	4.0	0.000082	0.00036	0.0	0.0	0.81	3.6	0.81	3.6	0.81	3.6	18225	79824	0.31	1.4	0.031	0.14	18241	79895
STK13 (S197)	Boiler 2	3.1	14	5.8	25	0.099	0.43	0.91	4.0	0.000082	0.00036	0.0	0.0	0.81	3.6	0.81	3.6	0.81	3.6	18225	79824	0.31	1.4	0.031	0.14	18241	79895
	Wind Erosion Storage Piles													
S198	Temporary Polyhalite Stockpile Wind Erosion	0.0	0.0	0.0	0.0	0.0	0.0	0.039	0.17	0.019	0.085	0.0029	0.013	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S199	Waste Stockpile Wind Erosion	0.0	0.0	0.0	0.0	0.0	0.0	0.082	0.36	0.041	0.18	0.0061	0.027	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Water Treatment													
STK14 (S200A,B)	Air Stripper - BioTrickling Filter	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Total	**36**	**157**	**38**	**165**	**0.65**	**2.8**	**5.9**	**26**	**0.00054**	**0.0024**	**1.6**	**7.1**	**164**	**342**	**82**	**191**	**37**	**134**	**119081**	**521576**	**2.0**	**8.9**	**0.20**	**0.89**	**119187**	**522040**

Controlled Facility Regulated HAPs Emission Rates

		Benzene		Formaldehyde		Naphthalene		Toluene		Arsenic		Beryllium		Cadmium		Chromium		Cobalt		Mangenese		Mercury		Nickel		Selenium	
Unit ID	Unit Description	lbs/hr	tons/yr	lbs/hr	tons/yr	lbs/hr	tons/yr	lbs/hr	tons/yr	lbs/hr	tons/yr	lbs/hr	tons/yr	lbs/hr	tons/yr	lbs/hr	tons/yr	lbs/hr	tons/yr	lbs/hr	tons/yr	lbs/hr	tons/yr	lbs/hr	tons/yr	lbs/hr	tons/yr
	Polyhalite Circuit																										
STK3A,B,C	Polyhalite Dryer/Calciner/Cooler with Dust Collector - 3 Units Total	1.4E-03	6.2E-03	5.1E-02	2.2E-01	4.1E-04	1.8E-03	2.3E-03	1.0E-02	1.4E-04	6.0E-04	8.2E-06	3.6E-05	7.5E-04	3.3E-03	9.5E-04	4.2E-03	5.7E-05	2.5E-04	2.6E-04	1.1E-03	1.8E-04	7.7E-04	1.4E-03	6.2E-03	1.6E-05	7.1E-05
	SOP Product Circuit																										
STK4	SOP Product Dryer and Dust Collector	4.2E-05	1.8E-04	1.5E-03	6.5E-03	1.2E-05	5.3E-05	6.7E-05	3.0E-04	4.0E-06	1.7E-05	2.4E-07	1.0E-06	2.2E-05	9.5E-05	2.8E-05	1.2E-04	1.7E-06	7.3E-06	7.5E-06	3.3E-05	5.2E-06	2.3E-05	4.2E-05	1.8E-04	4.8E-07	2.1E-06
STK6A,B	SOP Granulator Dryer with Dust Collector	7.3E-05	3.2E-04	2.6E-03	1.1E-02	2.1E-05	9.3E-05	1.2E-04	5.2E-04	7.0E-06	3.1E-05	4.2E-07	1.8E-06	3.8E-05	1.7E-04	4.9E-05	2.1E-04	2.9E-06	1.3E-05	1.3E-05	5.8E-05	9.1E-06	4.0E-05	7.3E-05	3.2E-04	8.4E-07	3.7E-06
	Langbeinite Product Circuit																										
STK7	Langbeinite Product Dryer with Dust Collector	2.3E-05	1.0E-04	8.2E-04	3.6E-03	6.7E-06	2.9E-05	3.7E-05	1.6E-04	2.2E-06	9.6E-06	1.3E-07	5.8E-07	1.2E-05	5.3E-05	1.5E-05	6.7E-05	9.2E-07	4.0E-06	4.2E-06	1.8E-05	2.8E-06	1.2E-05	2.3E-05	1.0E-04	2.6E-07	1.2E-06
STK10	Lang Granulator Glazer/Conditioner Unit with Dust Collector	4.4E-06	1.9E-05	1.6E-04	6.9E-04	1.3E-06	5.6E-06	7.2E-06	3.1E-05	4.2E-07	1.9E-06	2.5E-08	1.1E-07	2.3E-06	1.0E-05	3.0E-06	1.3E-05	1.8E-07	7.8E-07	8.0E-07	3.5E-06	5.5E-07	2.4E-06	4.4E-06	1.9E-05	5.1E-08	2.2E-07
	Boilers																										
STK12 (S198)	Boiler 1	3.5E-04	1.5E-03	1.2E-02	5.4E-02	1.0E-04	4.4E-04	5.6E-04	2.5E-03	3.3E-05	1.4E-04	2.0E-06	8.7E-06	1.8E-04	7.9E-04	2.3E-04	1.0E-03	1.4E-05	6.1E-05	6.3E-05	2.7E-04	4.3E-05	1.9E-04	3.5E-04	1.5E-03	4.0E-06	1.7E-05
STK13 (S199)	Boiler 2	3.5E-04	1.5E-03	1.2E-02	5.4E-02	1.0E-04	4.4E-04	5.6E-04	2.5E-03	3.3E-05	1.4E-04	2.0E-06	8.7E-06	1.8E-04	7.9E-04	2.3E-04	1.0E-03	1.4E-05	6.1E-05	6.3E-05	2.7E-04	4.3E-05	1.9E-04	3.5E-04	1.5E-03	4.0E-06	1.7E-05
	Total	**2.3E-03**	**9.9E-03**	**8.1E-02**	**3.5E-01**	**6.6E-04**	**2.9E-03**	**3.7E-03**	**1.6E-02**	**2.2E-04**	**9.4E-04**	**1.3E-05**	**5.7E-05**	**1.2E-03**	**5.2E-03**	**1.5E-03**	**6.6E-03**	**9.0E-05**	**4.0E-04**	**4.1E-04**	**1.8E-03**	**2.8E-04**	**1.2E-03**	**2.3E-03**	**9.9E-03**	**2.6E-05**	**1.1E-04**
		Benzene		**Formaldehyde**		**Naphthalene**		**Toluene**		**Arsenic**		**Beryllium**		**Cadmium**		**Chromium**		**Cobalt**		**Mangenese**		**Mercury**		**Nickel**		**Selenium**	
Total Facility Wide HAPs		**0.093**	**0.41**																								

Controlled Facility Regulated State TAPs Emission Rates

		Barium		Copper		Molybdenum		Vanadium		Zinc	
Unit ID	Unit Description	lbs/hr	tons/yr	lbs/hr	tons/yr	lbs/hr	tons/yr	lbs/hr	tons/yr	lbs/hr	tons/yr
	Polyhalite Circuit										
STK3A,B,C	Polyhalite Dryer/Calciner/Cooler with Dust Collector - 3 Units Total	3.0E-03	1.3E-02	5.8E-04	2.5E-03	7.5E-04	3.3E-03	1.6E-03	6.8E-03	2.0E-02	8.6E-02
	SOP Product Circuit										
STK4	SOP Product Dryer and Dust Collector	8.7E-05	3.8E-04	1.7E-05	7.4E-05	2.2E-05	9.5E-05	4.6E-05	2.0E-04	5.7E-04	2.5E-03
STK6A,B	SOP Granulator Dryer with Dust Collector	1.5E-04	6.7E-04	3.0E-05	1.3E-04	3.8E-05	1.7E-04	8.0E-05	3.5E-04	1.0E-03	4.4E-03
	Langbeinite Product Circuit										
STK7	Langbeinite Product Dryer with Dust Collector	4.8E-05	2.1E-04	9.3E-06	4.1E-05	1.2E-05	5.3E-05	2.5E-05	1.1E-04	3.2E-04	1.4E-03
STK10	Lang Granulator Glazer/Conditioner Unit with Dust Collector	9.3E-06	4.1E-05	1.8E-06	7.9E-06	2.3E-06	1.0E-05	4.9E-06	2.1E-05	6.1E-05	2.7E-04
	Boilers										
STK12 (S198)	Boiler 1	7.3E-04	3.2E-03	1.4E-04	6.1E-04	1.8E-04	7.9E-04	3.8E-04	1.7E-03	4.8E-03	2.1E-02
STK13 (S199)	Boiler 2	7.3E-04	3.2E-03	1.4E-04	6.1E-04	1.8E-04	7.9E-04	3.8E-04	1.7E-03	4.8E-03	2.1E-02
	Total	**4.7E-03**	**2.1E-02**	**9.2E-04**	**4.0E-03**	**1.2E-03**	**5.2E-03**	**2.5E-03**	**1.1E-02**	**3.1E-02**	**1.4E-01**
		Barium		**Copper**		**Molybdenum**		**Vanadium**		**Zinc**	

Section 3

Application Summary

The **Application Summary** shall include a brief description of the facility and its process, the type of permit application, the applicable regulation (i.e. 20.2.72.200.A.X, or 20.2.73 NMAC) under which the application is being submitted, and any air quality permit numbers associated with this site. If this facility is to be collocated with another facility, provide details of the other facility including permit number(s). In case of a revision or modification to a facility, provide the lowest level regulatory citation (i.e. 20.2.72.219.B.1.d NMAC) under which the revision or modification is being requested. Also describe the proposed changes from the original permit, how the proposed modification will effect the facility's operations and emissions, de-bottlenecking impacts, and changes to the facility's major/minor status (both PSD & Title V).

Routine or predictable emissions during Startup, Shutdown, and Maintenance (SSM): Provide an overview of how SSM emissions are accounted for in this application. Refer to "Guidance for Submittal of Startup, Shutdown, Maintenance Emissions in Permit Applications (http://www.nmenv.state.nm.us/aqb/permit/app_form.html) for more detailed instructions on SSM emissions.

Intercontinental Potash Corp. (USA) (ICP) is proposing to develop a new mine in southeastern Lea County, New Mexico to extract polyhalite ore for the production of sulphate of potash (SOP) and sulphate of potash magnesia (SOPM or langbeinite) for use as fertilizer. There are two primary operations to get the ore to a finished fertilizer product. The first operation is to mine raw polyhalite approximately 1,500 feet underground in the Rustler Formation. Once mined, the polyhalite is transported by underground and covered conveyor to the processing facilities at the surface where it is crushed, ground, washed, calcined, leached, crystallized, and granulated to produce SOP and SOPM, the saleable products. The final product would be moved by truck to a load-out facility near Jal, New Mexico, to be loaded on trains and shipped to distributors selling to farmers. Water used in the production will be pre-treated then piped to a Groundwater Pre-Treatment Plant to be located at the processing facilities from a location 12 miles east of the processing facilities.

This Prevention of Signification Deterioration (PSD) application is being submitted under the 20.2.74.200 "Permits – PSD" New Mexico Administrative Code (NMAC) regulation. The proposed Ochoa Project would be a major source for greenhouse gases (GHGs).

The proposed Ochoa Project will be located in Lea County that is part of the Pecos-Permian Basin Intrastate Air Quality Control Region (AQCR) 155 under the jurisdiction of the New Mexico Environment Department (NMED). AQCR 155 is composed of Quay, Curry, De Baca, Roosevelt, Chaves, Lea, and Eddy Counties. Generally, it includes the areas known as the Southern High Plains and the Middle Pecos River drainage basin. The climate of the area is characterized as a high plains desert. The surface consists of relatively flat terrain with minor arroyos and low-quality semi-arid rangeland.

The climate at the Ochoa Project is semi-arid with generally mild temperatures, and low precipitation and humidity. The prevailing winds are from the southeast in summer; during the winter strong winds come from the west. Winter temperatures range from lows of -6°centegrade (C) (-20° Fahrenheit [F]) to highs of 10°C (50°F). Summer daytime high temperatures are typically above 32°C (90°F) with nighttime lows of 21°C (70°F). The average precipitation is about 13 inches per year, about half of which comes from thunderstorms in June through September. The project area is sparsely vegetated and no cultivation is present.

Petroleum exploration and development is widespread around the project area. There is oil and gas production within the project area, however those existing wells in the vicinity of the Processing Facility are generally older and are experiencing declining production. The nearest Native American reservation is the Mescalero Apache, approximately 146 miles to the northwest. The nearest Mandatory Class I Federal Areas is Carlsbad Caverns National Park at 46.8 miles. The proposed Ochoa Plant elevation ranges from 3,500 ft [ft] to 3,585 ft above sea level.

The proposed Processing Plant will be located about 60 miles east-southeast of Carlsbad, New Mexico and less than 20 miles west of the Texas-New Mexico state line in T24S, R33E, Sections 23, 24, 25, 26, and 35. The overall Ochoa Project spans portions of 10 township-range blocks, and lease mineral rights totaling approximately 103,000 acres. Of this total area, the Ochoa Plant will operate year round and will restrict public access to approximately 1,850 acres. The regional location of the Ochoa Project is shown in Section 8, Figure 8-1. The location of each of the Ochoa Project facilities, Ochoa Processing Plant, Jal Loadout Facility, and Groundwater Pre-Treatment Plant, is shown in Figure 8-2 (see Section 8 of this Document). Figure 8-3 shows the general layout and location of Ochoa Processing Plant and Figure 8-4 illustrates the general layout and location of the Jal Loadout.

Ochoa Mine

The Ochoa Mine is an underground mine located north of Highway 128. Polyhalite will be mined using room and pillar retreat, which is a common method with adjacent potash mines in the area. An overall extraction rate of 90 percent is targeted for most portions of the mine; however, in areas of the mine that there is an active gas or oil well, only 60 percent of the polyhalite will be extracted in order to ensure the stability of the active well and that there is no ground subsidence in areas around the wells.

The entrance to the ramp is located at the processing plant in T24S, R33E, Section 24. The ramp entrance is 1,540 ft above the polyhalite ore and 16,500 ft from the polyhalite ore body. The ramp will decline at 15 percent until it reaches 1,540 ft below the surface where the polyhalite mining horizon is located. The decline will be 20 ft wide and will range in height from 10 ft along the sides to 13 ft in the center. The design of the ramp is shown on Figures 5-4. A road header will be used to excavate the ramp. Excavated material will be stored within the Ochoa Plant boundaries to be used later for reclamation. The storage pile will be stabilized to reduce potential fugitive emissions for long term storage. Construction of the ramp will coincide with construction of the Ochoa Plant.

A conveyor system will be installed in the ramp, which will be used to remove polyhalite ore from the mining level to the processing plant. Large equipment such as continuous miners and shuttle cars will use the ramp to access the mine. In addition to moving large equipment and polyhalite, the ramp will be used to exhaust air from the mine in order to provide proper ventilation. In cases when the conveyor might be out of service, it will be possible for trucks to use the ramp to remove polyhalite from the mine.

Ochoa Polyhalite Processing Plant

The proposed Ochoa Plant will be located in portions of T24S, R33E, Sections 23, 24, 25, 26 and 35 south of State Highway 128 (Figure 8-3). Run of Mine (ROM) material is sent to the Ochoa Plant by way of covered overland conveyor. ROM processing involves seven major unit operation steps; primary crushing, wet grinding and salt removal, calcination, leaching, evaporative crystallization of SOP (K_2SO_4), evaporative crystallization of SOPM ($2Mg(SO_4)•K_2SO_4$), and drying/granulation of both products. Polyhalite, $K_2Ca2Mg(SO_4)4•2(H_2O)$, is first crushed and washed to remove salt associated with the ore; this produces essentially salt-free material sized for optimum leaching conditions that can be quickly and easily calcined. The calcined product is cooled to recover energy and then leached in a counter current circuit using water as the solvent. The potassium and magnesium sulfates are taken into solution, leaving anhydrous calcium sulfate residue, which is removed and sent to the solid waste management area. The resulting potassium and magnesium sulfate rich brine is crystallized to create SOP (K_2SO_4) and then langbeinite crystals. The final step of the process, granulation, involves drying the SOP and the langbeinite and then granulating the material to produce a product that meets market standards for particle sizing

Waste Handling

An above ground, lined tailings storage facility (TSF) would receive the waste solids coming from the ore processing using a dry stacking deposition method of placement with haul trucks. The TSF would cover approximately 448 acres in T24S, R33E, Sections 26 and 35, with dimension of 3,770 by 5,178 feet and a maximum height of 200 feet at the end of 50 years. The TSF will be constructed in 20-foot high lifts with 10-foot-wide benches with final side slopes of 3 feet (horizontal) to 1 foot (vertical). Earthen berms and drainage swales would divert surface water runoff away from the stockpile. Water falling on the tailings pile would be contained by two ponds at the southwest corner of the TSF.

Tailings will consist of calcium sulfate, which would form gypsum through the interaction with water from precipitation and water spayed onto the pile for dust suppression. Once wet, the pile would harden to a concrete-like substance so that it would be less prone to wind erosion.

Jal Loadout Facility

The proposed load-out facility at Jal will be located approximately 19 miles east from the Ochoa Plant on private land in T24S, R36E, Sections 25 and 36 along an existing railroad track. Trucks will travel from the processing plant for 18 miles along highway 128, and for 3.5 miles on a planned road to be developed through rural, largely undeveloped areas. In order to move 1,100,300 tons of potassium sulfate and 373,000 tons of langbeinite, 25-ton load trucks will transport material on a continuous basis operating around the clock seven days per week.

All finished material will be stored in storage bins at the train load-out facility in Jal. The storage bins will have capacity to store up to 3 months worth of all finished products. Trucks will dump their finished product into one of four separate circuits, which prevents different products from co-mingling with each other. Once product is ready to be shipped, it will be screened to customer's specification and loaded into 100-ton rail cars. The load-out facility in Jal is approximately 175 acres in size. This area includes all storage and load-out facilities, a rail car wash area, and all rail sidings that will be constructed for the loadout.

Groundwater Pre-Treatment Plant

The proposed Groundwater Pre-Treatment Plant will be located approximately 12 miles east from the Ochoa Plant in T24S, R35E, Section 14. The Groundwater Pre-Treatment Plant will remove hydrogen sulfide (H_2S) and balance the pH levels for the Ochoa Plant supply water before conveying the water via buried pipeline from the groundwater pre-treatment to the Ochoa Processing Facility. During the pre-treatment process, the hydrogen sulfide (H2S) concentration and the water temperature will be monitored. The pH of the water will be reduced to 5.0 to convert the bisulfide ion (HS-) to H_2S. Reducing the pH to 5.0 will allow about 98% removal of H_2S through packed bed air strippers. The flow will be monitored then directed to one or both of the forced air H_2S strippers depending upon water and air temperatures. Each H_2S stripper will be sized to remove 98% of H_2S at 2,755 GPM with a water temperature of 80º F and air temperature of 68º F. The second H_2S stripper will allow continuous efficient operation (98% removal of H_2S) when the capacity of the H_2S strippers is reduced during cold periods. The stripped H_2S will be collected and treated by a bio-trickling filter with a control efficiency of 99%. The treated water will then be stored and piped to the Ochoa Plant.

The U.S. Environmental Protection Agency (USEPA) has classified the Pecos-Permian Basin as an attainment area for the National Ambient Air Quality Standards (NAAQS) for CO, particulate matter 10 microns in diameter and smaller (PM_{10}), particulate matter with aerodynamic diameter of 2.5 microns and less ($PM_{2.5}$), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and ozone. Table 3-1 presents the current NAAQS attainment status designations.

NMAC Regulation 20.2.3 specifies the New Mexico state standards for ambient air quality for CO, total suspended particulates (TSP), SO_2, and NO_2. Table 3-1 also presents the current attainment status of the proposed project location with respect to the New Mexico standards.

Table 3-1 Attainment Status Designations

Pollutant	NAAQS Status	State Status
CO	Attainment	Attainment
TSP	NA	Attainment
PM_{10}	Attainment	NA
$PM_{2.5}$	Attainment	NA
SO_2	Attainment	Attainment
NO_2	Attainment	Attainment
Ozone	Attainment	NA

NA = Not available

Startup, Shutdown, and Maintenance (SSM)

Startup, Shutdown, and Maintenance (SSM) emissions are not expected under normal or routine SSM operating conditions. All control equipment will be functioning prior to material processing.

Summary of Proposed Regulated Sources and Permit Emission Calculation Parameters

Maximum proposed permit emission rates from stack sources are based on the following parameters; BACT emission factors and the maximum actual flow rate per minute (ACFM) for fugitive dust collectors; and BACT emission factors, the maximum heat input, and standard flow rate per minute (SCFM) for steam boilers, calciners, and dryers. Tables 3-2 and 3-3 summarize the emission rate parameters for proposed stack sources.

Table 3-2 Maximum Permit Emission Parameters Boiler\Calciner\Dryer\Dust Collector

Emission Stack ID	Source Description	Heat Input MMBtu/Hr	Actual Flow Rate ACFM	Standard Flow Rate SCFM
STK1	ROM Area Dust Collector	****	5000	****
STK2	Crusher Area Dust Collector	****	14000	****
STK3A	Polyhalite Dryer/Calciner/Cooler with Dust Collector #1	214.23	286000	138778
STK3B	Polyhalite Dryer/Calciner/Cooler with Dust Collector #2	214.23	286000	138778
STK3C	Polyhalite Dryer/Calciner/Cooler with Dust Collector #3	214.23	286000	138778
STK4	SOP Product Dryer and Dust Collector	18.74	24000	14327
STK5	SOP Area Dust Collector	****	50000	****
STK6	SOP Granulator Dryer with Dust Collector	16.54	37000	23643
STK7	Langbeinite Product Dryer with Dust Collector	10.35	16700	9085
STK8	Langbeinite Area Dust Collector	****	21000	****
STK9	Langbeinite Compactor Dust Collector	****	24000	****
STK10	Langbeinite Granulator Glazer/Conditioner Unit with Dust Collector	2.0	19500	13832
STK11	Jal Loadout Area Dust Collector	****	36000	****
STK12	Steam Boiler 1	155.9	62307	34474
STK13	Steam Boiler 2	155.9	62307	34474

Table 3-3 BACT Emission Rates Boiler\Calciner\Dryer\Dust Collector

Emission Stack ID	Source Description	NO_X Lbs/MMBtu	CO Lbs/MMBtu	PM Lbs/MMBtu	PM Grains/SCF	CO_2e Lbs/MMBtu
STK1	ROM Area Dust Collector	****	****	****	0.005	****
STK2	Crusher Area Dust Collector	****	****	****	0.005	****
STK3A	Polyhalite Dryer/Calciner/Cooler with Dust Collector #1	0.042	0.037	0.0052	****	117.1
STK3B	Polyhalite Dryer/Calciner/Cooler with Dust Collector #2	0.042	0.037	0.0052	****	117.1
STK3C	Polyhalite Dryer/Calciner/Cooler with Dust Collector #3	0.042	0.037	0.0052	****	117.1
STK4	SOP Product Dryer and Dust Collector	0.042	0.037	0.0052	****	117.1
STK5	SOP Area Dust Collector	****	****	****	0.005	****
STK6	SOP Granulator Dryer with Dust Collector	0.042	0.037	0.0052	****	117.1
STK7	Langbeinite Product Dryer with Dust Collector	0.042	0.037	0.0052	****	117.1
STK8	Langbeinite Area Dust Collector	****	****	****	0.005	****
STK9	Langbeinite Compactor Dust Collector	****	****	****	0.005	****
STK10	Langbeinite Granulator Glazer/Conditioner Unit with Dust Collector	0.042	0.037	0.0052	****	117.1
STK11	Jal Loadout Area Dust Collector	****	****	****	0.005	****
STK12	Steam Boiler 1	0.02	0.037	0.0052	****	117.1
STK13	Steam Boiler 2	0.02	0.037	0.0052	****	117.1

The TSP/PM_{10}/$PM_{2.5}$ particulate sources located at the Ochoa Polyhalite Processing Plant, and the Jal Loadout Facility not emitted from the steam boilers, calciners, dryers, and fugitive dust collectors as follows.

- Raw Ore Mine (ROM) Underground Overland Conveyor
- Product Loading Circuit fugitives
- Additive fugitives
- SOP Jal Loadout Circuit fugitives
- Langbeinite Jal Loadout Circuit fugitives
- Ochoa Plant Waste Handling Circuit fugitives
- Wind Erosion Emissions Storage Piles fugitives

Particulate emission rates for the above sources are calculated using EPA AP-42 emission factors for material handling and proposed control methodologies.

The TSP/PM_{10}/$PM_{2.5}$ fugitive particulates due to truck traffic at the Ochoa Polyhalite Processing Plant, the Jal Loadout Facility, and the Groundwater Pre-Treatment Plant as follows.

- **Ochoa Plant Haul Truck Traffic Roads**
    - SOP/langbeinite product trucks traffic from Ochoa Plant to Jal Loadout Facility
    - SOP/langbeinite fines recycle trucks from Jal Loadout Facility to Ochoa Plant
    - Additive delivery truck traffic
    - Equipment delivery truck traffic
    - De-duster delivery truck traffic
    - Waste (Gypsum) haul trucks

- **Jal Loadout Facility Haul Truck Traffic Road**
    - SOP/langbeinite product trucks from Ochoa Plant
    - SOP/langbeinite fines recycle trucks return to Ochoa Plant
    - Additive delivery truck traffic
    - De-duster delivery truck traffic

- **Groundwater Pre-Treatment Plant Haul Truck Traffic Road**
    - Groundwater Pre-Treatment Plant chemical delivery trucks

Particulate emission rates for the above sources are calculated using EPA AP-42 emission factors for paved and unpaved roads, and proposed control methodologies.

Section 4

Process Flow Sheet

A **process flow sheet** and/or block diagram indicating the individual equipment, all emission points and types of control applied to those points. The unit numbering system should be consistent throughout this application.

Process flow diagram is attached.

LINE LEGEND

PRIMARY PROCESS LINE

SECONDARY PROCESS LINE

FUTURE

PACKAGE VENDOR

XXXX
STREAM NUMBER

ON/OFF PAGE CONNECTORS

FROM EQUIPMENT DESCRIPTION
XXXXX–XXXX–XXXX

TO EQUIPMENT DESCRIPTION
XXXXX–XXXX–XXXX

TANK, HOPPER AND BIN

PUMP BOX

TANK

TANK WITH AGITATOR

SEAL TANK

BIN

FILTRATE RECEIVER WITH SEAL TANK

SURGE BIN CW LIVE BOTTOM BIN SCREW CONVEYOR

COVERED TANK

FEED HOPPER

H_2S STRIPPERS

STORAGE TANK

DUMP HOPPER

PROCESS EQUIPMENT

ROLL CRUSHER

DISTRIBUTOR

FLAKE BREAKER COMPACTOR

CAGE MILL

COMPACTOR

DISC GRANULATOR

CONDITIONING DRUM

AIR HEATER

HEAT EXCHANGER

PROCESS EQUIPMENT

DRY/WET SIZING SCREEN

MULTI–DECK SIZING SCREEN

WEIGH BELT

VAPOUR HEAD TANK

COLUMN COOLER

FFE HEAT EXCHANGER

CYCLOPACK

BAGHOUSE

DUST COLLECTOR

VERTICAL FINE GRINDING MILL

CLARIFIER

UV TREATMENT UNIT

BELT FILTER

STEAM BOILER

ELECTRICAL DIESEL GENERATOR

CYCLONE DRY

SCREEN BOWL CENTRIFUGE

SOLID BOWL CENTRIFUGE

FLUID BED DRYER

FLUID BED COOLER

MOBILE EQUIPMENT

TRUCK

RAILCAR

TANK TRUCK

PUMPS

SUMP & PUMP

CENTRIFUGAL PUMP

GEAR PUMP

FILTER VACUUM PUMP

FIRE PROTECTION DIESEL PUMP

BOOSTER PUMP STATION

MATERIAL HANDLING

BELT CONVEYOR

BELT FEEDER

BELT TRIPPER

SCREW FEEDER

SCREW CONVEYOR

PUG MIXER

DRAG CONVEYOR

BUCKET ELEVATOR

2–WAY SPLITTER GATE

DIVERTER GATE

PIN MIXER

COMPRESSORS

COMPRESSOR

HEATLESS DESICCANT AIR DRYER

RECEIVER

THERMO COMPRESSOR

MISCELLANEOUS

GYPSUM STORAGE

STORAGE DOME

LOADOUT CAR WASH HOPPER

AGITATOR

WATER WELL

DEEP WELL

BULK BAG

FEED BOX

EVAPORATION POND

BELT SCALE

TRASH SCREEN

MAGNET

MVR

PLUG BOX

K40 ANALYZER

LEVELING PLOW

FAN

FILTER

LOUVER/ AIR FILTER

EDUCTOR

CALCIUM SULPHATE STORAGE

CRANES

OVERHEAD CRANE

STREAM LEGEND TABLE

STREAM NUMBER	STREAM TYPE
1000–1999	SOLIDS, BRINE, SLURRY
2000–2999	(RESERVED FOR EVAPORATOR/CRYSTALLIZER CIRCUITS)
3000–3999	(RESERVED FOR EVAPORATOR/CRYSTALLIZER CIRCUITS)
4000–4999	(RESERVED FOR EVAPORATOR/CRYSTALLIZER CIRCUITS)
5000–5499	PROCESS WATER
5500–5999	REAGENT
6000–6999	COOLING WATER, BLOWDOWN, EVAPORATION
7000–7299	PROCESS CONDENSATE, VAPOR
7300–7349	INSTRUMENT AIR
7350–7399	PROCESS AIR
7400–7499	VACUUM AIR
7500–7999	DRYER/SCRUBBER MAKE–UP AIR, OFFGAS, EXHAUST
8000–8999	LIVE STREAM
9000–9999	NATURAL GAS

ICPOTASHCORP

CLIENT

CLIENT DRAWING NUMBER

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PROFESSIONAL ENGINEER | NAME | NO

DRAWING NUMBER	REFERENCES	DRAWING NUMBER	REFERENCES	NO	DATE (YYYY–MM–DD)	REVISIONS	BY	CHK	LEAD ENG	ENG MAN	PROJ MAN	CLIENT ENG COORD	CLIENT AREA MAN
				03	2013–06–13	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		
				02	2013–05–21	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		
				01	2013–04–05	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		
				00	2013–02–04	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		

SU	DESIGNED	J. NAGY	JN	2013–02–04
	DRAWN	E. PERRERAS	EP	2013–02–04
	CHECKED	T. ZRYMIAK	TZ	2013–02–04
	APPROVED LEAD ENG	A. TOMTENE	AT	2013–02–04
CLIENT	APPROVED ENG MAN			
	APPROVED PROJ MAN			
	APPROVED ENG COORD			
	APPROVED AREA MAN			
SCALE	NTS	NAME (F. LAST)	INIT	DATE (YYYY–MM–DD)

TITLE
OCHOA POLYHALITE MINE FEASIBILITY STUDY
SOP AND MSOP PROCESSING PLANT
FLOWSHEET SYMBOL, LEGEND

PROJECT NUMBER	AREA	DISC	DOC	DRAWING NUMBER	REVISION NUMBER
510315	00000	49	DD	0001	03

Format 'ANSI D' Sheet Size

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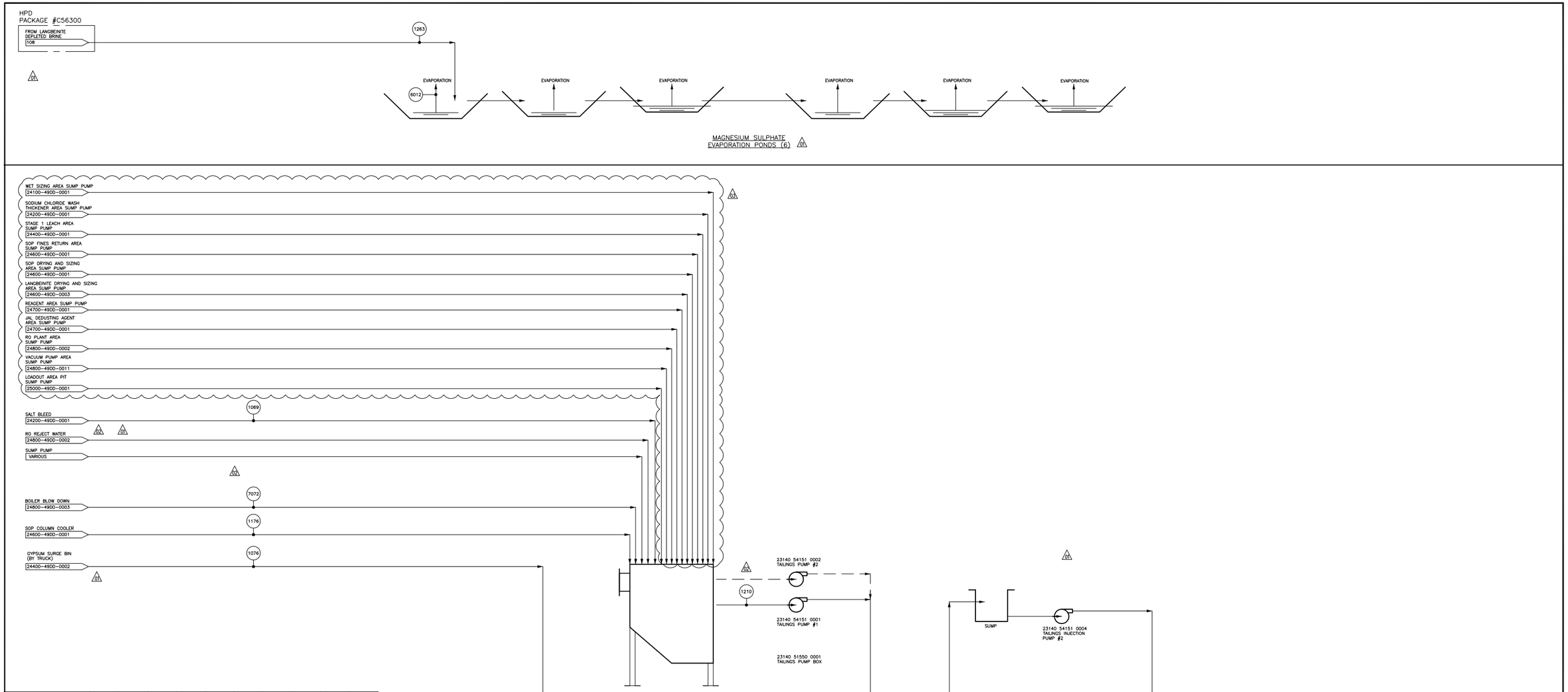

STREAM NUMBER	UNITS	1069	1076	1176	1210	1248	1263	6012	6013	7072
NOMINAL										
MASS - SOLIDS	STPH	0.00	226.06	0.00	0.00	0.00	1.08	0.00	0.00	0.00
MASS - SOLUTION	STPH	92.96	56.51	180.04	580.03	276.64	133.31	0.00	0.00	3.64
MASS - SLURRY	STPH	92.96	282.57	180.04	580.03	276.64	134.39	0.00	0.00	3.64
VOLUME - SLURRY	USGPM	337.67		654.79	2080.35	1007.64	376.65	0.00	0.00	15.18
SPECIFIC GRAVITY - SLURRY	S.G.	1.10	2.11	1.10	1.11	1.10	1.43	0.00	0.00	0.96
WT - % SOLIDS	%	0.00	80.00	0.00	0.00	0.00	0.80	0.00	0.00	0.00
SOLIDS - % K2SO4	%	0.00	1.84	0.00	0.00	0.00	42.70	0.00	0.00	0.00
SOLIDS - % MgSO4	%	0.00	1.27	0.00	0.00	0.00	57.30	0.00	0.00	0.00
GAS - MASS	STPH	0.00	0.00	0.00	0.00	0.00	0.00	79.76	405.35	0.00
GAS - VOLUME	ACFM	0.00	0.00	0.00	0.00	0.00	0.00	65311	331936	0
GAS - PRESSURE	PSIA					13.01				
TEMPERATURE	°F	65.56	200.00	75.64	73.43	77.00	187.63	77.00	77.00	211.74
DESIGN										
MASS - SOLIDS	STPH	0.00	270.95	0.00	0.00	0.00	1.30	0.00	0.00	0.00
MASS - SOLUTION	STPH	111.53	67.74	216.01	695.90	331.97	159.78	0.00	0.00	4.37
MASS - SLURRY	STPH	111.53	338.69	216.01	695.90	331.97	161.08	0.00	0.00	4.37
GAS - VOLUME	ACFM	0.00	0.00	0.00	0.00	0.00	0.00	78281	398280	0

DRAWING NUMBER	REFERENCES	DRAWING NUMBER	REFERENCES	NO	DATE (YYYY-MM-DD)	REVISIONS	BY	CHK	LEAD ENG	ENG MAN	PROJ MAN	CLIENT ENG COORD	CLIENT AREA MAN
				03	2013-06-13	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		
				02	2013-05-21	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		
				01	2013-04-05	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		
				00	2013-02-04	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		

DESIGNED	J. NAGY	JN	2013-02-04
DRAWN	E. PERRERAS	EP	2013-02-04
CHECKED	T. ZRYMIAK	TZ	2013-02-04
APPROVED LEAD ENG	A. TOMTENE	AT	2013-02-04
APPROVED ENG MAN			
APPROVED PROJ MAN			
APPROVED ENG COORD			
APPROVED AREA MAN			
SCALE NTS	NAME (F. LAST)	INIT	DATE (YYYY-MM-DD)

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PROFESSIONAL ENGINEER | NAME | NO

TITLE
OCHOA POLYHALITE MINE FEASIBILITY STUDY
SOP AND MSOP PROCESSING PLANT
EVAPORATING PONDS AND TAILINGS STORAGE
PROCESS FLOWSHEET

PROJECT NUMBER	AREA	DISC	DOC	DRAWING NUMBER	REVISION NUMBER
510315	23100	49	DD	0001	03

Format 'ANSI D' Sheet Size

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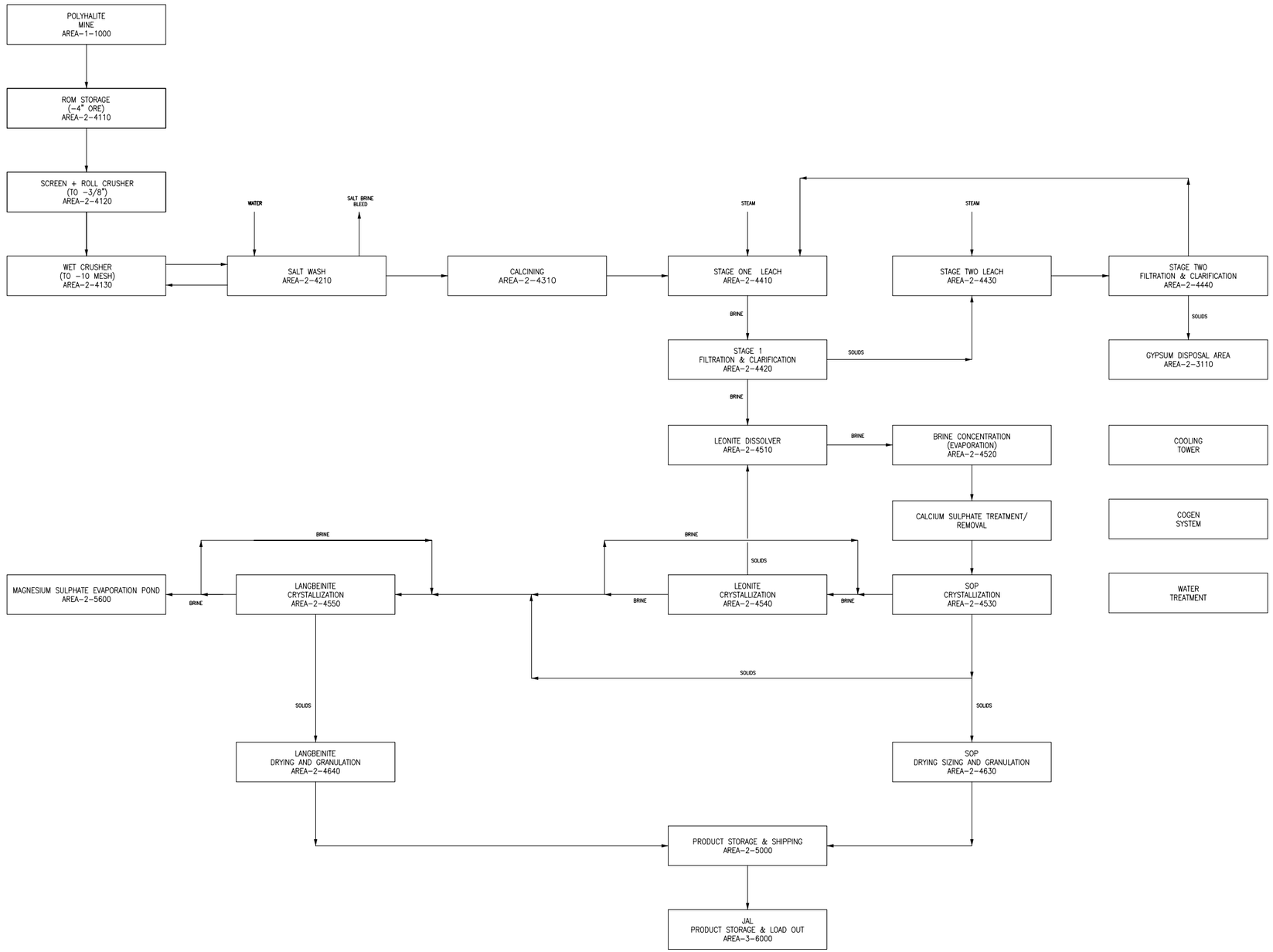

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DRAWING NUMBER	REFERENCES	DRAWING NUMBER	REFERENCES	NO	DATE (YYYY-MM-DD)	REVISIONS	BY	CHK	LEAD ENG	ENG MAN	PROJ MAN	CLIENT ENG COORD	CLIENT AREA MAN
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				02	2013-05-21	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		
				01	2013-04-05	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		
				00	2013-02-04	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		

SU	DESIGNED	J. NAGY	JN	2013-02-04
	DRAWN	E. PERRERAS	EP	2013-02-04
	CHECKED	T. ZRYMIAK	TZ	2013-02-04
	APPROVED LEAD ENG	A. TOMTENE	AT	2013-02-04
CLIENT	APPROVED ENG MAN			
	APPROVED PROJ MAN			
	APPROVED ENG COORD			
	APPROVED AREA MAN			
SCALE NTS	NAME (F. LAST)		INIT	DATE (YYYY-MM-DD)

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PROFESSIONAL ENGINEER | NAME | NO

TITLE
OCHOA POLYHALITE MINE FEASIBILITY STUDY
PROCESS BLOCK DIAGRAM
MEE OPTION

PROJECT NUMBER	AREA	DISC	DOC	DRAWING NUMBER	REVISION NUMBER
510315	24000	49	DD	0001	03

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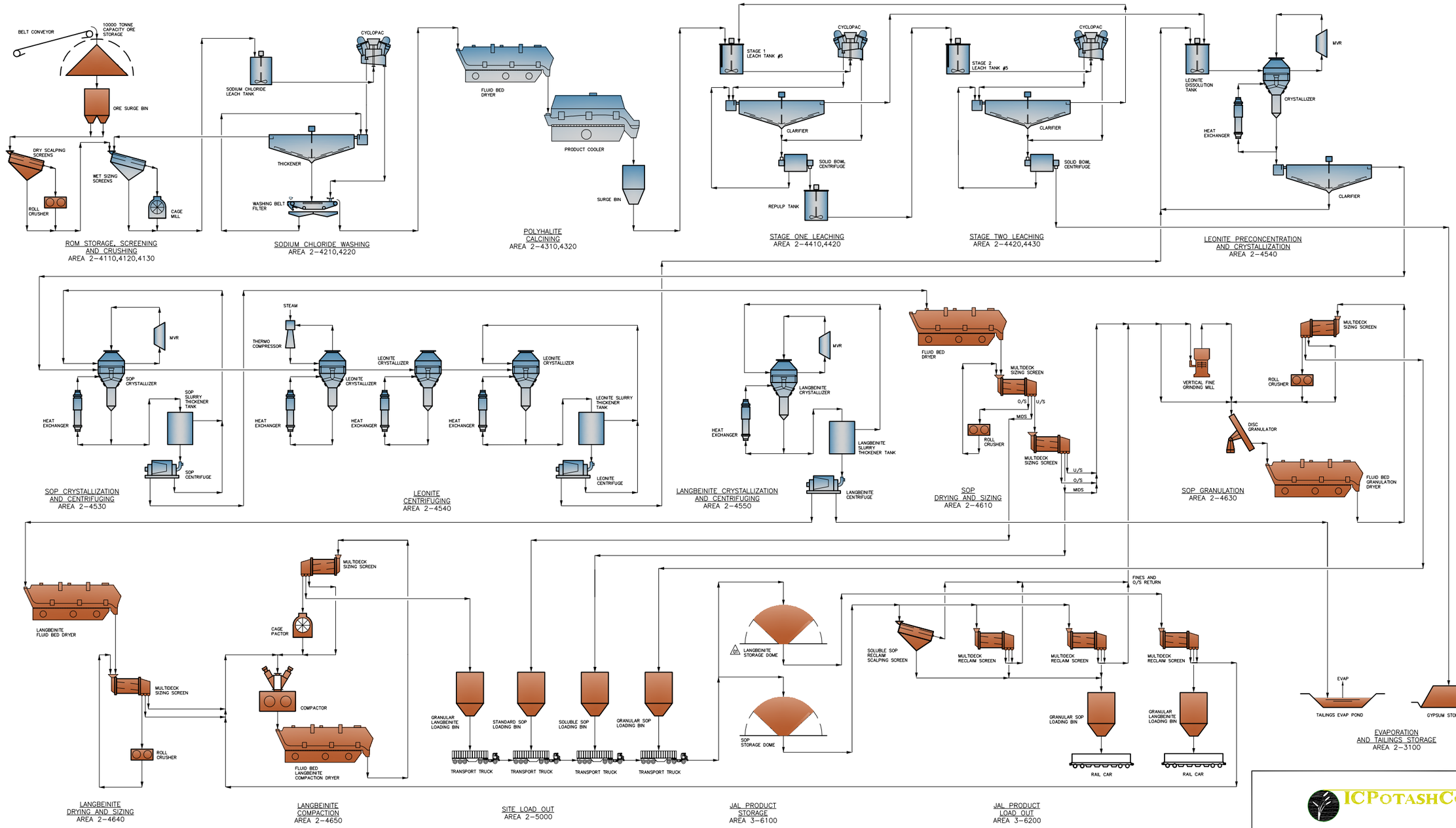
16-Jun-2013 - 12:46pm PERRER7



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PROFESSIONAL ENGINEER | NAME | NO

DRAWING NUMBER	REFERENCES	DRAWING NUMBER	REFERENCES	NO	DATE (YYYY-MM-DD)	REVISIONS	BY	CHK	LEAD ENG	ENG MAN	PROJ MAN	CLIENT ENG COORD	CLIENT AREA MAN
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				02	2013-05-21	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		
				01	2013-04-05	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		
				00	2013-02-04	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		

SU	DESIGNED	J. NAGY	JN	2013-02-04
	DRAWN	E. PERRERAS	EP	2013-02-04
	CHECKED	T. ZRYMIAK	TZ	2013-02-04
	APPROVED LEAD ENG	A. TOMTENE	AT	2013-02-04
CLIENT	APPROVED ENG MAN			
	APPROVED PROJ MAN			
	APPROVED ENG COORD			
	APPROVED AREA MAN			
SCALE	NTS	NAME (F. LAST)	INIT	DATE (YYYY-MM-DD)

TITLE
OCHOA POLYHALITE MINE FEASIBILITY STUDY
SOP AND MSOP PROCESSING PLANT
OVERALL PROCESS FLOWSHEET

PROJECT NUMBER	AREA	DISC	DOC	DRAWING NUMBER	REVISION NUMBER
510315	24000	49	DD	0002	03

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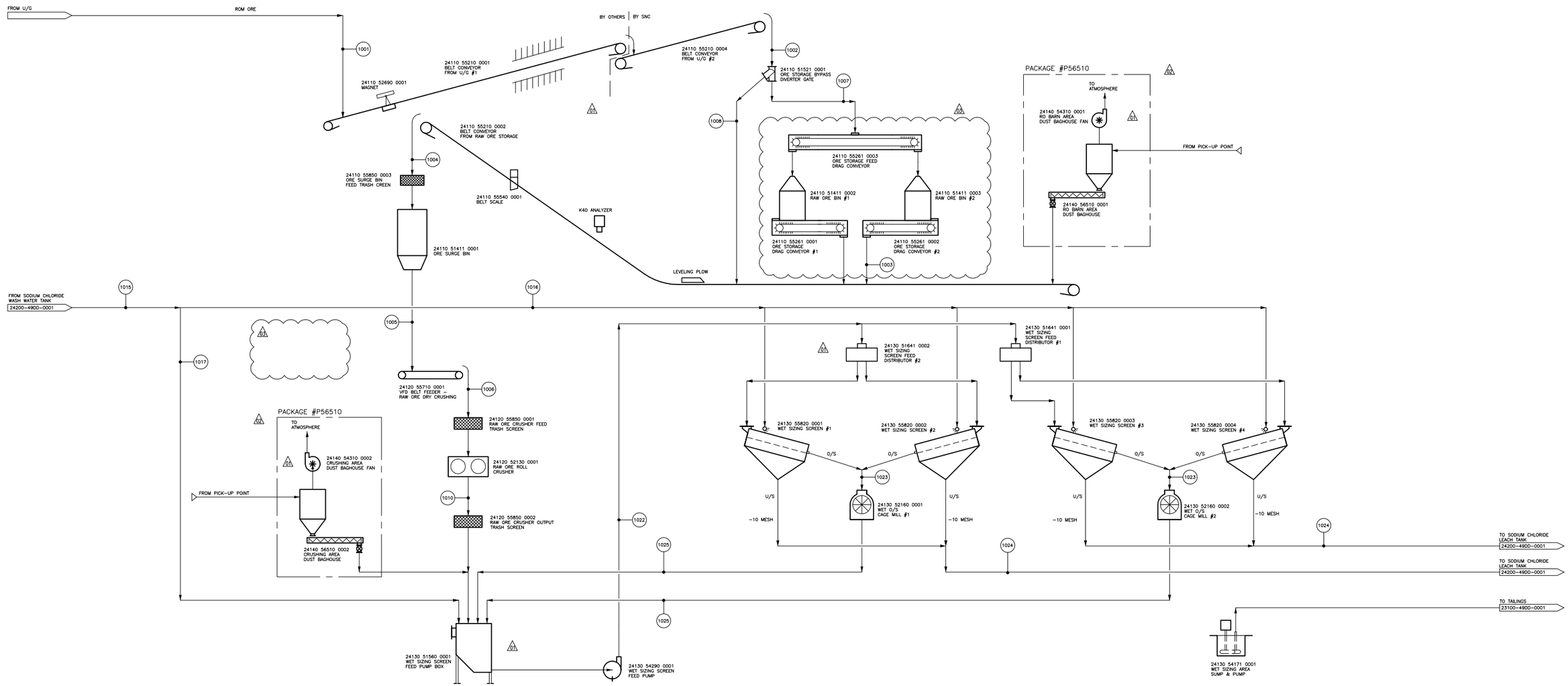

STREAM NUMBER	UNITS	1001	1002	1003	1004	1005	1006	1007	1008	1010	1015	1016	1017	1022	1023	1024	1025
NOMINAL																	
MASS - SOLIDS	STPH	445.00	445.00	445.00	448.27	448.27	440.55	445.00	0.00	440.55	0.01	0.00	0.01	871.89	220.48	215.47	220.48
MASS - SOLUTION	STPH	13.76	13.76	13.76	13.76	13.76	13.76	13.76	0.00	13.76	1253	54.45	1198	1332	55.12	638.05	55.12
MASS - SLURRY	STPH	458.76	458.76	458.76	462.03	462.03	454.31	458.76	0.00	454.31	1253	54.45	1198	2204	275.60	853.52	275.60
VOLUME - SLURRY	USGPM								0.00		4601	200.00	4401	6126		2644	
SPECIFIC GRAVITY - SLURRY	S.G.	2.63	2.63	2.63	2.63	2.63	2.63	2.63	0.00	2.63	1.09	1.09	1.09	1.44	2.12	1.29	2.12
WT - % SOLIDS	%	97.00	97.00	97.00	97.02	97.02	96.97	97.00	0.00	96.97	0.00	0.00	0.00	39.56	80.00	25.25	80.00
SOLIDS - % K2SO4	%	23.12	23.12	23.12	23.12	23.12	23.12	23.12	0.00	23.12	24.44	24.44	24.44	23.64	23.64	23.64	23.64
SOLIDS - % MgSO4	%	15.97	15.97	15.97	15.97	15.97	15.97	15.97	0.00	15.97	16.88	16.88	16.88	16.32	16.32	16.32	16.32
GAS - MASS	STPH	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GAS - VOLUME	ACFM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GAS - PRESSURE	PSIA																
TEMPERATURE	°F	68.00	68.00	68.00	68.01	68.01	69.87	68.00	68.00	69.87	66.23	66.23	66.23	66.30	66.30	66.30	66.30
DESIGN																	
MASS - SOLIDS	STPH	533.90	533.90	533.90	537.17	537.17	528.04	533.90	0.00	528.04	0.01	0.00	0.01	1043	263.25	258.27	263.25
MASS - SOLUTION	STPH	16.51	16.51	16.51	16.51	16.51	16.51	16.51	0.00	16.51	1488	54.45	1434	1593	65.81	758.07	65.81
MASS - SLURRY	STPH	550.41	550.41	550.41	553.68	553.68	544.55	550.41	0.00	544.55	1488	54.45	1434	2636	329.06	1016	329.06
GAS - VOLUME	ACFM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

NO	DATE (YYYY-MM-DD)	REVISIONS	BY	CHK	LEAD ENG	ENG MAN	PROJ MAN	CLIENT ENG COORD	CLIENT AREA MAN
03	2013-06-13	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		
02	2013-05-21	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		
01	2013-04-05	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		
00	2013-02-04	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		

DRAWING NUMBER | REFERENCES | DRAWING NUMBER | REFERENCES

DESIGNED	J. NAGY	JN	2013-02-04
DRAWN	E. PERRERAS	EP	2013-02-04
CHECKED	T. ZRYMIAK	TZ	2013-02-04
APPROVED LEAD ENG	A. TOMTENE	AT	2013-02-04
APPROVED ENG MAN			
APPROVED PROJ MAN			
APPROVED ENG COORD			
APPROVED AREA MAN			
SCALE NTS	NAME (F. LAST)	INIT	DATE (YYYY-MM-DD)

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PROFESSIONAL ENGINEER | NAME | NO

TITLE
OCHOA POLYHALITE MINE FEASIBILITY STUDY
SOP AND MSOP PROCESSING PLANT
ROM STORAGE, SCREENING AND CRUSHING
PROCESS FLOWSHEET

PROJECT NUMBER	AREA	DISC	DOC	DRAWING NUMBER	REVISION NUMBER
510315	24100	49	DD	0001	03

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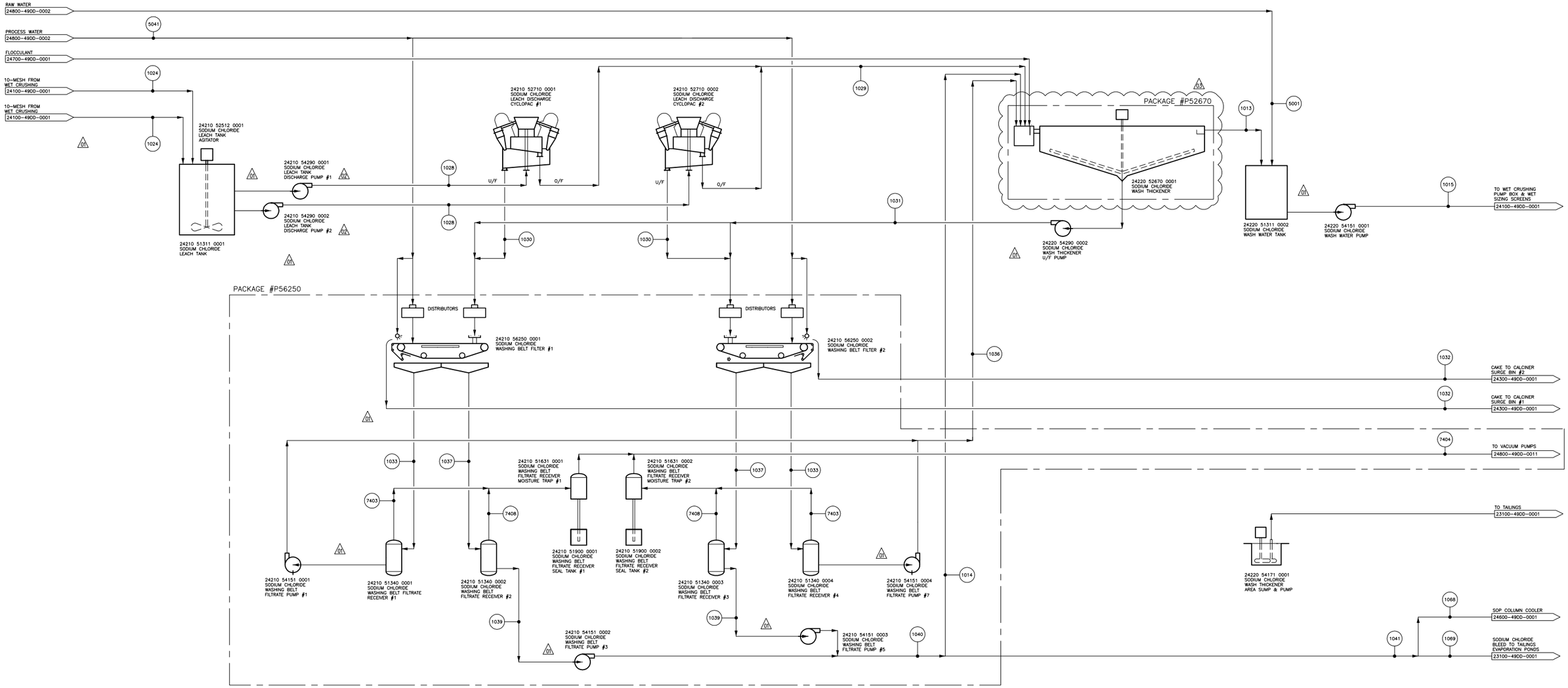

STREAM NUMBER	UNITS	1013	1014	1015	1024	1028	1029	1030	1031	1032	1033	1036	1037	1039	1040	1041	1068	1069	5001	5041	7403	7404	7408
NOMINAL																							
MASS - SOLIDS	STPH	0.01	0.00	0.01	215.47	208.34	62.50	177.09	62.50	208.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MASS - SOLUTION	STPH	1003.73	98.19	1253	638.05	645.17	936.17	177.09	62.50	23.22	13.46	31.87	185.19	185.60	371.19	273.00	180.04	92.96	248.98	26.93	0.00	0.00	0.00
MASS - SLURRY	STPH	1003.74	98.19	1253	853.52	853.52	998.67	354.18	124.99	231.56	13.46	31.87	185.19	185.60	371.19	273.00	180.04	92.96	248.98	26.93	0.00	0.00	0.00
VOLUME - SLURRY	USGPM	3646	356.69	4601	2644	2641	3490	896.08	316.26		48.78	116.32	672.73	674.18	1348	991.67	654.00	337.67	958.73	103.68	0.00	0.00	0.00
SPECIFIC GRAVITY - SLURRY	S.G.	1.10	1.10	1.09	1.29	1.29	1.14	1.58	1.58	2.40	1.10	1.09	1.10	1.10	1.10	1.10	1.10	1.10	1.04	1.04	0.00	0.00	0.00
WT - % SOLIDS	%	0.00	0.00	0.00	25.25	24.41	6.26	50.00	50.00	89.97	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SOLIDS - % K2SO4	%	24.44	0.00	24.44	23.64	24.44	24.44	24.44	24.44	24.44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SOLIDS - % MgSO4	%	16.88	0.00	16.88	16.32	16.88	16.88	16.88	16.88	16.88	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GAS - MASS	STPH	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	28.15	68.15	5.92
GAS - VOLUME	ACFM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	43766	106639	9553
GAS - PRESSURE	PSIA																				4.14	4.14	4.14
TEMPERATURE	°F	65.49	65.56	66.23	66.30	65.95	65.95	65.95	65.49	67.91	66.84	51.71	66.64	65.56	65.56	65.56	65.56	65.56	68.00	68.00	51.71	54.14	65.56
DESIGN																							
MASS - SOLIDS	STPH	0.01	0.00	0.01	258.27	249.72	74.92	212.26	74.91	249.71	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MASS - SOLUTION	STPH	1189.42	117.37	1488	758.07	766.62	1109	212.26	74.91	27.83	16.15	38.24	221.97	222.45	444.91	327.54	216.01	111.53	298.70	32.31	0.00	0.00	0.00
MASS - SLURRY	STPH	1189.43	117.37	1488	1016	1016	1184	424.52	149.82	277.55	16.15	38.24	221.97	222.45	444.91	327.54	216.01	111.53	298.70	32.31	0.00	0.00	0.00
GAS - VOLUME	ACFM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	52510	127942	11461

DRAWING NUMBER	REFERENCES	DRAWING NUMBER	REFERENCES

NO	DATE (YYYY-MM-DD)	REVISIONS	BY	CHK	LEAD ENG	ENG MAN	PROJ MAN	CLIENT ENG COORD	CLIENT AREA MAN
03	2013-06-13	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		
02	2013-05-21	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		
01	2013-04-05	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		
00	2013-02-04	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		

SLI				
	DESIGNED	J. NAGY	JN	2013-02-04
	DRAWN	E. PERRERAS	EP	2013-02-04
	CHECKED	T. ZRYMIAK	TZ	2013-02-04
	APPROVED LEAD ENG	A. TOMTENE	AT	2013-02-04
	APPROVED ENG MAN			
	APPROVED PROJ MAN			
CLIENT	APPROVED ENG COORD			
	APPROVED AREA MAN			

SCALE NTS

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PROFESSIONAL ENGINEER | NAME | ND

TITLE
OCHOA POLYHALITE MINE FEASIBILITY STUDY
SOP AND MSOP PROCESSING PLANT
SALT WASH
PROCESS FLOWSHEET

PROJECT NUMBER	AREA	DISC	DOC	DRAWING NUMBER	REVISION NUMBER
510315	24200	49	DD	0001	03

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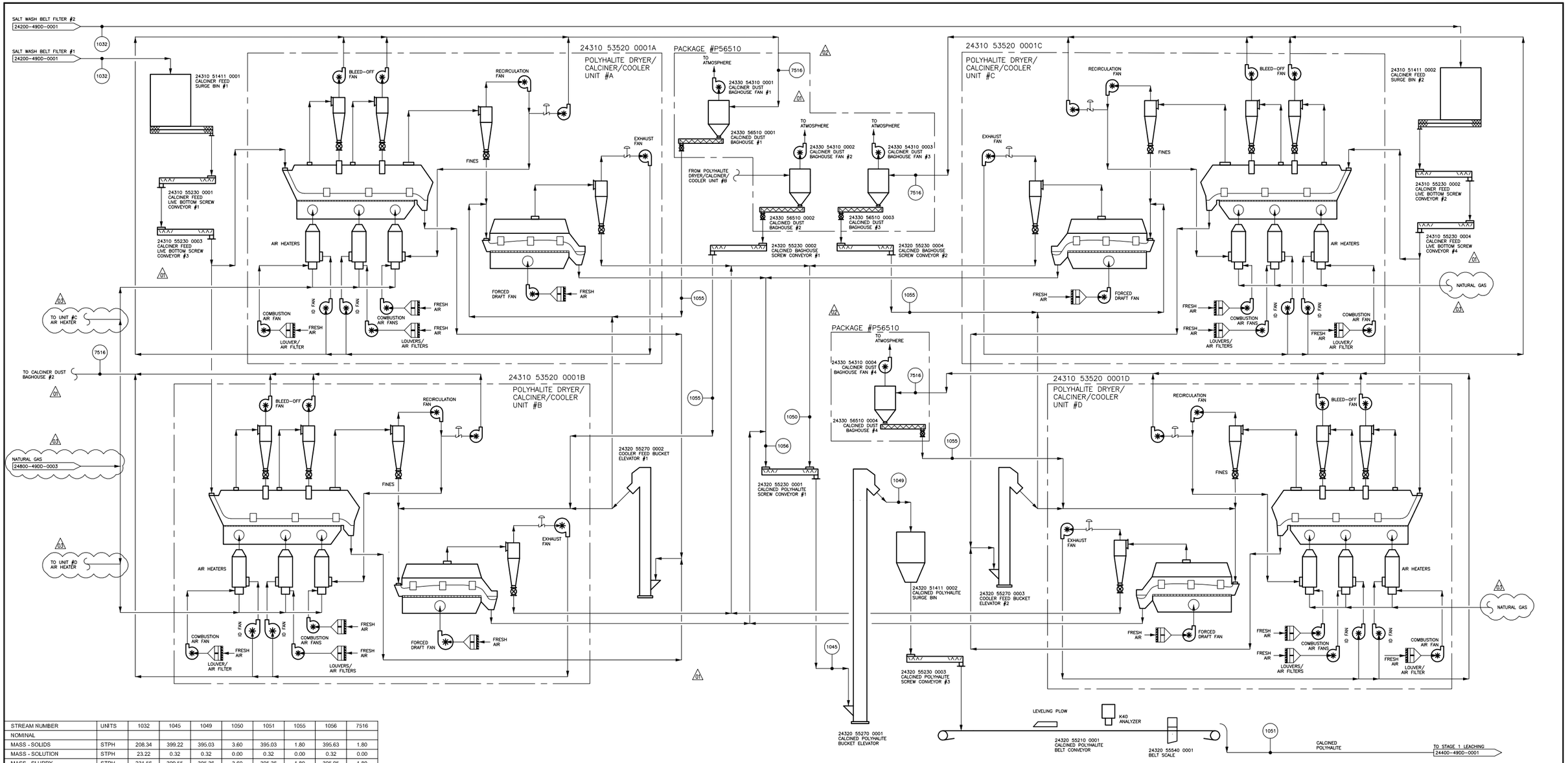

STREAM NUMBER	UNITS	1032	1045	1049	1050	1051	1055	1056	7516
NOMINAL									
MASS - SOLIDS	STPH	208.34	399.22	395.03	3.60	395.03	1.80	395.63	1.80
MASS - SOLUTION	STPH	23.22	0.32	0.32	0.00	0.32	0.00	0.32	0.00
MASS - SLURRY	STPH	231.56	399.55	395.36	3.60	395.36	1.80	395.95	1.80
VOLUME - SLURRY	USGPM								2.54
SPECIFIC GRAVITY - SLURRY	S.G.	2.40	2.82	2.82	2.83	2.82	2.83	2.82	2.83
WT - % SOLIDS	%	89.97	99.92	99.92	100.00	99.92	100.00	99.92	0.89
SOLIDS - % K2SO4	%	24.44	25.53	25.53	25.53	25.53	25.53	25.53	25.53
SOLIDS - % MgSO4	%	16.88	17.65	17.65	17.65	17.65	17.65	17.65	17.65
GAS - MASS	STPH	0.00	0.00	0.00	0.00	0.00	0.00	0.00	199.50
GAS - VOLUME	ACFM	0.00	0.00	0.00	0.00	0.00	0.00	0	232005
GAS - PRESSURE	PSIA								
TEMPERATURE	°F	67.91	210.02	205.78	210.02	205.78	678.94	81.75	678.94
DESIGN									
MASS - SOLIDS	STPH	249.71	478.51	473.48	4.31	473.48	2.15	474.19	2.15
MASS - SOLUTION	STPH	27.83	0.39	0.39	0.00	0.39	0.00	0.39	0.00
MASS - SLURRY	STPH	277.55	478.89	473.87	4.31	473.87	2.15	474.58	2.15
GAS - VOLUME	ACFM	0.00	0.00	0.00	0.00	0.00	0.00	0	232259

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01	2013-04-05	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		
00	2013-02-04	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		

SU	DESIGNED	J. NAGY	JN	2013-02-04
	DRAWN	E. PERRERAS	EP	2013-02-04
	CHECKED	T. ZRYMIAK	TZ	2013-02-04
	APPROVED LEAD ENG	A. TOMTENE	AT	2013-02-04
	APPROVED ENG MAN			
	APPROVED PROJ MAN			
CLIENT	APPROVED ENG COORD			
	APPROVED AREA MAN			
SCALE	NTS	NAME (F. LAST)	INIT	DATE (YYYY-MM-DD)

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PROFESSIONAL ENGINEER | NAME | NO

TITLE
OCHOA POLYHALITE MINE FEASIBILITY STUDY
SOP AND MSOP PROCESSING PLANT
POLYHALITE CALCINING
PROCESS FLOWSHEET

PROJECT NUMBER	AREA	DISC	DOC	DRAWING NUMBER	REVISION NUMBER
510315	24300	49	DD	0001	03

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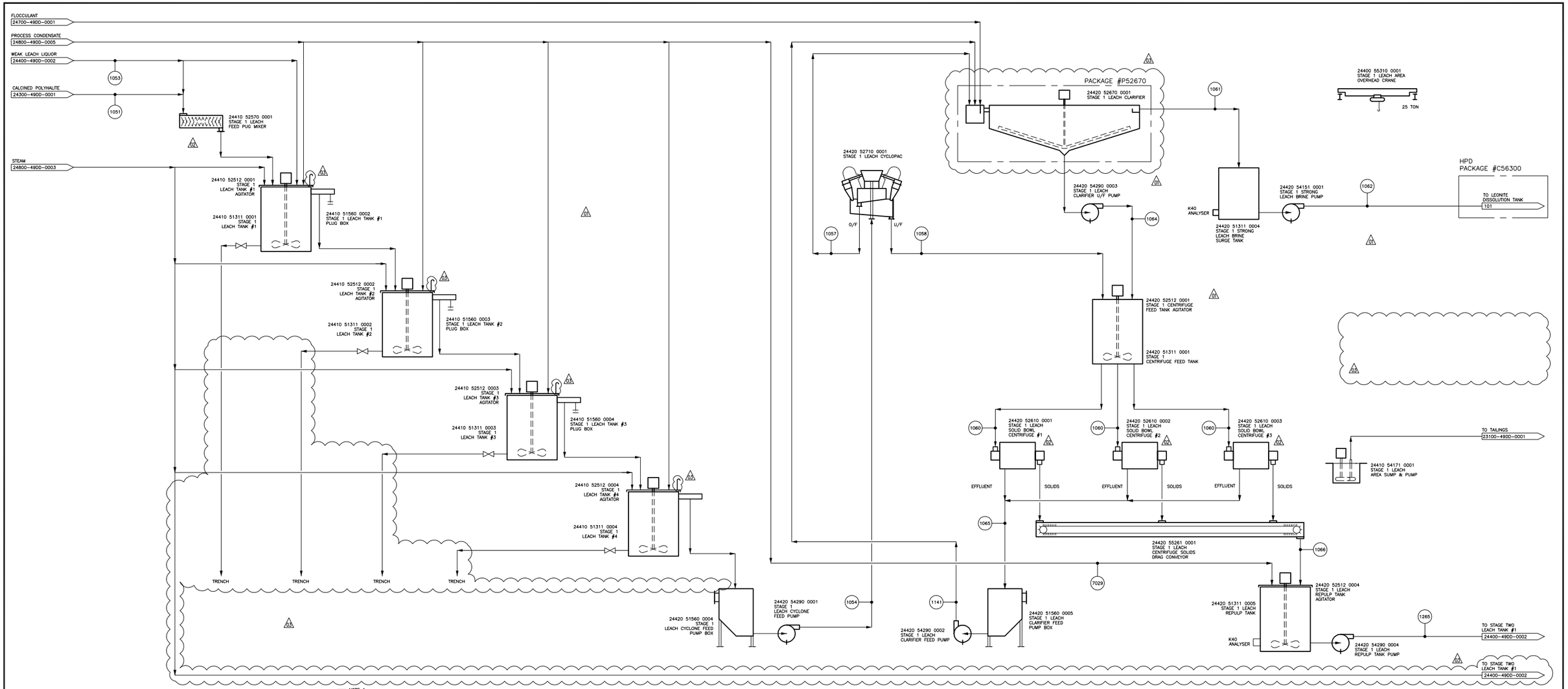

STREAM NUMBER	UNITS	1051	1053	1054	1057	1058	1060	1061	1062	1064	1065	1066	1141	1265	7029
NOMINAL															
MASS - SOLIDS	STPH	395.03	0.00	273.62	54.72	218.90	93.07	0.01	0.01	60.30	5.58	273.61	5.58	273.61	0.00
MASS - SOLUTION	STPH	0.32	1588	1710	1491	218.90	93.07	1641	1641	60.30	210.79	68.40	210.79	273.61	205.21
MASS - SLURRY	STPH	395.36	1588	1983	1545	437.79	186.13	1641	1641	120.60	216.38	342.02	216.38	547.23	205.21
VOLUME - SLURRY	USGPM		6420	6871	5737	1134	482.06	6233	6233	312.35	808.28		808.28	1484.74	846.39
SPECIFIC GRAVITY - SLURRY	S.G.	2.82	0.99	1.15	1.08	1.54	1.54	1.05	1.05	1.54	1.07	2.14	1.07	1.47	0.97
WT - % SOLIDS	%	99.92	0.00	13.80	3.54	50.00	50.00	0.00	0.00	50.00	2.58	80.00	2.58	50.00	0.00
SOLIDS - % K2SO4	%	25.53	1.84	10.13	10.13	10.13	10.13	10.13	10.13	10.13	10.13	10.13	10.13	10.13	0.00
SOLIDS - % MgSO4	%	17.65	1.27	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	0.00
GAS - MASS	STPH	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GAS - VOLUME	ACFM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GAS - PRESSURE	PSIA														
TEMPERATURE	°F	205.78	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00	190.42	185.00
DESIGN															
MASS - SOLIDS	STPH	473.48	0.01	327.96	65.59	262.36	111.55	0.01	0.01	72.28	6.69	327.95	6.69	327.95	0.00
MASS - SOLUTION	STPH	0.39	1903	2049	1787	262.36	111.55	1967	1967	72.28	252.65	81.99	252.65	327.95	245.96
MASS - SLURRY	STPH	473.87	1903	2377	1852	524.73	223.09	1967	1967	144.55	259.35	409.94	259.35	655.90	245.96
GAS - VOLUME	ACFM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

NOTE:

1. MASS BALANCE VALUES MAY NOT MATCH EXACTLY WITH CONNECTING STREAMS IN THE CRYSTALLIZATION SECTION OF THE PLANT.

STUDY DRAWING
NOT FOR CONSTRUCTION

DRAWING NUMBER	REFERENCES	DRAWING NUMBER	REFERENCES	NO	DATE (YYYY-MM-DD)	REVISIONS	BY	CHK	LEAD ENG	ENG MAN	PROJ MAN	CLIENT ENG COORD	CLIENT AREA MAN
				03	2013-06-13	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		
				02	2013-05-21	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		
				01	2013-04-05	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		
				00	2013-02-04	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		

		NAME (F. LAST)	INIT	DATE (YYYY-MM-DD)
SLI	DESIGNED	J. NAGY	JN	2013-02-04
	DRAWN	E. PERRERAS	EP	2013-02-04
	CHECKED	T. ZRYMIAK	TZ	2013-02-04
	APPROVED LEAD ENG	A. TOMTENE	AT	2013-02-04
	APPROVED ENG MAN			
	APPROVED PROJ MAN			
CLIENT	APPROVED ENG COORD			
	APPROVED AREA MAN			
SCALE	NTS			

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PROFESSIONAL ENGINEER | NAME | NO

TITLE
OCHOA POLYHALITE MINE FEASIBILITY STUDY
SOP AND MSOP PROCESSING PLANT
STAGE ONE LEACHING
PROCESS FLOWSHEET

PROJECT NUMBER	AREA	DISC	DOC	DRAWING NUMBER	REVISION NUMBER
510315	24400	49	DD	0001	03

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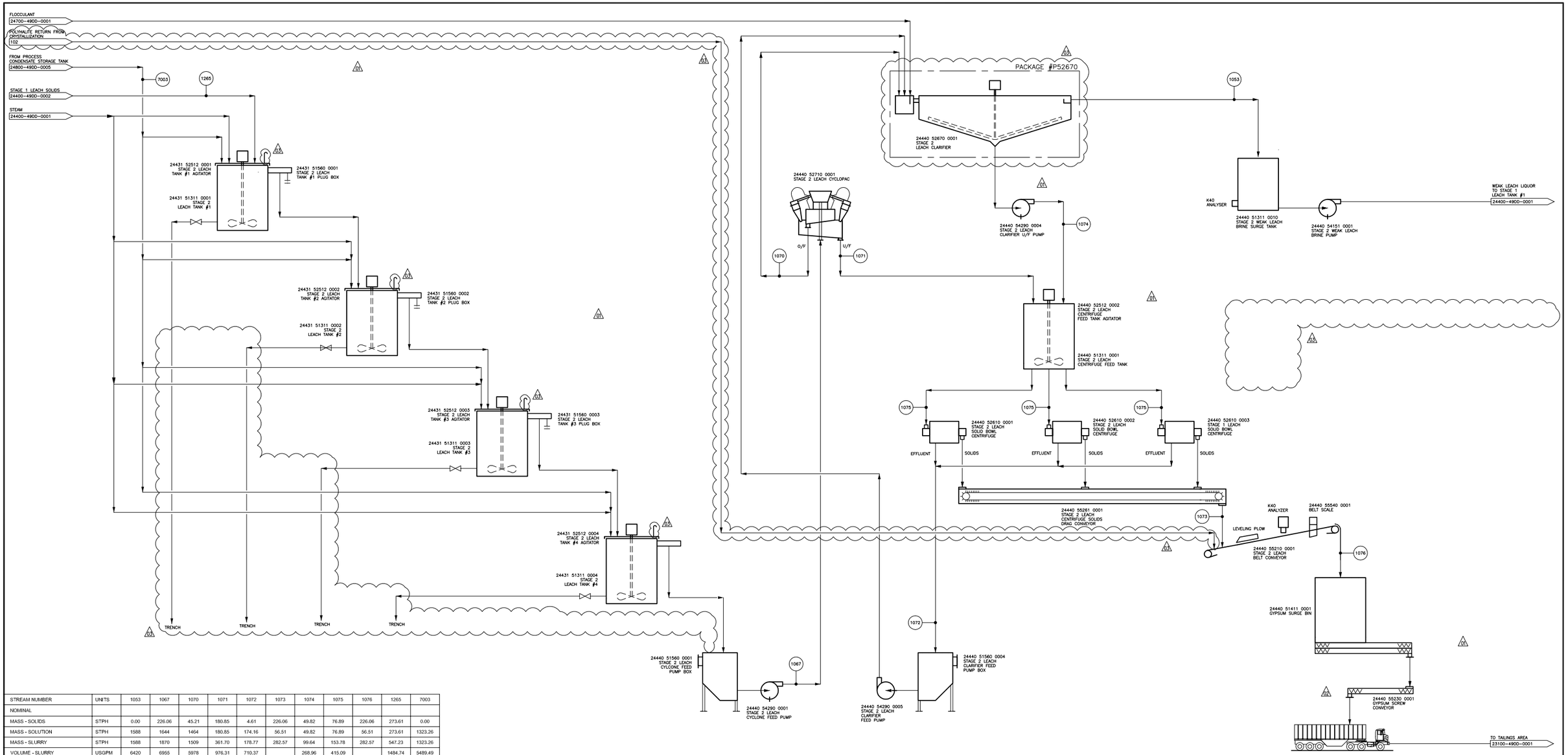

STREAM NUMBER	UNITS	1053	1067	1070	1071	1072	1073	1074	1075	1076	1265	7003
NOMINAL												
MASS - SOLIDS	STPH	0.00	226.06	45.21	180.85	4.61	226.06	49.82	76.89	226.06	273.61	0.00
MASS - SOLUTION	STPH	1588	1644	1464	180.85	174.16	56.51	49.82	76.89	56.51	273.61	1323.26
MASS - SLURRY	STPH	1588	1870	1509	361.70	178.77	282.57	99.64	153.78	282.57	547.23	1323.26
VOLUME - SLURRY	USGPM	6420	6955	5978	976.31	710.37		268.96	415.09		1484.74	5489.49
SPECIFIC GRAVITY - SLURRY	S.G.	0.99	1.07	1.01	1.48	1.01	2.11	1.48	1.48	2.11	1.47	0.96
WT - % SOLIDS	%	0.00	12.09	3.00	50.00	2.58	80.00	50.00	50.00	80.00	50.00	0.00
SOLIDS - % K2SO4	%	1.84	1.84	1.84	1.84	1.84	1.84	1.84	1.84	1.84	10.13	0.00
SOLIDS - % MgSO4	%	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	7.00	0.00
GAS - MASS	STPH	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GAS - VOLUME	ACFM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GAS - PRESSURE	PSIA											
TEMPERATURE	°F	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00	200.00	190.42	200.00
DESIGN												
MASS - SOLIDS	STPH	0.01	270.96	54.19	216.77	5.53	270.95	59.72	92.16	270.95	327.95	0.00
MASS - SOLUTION	STPH	1903	1971	1754	216.77	208.74	67.74	59.72	92.16	67.74	327.95	1586.05
MASS - SLURRY	STPH	1903	2242	1808	433.53	214.27	338.69	119.43	184.32	338.69	655.90	1586.05
GAS - VOLUME	ACFM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DRAWING NUMBER	REFERENCES	DRAWING NUMBER	REFERENCES

NO	DATE (YYYY-MM-DD)	REVISIONS	BY	CHK	LEAD ENG	ENG MAN	PROJ MAN	CLIENT ENG COORD	CLIENT AREA MAN
03	2013-06-13	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		
02	2013-05-21	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		
01	2013-04-05	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		
00	2013-02-04	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		

		NAME (F. LAST)	INIT	DATE (YYYY-MM-DD)
SU	DESIGNED	J. NAGY	JN	2013-02-04
	DRAWN	E. PERRERAS	EP	2013-02-04
	CHECKED	T. ZRYMIAK	TZ	2013-02-04
	APPROVED LEAD ENG	A. TOMTENE	AT	2013-02-04
	APPROVED ENG MAN			
	APPROVED PROJ MAN			
CLIENT	APPROVED ENG COORD			
	APPROVED AREA MAN			

SCALE NTS

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PROFESSIONAL ENGINEER | NAME | NO

TITLE
OCHOA POLYHALITE MINE FEASIBILITY STUDY
SOP AND MSOP PROCESSING PLANT
STAGE TWO LEACHING
PROCESS FLOWSHEET

PROJECT NUMBER	AREA	DISC	DOC	DRAWING NUMBER	REVISION NUMBER
510315	24400	49	DD	0002	03

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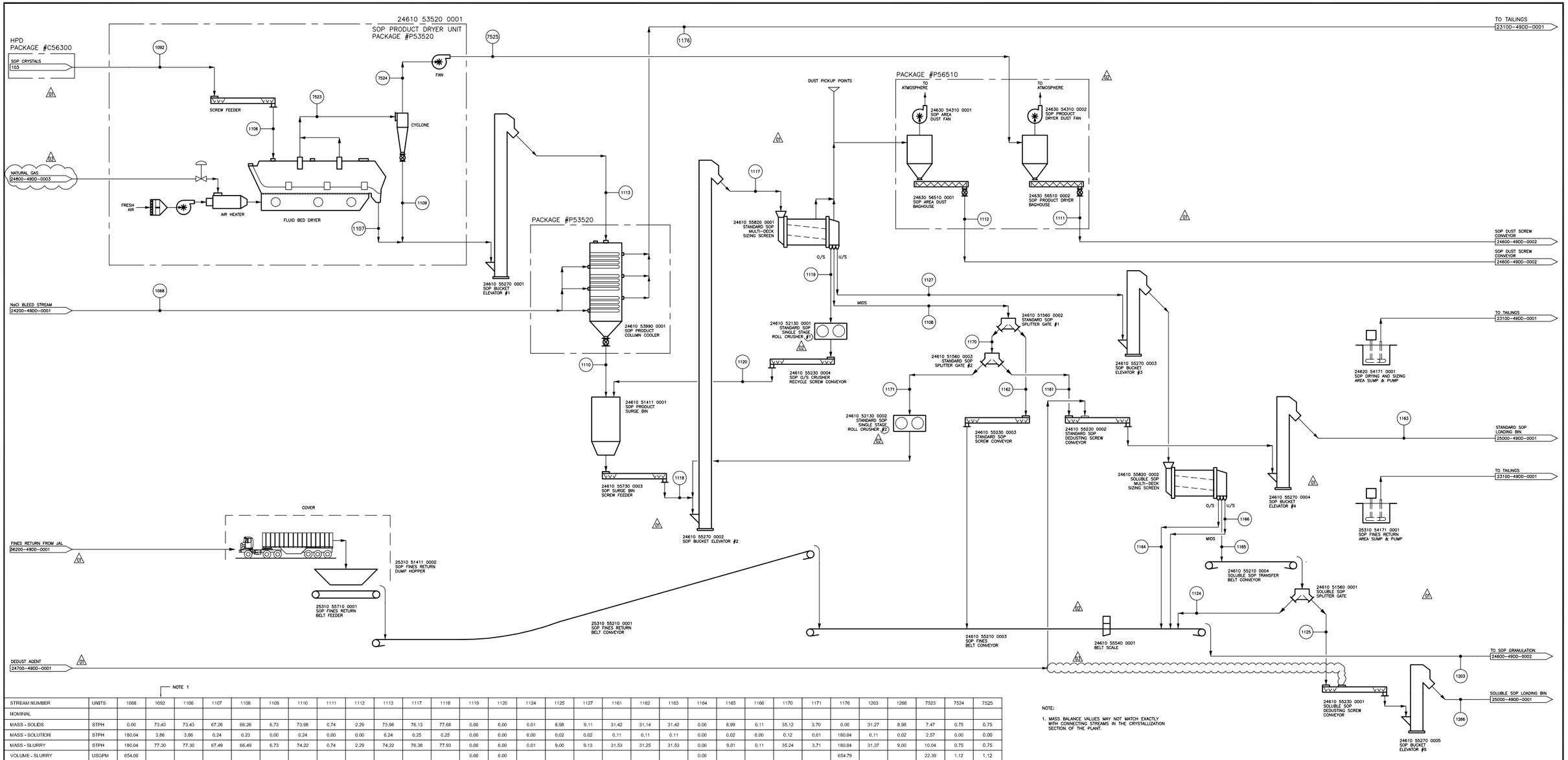

NOTE:

1. MASS BALANCE VALUES MAY NOT MATCH EXACTLY WITH CONNECTING STREAMS IN THE CRYSTALLIZATION SECTION OF THE PLANT.

NOTE 1

STREAM NUMBER	UNITS	1068	1092	1106	1107	1108	1109	1110	1111	1112	1113	1117	1118	1119	1120	1124	1125	1127	1161	1162	1163	1164	1165	1166	1170	1171	1176	1203	1266	7523	7524	7525
NOMINAL																																
MASS - SOLIDS	STPH	0.00	73.43	73.43	67.26	66.26	6.73	73.98	0.74	2.29	73.98	76.13	77.68	0.00	0.00	0.01	8.98	9.11	31.42	31.14	31.42	0.00	8.99	0.11	35.12	3.70	0.00	31.27	8.98	7.47	0.75	0.75
MASS - SOLUTION	STPH	180.04	3.86	3.86	0.24	0.23	0.00	0.24	0.00	0.00	0.24	0.25	0.25	0.00	0.00	0.00	0.02	0.02	0.11	0.11	0.11	0.00	0.02	0.00	0.12	0.01	180.04	0.11	0.02	2.57	0.00	0.00
MASS - SLURRY	STPH	180.04	77.30	77.30	67.49	66.49	6.73	74.22	0.74	2.29	74.22	76.38	77.93	0.00	0.00	0.01	9.00	9.13	31.53	31.25	31.53	0.00	9.01	0.11	35.24	3.71	180.04	31.37	9.00	10.04	0.75	0.75
VOLUME - SLURRY	USGPM	654.00												0.00	0.00							0.00					654.79			22.39	1.12	1.12
SPECIFIC GRAVITY - SLURRY	S.G.	1.10	2.53	2.53	2.64	2.65	2.66	2.65	2.66	2.66	2.65	2.65	2.65	0.00	0.00	2.65	2.65	2.65	2.65	2.65	2.65	0.00	2.65	2.66	2.65	2.65	1.10	2.65	2.65	1.79	2.66	2.66
WT - % SOLIDS	%	0.00	95.00	95.00	99.65	99.66	99.99	99.68	100.00	100.00	99.68	99.67	99.68	0.00	0.00	99.74	99.74	99.74	99.66	99.66	99.66	0.00	99.74	100.00	99.66	99.66	0.00	99.66	99.74	19.36	2.34	2.34
SOLIDS - % K2SO4	%	0.00	99.62	99.62	98.70	98.70	98.70	98.70	98.70	98.70	98.70	98.70	98.70	0.00	0.00	98.70	98.70	98.70	98.70	98.70	98.70	0.00	98.70	98.70	98.70	98.70	0.00	98.70	98.70	98.70	98.70	98.70
SOLIDS - % MgSO4	%	0.00	0.00	0.00	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.00	0.00	0.90	0.90	0.90	0.90	0.90	0.90	0.00	0.90	0.90	0.90	0.90	0.00	0.90	0.90	0.90	0.90	0.90
GAS - MASS	STPH	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	28.57	31.14	31.14
GAS - VOLUME	ACFM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	21024	24000	24000
GAS - PRESSURE	PSIA																															
TEMPERATURE	°F	65.56	194.00	194.00	300.00	157.07	300.00	190.04	300.00	164.61	300.00	171.80	188.53	68.00	157.21	157.07	157.07	157.07	157.07	157.07	157.07	68.00	157.07	157.07	157.07	157.07	75.64	157.07	157.07	300.00	300.00	300.00
DESIGN																																
MASS - SOLIDS	STPH	0.00	105.73	105.73	96.84	95.22	9.68	106.52	1.07	3.27	106.52	108.80	111.02	0.00	0.00	0.01	12.32	12.50	63.60	48.24	63.60	0.00	12.33	0.17	68.10	4.50	0.00	48.42	12.32	10.76	1.08	1.08
MASS - SOLUTION	STPH	260.15	5.57	5.57	0.34	0.32	0.00	0.34	0.00	0.00	0.34	0.36	0.36	0.00	0.00	0.00	0.03	0.03	0.22	0.16	0.22	0.00	0.03	0.00	0.23	0.02	260.15	0.16	0.03	3.70	0.00	0.00
MASS - SLURRY	STPH	260.15	111.30	111.30	97.18	95.54	9.69	106.87	1.07	3.27	106.87	109.16	111.38	0.00	0.00	0.01	12.35	12.53	63.82	48.40	63.82	0.00	12.37	0.17	68.33	4.52	260.15	48.58	12.35	14.46	1.08	1.08
GAS - VOLUME	ACFM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	19713	24000	24000

DRAWING NUMBER	REFERENCES	DRAWING NUMBER	REFERENCES	NO	DATE (YYYY-MM-DD)	REVISIONS	BY	CHK	LEAD ENG	ENG MAN	PROJ MAN	CLIENT ENG COORD	CLIENT AREA MAN
				03	2013-06-13	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		
				02	2013-05-21	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		
				01	2013-04-05	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		
				00	2013-02-04	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		

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PROFESSIONAL ENGINEER | NAME | NO

SIGN		NAME (F. LAST)	INIT	DATE (YYYY-MM-DD)
SIGN	DESIGNED	J. NAGY	JN	2013-02-04
	DRAWN	E. PERRERAS	EP	2013-02-04
	CHECKED	T. ZRYMIAK	TZ	2013-02-04
	APPROVED LEAD ENG	A. TOMTENE	AT	2013-02-04
	APPROVED ENG MAN			
	APPROVED PROJ MAN			
CLIENT	APPROVED ENG COORD			
CLIENT	APPROVED AREA MAN			

SCALE: NTS

TITLE
OCHOA POLYHALITE MINE FEASIBILITY STUDY
SOP AND MSOP PROCESSING PLANT
SOP DRYING AND SIZING
PROCESS FLOWSHEET

PROJECT NUMBER	AREA	DISC	DOC	DRAWING NUMBER	REVISION NUMBER
510315	24600	49	DD	0001	03

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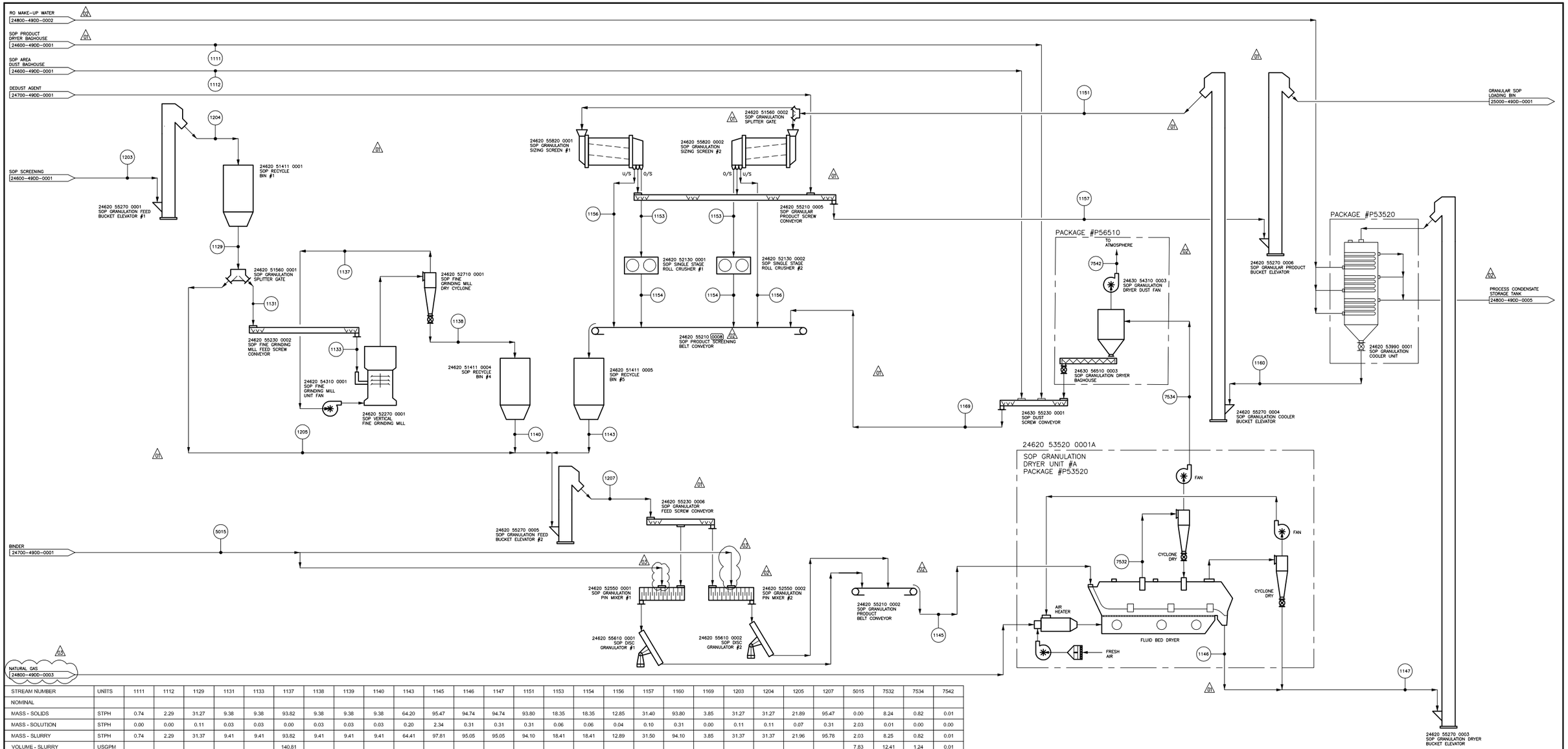

STREAM NUMBER	UNITS	1111	1112	1129	1131	1133	1137	1138	1139	1140	1143	1145	1146	1147	1151	1153	1154	1156	1157	1160	1169	1203	1204	1205	1207	5015	7532	7534	7542
NOMINAL																													
MASS - SOLIDS	STPH	0.74	2.29	31.27	9.38	9.38	93.82	9.38	9.38	9.38	64.20	95.47	94.74	94.74	93.80	18.35	18.35	12.85	31.40	93.80	3.85	31.27	31.27	21.89	95.47	0.00	8.24	0.82	0.01
MASS - SOLUTION	STPH	0.00	0.00	0.11	0.03	0.03	0.00	0.03	0.03	0.03	0.20	2.34	0.31	0.31	0.31	0.06	0.06	0.04	0.10	0.31	0.00	0.11	0.11	0.07	0.31	2.03	0.01	0.00	0.00
MASS - SLURRY	STPH	0.74	2.29	31.37	9.41	9.41	93.82	9.41	9.41	9.41	64.41	97.81	95.05	95.05	94.10	18.41	18.41	12.89	31.50	94.10	3.85	31.37	31.37	21.96	95.78	2.03	8.25	0.82	0.01
VOLUME - SLURRY	USGPM						140.81																			7.83	12.41	1.24	0.01
SPECIFIC GRAVITY - SLURRY	S.G.	2.66	2.66	2.65	2.65	2.65	2.66	2.65	2.65	2.65	2.65	2.56	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.65	2.66	2.65	2.65	2.65	2.65	1.04	2.65	2.66	2.66
WT - % SOLIDS	%	100.00	100.00	99.66	99.66	99.66	58.22	99.66	99.66	99.66	99.68	97.60	99.68	99.68	99.67	99.67	99.67	99.67	99.67	99.67	100.00	99.66	99.66	99.66	99.68	0.00	11.19	1.24	0.01
SOLIDS - % K2SO4	%	98.70	98.70	98.70	98.70	98.70	98.70	98.70	98.70	98.70	98.45	98.53	98.43	98.43	98.43	98.43	98.43	98.43	98.43	98.43	98.65	98.70	98.70	98.70	98.53	0.00	98.43	98.43	98.43
SOLIDS - % MgSO4	%	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.91	0.90	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.90	0.90	0.90	0.90	0.90	0.00	0.91	0.91	0.91
GAS - MASS	STPH	0.00	0.00	0.00	0.00	0.00	67.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	65.38	65.38	65.38
GAS - VOLUME	ACFM	0.00	0.00	0.00	0.00	0.00	39898	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	46000	46000	46000
GAS - PRESSURE	PSIA																												
TEMPERATURE	°F	300.00	164.61	157.07	157.07	157.07	157.07	157.07	157.07	157.07	164.41	151.51	250.00	250.00	179.96	179.96	179.96	179.96	179.96	179.96	211.95	157.07	157.07	157.07	162.02	68.00	250.00	250.00	250.00
DESIGN																													
MASS - SOLIDS	STPH	1.07	3.27	48.42	14.52	14.52	145.27	14.52	14.52	14.52	95.49	143.91	142.82	142.82	141.39	26.55	26.55	19.50	49.28	141.39	5.57	48.42	48.42	33.89	143.91	0.00	12.42	1.24	0.01
MASS - SOLUTION	STPH	0.00	0.00	0.16	0.05	0.05	0.00	0.05	0.05	0.05	0.30	3.62	0.46	0.46	0.46	0.09	0.09	0.06	0.16	0.46	0.00	0.16	0.16	0.12	0.47	3.15	0.01	0.00	0.00
MASS - SLURRY	STPH	1.07	3.27	48.58	14.57	14.57	145.27	14.57	14.57	14.57	95.80	147.52	143.28	143.28	141.85	26.64	26.64	19.56	49.44	141.85	5.57	48.58	48.58	34.01	144.38	3.15	12.43	1.24	0.01
GAS - VOLUME	ACFM	0.00	0.00	0.00	0.00	0.00	57621	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	46000	46000	46000

STUDY DRAWING
NOT FOR CONSTRUCTION

DRAWING NUMBER	REFERENCES	DRAWING NUMBER	REFERENCES	NO	DATE (YYYY-MM-DD)	REVISIONS	BY	CHK	LEAD ENG	ENG MAN	PROJ MAN	CLIENT ENG COORD	CLIENT AREA MAN
				03	2013-06-13	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		
				02	2013-05-21	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		
				01	2013-04-05	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		
				00	2013-02-04	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		

DESIGNED	J. NAGY	JN	2013-02-04
DRAWN	E. PERRERAS	EP	2013-02-04
CHECKED	T. ZRYMIAK	TZ	2013-02-04
APPROVED LEAD ENG	A. TOMTENE	AT	2013-02-04
APPROVED ENG MAN			
APPROVED PROJ MAN			
APPROVED ENG COORD			
APPROVED AREA MAN			
SCALE NTS	NAME (F. LAST)	INIT	DATE (YYYY-MM-DD)

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CLIENT

CLIENT DRAWING NUMBER

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PROFESSIONAL ENGINEER | NAME | NO

TITLE
OCHOA POLYHALITE MINE FEASIBILITY STUDY
SOP AND MSOP PROCESSING PLANT
SOP GRANULATION
PROCESS FLOWSHEET

PROJECT NUMBER	AREA	DISC	DOC	DRAWING NUMBER	REVISION NUMBER
510315	24600	49	DD	0002	03

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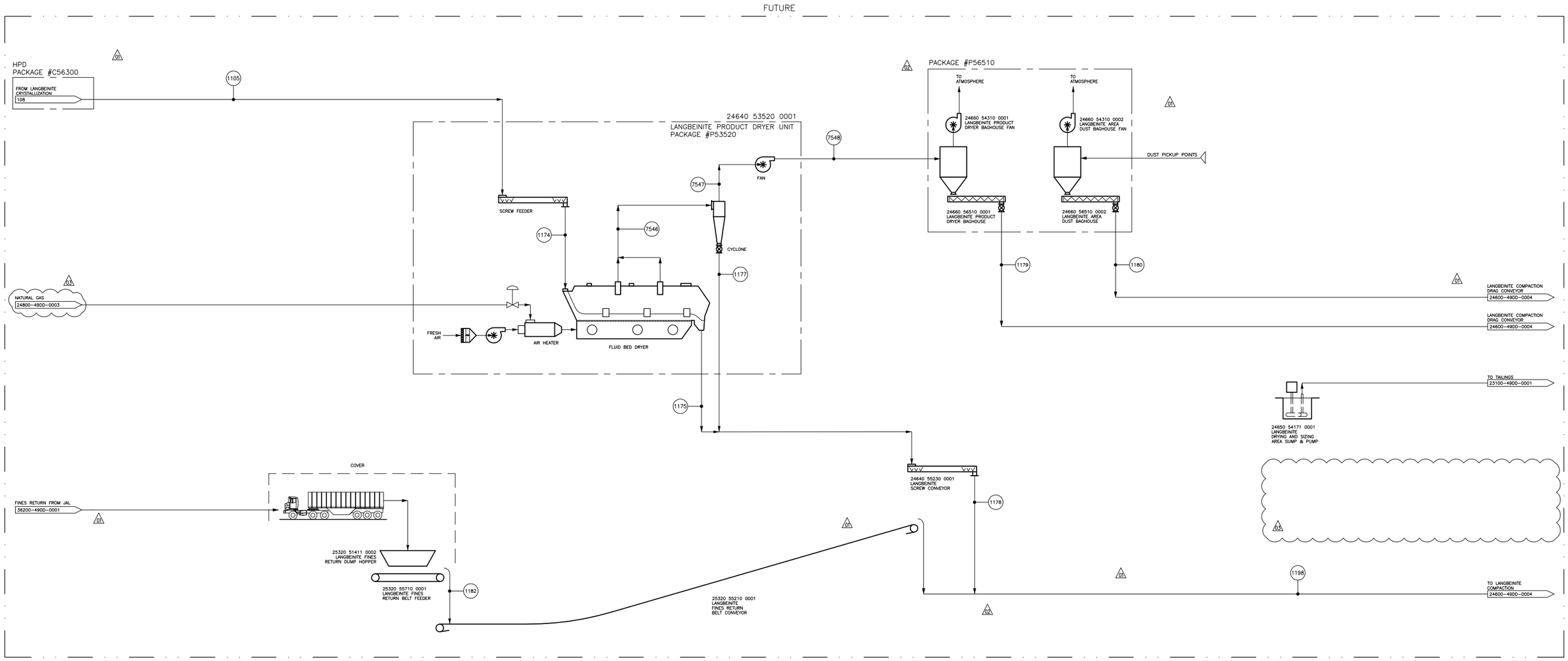

NOTE 1

STREAM NUMBER	UNITS	1105	1174	1175	1177	1178	1179	1180	1182	1198	7546	7547	7548
NOMINAL													
MASS - SOLIDS	STPH	34.94	34.94	31.44	3.46	34.55	0.03	0.35	0.00	34.55	3.49	0.03	0.03
MASS - SOLUTION	STPH	1.84	1.84	0.06	0.00	0.06	0.00	0.00	0.00	0.06	1.84	0.00	0.00
MASS - SLURRY	STPH	36.78	36.78	31.51	3.46	34.62	0.03	0.35	0.00	34.62	5.33	0.03	0.03
VOLUME - SLURRY	USGPM								0.00		13.32	0.05	0.05
SPECIFIC GRAVITY - SLURRY	S.G.	2.58	2.58	2.82	2.83	2.82	2.83	2.83	0.00	2.82	1.60	2.83	2.83
WT - % SOLIDS	%	95.00	95.00	99.80	100.00	99.82	100.00	100.00	0.00	99.82	15.09	0.18	0.18
SOLIDS - % K2SO4	%	42.70	42.70	42.70	42.70	42.70	42.70	42.70	0.00	42.70	42.70	42.70	42.70
SOLIDS - % MgSO4	%	57.30	57.30	57.30	57.30	57.30	57.30	57.30	0.00	57.30	57.30	57.30	57.30
GAS - MASS	STPH	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	17.83	19.66	19.66
GAS - VOLUME	ACFM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	14361	16700	16700
GAS - PRESSURE	PSIA												
TEMPERATURE	°F	162.33	162.33	374.00	374.00	374.00	374.00	92.91	68.00	374.00	374.00	374.00	374.00
DESIGN													
MASS - SOLIDS	STPH	41.88	41.88	37.69	4.15	41.42	0.04	0.41	0.00	41.42	4.19	0.04	0.04
MASS - SOLUTION	STPH	2.20	2.20	0.08	0.00	0.08	0.00	0.00	0.00	0.08	2.20	0.00	0.00
MASS - SLURRY	STPH	44.08	44.08	37.76	4.15	41.49	0.04	0.41	0.00	41.49	6.39	0.04	0.04
GAS - VOLUME	ACFM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	13896	16700	16700

NOTE:

1. MASS BALANCE VALUES MAY NOT MATCH EXACTLY WITH CONNECTING STREAMS IN THE CRYSTALLIZATION SECTION OF THE PLANT.

NO	DATE (YYYY-MM-DD)	REVISIONS	BY	CHK	LEAD ENG	ENG MAN	PROJ MAN	CLIENT ENG COORD	CLIENT AREA MAN
03	2013-06-13	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		
02	2013-05-21	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		
01	2013-04-05	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		
00	2013-02-04	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		

DRAWING NUMBER | REFERENCES | DRAWING NUMBER | REFERENCES

SU			
DESIGNED	J. NAGY	JN	2013-02-04
DRAWN	E. PERRERAS	EP	2013-02-04
CHECKED	T. ZRYMIAK	TZ	2013-02-04
APPROVED LEAD ENG	A. TOMTENE	AT	2013-02-04
APPROVED ENG MAN			
APPROVED PROJ MAN			
CLIENT APPROVED ENG COORD			
CLIENT APPROVED AREA MAN			

SCALE NTS | NAME (F. LAST) | INIT | DATE (YYYY-MM-DD)

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PROFESSIONAL ENGINEER | NAME | NO

TITLE
OCHOA POLYHALITE MINE FEASIBILITY STUDY
SOP AND MSOP PROCESSING PLANT
LANGBEINITE DRYING AND SIZING
PROCESS FLOWSHEET

PROJECT NUMBER	AREA	DISC	DOC	DRAWING NUMBER	REVISION NUMBER
510315	24600	49	DD	0003	03

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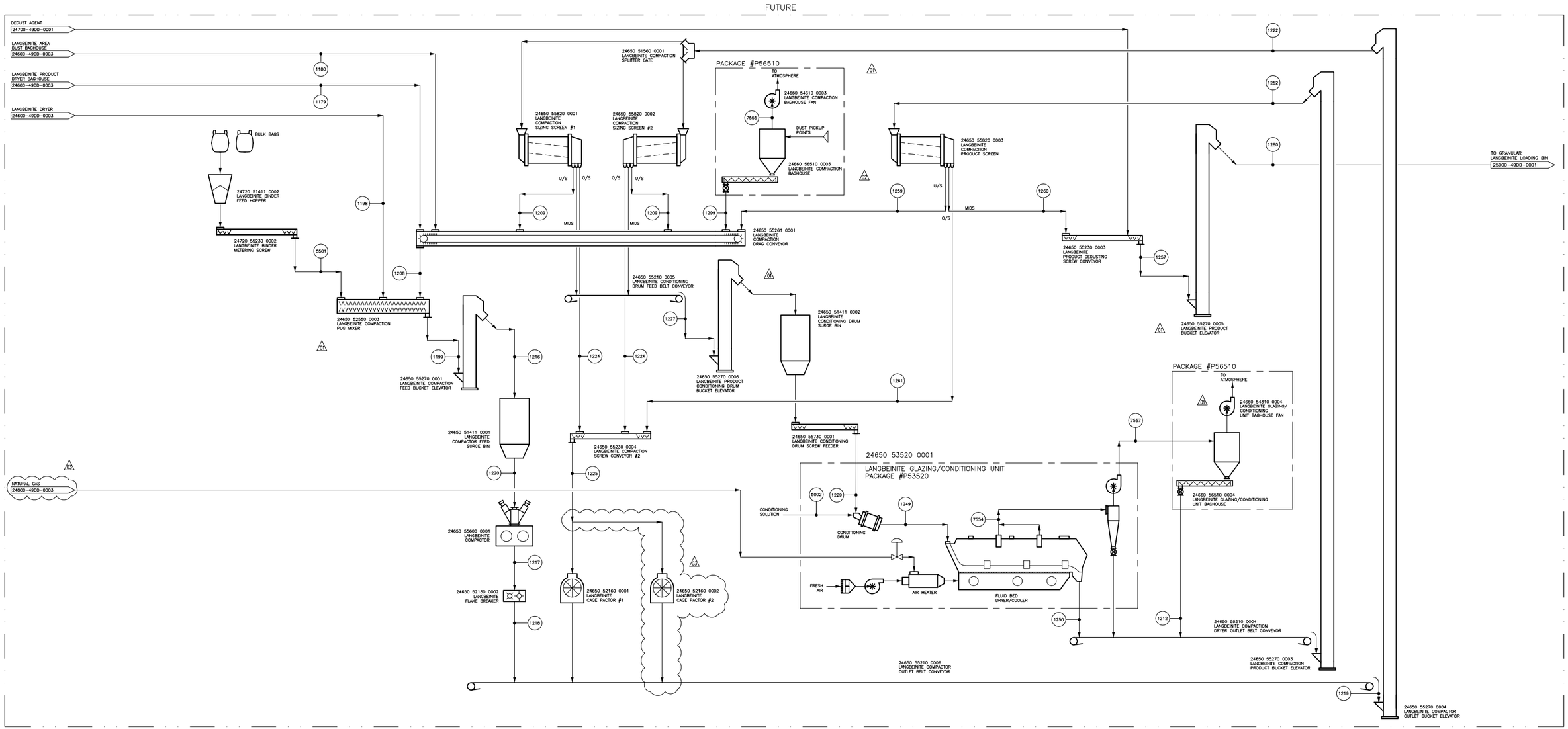

STREAM NUMBER	UNITS	1179	1180	1198	1199	1208	1209	1212	1216	1217	1218	1219	1220	1222	1224	1225	1227	1229	1249	1250	1252	1257	1259	1260	1261	1280	1299	5002	5501	7554	7555	7557
NOMINAL																																
MASS - SOLIDS	STPH	0.03	0.35	34.55	140.03	104.96	47.86	0.01	140.03	140.03	140.03	497.62	140.03	497.62	138.77	357.58	119.38	119.38	119.38	118.20	119.46	35.49	3.93	35.49	80.04	35.49	4.93	0.00	0.52	1.27	4.98	0.01
MASS - SOLUTION	STPH	0.00	0.00	0.06	0.20	0.13	0.07	0.00	0.20	0.20	0.20	0.67	0.20	0.67	0.19	0.47	0.16	0.16	1.95	0.14	0.14	0.04	0.00	0.04	0.09	0.04	0.00	1.79	0.00	0.00	0.00	0.00
MASS - SLURRY	STPH	0.03	0.35	34.62	140.23	105.09	47.93	0.01	140.23	140.23	140.23	498.29	140.23	498.29	138.96	358.05	119.54	119.54	121.33	118.34	119.61	35.53	3.94	35.53	80.14	35.53	4.93	1.79	0.52	1.27	4.98	0.01
VOLUME - SLURRY	USGPM																											6.90		1.81	7.09	0.02
SPECIFIC GRAVITY - SLURRY	S.G.	2.83	2.83	2.82	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.72	2.80	2.80	2.80	2.80	2.80	2.80	2.80	2.80	1.04	1.80	2.80	2.80	2.80
WT - % SOLIDS	%	100.00	100.00	99.82	99.86	99.87	99.86	100.00	99.86	99.86	99.86	99.87	99.86	99.87	99.86	99.87	99.86	99.86	98.39	99.88	99.88	99.88	99.88	99.88	99.88	99.88	100.00	0.00	100.00	3.96	33.22	0.04
SOLIDS - % K2SO4	%	42.70	42.70	42.70	42.02	42.01	42.01	41.98	42.02	42.02	42.02	42.01	42.02	42.01	42.01	42.00	42.01	42.01	42.01	41.98	41.98	41.98	41.98	41.98	41.98	41.98	42.01	0.00	0.00	41.98	42.01	41.98
SOLIDS - % MgSO4	%	57.30	57.30	57.30	56.39	56.38	56.37	56.34	56.39	56.39	56.39	56.37	56.39	56.37	56.37	56.37	56.37	56.37	56.37	56.34	56.34	56.34	56.34	56.34	56.34	56.34	56.37	0.00	0.00	56.34	56.37	56.34
GAS - MASS	STPH	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	30.68	10.00	30.68
GAS - VOLUME	ACFM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	19500	6550	19500
GAS - PRESSURE	PSIA																															
TEMPERATURE	°F	374.00	92.91	374.00	257.70	218.65	220.56	179.60	257.70	257.70	257.70	224.44	257.70	224.44	220.56	211.40	220.56	220.56	209.39	179.60	179.60	179.60	179.60	179.60	179.60	179.60	220.56	68.00	68.00	179.60	220.56	179.60
DESIGN																																
MASS - SOLIDS	STPH	0.04	0.41	41.42	167.12	125.08	56.95	0.01	167.12	167.12	167.12	606.21	167.12	606.21	171.72	439.10	142.81	142.81	142.81	141.40	142.91	42.53	4.72	42.53	95.66	42.53	6.00	0.00	0.62	1.51	6.06	0.02
MASS - SOLUTION	STPH	0.00	0.00	0.08	0.24	0.16	0.08	0.00	0.24	0.24	0.24	0.82	0.24	0.82	0.23	0.58	0.19	0.19	2.34	0.17	0.17	0.05	0.01	0.05	0.11	0.05	0.00	2.14	0.00	0.00	0.00	0.00
MASS - SLURRY	STPH	0.04	0.41	41.49	167.35	125.24	57.03	0.01	167.35	167.35	167.35	607.03	167.35	607.03	171.95	439.68	143.00	143.00	145.14	141.56	143.08	42.58	4.72	42.58	95.77	42.58	6.00	2.14	0.62	1.52	6.06	0.02
GAS - VOLUME	ACFM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	19500	7859	19500

DRAWING NUMBER	REFERENCES	DRAWING NUMBER	REFERENCES	NO	DATE (YYYY-MM-DD)	REVISIONS	BY	CHK	LEAD ENG	ENG MAN	PROJ MAN	CLIENT ENG COORD	CLIENT AREA MAN
				03	2013-06-13	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		
				02	2013-05-21	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		
				01	2013-04-05	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		
				00	2013-02-04	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		

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PROFESSIONAL ENGINEER | NAME | NO

DESIGNED	J. NAGY	JN	2013-02-04
DRAWN	E. PERRERAS	EP	2013-02-04
CHECKED	T. ZRYMIAK	TZ	2013-02-04
APPROVED LEAD ENG	A. TOMTENE	AT	2013-02-04
APPROVED ENG MAN			
APPROVED PROJ MAN			
APPROVED ENG COORD			
APPROVED AREA MAN			
SCALE NTS	NAME (F. LAST)	INIT	DATE (YYYY-MM-DD)

TITLE
OCHOA POLYHALITE MINE FEASIBILITY STUDY
SOP AND MSOP PROCESSING PLANT
LANGBEINITE COMPACTION
PROCESS FLOWSHEET

PROJECT NUMBER	AREA	DISC	DOC	DRAWING NUMBER	REVISION NUMBER
510315	24600	49	DD	0004	03

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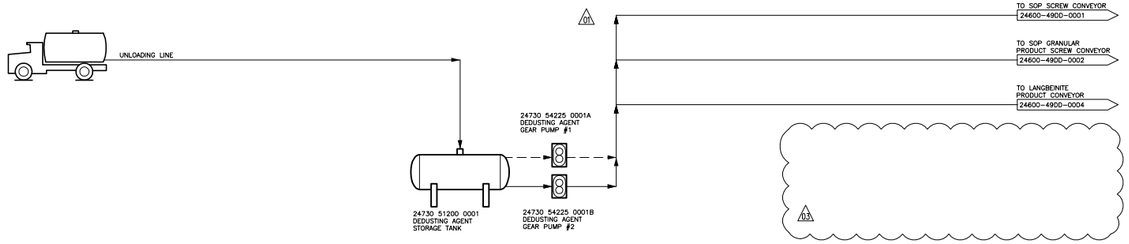
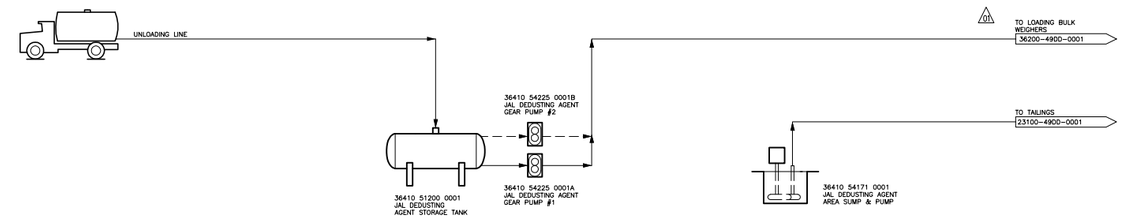
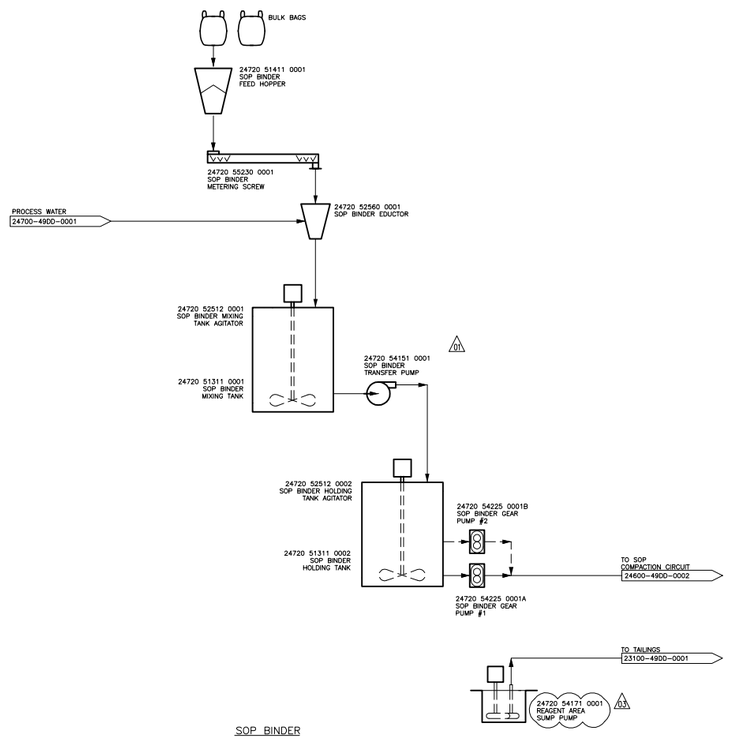


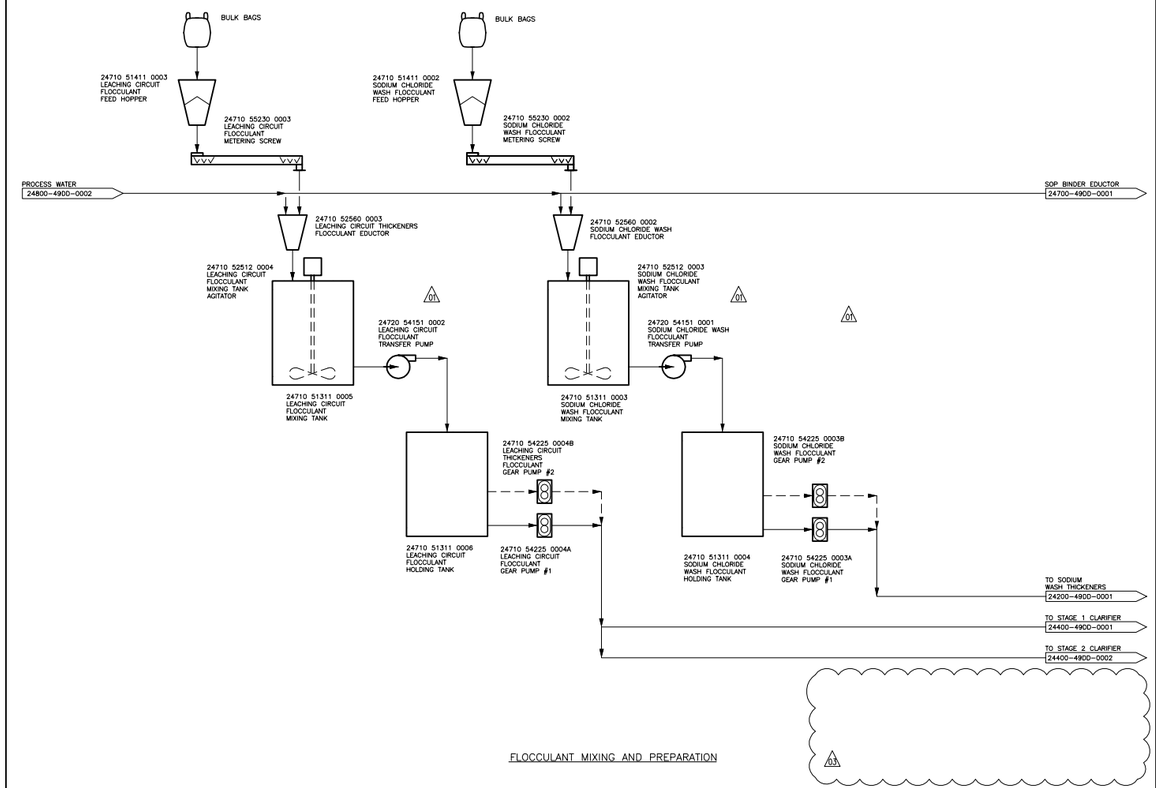
DEDUSTING AGENT – PLANT SITE (AREA–2)



DEDUSTING AGENT – JAL SITE (AREA 3)



SOP BINDER



FLOCCULANT MIXING AND PREPARATION

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CLIENT

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PROFESSIONAL ENGINEER | NAME | NO

STUDY DRAWING
NOT FOR CONSTRUCTION

DRAWING NUMBER	REFERENCES	DRAWING NUMBER	REFERENCES	NO	DATE (YYYY–MM–DD)	REVISIONS	BY	CHK	LEAD ENG	ENG MAN	PROJ MAN	CLIENT ENG COORD	CLIENT AREA MAN
				03	2013–06–13	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		
				02	2013–05–21	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		
				01	2013–04–05	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		
				00	2013–02–04	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		

SIGN		NAME (F. LAST)	INIT	DATE (YYYY–MM–DD)
SIGN	DESIGNED	J. NAGY	JN	2013–02–04
	DRAWN	E. PERRERAS	EP	2013–02–04
	CHECKED	T. ZRYMIAK	TZ	2013–02–04
	APPROVED LEAD ENG	A. TOMTENE	AT	2013–02–04
CLIENT	APPROVED ENG MAN			
	APPROVED PROJ MAN			
	APPROVED ENG COORD			
	APPROVED AREA MAN			

SCALE: NTS

TITLE
OCHOA POLYHALITE MINE FEASIBILITY STUDY
SOP AND MSOP PROCESSING PLANT
REAGENT MIXING AND STORAGE
PROCESS FLOWSHEET

PROJECT NUMBER	AREA	DISC	DOC	DRAWING NUMBER	REVISION NUMBER
510315	24700	49	DD	0001	03

Format 'ANSI D' Sheet Size

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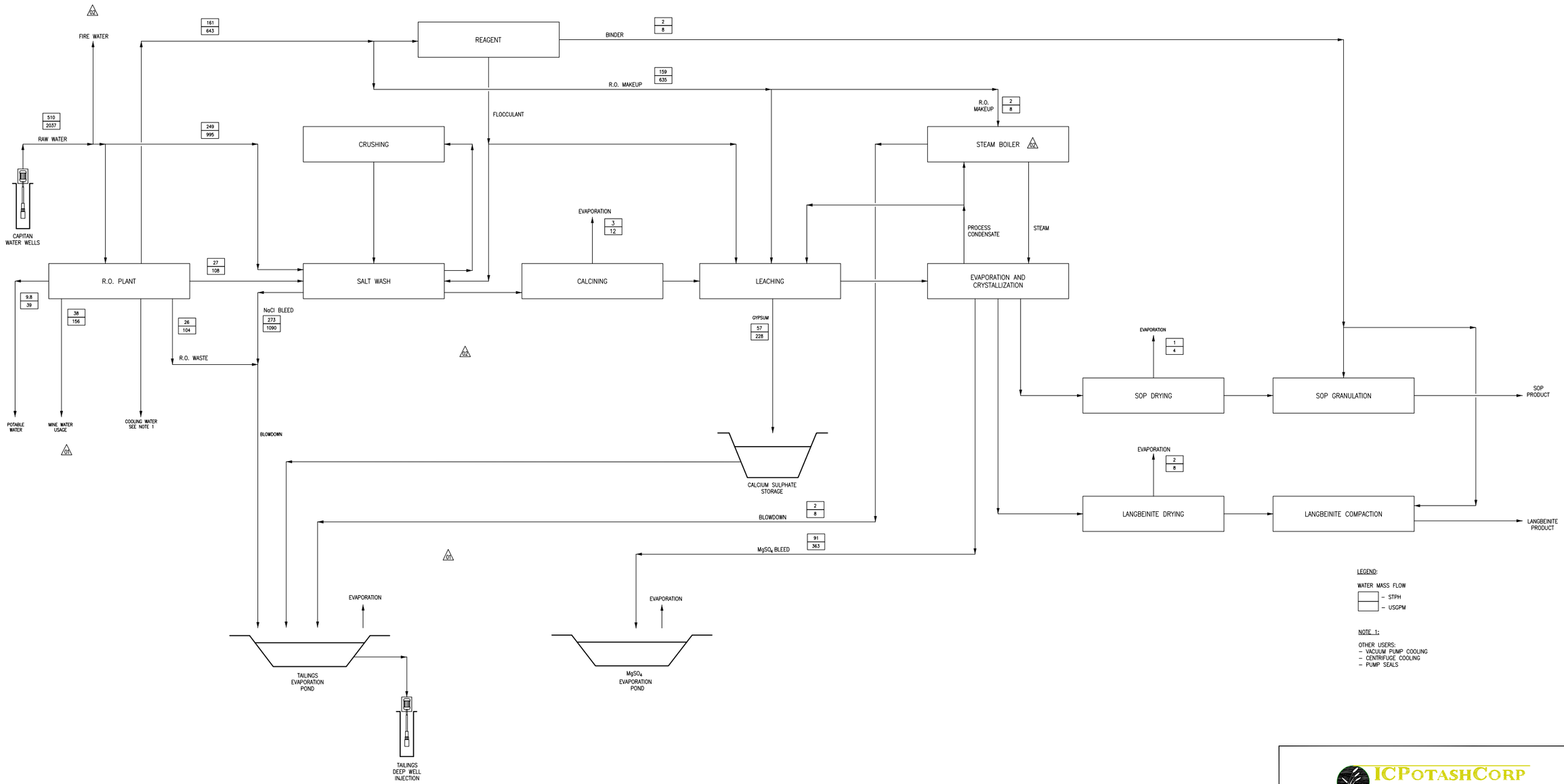

STUDY DRAWING
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CLIENT

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PROFESSIONAL ENGINEER | NAME | NO

DRAWING NUMBER	REFERENCES	DRAWING NUMBER	REFERENCES	NO	DATE (YYYY–MM–DD)	REVISIONS	BY	CHK	LEAD ENG	ENG MAN	PROJ MAN	CLIENT ENG COORD	CLIENT AREA MAN
				03	2013–06–13	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		
				02	2013–05–21	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		
				01	2013–04–05	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		
				00	2013–02–04	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		

SLI	DESIGNED	J. NAGY	JN	2013–02–04
	DRAWN	E. PERRERAS	EP	2013–02–04
	CHECKED	T. ZRYMIAK	TZ	2013–02–04
	APPROVED LEAD ENG	A. TOMTENE	AT	2013–02–04
CLIENT	APPROVED ENG MAN			
	APPROVED PROJ MAN			
	APPROVED ENG COORD			
	APPROVED AREA MAN			
SCALE NTS	NAME (F. LAST)		INIT	DATE (YYYY–MM–DD)

TITLE
OCHOA POLYHALITE MINE FEASIBILITY STUDY
SOP AND MSOP PROCESSING PLANT
FEASIBILITY STUDY
OVERALL WATER BALANCE

PROJECT NUMBER	AREA	DISC	DOC	DRAWING NUMBER	REVISION NUMBER
510315	24800	49	DD	0001	03

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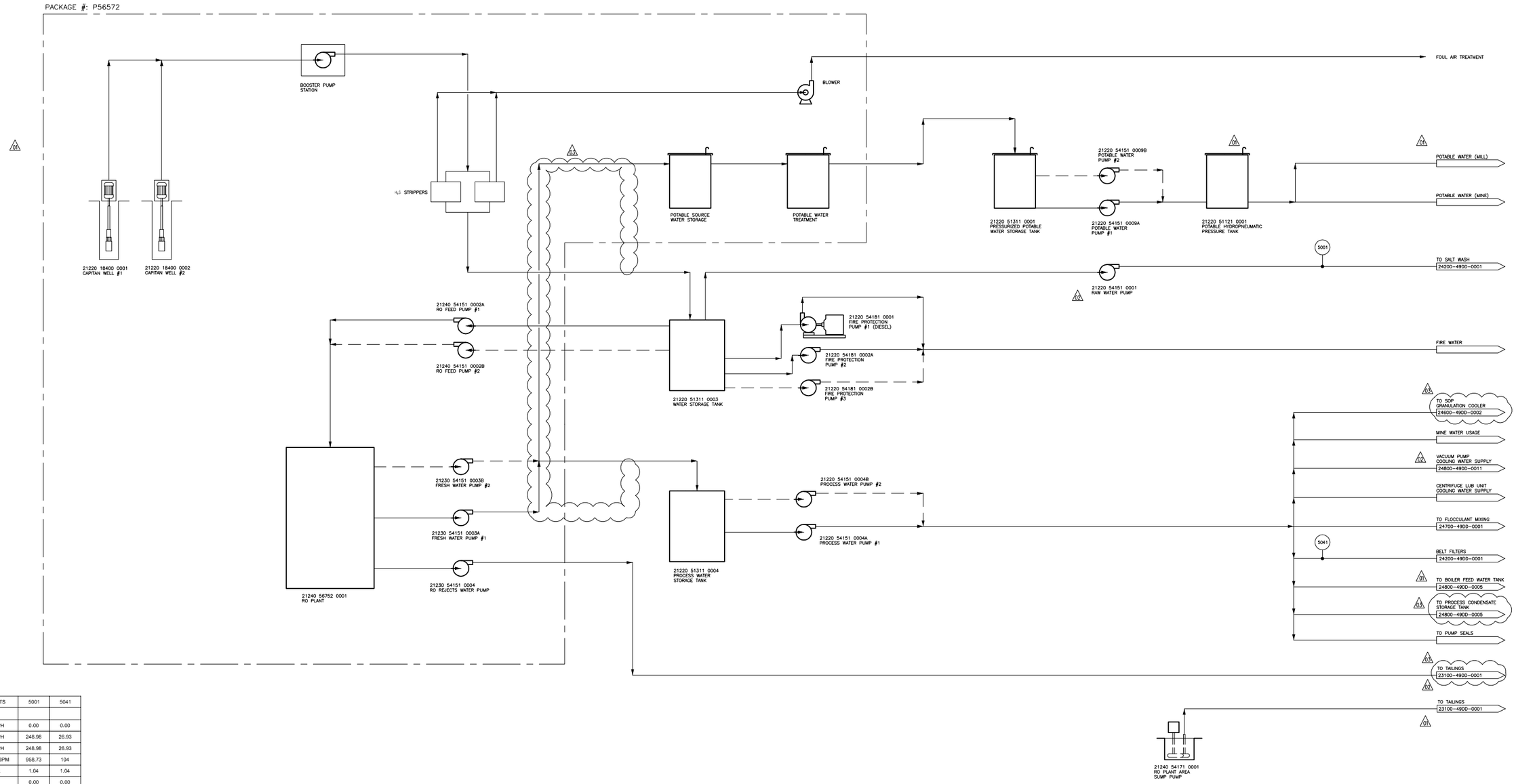

STREAM NUMBER	UNITS	5001	5041
NOMINAL			
MASS - SOLIDS	STPH	0.00	0.00
MASS - SOLUTION	STPH	248.98	26.93
MASS - SLURRY	STPH	248.98	26.93
VOLUME - SLURRY	USGPM	958.73	104
SPECIFIC GRAVITY - SLURRY	S.G.	1.04	1.04
WT - % SOLIDS	%	0.00	0.00
SOLIDS - % K2SO4	%	0.00	0.00
SOLIDS - % MgSO4	%	0.00	0.00
GAS - MASS	STPH	0.00	0.00
GAS - VOLUME	ACFM	0.00	0.00
GAS - PRESSURE	PSIA		
TEMPERATURE	°F	68.00	68.00
DESIGN			
MASS - SOLIDS	STPH	0.00	0.00
MASS - SOLUTION	STPH	298.70	32.31
MASS - SLURRY	STPH	298.70	32.31
GAS - VOLUME	ACFM	0.00	0.00

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DRAWING NUMBER	REFERENCES	DRAWING NUMBER	REFERENCES

NO	DATE (YYYY-MM-DD)	REVISIONS	BY	CHK	LEAD ENG	ENG MAN	PROJ MAN	CLIENT ENG COORD	CLIENT AREA MAN
03	2013-06-13	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		
02	2013-05-21	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		
01	2013-04-05	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		
00	2013-02-04	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		

		NAME (F. LAST)	INIT	DATE (YYYY-MM-DD)
SLI	DESIGNED	J. NAGY	JN	2013-02-04
	DRAWN	E. PERRERAS	EP	2013-02-04
	CHECKED	T. ZRYMIAK	TZ	2013-02-04
	APPROVED LEAD ENG	A. TOMTENE	AT	2013-02-04
	APPROVED ENG MAN			
	APPROVED PROJ MAN			
CLIENT	APPROVED ENG COORD			
	APPROVED AREA MAN			
SCALE	NTS			

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CLIENT

CLIENT DRAWING NUMBER

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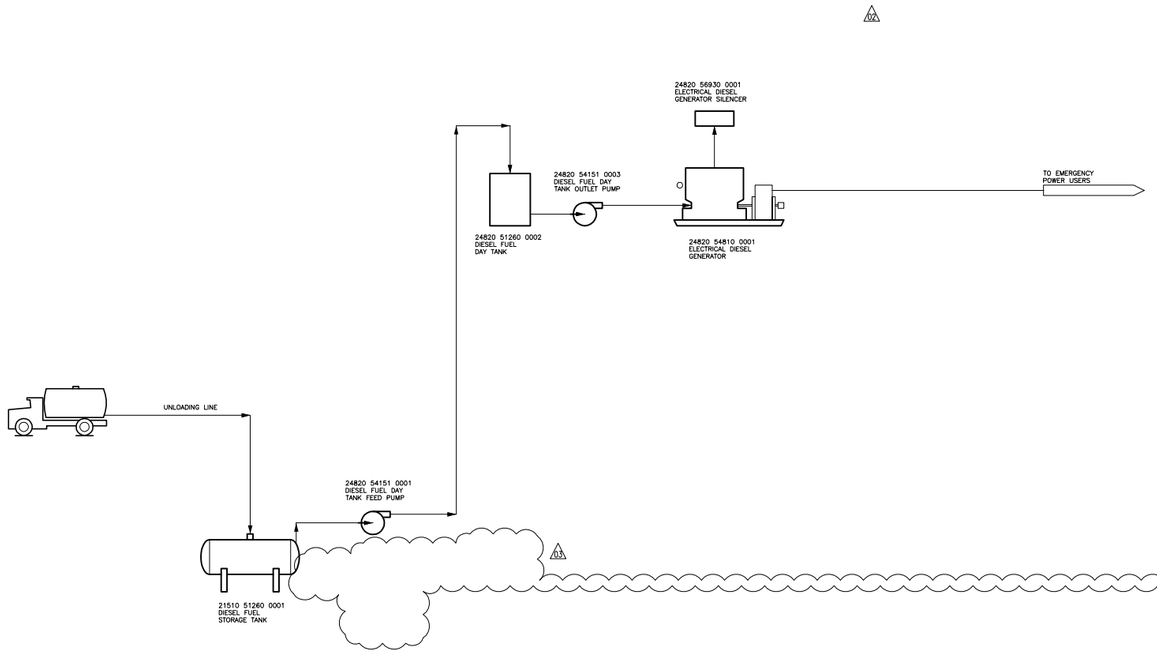
PROFESSIONAL ENGINEER | NAME | NO

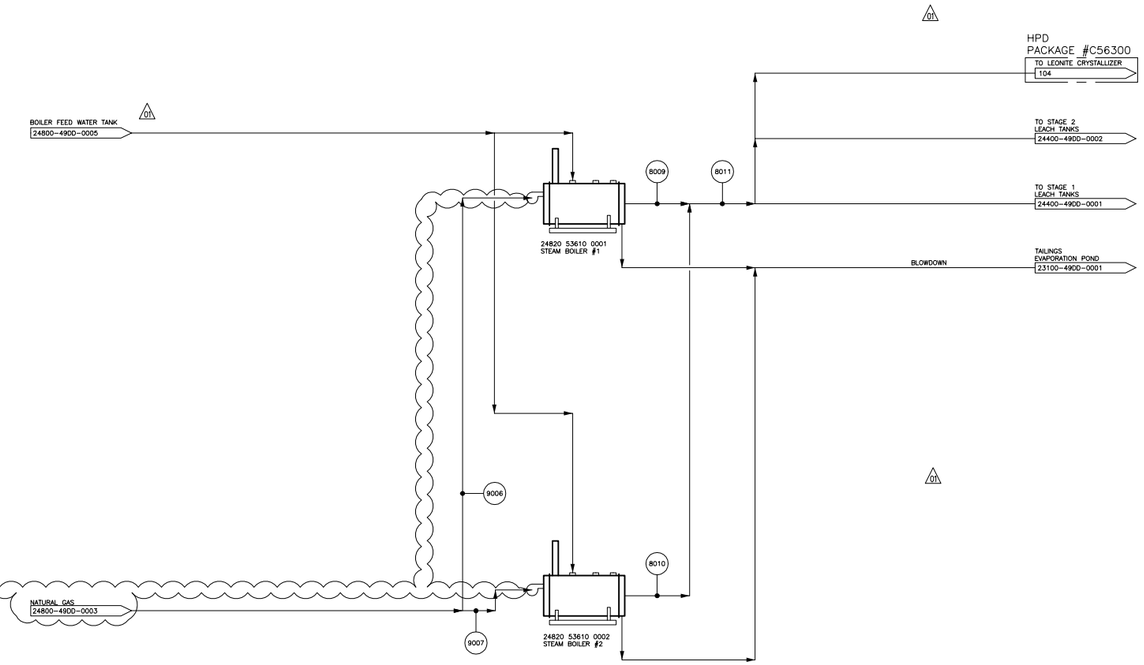
TITLE
OCHOA POLYHALITE MINE FEASIBILITY STUDY
SOP AND MSOP PROCESSING PLANT
WATER MANAGEMENT
PROCESS FLOWSHEET

PROJECT NUMBER	AREA	DISC	DOC	DRAWING NUMBER	REVISION NUMBER
510315	24800	49	DD	0002	03

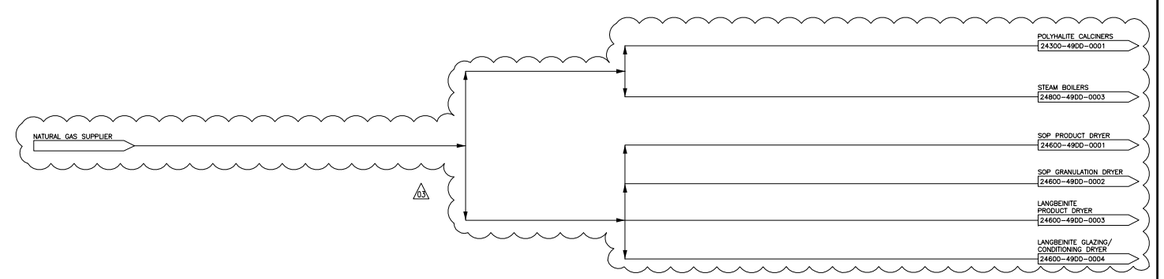
Format 'ANSI D' Sheet Size



STANDBY POWER GENERATION



STEAM GENERATION



NATURAL GAS

STREAM NUMBER	UNITS	8009	8010	8011	9006	9007
NOMINAL						
MASS - SOLIDS	STPH	0.00	0.00	0.00	0.00	0.00
MASS - SOLUTION	STPH	0.00	0.00	0.00	0.00	0.00
MASS - SLURRY	STPH	0.00	0.00	0.00	0.00	0.00
VOLUME - SLURRY	USGPM	0.00	0.00	0.00	0.00	0.00
SPECIFIC GRAVITY - SLURRY	S.G.	0.00	0.00	0.00	0.00	0.00
WT - % SOLIDS	%	0.00	0.00	0.00	0.00	0.00
SOLIDS - % K2SO4	%	0.00	0.00	0.00	0.00	0.00
SOLIDS - % MgSO4	%	0.00	0.00	0.00	0.00	0.00
GAS - MASS	STPH	80.96	80.96	161.92	10.66	10.66
GAS - VOLUME	ACFM	8729	8729	17457	9640	9640
GAS - PRESSURE	PSIA	145.42	145.42	145.42		
TEMPERATURE	°F	356.00	356.00	356.00	68.00	68.00
DESIGN						
MASS - SOLIDS	STPH	0.00	0.00	0.00	0.00	0.00
MASS - SOLUTION	STPH	0.00	0.00	0.00	0.00	0.00
MASS - SLURRY	STPH	0.00	0.00	0.00	0.00	0.00
GAS - VOLUME	ACFM	10472	10472	20945	11704	11704

NO	DATE (YYYY-MM-DD)	REVISIONS	BY	CHK	LEAD ENG	ENG MAN	PROJ MAN	CLIENT ENG COORD	CLIENT AREA MAN
03	2013-06-13	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		
02	2013-05-21	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		
01	2013-04-05	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		
00	2013-02-04	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		

DRAWING NUMBER	REFERENCES	DRAWING NUMBER	REFERENCES

STUDY DRAWING
NOT FOR CONSTRUCTION

SLI			
DESIGNED	J. NAGY	JN	2013-02-04
DRAWN	E. PERRERAS	EP	2013-02-04
CHECKED	T. ZRYMIAK	TZ	2013-02-04
APPROVED LEAD ENG	A. TOMTENE	AT	2013-02-04
APPROVED ENG MAN			
APPROVED PROJ MAN			
CLIENT APPROVED ENG COORD			
CLIENT APPROVED AREA MAN			
SCALE NTS	NAME (F. LAST)	INIT	DATE (YYYY-MM-DD)

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PROFESSIONAL ENGINEER | NAME | NO

TITLE
OCHOA POLYHALITE MINE FEASIBILITY STUDY
SOP AND MSOP PROCESSING PLANT
STANDBY POWER AND STEAM BOILERS
PROCESS FLOWSHEET

PROJECT NUMBER	AREA	DISC	DOC	DRAWING NUMBER	REVISION NUMBER
510315	24800	49	DD	0003	03

Format 'ANSI D' Sheet Size

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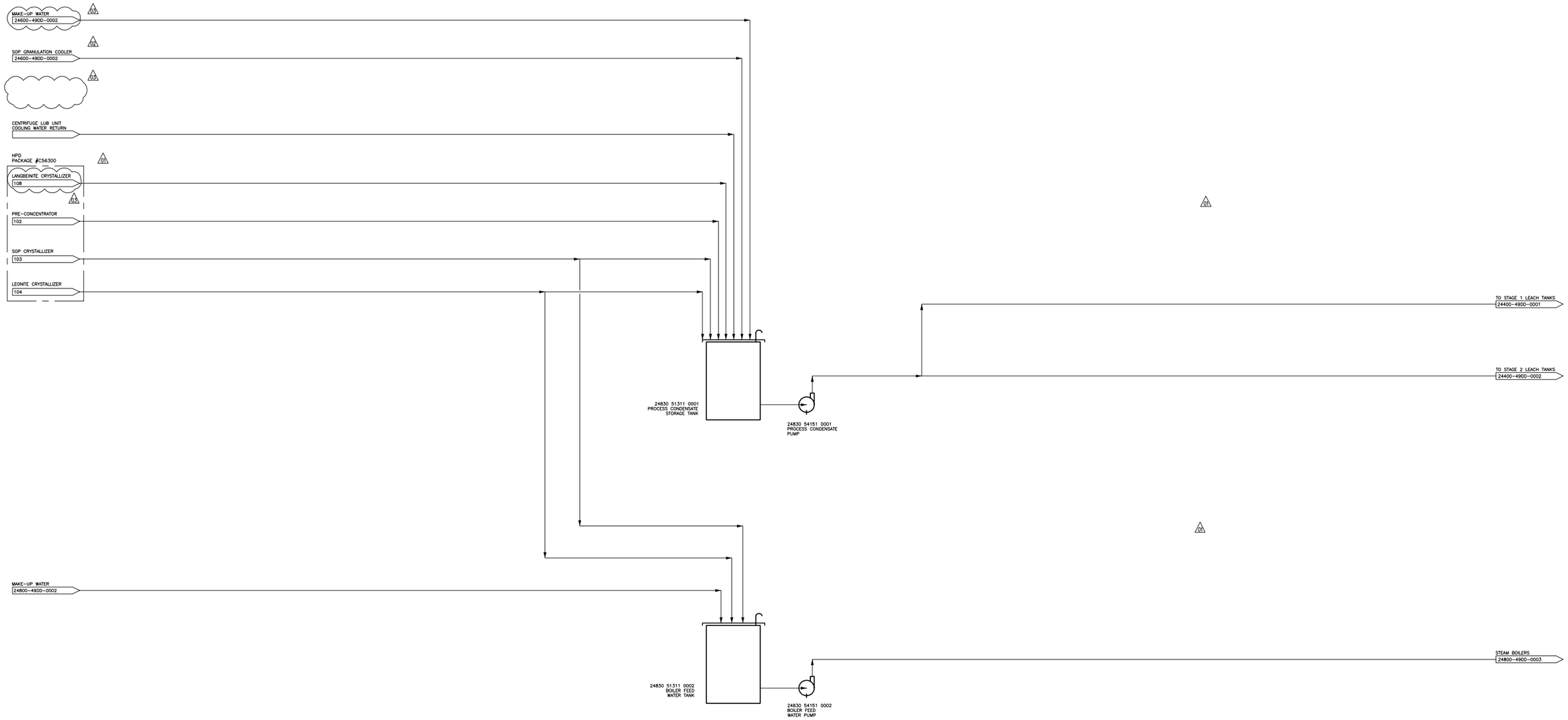
17-Jun-2013 - 11:00am PERRE7



STUDY DRAWING
NOT FOR CONSTRUCTION

NO	DATE (YYYY-MM-DD)	REVISIONS	BY	CHK	LEAD ENG	ENG MAN	PROJ MAN	CLIENT ENG COORD	CLIENT AREA MAN
03	2013-06-13	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		
02	2013-05-21	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		
01	2013-04-05	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		
00	2013-02-04	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		

DRAWING NUMBER	REFERENCES	DRAWING NUMBER	REFERENCES

SLI			
DESIGNED	J. NAGY	JN	2013-02-04
DRAWN	E. PERRERAS	EP	2013-02-04
CHECKED	T. ZRYMIAK	TZ	2013-02-04
APPROVED LEAD ENG	A. TOMTENE	AT	2013-02-04
APPROVED ENG MAN			
APPROVED PROJ MAN			
CLIENT APPROVED ENG COORD			
CLIENT APPROVED AREA MAN			
SCALE NTS	NAME (F. LAST)	INIT	DATE (YYYY-MM-DD)

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PROFESSIONAL ENGINEER | NAME | NO

TITLE
OCHOA POLYHALITE MINE FEASIBILITY STUDY
SOP AND MSOP PROCESSING PLANT
PROCESS CONDENSATE HANDLING
PROCESS FLOWSHEET

PROJECT NUMBER	AREA	DISC	DOC	DRAWING NUMBER	REVISION NUMBER
510315	24800	49	DD	0005	03

Format 'ANSI D' Sheet Size

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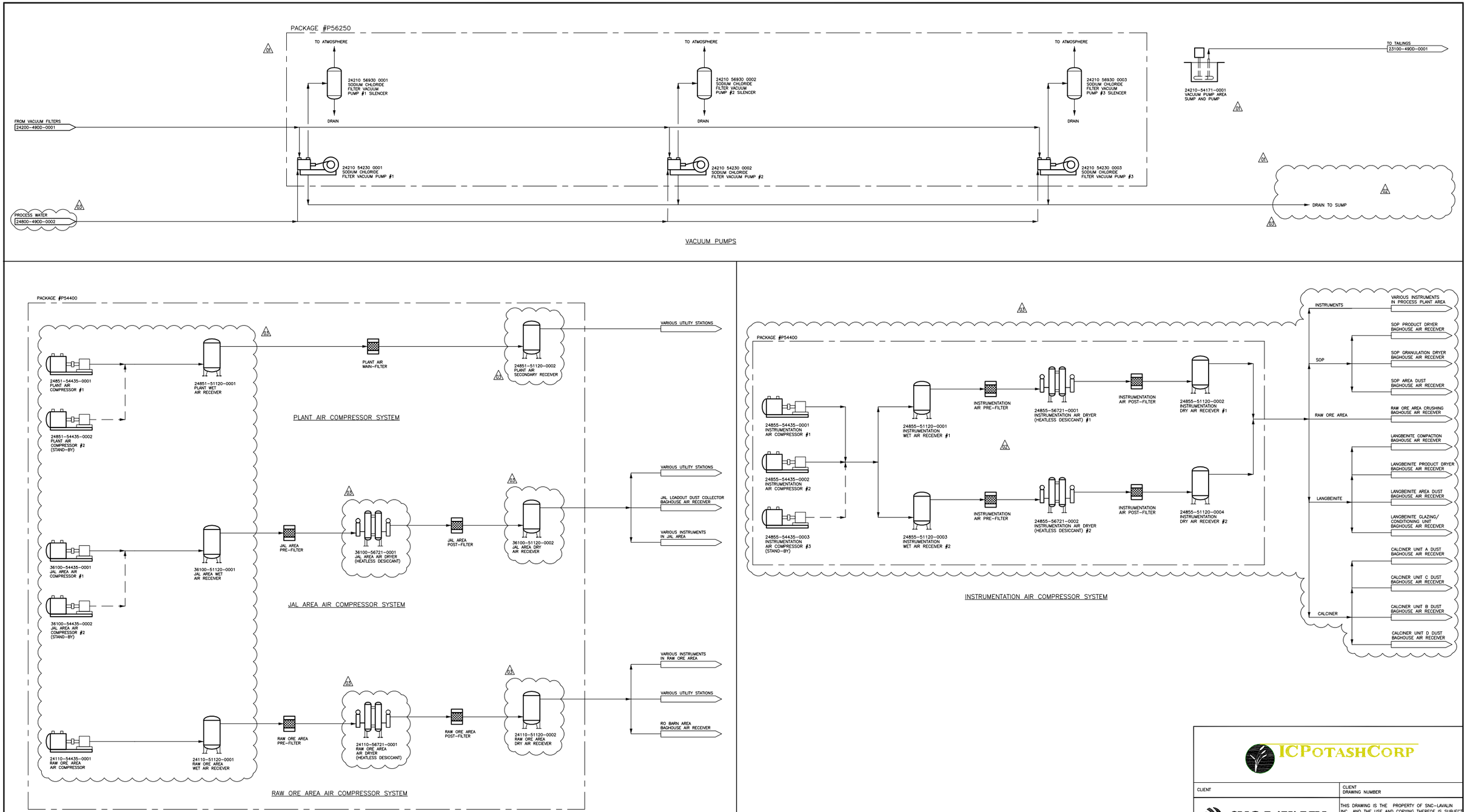
18-Jun-2013 - 10:36am PERRE7



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PROFESSIONAL ENGINEER | NAME | NO

TITLE
OCHOA POLYHALITE MINE FEASIBILITY STUDY
SOP AND MSOP PROCESSING PLANT
VACUUM PUMPS AND COMPRESSED AIR
PROCESS FLOWSHEET

DRAWING NUMBER	REFERENCES	DRAWING NUMBER	REFERENCES	NO	DATE (YYYY-MM-DD)	REVISIONS	BY	CHK	LEAD ENG	ENG MAN	PROJ MAN	CLIENT ENG COORD	CLIENT AREA MAN
				03	2013-06-13	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		
				02	2013-05-21	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		
				01	2013-04-05	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		
				00	2013-02-04	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		

SLI	DESIGNED	J. NAGY	JN	2013-02-04
	DRAWN	E. PERRERAS	EP	2013-02-04
	CHECKED	T. ZRYMIAK	TZ	2013-02-04
	APPROVED LEAD ENG	A. TOMTENE	AT	2013-02-04
	APPROVED ENG MAN			
	APPROVED PROJ MAN			
CLIENT	APPROVED ENG COORD			
	APPROVED AREA MAN			
SCALE NTS	NAME (F. LAST)		INIT	DATE (YYYY-MM-DD)

PROJECT NUMBER	AREA	DISC	DOC	DRAWING NUMBER	REVISION NUMBER
510315	24800	49	DD	0011	03

Format 'ANSI D' Sheet Size

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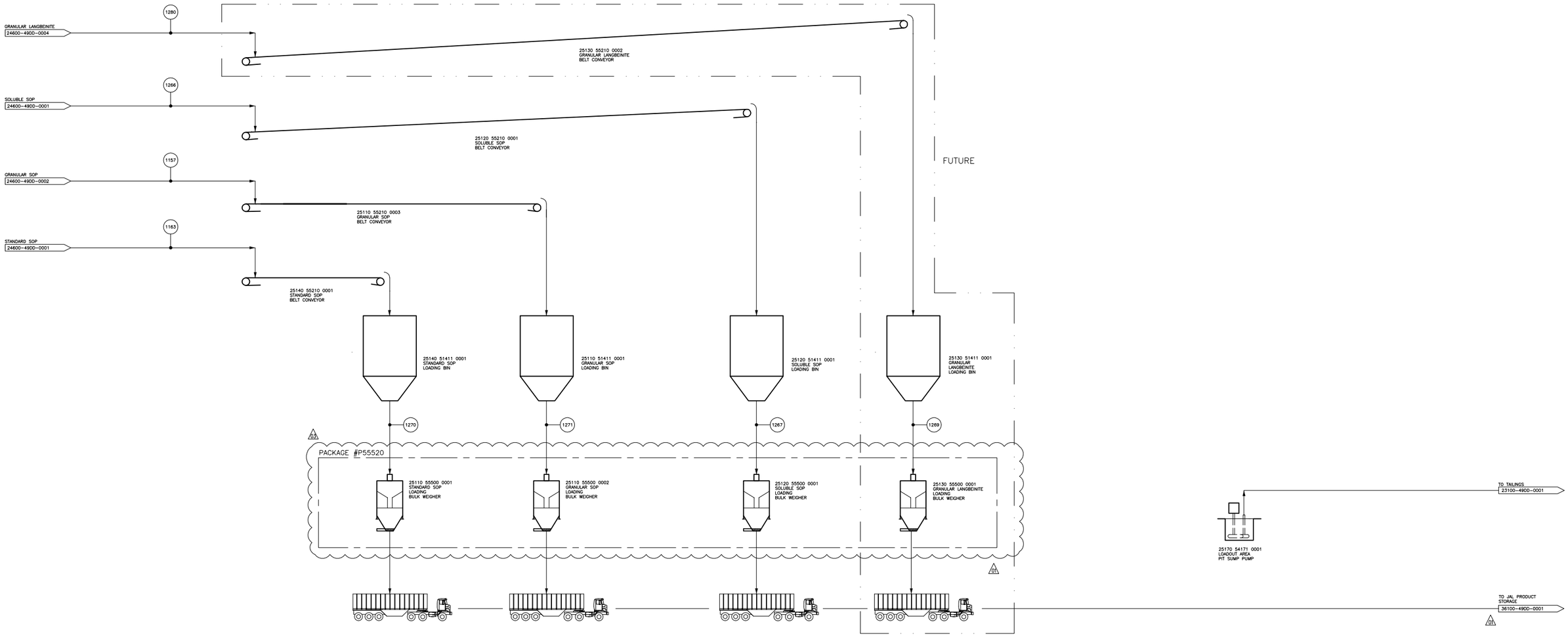

STREAM NUMBER	UNITS	1157	1163	1266	1267	1269	1270	1271	1280
NOMINAL									
MASS - SOLIDS	STPH	31.40	31.42	8.98	250.00	250.00	250.00	250.00	35.49
MASS - SOLUTION	STPH	0.10	0.11	0.02	0.30	0.30	0.98	0.98	0.04
MASS - SLURRY	STPH	31.50	31.53	9.00	250.30	250.30	250.98	250.98	35.53
VOLUME - SLURRY	USGPM								
SPECIFIC GRAVITY - SLURRY	S.G.	2.65	2.65	2.65	2.80	2.80	2.64	2.64	2.80
WT - % SOLIDS	%	99.67	99.66	99.74	99.88	99.88	99.61	99.61	99.88
SOLIDS - % K2SO4	%	98.43	98.70	98.70	41.60	41.60	97.52	97.52	41.98
SOLIDS - % MgSO4	%	0.91	0.90	0.90	56.71	56.71	0.95	0.95	56.34
GAS - MASS	STPH	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GAS - VOLUME	ACFM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GAS - PRESSURE	PSIA								
TEMPERATURE	°F	179.96	157.07	157.07	157.21	179.60	157.21	179.96	179.60
DESIGN									
MASS - SOLIDS	STPH	49.28	63.60	12.32	250.00	250.00	250.00	250.00	42.53
MASS - SOLUTION	STPH	0.16	0.22	0.03	0.30	0.30	0.98	0.98	0.05
MASS - SLURRY	STPH	49.44	63.82	12.35	250.30	250.30	250.98	250.98	42.58
GAS - VOLUME	ACFM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

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DRAWING NUMBER	REFERENCES	DRAWING NUMBER	REFERENCES	NO	DATE (YYYY-MM-DD)	REVISIONS	BY	CHK	LEAD ENG	ENG MAN	PROJ MAN	CLIENT ENG COORD	CLIENT AREA MAN
				03	2013-06-13	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		
				02	2013-05-21	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		
				01	2013-04-05	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		
				00	2013-02-04	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		

STUDY DRAWING
NOT FOR CONSTRUCTION

SLI	DESIGNED	J. NAGY	JN	2013-02-04
	DRAWN	E. PERRERAS	EP	2013-02-04
	CHECKED	T. ZRYMIAK	TZ	2013-02-04
	APPROVED LEAD ENG	A. TOMTENE	AT	2013-02-04
	APPROVED ENG MAN			
	APPROVED PROJ MAN			
CLIENT	APPROVED ENG COORD			
	APPROVED AREA MAN			
SCALE	NTS	NAME (F. LAST)	INIT	DATE (YYYY-MM-DD)

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PROFESSIONAL ENGINEER | NAME | NO

TITLE
OCHOA POLYHALITE MINE FEASIBILITY STUDY
SOP AND MSOP PROCESSING PLANT
SITE LOAD OUT
PROCESS FLOWSHEET

PROJECT NUMBER	AREA	DISC	DOC	DRAWING NUMBER	REVISION NUMBER
510315	25000	49	DD	0001	03

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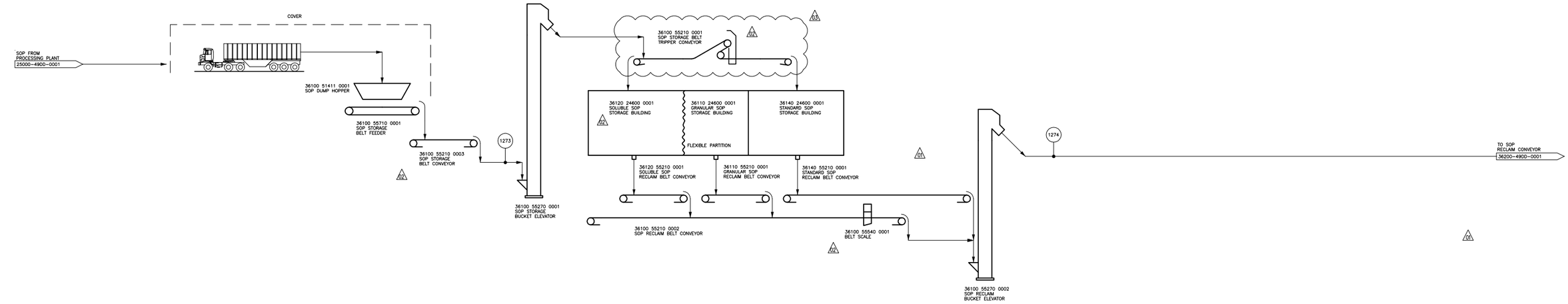

STREAM NUMBER	UNITS	1273	1274	1275	1276
NOMINAL					
MASS - SOLIDS	STPH	250.06	300.06	250.06	300.07
MASS - SOLUTION	STPH	0.84	1.00	1.16	1.39
MASS - SLURRY	STPH	250.90	301.07	251.22	301.46
VOLUME - SLURRY	USGPM				
SPECIFIC GRAVITY - SLURRY	S.G.	2.65	2.65	2.80	2.80
WT - % SOLIDS	%	99.67	99.67	99.54	99.54
SOLIDS - % K2SO4	%	98.27	98.27	42.01	42.01
SOLIDS - % MgSO4	%	0.92	0.92	57.25	57.25
GAS - MASS	STPH	0.00	0.00	0.00	0.00
GAS - VOLUME	ACFM	0.00	0.00	0.00	0.00
GAS - PRESSURE	PSIA				
TEMPERATURE	°F	68.00	68.00	68.00	68.00
DESIGN					
MASS - SOLIDS	STPH	300.02	360.01	300.02	360.02
MASS - SOLUTION	STPH	1.00	1.21	1.39	1.66
MASS - SLURRY	STPH	301.02	361.21	301.40	361.68
GAS - VOLUME	ACFM	0.00	0.00	0.00	0.00

STUDY DRAWING
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DRAWING NUMBER	REFERENCES	DRAWING NUMBER	REFERENCES	NO	DATE (YYYY-MM-DD)	REVISIONS	BY	CHK	LEAD ENG	ENG MAN	PROJ MAN	CLIENT ENG COORD	CLIENT AREA MAN
				03	2013-06-13	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		
				02	2013-05-21	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		
				01	2013-04-05	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		
				00	2013-02-04	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		

SLU			
	DESIGNED	J. NAGY	JN	2013-02-04
	DRAWN	E. PERRERAS	EP	2013-02-04
	CHECKED	T. ZRYMIAK	TZ	2013-02-04
	APPROVED LEAD ENG	A. TOMTENE	AT	2013-02-04
	APPROVED ENG MAN			
	APPROVED PROJ MAN			
CLIENT	APPROVED ENG COORD			
	APPROVED AREA MAN			

SCALE NTS

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PROFESSIONAL ENGINEER | NAME | NO

TITLE
OCHOA POLYHALITE MINE FEASIBILITY STUDY
SOP AND MSOP PROCESSING PLANT
JAL PRODUCT STORAGE
PROCESS FLOWSHEET

PROJECT NUMBER	AREA	DISC	DOC	DRAWING NUMBER	REVISION NUMBER
510315	36100	49	DD	0001	03

Format 'ANSI D' Sheet Size

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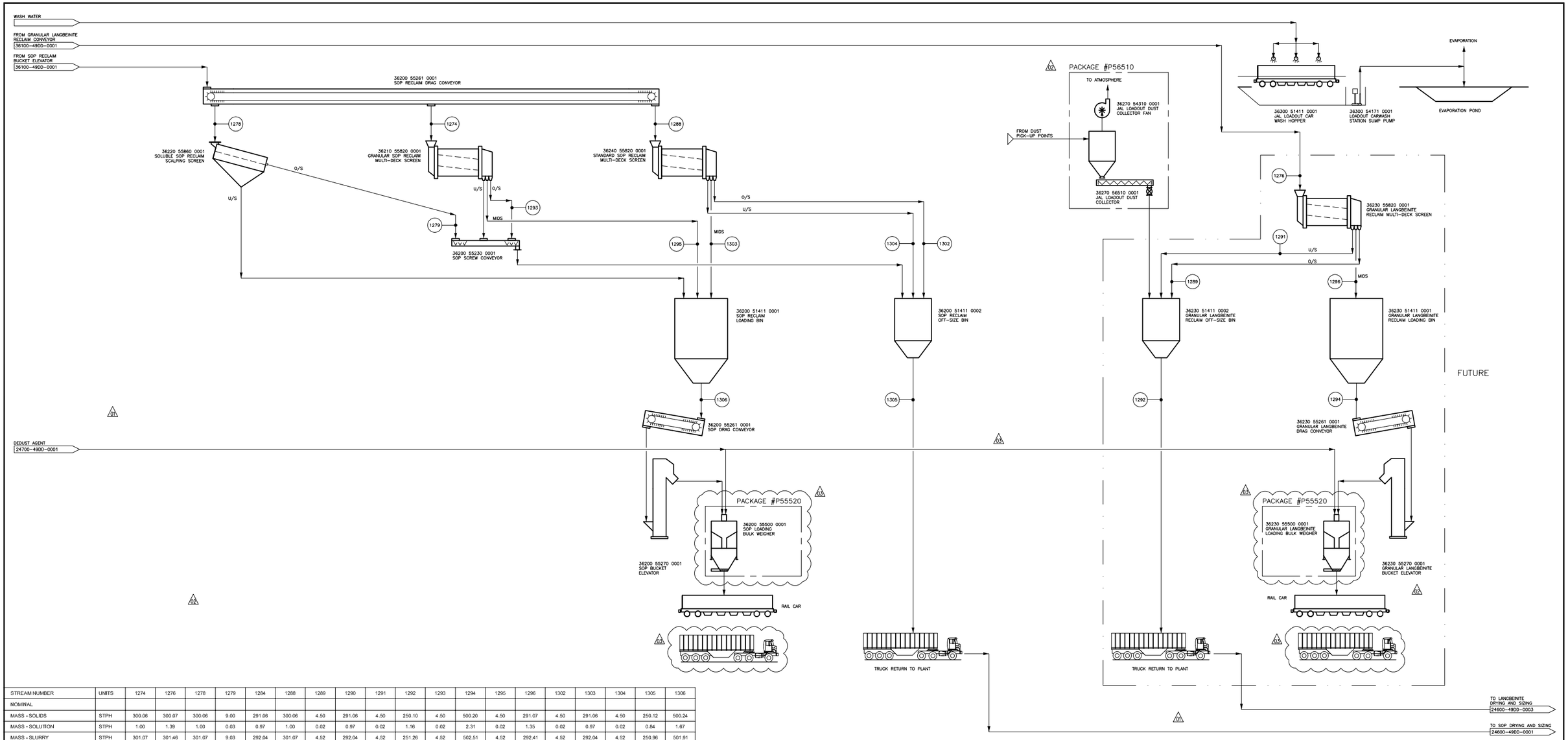
18-Jun-2013 - 2:00pm PERRER7



STREAM NUMBER	UNITS	1274	1276	1278	1279	1284	1288	1289	1290	1291	1292	1293	1294	1295	1296	1302	1303	1304	1305	1306
NOMINAL																				
MASS - SOLIDS	STPH	300.06	300.07	300.06	9.00	291.06	300.06	4.50	291.06	4.50	250.10	4.50	500.20	4.50	291.07	4.50	291.06	4.50	250.12	500.24
MASS - SOLUTION	STPH	1.00	1.39	1.00	0.03	0.97	1.00	0.02	0.97	0.02	1.16	0.02	2.31	0.02	1.35	0.02	0.97	0.02	0.84	1.67
MASS - SLURRY	STPH	301.07	301.46	301.07	9.03	292.04	301.07	4.52	292.04	4.52	251.26	4.52	502.51	4.52	292.41	4.52	292.04	4.52	250.96	501.91
VOLUME - SLURRY	USGPM																			
SPECIFIC GRAVITY - SLURRY	S.G.	2.65	2.80	2.65	2.65	2.65	2.65	2.80	2.65	2.80	2.80	2.65	2.80	2.65	2.80	2.65	2.65	2.65	2.65	2.65
WT - % SOLIDS	%	99.67	99.54	99.67	99.67	99.67	99.67	99.54	99.67	99.54	99.54	99.67	99.54	99.67	99.54	99.67	99.67	99.67	99.67	99.67
SOLIDS - % K2SO4	%	98.27	42.01	98.27	98.27	98.27	98.27	42.01	98.27	42.01	42.01	98.27	42.01	98.27	42.01	98.27	98.27	98.27	98.27	98.27
SOLIDS - % MgSO4	%	0.92	57.25	0.92	0.92	0.92	0.92	57.25	0.92	57.25	57.25	0.92	57.25	0.92	57.25	0.92	0.92	0.92	0.92	0.92
GAS - MASS	STPH	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GAS - VOLUME	ACFM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GAS - PRESSURE	PSIA																			
TEMPERATURE	°F	68.00	68.00	68.00	68.00	68.00	68.00	68.00	68.00	68.00	68.00	68.00	68.00	68.00	68.00	68.00	68.00	68.00	68.00	68.00
DESIGN																				
MASS - SOLIDS	STPH	360.01	360.02	360.01	10.80	349.21	360.01	5.40	349.21	5.40	300.06	5.40	600.13	5.40	349.22	5.40	349.21	5.40	300.09	600.17
MASS - SOLUTION	STPH	1.21	1.66	1.21	0.04	1.17	1.21	0.02	1.17	0.02	1.39	0.02	2.77	0.02	1.61	0.02	1.17	0.02	1.00	2.01
MASS - SLURRY	STPH	361.21	361.68	361.21	10.84	350.38	361.21	5.43	350.38	5.43	301.45	5.42	602.90	5.42	350.83	5.42	350.38	5.42	301.09	602.18
GAS - VOLUME	ACFM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DRAWING NUMBER	REFERENCES	DRAWING NUMBER	REFERENCES	NO	DATE (YYYY-MM-DD)	REVISIONS	BY	CHK	LEAD ENG	ENG MAN	PROJ MAN	CLIENT ENG COORD	CLIENT AREA MAN
				03	2013-06-13	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		
				02	2013-05-15	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		
				01	2013-04-05	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		
				00	2013-02-04	ISSUED FOR FEASIBILITY STUDY	EP	TZ	JN		AT		

SU	DESIGNED	J. NAGY	JN	2013-02-04
	DRAWN	E. PERRERAS	EP	2013-02-04
	CHECKED	T. ZRYMIAK	TZ	2013-02-04
	APPROVED LEAD ENG	A. TOMTENE	AT	2013-02-04
	APPROVED ENG MAN			
	APPROVED PROJ MAN			
CLIENT	APPROVED ENG COORD			
	APPROVED AREA MAN			
SCALE	NTS	NAME (F. LAST)	INIT	DATE (YYYY-MM-DD)

STUDY DRAWING
NOT FOR CONSTRUCTION

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PROFESSIONAL ENGINEER | NAME | NO

TITLE
OCHOA POLYHALITE MINE FEASIBILITY STUDY
SOP AND MSOP PROCESSING PLANT
JAL PRODUCT LOAD OUT
PROCESS FLOWSHEET

PROJECT NUMBER	AREA	DISC	DOC	DRAWING NUMBER	REVISION NUMBER
510315	36200	49	DD	0001	03

Format 'ANSI D' Sheet Size

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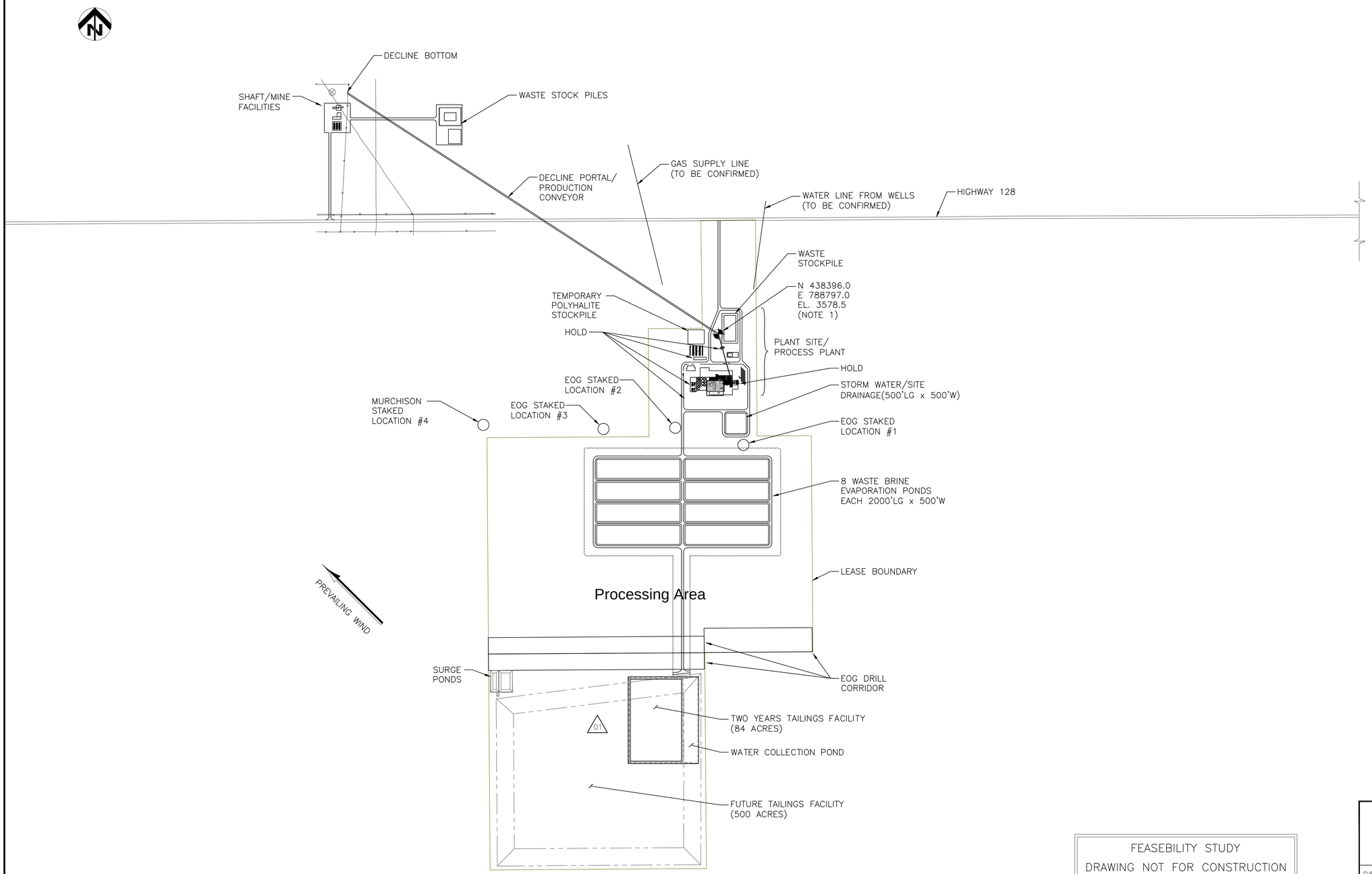
16-Jun-2013 - 10:41am PERRE7

Section 5

Plot Plan Drawn To Scale

A **plot plan drawn to scale** showing emissions points, roads, structures, tanks, and fences of property owned, leased, or under direct control of the applicant. This plot plan must clearly designate the restricted area as defined in UA1, Section 1-D.12. The unit numbering system should be consistent throughout this application.

Plot Plan is attached.



GENERAL NOTES

1. COORDINATE DIMENSIONS EXPRESSED IN U.S. CUSTOMARY UNITS, AS FEET.

NOTES

1. DECLINE PORTAL INVERT (TOP OF CONCRETE).

REVISION IN PROGRESS
DATE: 03 JUNE 2013

FEASEBILITY STUDY
DRAWING NOT FOR CONSTRUCTION

ICPOTASHCORP

CLIENT | CLIENT DRAWING NUMBER

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PROFESSIONAL ENGINEER | NAME | NO

TITLE
OCHOA POLYHALITE MINE FEASIBILITY STUDY
GENERAL SITE – PROCESS PLANT
PRELIMINARY CONCEPTUAL LAYOUT
OVERALL PROCESS PLANT SITE PLAN

DRAWING NUMBER	REFERENCES
510315–21000–4LD1–0001	PROCESS PLANT SITE PLAN

DRAWING NUMBER	REFERENCES

NO	DATE (YYYY–MM–DD)	REVISIONS	BY	CHK	LEAD ENG	ENG MAN	PROJ MAN	CLIENT ENG COORD	CLIENT AREA MAN
01	2013–05–23	ADDED TWO YEARS TAILINGS FACILITY	NM	JLJ		AKT	LDB		
00	2013–04–29	ISSUED FOR FEASIBILITY STUDY	DJS	JLJ		AKT	LDB		

SLI	DESIGNED	A. TOMTENE	AKT	2012–12–20
	DRAWN	D. STROHAN	DJS	2012–12–20
	CHECKED	J. JANIS		2013–04–29
	APPROVED LEAD ENG			
	APPROVED ENG MAN	A. TOMTENE		2013–04–29
	APPROVED PROJ MAN	L. BERTHELET		2013–04–29
CLIENT	APPROVED ENG COORD			
	APPROVED AREA MAN			
SCALE 1:15000	NAME (F. LAST)		INIT	DATE (YYYY–MM–DD)

PROJECT NUMBER	AREA	DISC	DOC	DRAWING NUMBER	REVISION NUMBER
510315	21000	4L	D1	0002	01

Format 'ANSI D' Sheet Size

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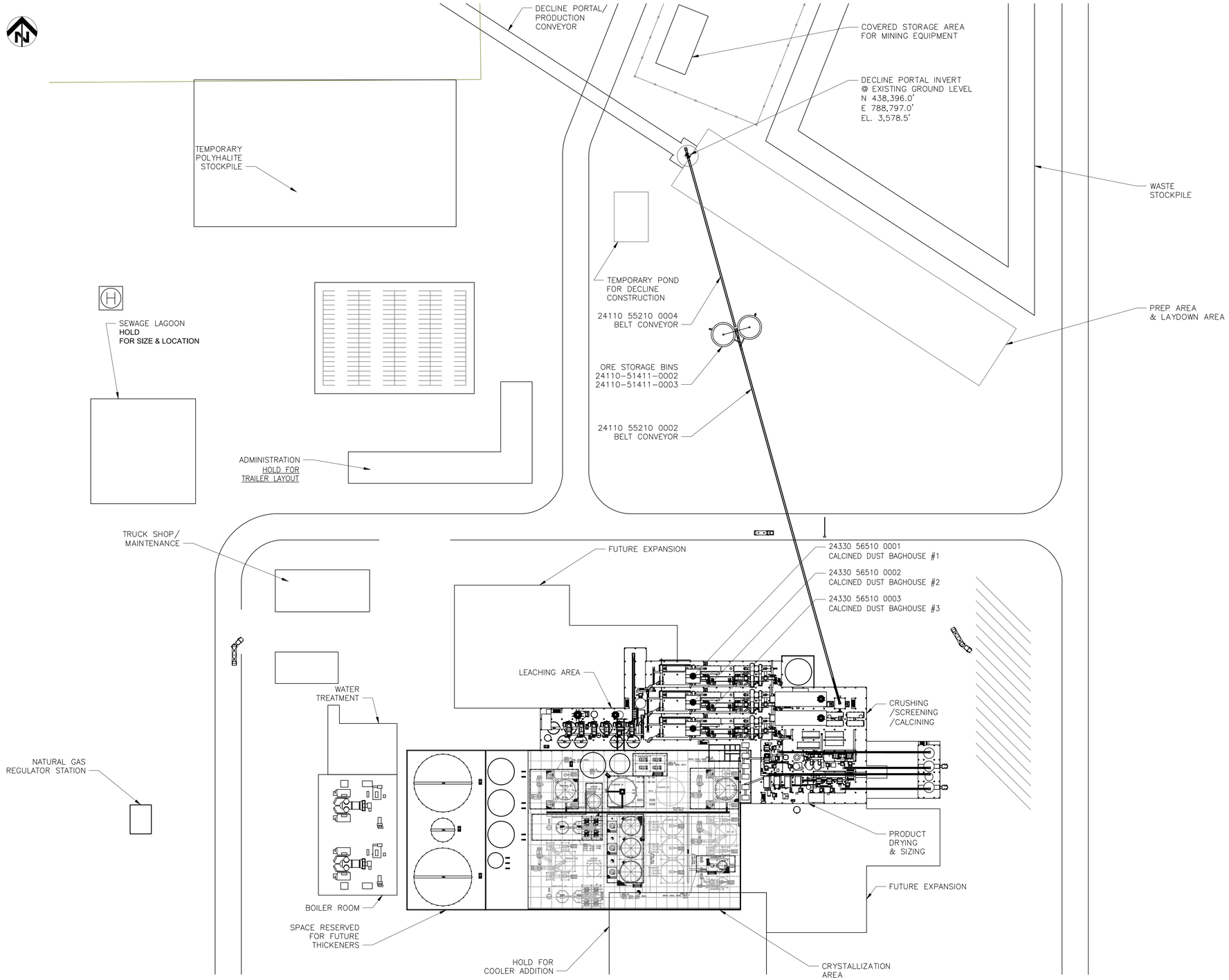
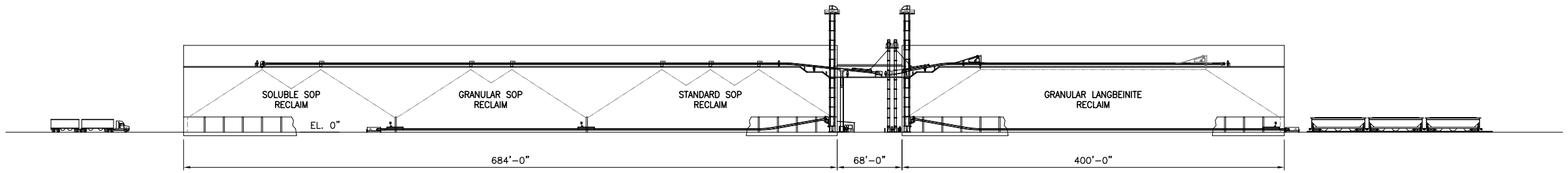
03-Jun-2013 - 8:13am MISEN

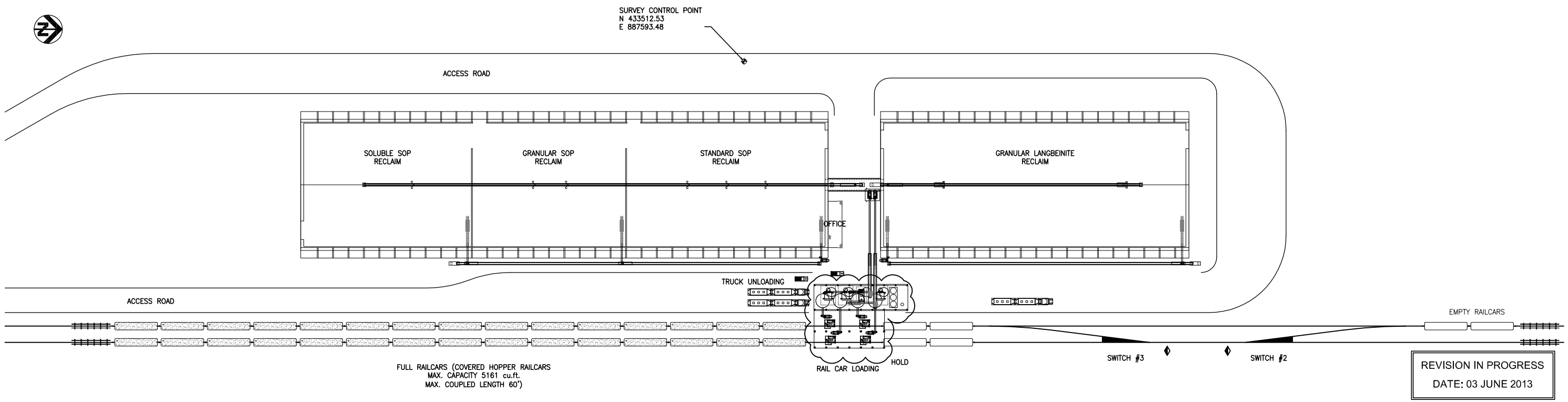


GENERAL NOTES:

1. COORDINATE DIMENSIONS EXPRESSED IN U.S. CUSTOMARY UNITS, AS FEET.



ELEVATION LOOKING WEST
1/64" = 1'-0"



REVISION IN PROGRESS
DATE: 03 JUNE 2013

SITE PLAN VIEW
1/64" = 1'-0"

FEASEBILITY STUDY
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CLIENT DRAWING NUMBER

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PROFESSIONAL ENGINEER | NAME | NO

TITLE
OCHOA POLYHALITE MINE FEASIBILITY STUDY
GENERAL SITE – JAL
PRELIMINARY CONCEPTUAL LAYOUT
LOADOUT SITE PLAN

	NAME (F. LAST)	INIT	DATE (YYYY-MM-DD)
SNC DESIGNED	N. MISEVSKI	NM	2013-04-08
SNC DRAWN	N. MISEVSKI	NM	2013-04-08
SNC CHECKED	J. JANIS		2013-04-29
SNC APPROVED LEAD ENG			
SNC APPROVED ENG MAN	A. TOMTENE		2013-04-29
SNC APPROVED PROJ MAN	L. BERTHELET		2013-04-29
CLIENT APPROVED ENG COORD			
CLIENT APPROVED AREA MAN			

SCALE: AS NOTED

PROJECT NUMBER	AREA	DISC	DOC	DRAWING NUMBER	REVISION NUMBER
510315	36000	4L	D1	0001	00

Format 'ANSI D' Sheet Size

DRAWING NUMBER	REFERENCES	DRAWING NUMBER	REFERENCES	NO	DATE (YYYY-MM-DD)	REVISIONS	BY	CHK	LEAD ENG	ENG MAN	PROJ MAN	CLIENT ENG COORD	CLIENT AREA MAN	NO	DATE (YYYY-MM-DD)	REVISIONS	BY	CHK	LEAD ENG	ENG MAN	PROJ MAN	CLIENT ENG COORD	CLIENT AREA MAN
														00	2013-04-29	ISSUED FOR FEASIBILITY STUDY	DJS	JLJ		AKT	LDB		

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03-Jun-2013 - 6:08am MISEN

Section 6

All Calculations

Show all calculations used to determine both the hourly and annual controlled and uncontrolled emission rates. All calculations shall be performed keeping a minimum of three significant figures. Document the source of each emission factor used (if an emission rate is carried forward and not revised, then a statement to that effect is required). If identical units are being permitted and will be subject to the same operating conditions, submit calculations for only one unit and a note specifying what other units to which the calculations apply. All formulas and calculations used to calculate emissions must be submitted. The "Calculations" tab in the UA2 has been provided to allow calculations to be linked to the emissions tables. Add additional "Calc" tabs as needed. If the UA2 or other spread sheets are used, all calculation spread sheet(s) shall be submitted electronically in Microsoft Excel compatible format so that formulas and input values can be checked. Format all spread sheets and calculations such that the reviewer can follow the logic and verify the input values. Define all variables. If calculation spread sheets are not used, provide the original formulas with defined variables. Additionally, provide subsequent formulas showing the input values for each variable in the formula. All calculations, including those calculations are imbedded in the Calc tab of the UA2 portion of the application, the printed Calc tab(s), should be submitted under this section.

Tank Flashing Calculations: The information provided to the AQB shall include a discussion of the method used to estimate tank-flashing emissions, relative thresholds (i.e., NOI, permit, or major source (NSPS, PSD or Title V)), accuracy of the model, the input and output from simulation models and software, all calculations, documentation of any assumptions used, descriptions of sampling methods and conditions, copies of any lab sample analysis. If Hysis is used, all relevant input parameters shall be reported, including separator pressure, gas throughput, and all other relevant parameters necessary for flashing calculation.

SSM Calculations: It is the applicant's responsibility to provide an estimate of SSM emissions or to provide justification for not doing so. In this Section, provide emissions calculations for Startup, Shutdown, and Routine Maintenance (SSM) emissions listed in the Section 2 SSM and/or Section 22 GHG Tables and the rational for why the others are reported as zero (or left blank in the SSM/GHG Tables). Refer to "Guidance for Submittal of Startup, Shutdown, Maintenance Emissions in Permit Applications (http://www.nmenv.state.nm.us/aqb/permit/app_form.html) for more detailed instructions on calculating SSM emissions. If SSM emissions are greater than those reported in the Section 2, Requested Allowables Table, modeling may be required to ensure compliance with the standards whether the application is NSR or Title V. Refer to the Modeling Section of this application for more guidance on modeling requirements.

Glycol Dehydrator Calculations: The information provided to the AQB shall include the manufacturer's maximum design recirculation rate for the glycol pump. If GRI-Glycalc is used, the full input summary report shall be included as well as a copy of the gas analysis that was used.

Road Calculations: Calculate fugitive particulate emissions and enter haul road fugitives in Tables 2-A, 2-D and 2-E for:

1. If you transport raw material, process material and/or product into or out of or within the facility and have PER emissions greater than 0.5 tpy.
2. If you transport raw material, process material and/or product into or out of the facility more frequently than one round trip per day.

Significant Figures:
A. All emissions standards are deemed to have at least two significant figures, but not more than three significant figures.
B. At least 5 significant figures shall be retained in all intermediate calculations.
C. In calculating emissions to determine compliance with an emission standard, the following rounding off procedures shall be used:

(1) If the first digit to be discarded is less than the number 5, the last digit retained shall not be changed;
(2) If the first digit discarded is greater than the number 5, or if it is the number 5 followed by at least one digit other than the number zero, the last figure retained shall be increased by one unit; **and**
(3) If the first digit discarded is exactly the number 5, followed only by zeros, the last digit retained shall be rounded upward if it is an odd number, but no adjustment shall be made if it is an even number.
(4) The final result of the calculation shall be expressed in the units of the standard.

Control Devices: In accordance with 20.2.72.203.A(3) and (8) NMAC, 20.2.70.300.D(5)(b) and (e) NMAC, and 20.2.73.200.B(7) NMAC, the permittee shall report all control devices and list each pollutant controlled by the control device

regardless if the applicant takes credit for the reduction in emissions. The applicant can indicate in this section of the application if they chose to not take credit for the reduction in emission rates. For notices of intent submitted under 20.2.73 NMAC, only uncontrolled emission rates can be considered to determine applicability unless the state or federal Acts require the control. This information is necessary to determine if federally enforceable conditions are necessary for the control device, and/or if the control device produces its own regulated pollutants or increases emission rates of other pollutants.

Section 6 consists of seven parts;

1. Temporary emissions due to facility construction.
2. Potential Pre-Controlled Particulate Emission Rate – presents potential particulate emission factors/equations from all particulate sources, except calciners, dryers, and boilers (see next part), prior to any controls, active or passive.
3. Calciners/Dryers/Boilers Emission Inputs - presents the potential pollutant emission factors and calculation inputs parameters from all calciners, dryers, and boilers used to calculate the potential pollutant emission rate.
4. Hydrogen Sulfide (H_2S) Air Stripper Bio Trickling Filter Emission Inputs – presents the mass balance approach for calculation of H_2S emissions from the Groundwater Pre-Treatment Plant.
5. Pollutant Control Methodologies – presents the control methodologies used to control potential pollutant emissions from sources of regulated emissions for the Ochoa Project.
6. Hazardous air pollutants (HAPs) and state toxic air pollutants (TAPs) emission factors for combustion sources burning natural gas.
7. Hardcopy of all regulated pollutant emission rates for all sources at the Ochoa Project. Spreadsheet version of emission calculations are included in the Permit Application Section 2 excel file.

Temporary Construction Activities Particulate Emission Rates

During construction, temporary sources would be involved in mine and facility construction. Vehicles would generate fugitive dust emissions while traveling on paved and unpaved roads. There would be fugitive dust emissions from surface disturbances associated with the construction process. Specific activities include the construction of prepared surfaces, access roads, mine shaft and ramp, power lines, pipelines, ponds, and buildings.

While emission rates from these temporary sources are not calculated within the PSD permitting framework, good work practices will be used to reduce the generation of fugitive emissions during construction activities. These include, but are not limited to, wet suppression during earth moving activities, apply chemical soil stabilizers or ground cover to graded area where construction is not to begin within 60 days, cover loads for truck hauling material, chemical stabilizers for long-term material storage piles, wet suppression on unpaved road truck routes, track out ramps for haul trucks leaving the site, and wind fences to reduce wind erosion by reducing the wind speed at ground level,

Pre-Controlled Particulate Emission Rates

Material Handling and Processing ($PM_{2.5}$, PM_{10}, and TSP)

To estimate material handling pre-control particulate emissions rates for conveyor transfer, tertiary crushing, fine crushing, and fine screening operations, emission factors were obtained from EPA's Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, Aug. 2004, Section 11.19.2, Table 11.19.2-2. To determine missing $PM_{2.5}$ emission factors the ratio of 0.35/0.053 from $PM_{10}/PM_{2.5}$ *k* factors found in AP-42 Section 13.2.4 (11/2006) were used.

To estimate material handling pre-control particulate emissions rates for fine material (baghouse fines, dryer exits) emission factors were obtained from EPA's Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, Aug. 2004, Section 11.19.2, Table 11.19.2-4. The uncontrolled emission rates are derived from "Product Storage with Fabric Filter" and "Grinding (Dry) with Fabric Filter" controlled emission rates plus a 99.5% control efficiency from the fabric filter.

To estimate material handling pre-control particulate emission rates for aggregate handling operations (batch or continuous drop operations), an emission equation was obtained from EPA's Compilation of Air Pollutant Emission Factors, Volume I: Stationary Point and Area Sources, Fifth Edition, Section 13.2.4 (11/2004), where the k (TSP = 0.74, PM_{10} = 0.35, $PM_{2.5}$ =

0.053), wind speed for determining the maximum hourly emission rate is the NMED's recommended values of 11 mph, wind speed for determining the average annual emission rate and hourly modeled emission rate are based on the average wind speed for 2004-2008 WIPP Site 10 meter level meteorological tower of 6.2 mph, and the moisture content varies with material processed and is based on the expected facility maximum process design.

All production hourly emission rates for material handling and processing will be based on the maximum design capacity. Uncontrolled and controlled annual emissions for tons per year (tpy) were calculated assuming operation for 8760 hours per year.

To estimate paved road emissions PM emission rates are calculated using an emission equation from AP-42 Section 13.2.1 (01/11).

To estimate unpaved road emissions PM emission rates are calculated using an emission equation from AP-42 Section 13.2.2 (11/06).

To estimate bulldozer operations at the waste storage area, PM emission rates are calculated using an emission factor from AP-42 Section 11.9 Table 11.9-1 "Bulldozing Overburden" (ver 07/98). Bulldozer operations will occur 24 hours per day with 50% of the time material moved.

Aggregate Handling Emission Equation - Section 13.2.4:

Maximum 24 Hour Emission Factor

E (lbs/ton) = k x 0.0032 x $(U/5)^{1.3}$ / $(M/2)^{1.4}$

E_{TSP} (lbs/ton) = 0.74 x 0.0032 x $(11/5)^{1.3}$ / $(M/2)^{1.4}$

E_{PM10} (lbs/ton) = 0.35 x 0.0032 x $(11/5)^{1.3}$ / $(M/2)^{1.4}$

$E_{PM2.5}$ (lbs/ton) = 0.053 x 0.0032 x $(11/5)^{1.3}$ / $(M/2)^{1.4}$

Maximum Annual Emission Factor

E (lbs/ton) = k x 0.0032 x $(U/5)^{1.3}$ / $(M/2)^{1.4}$

E_{TSP} (lbs/ton) = 0.74 x 0.0032 x $(6.2/5)^{1.3}$ / $(M/2)^{1.4}$

E_{PM10} (lbs/ton) = 0.35 x 0.0032 x $(6.2/5)^{1.3}$ / $(M/2)^{1.4}$

$E_{PM2.5}$ (lbs/ton) = 0.053 x 0.0032 x $(6.2/5)^{1.3}$ / $(M/2)^{1.4}$

Pulverized Mineral Handling- Section 11.19.2, Table 11.19.2-4:

Controlled Pulverized Mineral - Product Storage Emission Equation:

E_{TSP} (lbs/ton) = 0.0099 lbs/ton

E_{PM10} (lbs/ton) = 0.0016 lbs/ton

$E_{PM2.5}$ (lbs/ton) = 0.0006 lbs/ton

Uncontrolled Pulverized Mineral - Product Storage Emission Equation:

EF (lbs/ton) = EF (lbs/ton) /(1 - CE); (CE = 99.5%)

E_{TSP} (lbs/ton) = 0.0099 lbs/ton / (1 - 0.995) = 1.98 lbs/ton

E_{PM10} (lbs/ton) = 0.0016 lbs ton / (1 - 0.995) = 0.32 lbs/ton

$E_{PM2.5}$ (lbs/ton) = 0.0006 lbs/ton / (1 - 0.995) = 0.12 lbs/ton

Controlled Pulverized Mineral - Grinding Emission Equation:

E_{TSP} (lbs/ton) = 0.0404 lbs/ton

E_{PM10} (lbs/ton) = 0.0339 lbs/ton

$E_{PM2.5}$ (lbs/ton) = 0.0121 lbs/ton

Uncontrolled Pulverized Mineral - Grinding Emission Equation:

EF (lbs/ton) = EF (lbs/ton) /(1 - CE); (CE = 99.5%)

E_{TSP} (lbs/ton) = 0.0404 lbs/ton / (1 - 0.995) = 8.08 lbs/ton

E_{PM10} (lbs/ton) = 0.0339 lbs ton / (1 - 0.995) = 6.78 lbs/ton

$E_{PM2.5}$ (lbs/ton) = 0.0121 lbs/ton / (1 - 0.995) = 2.42 lbs/ton

AP-42 Emission Factors - Section 11.19.2, Table 11.19.2-2:
Primary Crushing Sources = Uncontrolled Tertiary Crushing Emission Factor
Secondary Crushing Sources = Uncontrolled Fine Crushing Emission Factor
All Screening Sources = Uncontrolled Fine Screening Emission Factor
All Conveyor Transfers Sources = Uncontrolled Conveyor Transfer Emission Factor

Material Handling Emission Factors - Section 11.19.2:

Process Unit	TSP Emission Factor (lbs/ton)	PM_{10} Emission Factor (lbs/ton)	$PM_{2.5}$ Emission Factor (lbs/ton)
Uncontrolled Tertiary Crushing	0.00540	0.00240	0.00036
Uncontrolled Fine Crushing	0.39000	0.15000	0.00880
Uncontrolled Fines Screening	0.30000	0.07200	0.00490
Uncontrolled Conveyor Transfer	0.00300	0.00110	0.00017
Uncontrolled Grinding (Dry)	8.08	6.78	2.42
Uncontrolled Product Storage (Material Handling)	1.98	0.32	0.12

The following equations were used to calculate the hourly emission rate for each process unit:

Emission Rate (lbs/hour) = Process Rate (tons/hour) * Emission Factor (lbs/ton)

The following equations were used to calculate the annual emission rate for each process unit:

$$\text{Emission Rate (tons/year)} = \frac{\text{Emission Rate (lbs/hour)} * \text{Operating Hour (hrs/year)}}{\text{2000 lbs/ton}}$$

Several additional equations are used for estimating emission rates.

For emissions based on grain loading per dry standard cubic foot of exhaust (baghouse), the emissions were calculated using the following equation:

Emission lbs/hr = grain loading/dscf * dscf/hr * 7000 grains/lb
dscf/hr = dry standard cubic foot of exhaust gas

Emission ton/yr = Emission lbs/hr * hour/yr / 2000 lbs/ton
Hour/yr = operational hour per year = 8760 hours

For emissions based on pounds of emission per Btu of fuel burned, the emissions were calculated using the following equation:

Emission lbs/hr = lb/MMBtu * MMBtu/hr burner
lb/MMBtu = emission factor in pounds per million Btu burned
MMBtu/hr = million Btu of fuel burned in the unit

Emission ton/hr = Emission lbs/hr * hour/yr / 2000 lbs/ton
Hour/yr = operational hour per year = 8760 hours

For emissions based on pounds of emission per cubic feet of natural gas burned, the emissions were calculated using the following equation:

Emission lbs/hr = lb/MMSCF * MMSCF/hr burner
lb/MMSCF = emission factor in pounds per million standard cubic feet
MMSCF/hr = million standard cubic feet of natural gas burned in the unit

Emission ton/hr = Emission lbs/hr * hour/yr / 2000 lbs/ton
Hour/yr = operational hour per year = 8760 hours

Run of Mine (ROM) Storage Pile Loading and Unloading PM Emission Rates (S1 – S7)
Fugitive particulate emissions will be generated during material transfers at the overland conveyors, and loading and unloading of the ROM storage silos. To control excess particulate emissions during ROM conveyor transfers at the overland conveyors, the conveyor will be enclosed for an estimated 85% control efficiency. All other particulate emissions will be controlled by a fabric filter dust collector with an exit flow rate of 5000 ACFM and a grain loading of 0.005 gr/dscf.

Crushing Area PM Emission Rates (S8 – S13)
Fugitive particulate emissions will be generated during aggregate material transfers, crushing, and fines material transfers. All particulate emissions will be controlled by a fabric filter dust collector with a exit flow rate of 14000 ACFM and a grain loading of 0.005 gr/dscf.

Calciner Area PM Emission Rates (S14 – S30)
Fugitive particulate emissions will be generated during crushing and fines material transfers. All particulate emissions will be controlled by the SOP Area fabric filter dust collector with an exit flow rate of 42401.6 SCFM and a grain loading of 0.005 gr/dscf.

SOP Drying and Sizing Circuit PM Emission Rates (S32 – S60)
Fugitive particulate emissions will be generated during fine crushing, fine screening, fine aggregate material transfers, and aggregate material transfers. All particulate emissions will be controlled by the SOP Area fabric filter dust collector with an exit flow rate of 42401.6 SCFM and a grain loading of 0.005 gr/dscf.

SOP Granulation Circuit PM Emission Rates (S61 – S87)
Fugitive particulate emissions will be generated during dry grinding, fine crushing, fine screening, fine aggregate material transfers, and aggregate material transfers. All particulate emissions will be controlled by the SOP Area fabric filter dust collector with an exit flow rate of 42401.6 SCFM and a grain loading of 0.005 gr/dscf.

Langbeinite Drying and Sizing Circuit PM Emission Rates (S88- S123)
Fugitive particulate emissions will be generated during fine screening, fine aggregate material transfers, and aggregate material transfers. All particulate emissions will be controlled by the Langbeinite Area fabric filter dust collector with an exit flow rate of 17808.7 SCFM and a grain loading of 0.005 gr/dscf or Langbeinite Compactor fabric filter dust collector with an exit flow rate of 16018.2 SCFM and a grain loading of 0.005 gr/dscf.

Ochoa Product Loading Circuit PM Emission Rates (S124 – S135)
Fugitive particulate emissions will be generated during product material transfers. All particulate emissions except truck loading will be controlled by the SOP Area fabric filter dust collector with an exit flow rate of 42401.6 SCFM and a grain loading of 0.005 gr/dscf.

Jal Loadout Facility Circuit PM Emission Rates (S136 – S174)
Fugitive particulate emissions will be generated during product material handling, conveyor transfers, and fine screening. A number of the particulate emission sources will be controlled by the Jal Loadout fabric filter dust collector with an exit flow rate of 36000 ACFM and a grain loading of 0.005 gr/dscf.

Waste Handling PM Emission Rates (S175 – S177)
Fugitive particulate emissions will be generated during waste material transfers. Waste material has a high moisture content reducing the potential of fugitive particulate emissions. No controls are proposed for these operations.

Bulldozing at Gypsum Stockpile (S178)

Bulldozers are used to push material during construction and maintenance of the gypsum stockpile. Bulldozer operations are not a continuous activity. For this permitting action it is estimated that the bulldozer will push material only 50% or 12 hours per day.

The emission equation for "Bulldozing" of the gypsum stockpile in Table 11.9-1 of AP-42 was used to estimate particulate emissions from pushing during construction and maintenance.

Pushing during construction and maintenance
AP-42 Section 11.9, Table 11.9-2

$E_{TSP} = (5.7)\ (s)^{1.2}/(M)^{1.3}$ lb/hr
$E_{PM10} = (0.75)\ (1.0)\ (s)^{1.5}/(M)^{1.4}$ lb/hr
$E_{PM2.5} = (0.105)\ (5.7)\ (s)^{1.2}/(M)^{1.3}$ lb/hr
s = % Silt Content
M = % Moisture Content

This emission equation includes three inputs; percent silt content of the material moved, percent moisture of the material moved, and the annual hours the bulldozers are moving material. Percent silt content and moisture content for gypsum waste material is estimated to be 15% for silt content and 15% for moisture content.

Wind Erosion PM Emission Rates (S180, S198, S199)
Fugitive particulate emissions generated by wind speeds high enough to cause wind erosion were calculated by using the equations and procedures found in AP-42 Section 13.2.5.

The erosion potential function for a dry, exposed surface is:

$P = k * 58\ (u^* - u_t^*)^2 + 25\ (u^* - u_t^*)$
$P = 0$ for $u^* \leq u_t^*$

where:
u^* = friction velocity (m/s)
u_t^* = threshold friction velocity (m/s)
k = (TSP = 1); (PM10 = 0.5); (PM2.5 = 0.075)

Information input into the analysis for wind erosion include; the area of the erodible source, the roughness length of the erodible material, the threshold friction velocity of the erodible material, the daily fastest mile of wind (time it takes for 1 mile of wind to travel 1 mile or maximum daily 2-minute wind speed), erodible area shape (pile or flat), and frequency of disturbance. Emissions generated by wind erosion are also dependent on the frequency of disturbance of the erodible surface, because each time that a surface is disturbed, its erosion potential is restored. A disturbance is defined as an action that results in the exposure of fresh surface material to the entire area. Daily fastest mile is based on Albuquerque maximum daily 2-minute wind speed for the year 2011.
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Chemical Additive Handling PM Emission Rates (S181 – S188)
Fugitive particulate emissions will be generated during chemical additive material transfers prior to mixing into a solution.

Paved Light Vehicle Travel (S189 – S191)
Particulate emissions occur whenever vehicles travel over a paved surface such as a road or parking lot. Particulate emissions from paved roads are due to direct emissions from vehicles in the form of re-suspension of loose material on the road surface. In general terms, re-suspended particulate emissions from paved roads originate from, and result in the depletion of, the loose material present on the surface (i.e., the surface loading). In turn, that surface loading is continuously replenished by other sources. At industrial sites, surface loading is replenished by spillage of material and trackout from unpaved roads and staging areas. For the Ochoa Project, haul truck travel paved road emissions were estimated using AP-42, Section 13.2.1 (ver.11/06) "Paved Roads" emission equation. The paved road emission equation has three variables; silt loading (sL), fleet averaged weight (W), and vehicle miles traveled (VMT).

One of the inputs to the emission equation is silt loading value and is based on AP-42, Section 13.2.1, Table 13.2.1-2 "Limited access roadway (<500 ADT)" of 0.6 g/m^2. VMT for paved haul road traffic is based on the amount of material transported per day, per year, and the capacity of the haul trucks.

AP-42, Section 13.2.1 (ver.01/11) "Paved Roads" emission equation

$$E = k*(sL)^{0.91}*(W)^{1.02}*(1-P/4N)*VMT$$

Where k = constant PM2.5 = 0.00054
PM10 = 0.016
TSP = 0.011
sL = silt loading (AP-42, Section 13.2.1, Table 13.2.1-2 "Limited access roadway (<500 ADT)" of 0.6 g/m^2)
W = mean fleet vehicle weight (25.99 tons)
P = number of days with at least 0.01 in of precip. (Figure 13.2.2-3 = 60 days)
VMT = Vehicle Miles Traveled

Reduction in emissions due to precipitation was only accounted for in the annual emission rate.

Unpaved Haul Road Truck Travel (S192 – S195)
When a vehicle travels an unpaved road, the force of the wheels on the road surface causes pulverization of the road surface material. Particles are lifted and dropped from the rolling wheels, and the road surface is exposed to strong air currents in turbulent shear with the surface. The turbulent wake behind the vehicle continues to act on the road surface after the vehicle has passed. For the Ochoa Project, haul truck travel unpaved road emissions were estimated using AP-42, Section 13.2.2 (ver.11/06) "Unpaved Roads" emission equation. Three main types of traffic can be found operating at the Ochoa Project: delivery traffic at the Ochoa Plant; waste hauling traffic at the Ochoa Plant; and haul truck traffic at the Jal Loadout. The emission equation from AP-42, Section 13.2.2 (ver.11/06) "Unpaved Roads" emission equation is as follows:

$$E = k*(s/12)^{a}*(W/3)^{b}*[(365-p)/365]*VMT$$

Where k = constant PM2.5 = 0.15
PM10 = 1.5
TSP = 4.9
s = % silt content (Table 13.2.2-1, "Sand and Gravel Processing = 4.8%)
W = mean vehicle weight (Ochoa Deliveries = 25 tons; Waste Hauling = 58.5 tons; Jal Loadout = 25 tons)
p = number of days with at least 0.01 in of precip. (Figure 13.2.2-3 = 60 days)
a = Constant PM2.5 = 0.9
PM10 = 0.9
TSP = 0.7
b = Constant PM2.5 = 0.45
PM10 = 0.45
TSP = 0.45
VMT = Vehicle Miles Traveled

Reduction in emissions due to precipitation was only accounted for in the annual emission rate.

Annual Precipitation Reduction Equation = [(365-p)/365]

One of the inputs to the emission equation for unpaved road particulate matter emissions is vehicle miles traveled (VMT). For haul roads this is based on the amount of material transported per day, per year, and the capacity of the haul truck.

Calciners/Dryers/Boilers Emission Inputs

Polyhalite Dryer/Calciner/Cooler Emission Rates (3 Units) (S18A,B,C)
Emission Units S18A,B,C will combust natural gas. Maximum hourly and annual emission rates were estimated based on preliminary "best available control technology" (BACT) determinations for NO_X, CO, CO_2, and PM; and AP-42 Section 1.4 for sulfur dioxide (SO_2), lead, formaldehyde, methane, and N_2O. Emission rates for the Polyhalite Dryer/Calciner/Coolers are based on the following:

Unit – S18A,B,C

AP-42 Section 1.4 "Natural Gas Combustion"			**SO2, Lead, Formaldehyde, Methane, N2O**
BACT			**NOx, CO, CO2, PM (Total)**
NO_X	0.042	lbs/MMBtu	BACT
CO	0.037	lbs/MMBtu	BACT
SO_2	0.6	lbs/MMSCF	AP-42 Section 1.4
VOC	5.5	lbs/MMSCF	AP-42 Section 1.4
PM Uncontrolled	4300	lbs/hr	Mass Balance
PM Controlled	0.0052	grains/DSCF	BACT
CO_2	116.9	lbs/MMBtu	BACT
Methane	0.002	lbs/MMBtu	BACT
N_2O	0.0002	lbs/MMBtu	BACT
CO_2e	117.004	lbs/MMBtu	BACT
Lead	0.0005	lbs/MMSCF	AP-42 Section 1.4

Burner Maximum Rated Capacity
214.23 MMBtu/Hr Each

Controlled Hours of Operation
8760 hr/yr

Natural Gas LHV
946 Btu/standard cubic feet

Maximum Natural Gas Usage
226458.8 cubic feet/hr each
0.2264588 million scf/hr

Exhaust Flowrate
138777.8 SCFM Each
286000 ACFM Each

SOP Product Dryer Emission Rates (S34)

Emission Unit S34 will combust natural gas. Maximum hourly and annual emission rates were estimated based on preliminary "best available control technology" (BACT) determinations for NO_X, CO,CO_2, and PM; and AP-42 Section 1.4 for sulfur dioxide (SO_2), lead, formaldehyde, methane, and N_2O. Emission rates for the SOP Product Dryer are based on the following:

Unit – S34

AP-42 Section 1.4 "Natural Gas Combustion"			**SO2, Lead, Formaldehyde, Methane, N2O**
BACT			**NOx, CO, CO2, PM (Total)**
NO_X	0.042	lbs/MMBtu	BACT
CO	0.037	lbs/MMBtu	BACT
SO_2	0.6	lbs/MMSCF	AP-42 Section 1.4
VOC	5.5	lbs/MMSCF	AP-42 Section 1.4
PM Uncontrolled	4300	lbs/hr	Mass Balance
PM Controlled	0.0052	grains/DSCF	BACT
CO_2	116.9	lbs/MMBtu	BACT
Methane	0.002	lbs/MMBtu	BACT
N_2O	0.0002	lbs/MMBtu	BACT
CO_2e	117.004	lbs/MMBtu	BACT
Lead	0.0005	lbs/MMSCF	AP-42 Section 1.4

Burner Maximum Rated Capacity

18.74 MMBtu/Hr

Controlled Hours of Operation

8760 hr/yr

Natural Gas LHV

946 Btu/standard cubic feet

Maximum Natural Gas Usage

19809.7 cubic feet/hr

0.0198097 million scf/hr

Exhaust Flowrate

14327.3 SCFM

24000 ACFM

SOP Granulator Dryers Emission Rates (2 Units) (S69A,B)

Emission Units S69A,B will combust natural gas. Maximum hourly and annual emission rates were estimated based on preliminary "best available control technology" (BACT) determinations for NO_X, CO,CO_2, and PM; and AP-42 Section 1.4 for sulfur dioxide (SO_2), lead, formaldehyde, methane, and N_2O. Emission rates for the SOP Granulator Dryers are based on the following:

Unit – S69A,B

AP-42 Section 1.4 "Natural Gas Combustion"			**SO2, Lead, Formaldehyde, Methane, N2O**
BACT			**NOx, CO, CO2, PM (Total)**
NO_X	0.042	lbs/MMBtu	BACT
CO	0.037	lbs/MMBtu	BACT
SO_2	0.6	lbs/MMSCF	AP-42 Section 1.4
VOC	5.5	lbs/MMSCF	AP-42 Section 1.4
PM Uncontrolled	4300	lbs/hr	Mass Balance
PM Controlled	0.0052	grains/DSCF	BACT
CO_2	116.9	lbs/MMBtu	BACT
Methane	0.002	lbs/MMBtu	BACT
N_2O	0.0002	lbs/MMBtu	BACT
CO_2e	117.004	lbs/MMBtu	BACT
Lead	0.0005	lbs/MMSCF	AP-42 Section 1.4

Burner Maximum Rated Capacity

16.54 MMBtu/Hr Each

Controlled Hours of Operation

8760 hr/yr

Natural Gas LHV

946 Btu/standard cubic feet

Maximum Natural Gas Usage

17484.1 cubic feet/hr each
0.0174841 million scf/hr

Exhaust Flowrate

11821.7 SCFM Each
18500 ACFM Each

Langbeinite Product Dryer Emission Rates (S90)

Emission Unit S90 will combust natural gas. Maximum hourly and annual emission rates were estimated based on preliminary "best available control technology" (BACT) determinations for NO_X, CO,CO_2, and PM; and AP-42 Section 1.4 for sulfur dioxide (SO_2), lead, formaldehyde, methane, and N_2O. Emission rates for the Langbeinite Product Dryer are based on the following:

Unit – S90

AP-42 Section 1.4 "Natural Gas Combustion"			**SO2, Lead, Formaldehyde, Methane, N2O**
BACT			**NOx, CO, CO2, PM (Total)**
NO_X	0.042	lbs/MMBtu	BACT
CO	0.037	lbs/MMBtu	BACT
SO_2	0.6	lbs/MMSCF	AP-42 Section 1.4
VOC	5.5	lbs/MMSCF	AP-42 Section 1.4
PM Uncontrolled	4300	lbs/hr	Mass Balance
PM Controlled	0.0052	grains/DSCF	BACT
CO_2	116.9	lbs/MMBtu	BACT
Methane	0.002	lbs/MMBtu	BACT
N_2O	0.0002	lbs/MMBtu	BACT
CO_2e	117.004	lbs/MMBtu	BACT
Lead	0.0005	lbs/MMSCF	AP-42 Section 1.4

Burner Maximum Rated Capacity

10.35 MMBtu/Hr

Controlled Hours of Operation

8760 hr/yr

Natural Gas LHV

946 Btu/standard cubic feet

Maximum Natural Gas Usage

10940.8 cubic feet/hr
0.0109408 million scf/hr

Exhaust Flowrate

9084.8 SCFM
16700 ACFM

Langbeinite Granulator Dryer Emission Rates (S112)

Emission Unit S112 will combust natural gas. Maximum hourly and annual emission rates were estimated based on preliminary "best available control technology" (BACT) determinations for NO_X, CO,CO_2, and PM; and AP-42 Section 1.4 for sulfur dioxide (SO_2), lead, formaldehyde, methane, and N_2O. Emission rates for the Langbeinite Granulator Dryer are based on the following:

Unit – S112

AP-42 Section 1.4 "Natural Gas Combustion"			**SO2, Lead, Formaldehyde, Methane, N2O**
BACT			**NOx, CO, CO2, PM (Total)**
NO_X	0.042	lbs/MMBtu	BACT
CO	0.037	lbs/MMBtu	BACT
SO_2	0.6	lbs/MMSCF	AP-42 Section 1.4
VOC	5.5	lbs/MMSCF	AP-42 Section 1.4
PM Uncontrolled	4300	lbs/hr	Mass Balance
PM Controlled	0.0052	grains/DSCF	BACT
CO_2	116.9	lbs/MMBtu	BACT
Methane	0.002	lbs/MMBtu	BACT
N_2O	0.0002	lbs/MMBtu	BACT
CO_2e	117.004	lbs/MMBtu	BACT
Lead	0.0005	lbs/MMSCF	AP-42 Section 1.4

Burner Maximum Rated Capacity

2.0 MMBtu/Hr

Controlled Hours of Operation

8760 hr/yr

Natural Gas LHV

946 Btu/standard cubic feet

Maximum Natural Gas Usage

2114.2 cubic feet/hr
0.0021142 million scf/hr

Exhaust Flowrate

13832.2 SCFM
19500 ACFM

Steam Boilers Emission Rates (2 Units) (S196 and S197)

Emission Units S196 and S197 will combust natural gas. Maximum hourly and annual emission rates were estimated based on preliminary "best available control technology" (BACT) determinations for NO_X, CO,CO_2, and PM; and AP-42 Section 1.4 for sulfur dioxide (SO_2), lead, formaldehyde, methane, and N_2O. Emission rates for the Stream Boiler are based on the following:

Unit – S196 and S197

AP-42 Section 1.4 "Natural Gas Combustion"			**SO2, Lead, Formaldehyde, Methane, N2O**
BACT			**NOx, CO, CO2, PM (Total)**
NO_X	0.02	lbs/MMBtu	BACT
CO	0.037	lbs/MMBtu	BACT
SO_2	0.6	lbs/MMSCF	AP-42 Section 1.4
VOC	5.5	lbs/MMSCF	AP-42 Section 1.4
PM Uncontrolled	0.0052	lbs/hr	Mass Balance
PM Controlled	116.9	grains/DSCF	BACT
CO_2	0.002	lbs/MMBtu	BACT
Methane	0.0002	lbs/MMBtu	BACT
N_2O	117.004	lbs/MMBtu	BACT
CO_2e	0.0005	lbs/MMBtu	BACT
Lead	0.02	lbs/MMSCF	AP-42 Section 1.4

Burner Maximum Rated Capacity

155.9 MMBtu/Hr

Controlled Hours of Operation

8760 hr/yr

Natural Gas LHV

1000 Btu/standard cubic feet

Maximum Natural Gas Usage

164799.2 cubic feet/hr
0.1647992 million scf/hr

Exhaust Flowrate

34474 SCFM
62307 ACFM

Hydrogen Sulfide (H_2S) Air Stripper BioTrickling Filter Emission Inputs (S200A,B)

The water supply, from the Groundwater Pre-Treatment Plant, will be pre-treated to remove hydrogen sulfide (H_2S) using two air strippers. H_2S emissions from the air strippers are vented to a BioTrickling Filter to remove 99% of the H_2S emissions from the air strippers exhaust before it is emitted to the atmosphere. Chemical used in the pre-treatment process to balance the pH and oxidize the H_2S include chlorine or 12% sodium hypochlorite and sulfuric acid. Chemical truck deliveries will occur approximately 2 to 3 times per week.

Mass Balance

H2S Concentration out of Air Stripper	=	2.7	lbs/min H2S
H2S Flowrate out of BioTrickling Filter	=	160000	ACFM
BioTrickling Filter Control	=	99	% removal

Mass Balance Calculations

lbs/hr = lbs/min * 60 min/hr

Uncontrolled Emission
lbs/hr = 162
ton/year = 710

Controlled Emission
lbs/hr = 1.620
ton/year = 7.10

Particulate Emission Rates Control Methodologies

No controls or emission reductions are proposed for the following sources.

Source ID	Source Description
S177	Gypsum Screw Conveyor
S178	Gypsum Haul Trucks Unload
S179	Gypsum Stockpile - Bulldozer
S180	Gypsum Stockpile Wind Erosion
S189	Product Truck Traffic Ochoa Plant to Jal Loadout
S190	Recycle Truck Traffic Ochoa Plant from Jal Loadout
S191	Additive Truck Traffic to Ochoa Plant
S198	Temporary Polyhalite Stockpile Wind Erosion
S199	Waste Stockpile Wind Erosion

The controlled hourly and annual emissions for particulate sources not associated with a fabric filter dust collector where calculated by using the following equations.

Uncontrolled emission rate * (1 - %control efficiency/100) = Controlled emission rate

Control efficiency percentages for enclosures and chemical sprays are taken from "Mojave Desert Air Quality Management District, Antelope Valley Air Pollution Control District, *Emissions Inventory Guidance*", Material Handling Table 5 – Control Techniques (see table below).

Material Handling Table 5 -- Control Techniques		
Control Technique	Control Efficiency (%)	Discussion
Water Spray (Application Point)	75	
Chemical Additive (Application Point)	85	
Water Spray (Downstream Effect)	75-(5*n)	n = number of transfer points from initial application
Chemical Additive (Downstream Effect)	85-(5*n)	
Conveyor with Half Cover	50	Covers less than 60 percent of conveyor
Conveyor with Three Quarter Cover	70	Covers less than 85 percent of conveyor
Conveyor with Full Cover	85	Completely covers conveyor width
Baghouse with Multiple Pickups	95	Baghouse must meet minimum flow standard given in Table 6
Baghouse with Single Pickup (Unenclosed)	97	
Baghouse with Single Pickup (Partial Enclosure)	98	
Baghouse with Single Pickup (Full Enclosure)	99	
Baghouse with Single Pickup (Attached)	99.5	

Full enclosure (Control Method SC1) will be used to control particulate matter emissions for material transfer units S1, S2, S175, S176, S181, S182, S183, S184, S185, S186, S187, and S188. For full enclosure control efficiency is 85%.

A fabric filter dust control baghouse (Control Method SC2) will be used to control particulate matter emissions for ROM material handling units S3, S4, S5A,B, S6A,B, and S7. From the BACT analysis, the baghouse will control particulate emissions to 0.005 grains per dry standard cubic foot. This is estimated to be equivalent to and control efficiency of 99.9%+.

A fabric filter dust control baghouse (Control Method SC3) will be used to control particulate matter emissions for Crusher Area material processing units S8, S9, S10, S11, S12, S13, S14A,B, and S15A,B. From the BACT analysis, the baghouse will control particulate emissions to 0.005 grains per dry standard cubic foot. This is estimated to be equivalent to and control efficiency of 99.9%+.

A fabric filter dust control baghouse (Control Method SC4) will be used to control particulate matter emissions for Calciner #1 processing units S18A, S19A, S21A, S22A, and S30A. From the BACT analysis, the baghouse will control particulate emissions to 0.0052 grains per dry standard cubic foot. This is estimated to be equivalent to and control efficiency of 99.9%+.

A fabric filter dust control baghouse (Control Method SC5) will be used to control particulate matter emissions for Calciner #2 processing units S18B, S19B, S21B, S22B, and S30B. From the BACT analysis, the baghouse will control particulate emissions to 0.0052 grains per dry standard cubic foot. This is estimated to be equivalent to and control efficiency of 99.9%+.

A fabric filter dust control baghouse (Control Method SC6) will be used to control particulate matter emissions for Calciner #3 processing units S18C, S19C, S21C, S22C, and S30C. From the BACT analysis, the baghouse will control particulate emissions to 0.0052 grains per dry standard cubic foot. This is estimated to be equivalent to and control efficiency of 99.9%+.

A fabric filter dust control baghouse (Control Method SC7) will be used to control particulate matter emissions for SOP Area material processing units 16A,B, 17A,B, 20A,B, S23, S24, S25, S26, S27, S28, S36, S37, S38, S39, S40, S41, S42, S43, S44, S45, S46, S47, S48, S49, S50, S51, S52, S53, S54, S55, S58, S59, S60, S61, S62, S63, S64, S65, S66, S67, S68, S69A,B, S70A,B, S71A,B, S74, S75, S76, S77, S78A,B, S79A,B, S80, S81, S82, S83, S84, S86, S87, S124, S125, S127, S128, S130, S131, S133, and S134. From the BACT analysis, the baghouse will control particulate emissions to 0.005 grains per dry standard cubic foot. This is estimated to be equivalent to and control efficiency of 99.9%+.

A fabric filter dust control baghouse (Control Method SC8) will be used to control particulate matter emissions for SOP Product Dryer processing units S32 S33, S34, and S35. From the BACT analysis, the baghouse will control particulate emissions to 0.0052 grains per dry standard cubic foot. This is estimated to be equivalent to and control efficiency of 99.9%+.

Chemical suppressant sprays (De-dusting oils) – 2 (2 transfer points removed) and ½ enclosure (Control Method SC9) will be used to control particulate matter emissions for units S56 and S92. For chemical sprays the control efficiency is 85% minus 2 transfers removed or 85% - 2*5 = 75%, and the control efficiency for ½ enclosure is 50%.

$$\%\text{Control Efficiency} = \{1 - [(1 - (85-2*5)\%) * (1 - 50\%)]\} * 100 \approx 87.5\%$$

Chemical suppressant sprays (De-dusting oils) – 3 (3 transfer points removed) and ½ enclosure (Control Method SC10) will be used to control particulate matter emissions for units S57, S93, S126, S129, S132, and S135. For chemical sprays the control efficiency is 85% minus 3 transfers removed or 85% - 3*5 = 70%, and the control efficiency for ½ enclosure is 50%.

$$\%\text{Control Efficiency} = \{1 - [(1 - (85-3*5)\%) * (1 - 50\%)]\} * 100 \approx 85\%$$

A fabric filter dust control baghouse (Control Method SC11) will be used to control particulate matter emissions for SOP Granulator Dryers processing units S72, S73A,B, and S85. From the BACT analysis, the baghouse will control particulate emissions to 0.0052 grains per dry standard cubic foot. This is estimated to be equivalent to and control efficiency of 99.9%+.

A fabric filter dust control baghouse (Control Method SC12) will be used to control particulate matter emissions for Langbeinite Product Dryer processing units S88, S89, and S90. From the BACT analysis, the baghouse will control particulate emissions to 0.0052 grains per dry standard cubic foot. This is estimated to be equivalent to and control efficiency of 99.9%+.

A fabric filter dust control baghouse (Control Method SC13) will be used to control particulate matter emissions for Langbeinite Area material processing units S91, S94, S95, S96, S97, S98, S99, S100, S101, S102, S103, and S104A,B. From the BACT analysis, the baghouse will control particulate emissions to 0.005 grains per dry standard cubic foot. This is estimated to be equivalent to and control efficiency of 99.9%+.

A fabric filter dust control baghouse (Control Method SC14) will be used to control particulate matter emissions for Langbeinite Area material processing units S105, S106, S107A,B, S108, S109, S110, S115, S116, S117, S118, S119, S120, S121, S122, and S123. From the BACT analysis, the baghouse will control particulate emissions to 0.005 grains per dry standard cubic foot. This is estimated to be equivalent to and control efficiency of 99.9%+.

A fabric filter dust control baghouse (Control Method SC15) will be used to control particulate matter emissions for Langbeinite Glazing/Conditioning processing units S111, S112, S113, and S114. From the BACT analysis, the baghouse will control particulate emissions to 0.0052 grains per dry standard cubic foot. This is estimated to be equivalent to and control efficiency of 99.9%+.

Chemical suppressant sprays (De-dusting oils) – 5 (5 transfer points removed) and ½ enclosure (Control Method SC16) will be used to control particulate matter emissions for units S136 and S157. For chemical sprays the control efficiency is 85% minus 5 transfers removed or 85% - 5*5 = 60%, and the control efficiency for ½ enclosure is 50%.

%Control Efficiency = {1 - [(1 – (85-5*5)%) * (1 – 50%)]} * 100 ≈ 80%

Chemical suppressant sprays (De-dusting oils) – 6 (6 transfer points removed) and ½ enclosure (Control Method SC17) will be used to control particulate matter emissions for units S137 and S158. For chemical sprays the control efficiency is 85% minus 6 transfers removed or 85% - 6*5 = 55%, and the control efficiency for ½ enclosure is 50%.

%Control Efficiency = {1 - [(1 – (85-6*5)%) * (1 – 50%)]} * 100 ≈ 77.5%

Chemical suppressant sprays (De-dusting oils) – 7 (7 transfer points removed) and ½ enclosure (Control Method SC18) will be used to control particulate matter emissions for units S138 and S159. For chemical sprays the control efficiency is 85% minus 7 transfers removed or 85% - 7*5 = 50%, and the control efficiency for ½ enclosure is 50%.

%Control Efficiency = {1 - [(1 – (85-7*5)%) * (1 – 50%)]} * 100 ≈ 75%

Chemical suppressant sprays (De-dusting oils) – 8 (8 transfer points removed) and ¾ enclosure (Control Method SC19) will be used to control particulate matter emissions for units S139 and S160. For chemical sprays the control efficiency is 85% minus 8 transfers removed or 85% - 8*5 = 45%, and the control efficiency for ¾ enclosure is 70%.

%Control Efficiency = {1 - [(1 – (85-8*5)%) * (1 – 70%)]} * 100 ≈ 83.5%

Chemical suppressant sprays (De-dusting oils) – 9 (9 transfer points removed) and ¾ enclosure (Control Method SC20) will be used to control particulate matter emissions for units S140 and S161. For chemical sprays the control efficiency is 85% minus 9 transfers removed or 85% - 9*5 = 40%, and the control efficiency for ¾ enclosure is 70%.

%Control Efficiency = {1 - [(1 – (85-9*5)%) * (1 – 70%)]} * 100 ≈ 82%

Chemical suppressant sprays (De-dusting oils) – 10 (10 transfer points removed) and ¾ enclosure (Control Method SC21) will be used to control particulate matter emissions for units S141 and S162. For chemical sprays the control efficiency is 85% minus 10 transfers removed or 85% - 10*5 = 35%, and the control efficiency for ¾ enclosure is 70%.

%Control Efficiency = {1 - [(1 – (85-10*5)%) * (1 – 70%)]} * 100 ≈ 80.5%

Chemical suppressant sprays (De-dusting oils) – 11 (11 transfer points removed) and ¾ enclosure (Control Method SC22) will be used to control particulate matter emissions for units S142 and S163. For chemical sprays the control efficiency is 85% minus 11 transfers removed or 85% - 11*5 = 30%, and the control efficiency for ¾ enclosure is 70%.

%Control Efficiency = {1 - [(1 – (85-11*5)%) * (1 – 70%)]} * 100 ≈ 79%

Chemical suppressant sprays (De-dusting oils) – 12 (12 transfer points removed) and ¾ enclosure (Control Method SC23) will be used to control particulate matter emissions for units S143 and S164. For chemical sprays the control efficiency is 85% minus 12 transfers removed or 85% - 12*5 = 25%, and the control efficiency for ¾ enclosure is 70%.

%Control Efficiency = {1 - [(1 – (85-12*5)%) * (1 – 70%)]} * 100 ≈ 77.5%

Chemical suppressant sprays (De-dusting oils) – 13 (13 transfer points removed) and ¾ enclosure (Control Method SC24) will be used to control particulate matter emissions for units S144 and S165A,B. For chemical sprays the control efficiency is 85% minus 13 transfers removed or 85% - 13*5 = 20%, and the control efficiency for ¾ enclosure is 70%.

%Control Efficiency = {1 - [(1 – (85-13*5)%) * (1 – 70%)]} * 100 ≈ 76%

Chemical suppressant sprays (De-dusting oils) – 14 (14 transfer points removed) and ¾ enclosure (Control Method SC25) will be used to control particulate matter emissions for units S145 and S166A,B. For chemical sprays the control efficiency is 85% minus 14 transfers removed or 85% - 14*5 = 15%, and the control efficiency for ¾ enclosure is 70%.

%Control Efficiency = {1 - [(1 – (85-14*5)%) * (1 – 70%)]} * 100 ≈ 74.5%

A fabric filter dust control baghouse (Control Method SC26) will be used to control particulate matter emissions for Jal Loadout Facility material processing units S146, S147, S148, S149, S150, S151, S152, S153, S155, S167, S168, S169, S170, S171, and S174. From the BACT analysis, the baghouse will control particulate emissions to 0.005 grains per dry standard cubic foot. This is estimated to be equivalent to and control efficiency of 99.9%+.

Chemical suppressant sprays (De-dusting oils) – 1 (1 transfer point removed) (Control Method SC27) will be used to control particulate matter emissions for units S154, S156, S172, and S173. For chemical sprays the control efficiency is 85% minus 1 transfer removed or 85% - 1*5 = 80%.

%Control Efficiency = 85% - 1*5 = 80%

Surfactants (Control Method SC27) will be used to control particulate matter emissions for units S192, S193, S194, and S195, unpaved roads at the Ochoa Processing and Jal Loadout Facilities. Based on NMED policy, the control efficiency for unpaved roads is 90%.

HAPs and TAPs Emission Rate Factors Used for Natural Gas Combustion Sources

The following table presents the emission factors used to determine the emission rates for hazardous air pollutants (HAPs) and New Mexico State toxic air pollutants (TAPs). Emission factors used can be found in EPA AP-42 Section 1.4 "Natural Gas Combustion", Tables 1.4-3 and 1.4-4.

AP-42 Section 1.4 "Natural Gas Combustion" Tables 1.4-3 and -4

Federal HAPs

Speciated Organic Compounds	Case #	Emission Factor (lbs/MMSCF)
Benzene	71-43-2	2.10E-03
Formaldehyde	50-00-0	7.50E-02
Naphthalene	91-20-3	6.10E-04
Toluene	108-88-3	3.40E-03

Metals	Case #	Emission Factor (lbs/MMSCF)
Arsenic	7440-38-2	2.00E-04
Beryllium	7440-41-7	1.20E-05
Cadmium	7440-43-9	1.10E-03
Chromium	7440-47-3	1.40E-03
Cobalt	7440-48-4	8.40E-05
Manganese	7439-96-5	3.80E-04
Mercury	7439-97-6	2.60E-04
Nickel	7440-02-0	2.10E-03
Selenium	7782-49-2	2.40E-05

State TAPs

Metals	Case #	Emission Factor (lbs/MMSCF)
Barium	7440-39-3	4.40E-03
Copper	7440-50-8	8.50E-04
Molybdenum	7439-98-7	1.10E-03
Vanadium	7440-62-2	2.30E-03
Zinc	7440-66-6	2.90E-02

Ochoa Project Emission Rate Calculations for All Sources

Attached are the emission calculation spreadsheets. These same emission calculations can be found in the Section 2 excel file.

Section 7

Information Used To Determine Emissions

<u>Information Used to Determine Emissions</u> shall include the following:

- ☐ If manufacturer data are used, include specifications for emissions units <u>and</u> control equipment, including control efficiencies specifications and sufficient engineering data for verification of control equipment operation, including design drawings, test reports, and design parameters that affect normal operation.
- ☐ If test data are used, include a copy of the complete test report. If the test data are for an emissions unit other than the one being permitted, the emission units must be identical. Test data may not be used if any difference in operating conditions of the unit being permitted and the unit represented in the test report significantly effect emission rates.
- **X** If the most current copy of AP-42 is used, reference the section and date located at the bottom of the page. Include a copy of the page containing the emissions factors, and clearly mark the factors used in the calculations.
- ☐ If an older version of AP-42 is used, include a complete copy of the section.
- **X** If an EPA document or other material is referenced, include a complete copy.
- **X** Fuel specifications sheet.
- **X** If computer models are used to estimate emissions, include an input summary (if available) and a detailed report, and a disk containing the input file(s) used to run the model. For tank-flashing emissions, include a discussion of the method used to estimate tank-flashing emissions, relative thresholds (i.e., permit or major source (NSPS, PSD or Title V)), accuracy of the model, the input and output from simulation models and software, all calculations, documentation of any assumptions used, descriptions of sampling methods and conditions, copies of any lab sample analysis.

Dust Collectors:	Grain Loading	BACT Analysis
Calciners/Dryers/Boilers:	Combustion Emissions	BACT Analysis
Bulldozers:	AP-42 Section 11.9	A-XXXX-7-AP42S11-9
Material Processing:	AP-42 Section 11.19.2	A-XXXX-7-AP42S11-19-2
Paved Roads:	AP-42 Section 13.2.1	A-XXXX-7-AP42S13-2-1
Unpaved Roads:	AP-42 Section 13.2.2	A-XXXX-7-AP42S13-2-2
Material Handling:	AP-42 Section 13.2.4	A-XXXX-7-AP42S13-2-4
Wind Erosion:	AP-42 Section 13.2.5	A-XXXX-7-AP42S13-2-5
Wind Erosion:	Fastest Mile Data Alb 2011	A-XXXX-7-FastestMileAlb2011
Wind Erosion:	Wind Erosion Spreadsheet	A-XXXX-7-WindErosionAlb2011
Control Efficiency:	Mojave AQMD Mining Document	A-XXXX-7-Mojave
MSDS Data Sheets:	Manufacturer	A-XXXX-7-MSDS
Boilers:	Manufacture Specification	A-XXXX-7-Boilers
Calciners:	Manufacture Specification	A-XXXX-7-Calciner
SOP Product Dryer:	Manufacture Specification	A-XXXX-7-SOPProdDryer
SOP Granulator Dryer:	Manufacture Specification	A-XXXX-7-SOPGran
Langbeinite Product Dryer:	Manufacture Specification	A-XXXX-7-LangProdDryer
Langbeinite Condition/Glaze:	Manufacture Specification	A-XXXX-7-LangGlazing
Emergency Generator:	Manufacture Specification	A-XXXX-7-EmergGen
Fire Pump Engine:	Manufacture Specification	A-XXXX-7-FirePump

11.9 Western Surface Coal Mining

11.9.1 General[1]

There are 12 major coal fields in the western states (excluding the Pacific Coast and Alaskan fields), as shown in Figure 11.9-1. Together, they account for more than 64 percent of the surface minable coal reserves in the United States.[2] The 12 coal fields have varying characteristics that may influence fugitive dust emission rates from mining operations including overburden and coal seam thicknesses and structure, mining equipment, operating procedures, terrain, vegetation, precipitation and surface moisture, wind speeds, and temperatures. The operations at a typical western surface mine are shown in Figure 11.9-2. All operations that involve movement of soil or coal, or exposure of erodible surfaces, generate some amount of fugitive dust.

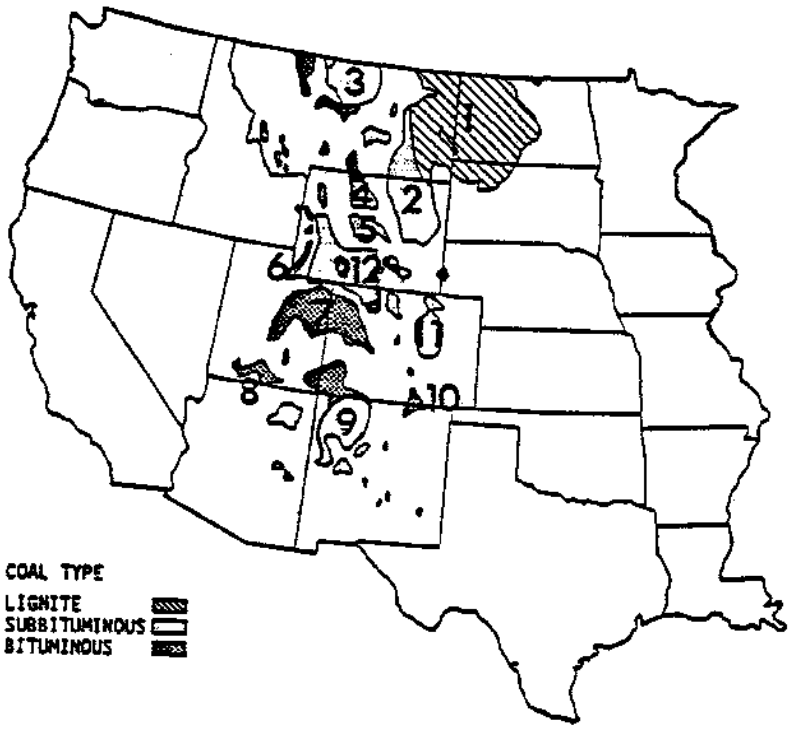
The initial operation is removal of topsoil and subsoil with large scrapers. The topsoil is carried by the scrapers to cover a previously mined and regraded area as part of the reclamation process or is placed in temporary stockpiles. The exposed overburden, the earth that is between the topsoil and the coal seam, is leveled, drilled, and blasted. Then the overburden material is removed down to the coal seam, usually by a dragline or a shovel and truck operation. It is placed in the adjacent mined cut, forming a spoils pile. The uncovered coal seam is then drilled and blasted. A shovel or front end loader loads the broken coal into haul trucks, and it is taken out of the pit along graded haul roads to the tipple, or truck dump. Raw coal sometimes may be dumped onto a temporary storage pile and later rehandled by a front end loader or bulldozer.

At the tipple, the coal is dumped into a hopper that feeds the primary crusher, then is conveyed through additional coal preparation equipment such as secondary crushers and screens to the storage area. If the mine has open storage piles, the crushed coal passes through a coal stacker onto the pile. The piles, usually worked by bulldozers, are subject to wind erosion. From the storage area, the coal is conveyed to a train loading facility and is put into rail cars. At a captive mine, coal will go from the storage pile to the power plant.

During mine reclamation, which proceeds continuously throughout the life of the mine, overburden spoils piles are smoothed and contoured by bulldozers. Topsoil is placed on the graded spoils, and the land is prepared for revegetation by furrowing, mulching, etc. From the time an area is disturbed until the new vegetation emerges, all disturbed areas are subject to wind erosion.

11.9.2 Emissions

Predictive emission factor equations for open dust sources at western surface coal mines are presented in Tables 11.9-1 and 11.9-2. Each equation applies to a single dust-generating activity, such as vehicle traffic on haul roads. The predictive equation explains much of the observed variance in emission factors by relating emissions to three sets of source parameters: (1) measures of source activity or energy expended (e. g., speed and weight of a vehicle traveling on an unpaved road); (2) properties of the material being disturbed (e. g., suspendable fines in the surface material of an unpaved road); and (3) climate (in this case, mean wind speed).



	Coal field	Strippable reserves (10^6 tons)
1	Fort Union	23,529
2	Powder River	56,727
3	North Central	All underground
4	Bighorn Basin	All underground
5	Wind River	3
6	Hams Fork	1,000
7	Uinta	308
8	Southwestern Utah	224
9	San Juan River	2,318
10	Raton Mesa	All underground
11	Denver	All underground
12	Green River	2,120

Figure 11.9-1. Coal fields of the western United States.[3]

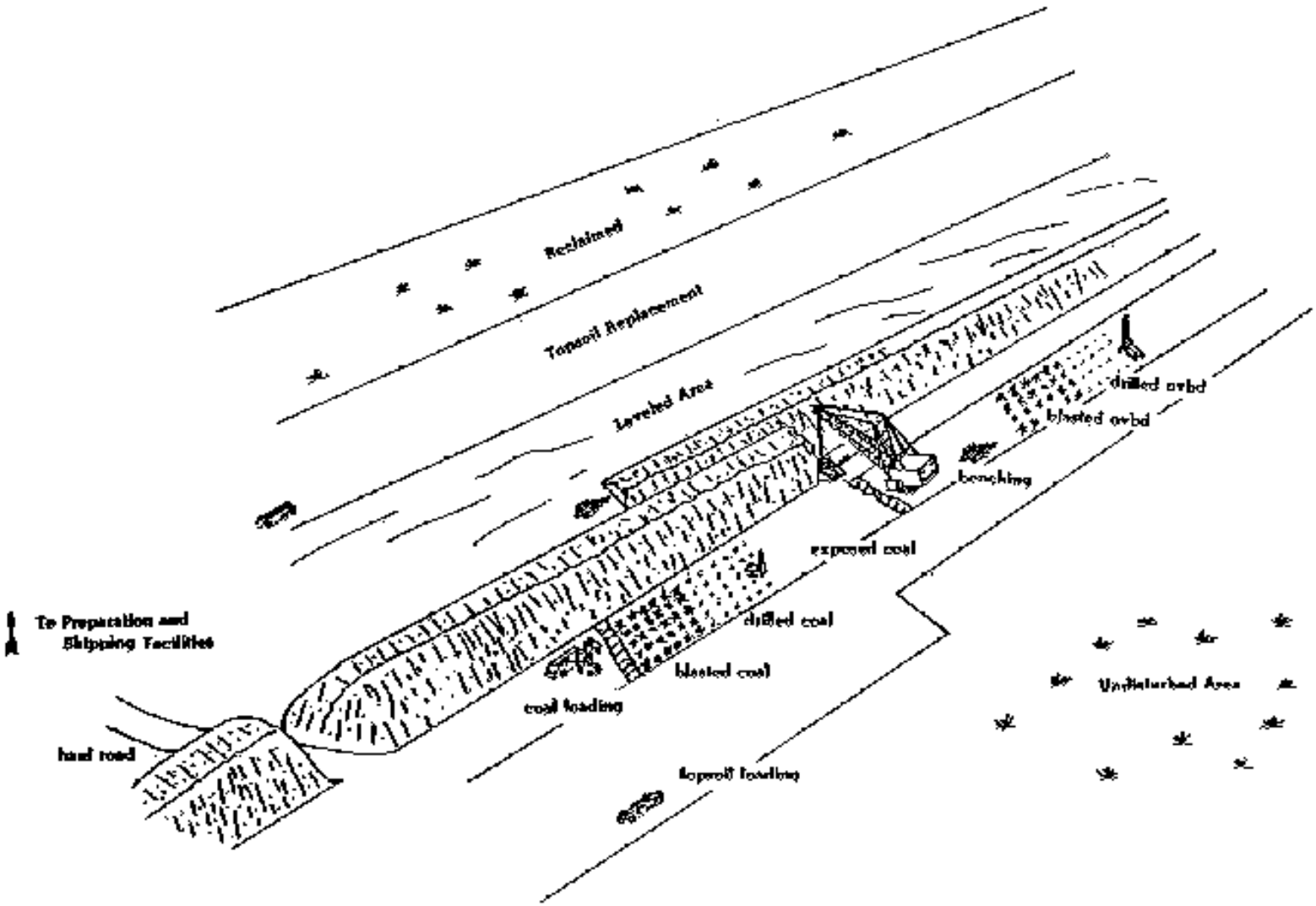


Figure 11.9-2. Operations at typical western surface coal mines.

The equations may be used to estimate particulate emissions generated per unit of source extent or activity (e. g., distance traveled by a haul truck or mass of material transferred). The equations were developed through field sampling of various western surface mine types and are thus applicable to any of the surface coal mines located in the western United States.

In Tables 11.9-1 and 11.9-2, the assigned quality ratings apply within the ranges of source conditions that were tested in developing the equations given in Table 11.9-3. However, the equations should be derated 1 letter value (e. g., A to B) if applied to eastern surface coal mines.

In using the equations to estimate emissions from sources found in a specific western surface mine, it is necessary that reliable values for correction parameters be determined for the specific sources of interest if the assigned quality ratings of the equations are to be applicable. For example, actual silt content of coal or overburden measured at a facility should be used instead of estimated values. In the event that site-specific values for correction parameters cannot be obtained, the appropriate geometric mean values from Table 11.9-3 may be used, but the assigned quality rating of each emission factor equation should be reduced by 1 level (e. g., A to B).

Emission factors for open dust sources not covered in Table 11.9-3 are in Table 11.9-4. These factors were determined through source testing at various western coal mines.

The factors in Table 11.9-4 for mine locations I through V were developed for specific geographical areas. Tables 11.9-5 and 11.9-6 present characteristics of each of these mines (areas). A "mine-specific" emission factor should be used only if the characteristics of the mine for which an emissions estimate is needed are very similar to those of the mine for which the emission factor was developed. The other (nonspecific) emission factors were developed at a variety of mine types and thus are applicable to any western surface coal mine.

As an alternative to the single valued emission factors given in Table 11.9-4 for train or truck loading and for truck or scraper unloading, two empirically derived emission factor equations are presented in Section 13.2.4 of this document. Each equation was developed for a source operation (i. e., batch drop and continuous drop, respectively) comprising a single dust-generating mechanism that crosses industry lines.

Because the predictive equations allow emission factor adjustment to specific source conditions, the equations should be used in place of the single-valued factors in Table 11.9-4 for the sources identified above, if emission estimates for a specific western surface coal mine are needed. However, the generally higher quality ratings assigned to the equations are applicable only if: (1) reliable values of correction parameters have been determined for the specific sources of interest, and (2) the correction parameter values lie within the ranges tested in developing the equations. Caution must be exercised so that only the unbound (sorbed) moisture (i. e., not any bound moisture) is used in determining the moisture content for input to the Chapter 13 equations.

Table 11.9-1 (English Units). EMISSION FACTOR EQUATIONS FOR UNCONTROLLED OPEN DUST SOURCES AT WESTERN SURFACE COAL MINES[a]

Operation	Material	Emissions By Particle Size Range (Aerodynamic Diameter)[b,c]				Units	EMISSION FACTOR RATING
		Emission Factor Equations		Scaling Factors			
		TSP ≤30 µm	≤15 µm	≤10 µm[d]	≤2.5 µm/TSP[e]		
Blasting[f]	Coal or overburden	$0.000014(A)^{1.5}$	ND	0.52[e]	0.03	lb/blast	C_DD
Truck loading	Coal	$\frac{1.16}{(M)^{1.2}}$	$\frac{0.119}{(M)^{0.9}}$	0.75	0.019	lb/ton	BBCC
Bulldozing	Coal	$\frac{78.4\ (s)^{1.2}}{(M)^{1.3}}$	$\frac{18.6\ (s)^{1.5}}{(M)^{1.4}}$	0.75	0.022	lb/hr	CCDD
	Overburden	$\frac{5.7\ (s)^{1.2}}{(M)^{1.3}}$	$\frac{1.0\ (s)^{1.5}}{(M)^{1.4}}$	0.75	0.105	lb/hr	BCDD
Dragline	Overburden	$\frac{0.0021\ (d)^{1.1}}{(M)^{0.3}}$	$\frac{0.0021\ (d)^{0.7}}{(M)^{0.3}}$	0.75	0.017	lb/yd^3	BCDD
Vehicle traffic[g]							
Grading		$0.040\ (S)^{2.5}$	$0.051\ (S)^{2.0}$	0.60	0.031	lb/VMT	CCDD
Active storage pile[h] (wind erosion and maintenance)	Coal	0.72 u	ND	ND	ND	$\frac{lb}{(acre)(hr)}$	C[i]_ _ _

[a] Reference 1, except as noted. VMT = vehicle miles traveled. ND = no data. Quality ratings coded where "Q, X, Y, Z" are ratings for ≤30 µm, ≤15 µm, ≤10 µm, and ≤2.5 µm, respectively. See also note below.

[b] Particulate matter less than or equal to 30 µm in aerodynamic diameter is sometimes termed "suspendable particulate" and is often used as a surrogate for TSP (total suspended particulate). TSP denotes what is measured by a standard high volume sampler (see Section 13.2).

[c] Symbols for equations:

A = horizontal area (ft^2), with blasting depth ≤ 70 ft. Not for vertical face of a bench.
M = material moisture content (%)
s = material silt content (%)
u = wind speed (mph)
d = drop height (ft)
W = mean vehicle weight (tons)
S = mean vehicle speed (mph)
w = mean number of wheels

Table 11.9-1 (cont.).

[d] Multiply the ≤15-µm equation by this fraction to determine emissions, except as noted.
[e] Multiply the TSP predictive equation by this fraction to determine emissions.
[f] Blasting factor taken from a reexamination of field test data reported in Reference 1. See Reference 4.
[g] To estimate emissions from traffic on unpaved surfaces by vehicles such as haul trucks, light-to-medium duty vehicles, or scrapers in the travel mode, see the unpaved road emission factor equation in AP-42 Section 13.2.2.
[h] Coal storage pile factor taken from Reference 5. To estimate emissions on a shorter time scale (e. g., worst-case day), see the procedure presented in Section 13.2.5.
[i] Rating applicable to mine types I, II, and IV (see Tables 11.9-5 and 11.9-6).

Note: Section 234 of the Clean Air Act of 1990 required EPA to review and revise the emission factors in this Section (and models used to evaluate ambient air quality impact), to ensure that they did not overestimate emissions from western surface coal mines. Due to resource and technical limitations, the haul road emission factors were isolated to receive the most attention during these studies, as the largest contributor to emissions. Resultant model evaluation with revised emission factors have improved model prediction for total suspended particulate (TSP); however, there is still a tendency for overprediction of particulate matter impact for PM-10, for as yet undetermined causes, prompting the Agency to make a policy decision not to use them for regulatory applications to these sources. However, the technical consideration exists that no better alternative data are currently available and the information should be made known. Users should accordingly use these factors with caution and awareness of their likely limitations.

Table 11.9-2 (Metric Units). EMISSION FACTOR EQUATIONS FOR UNCONTROLLED OPEN DUST SOURCES AT WESTERN SURFACE COAL MINES[a]

Operation	Material	Emissions By Particle Size Range (Aerodynamic Diameter)[b,c]				Units	EMISSION FACTOR RATING
		Emission Factor Equations		Scaling Factors			
		TSP ≤30 µm	≤15 µm	≤10 µm[d]	≤2.5 µm/TSP[e]		
Blasting[f]	Coal or overburden	$0.00022(A)^{1.5}$	ND	0.52[e]	0.03	kg/blast	C_DD
Truck loading	Coal	$\frac{0.580}{(M)^{1.2}}$	$\frac{0.0596}{(M)^{0.9}}$	0.75	0.019	kg/Mg	BBCC
Bulldozing	Coal	$\frac{35.6\ (s)^{1.2}}{(M)^{1.3}}$	$\frac{8.44\ (s)^{1.5}}{(M)^{1.4}}$	0.75	0.022	kg/hr	CCDD
	Overburden	$\frac{2.6\ (s)^{1.2}}{(M)^{1.3}}$	$\frac{0.45\ (s)^{1.5}}{(M)^{1.4}}$	0.75	0.105	kg/hr	BCDD
Dragline	Overburden	$\frac{0.0046\ (d)^{1.1}}{(M)^{0.3}}$	$\frac{0.0029\ (d)^{0.7}}{(M)^{0.3}}$	0.75	0.017	kg/m^3	BCDD
Vehicle traffic[g]							
Grading		$0.0034\ (S)^{2.5}$	$0.0056\ (S)^{2.0}$	0.60	0.031	kg/VKT	CCDD
Active storage pile[h] (wind erosion and maintenance)	Coal	1.8 u	ND	ND	ND	$\frac{kg}{(hectare)(hr)}$	C[i]_ _ _

[a] Reference 1, except as noted. VKT = vehicle kilometers traveled. ND = no data. Quality ratings coded as "QXYZ", where Q, X, Y, and Z are quality ratings for ≤30 µm, ≤15 µm, ≤10 µm, and ≤2.5 µm, respectively. See also note below.

[b] Particulate matter less than or equal to 30 µm in aerodynamic diameter is sometimes termed "suspendable particulate" and is often used as a surrogate for TSP (total suspended particulate). TSP denotes what is measured by a standard high volume sampler (see Section 13.2).

[c] Symbols for equations:

A = horizontal area (m^2), with blasting depth ≤ 21 m. Not for vertical face of a bench.
M = material moisture content (%)
s = material silt content (%)
u = wind speed (m/sec)
d = drop height (m)
W = mean vehicle weight (Mg)
S = mean vehicle speed (kph)
w = mean number of wheels

Table 11.9-2 (cont.).

[d] Multiply the ≤ 15-µm equation by this fraction to determine emissions, except as noted.
[e] Multiply the TSP predictive equation by this fraction to determine emissions.
[f] Blasting factor taken from a reexamination of field test data reported in Reference 1. See Reference 4.
[g] To estimate emissions from traffic on unpaved surfaces by vehicles such as haul trucks, light-to-medium duty vehicles, or scrapers in the travel mode, see the unpaved road emission factor equation in AP-42 Section 13.2.2
[h] Coal storage pile factor taken from Reference 5. To estimate emissions on a shorter time scale (e. g., worst-case day), see the procedure presented in Section 13.2.5.
[i] Rating applicable to mine types I, II, and IV (see Tables 11.9-5 and 11.9-6).

Note: Section 234 of the Clean Air Act of 1990 required EPA to review and revise the emission factors in this Section (and models used to evaluate ambient air quality impact), to ensure that they did not overestimate emissions from western surface coal mines. Due to resource and technical limitations, the haul road emission factors were isolated to receive the most attention during these studies, as the largest contributor to emissions. Resultant model evaluation with revised emission factors have improved model prediction for total suspended particulate (TSP); however, there is still a tendency for overprediction of particulate matter impact for PM-10, for as yet undetermined causes, prompting the Agency to make a policy decision not to use them for regulatory applications to these sources. However, the technical consideration exists that no better alternative data are currently available and the information should be made known. Users should accordingly use these factors with caution and awareness of their likely limitations.

Table 11.9-3 (Metric And English Units). TYPICAL VALUES FOR CORRECTION FACTORS APPLICABLE TO THE PREDICTIVE EMISSION FACTOR EQUATIONS[a]

Source	Correction Factor	Number Of Test Samples	Range	Geometric Mean	Units
Blasting	Area blasted	17	100 – 6,800	1,590	m^2
	Area blasted	17	1100 – 73,000	17,000	ft^2
Coal loading	Moisture	7	6.6 - 38	17.8	%
Bulldozers					
Coal	Moisture	3	4.0 - 22.0	10.4	%
	Silt	3	6.0 - 11.3	8.6	%
Overburden	Moisture	8	2.2 - 16.8	7.9	%
	Silt	8	3.8 - 15.1	6.9	%
Dragline	Drop distance	19	1.5 - 30	8.6	m
	Drop distance	19	5 - 100	28.1	ft
	Moisture	7	0.2 - 16.3	3.2	%
Scraper	Silt	10	7.2 - 25.2	16.4	%
	Weight	15	33 - 64	48.8	Mg
	Weight	15	36 - 70	53.8	ton
Grader	Speed	7	8.0 - 19.0	11.4	kph
	Speed		5.0 - 11.8	7.1	mph
Haul truck	Silt content	61	1.2 – 19.2	4.3	%
	Moisture	60	0.3 – 20.1	2.4	%
	Weight	61	20.9 – 260	110	mg
	Weight	61	23.0 – 290	120	ton

[a] Reference 1,6.

Table 11.9-4 (English And Metric Units). UNCONTROLLED PARTICULATE EMISSION FACTORS FOR OPEN DUST SOURCES AT WESTERN SURFACE COAL MINES

Source	Material	Mine Location[a]	TSP Emission Factor[b]	Units	EMISSION FACTOR RATING
Drilling	Overburden	Any	1.3	lb/hole	C
			0.59	kg/hole	C
	Coal	V	0.22	lb/hole	E
			0.10	kg/hole	E
Topsoil removal by scraper	Topsoil	Any	0.058	lb/ton	E
			0.029	kg/Mg	E
		IV	0.44	lb/ton	E
			0.22	kg/Mg	E
Overburden replacement	Overburden	Any	0.012	lb/ton	C
			0.0060	kg/Mg	C
Truck loading by power shovel (batch drop)[c]	Overburden	V	0.037	lb/ton	E
			0.018	kg/Mg	E
Train loading (batch or continuous drop)[c]	Coal	Any	0.028	lb/ton	E
			0.014	kg/Mg	E
		III	0.0002	lb/ton	E
			0.0001	kg/Mg	E
Bottom dump truck unloading (batch drop)[c]	Overburden	V	0.002	lb/ton	E
			0.001	kg/Mg	E
	Coal	IV	0.027	lb/ton	E
			0.014	kg/Mg	E
		III	0.005	lb/ton	E
			0.002	kg/Mg	E
		II	0.020	lb/ton	E
			0.010	kg/Mg	E
		I	0.014	lb/T	E
			0.0070	kg/Mg	E
		Any	0.066	lb/T	D
			0.033	kg/Mg	D

Table 11.9-4 (cont.).

Source	Material	Mine Location[a]	TSP Emission Factor[b]	Units	EMISSION FACTOR RATING
End dump truck unloading (batch drop)[c]	Coal	V	0.007 0.004	lb/T kg/Mg	E E
Scraper unloading (batch drop)[c]	Topsoil	IV	0.04 0.02	lb/T kg/Mg	E E
Wind erosion of exposed areas[d]	Seeded land, stripped overburden, graded overburden	Any	0.38 0.85	T/(acre)(yr) Mg/(hectare)(yr)	C C

[a] Roman numerals I through V refer to specific mine locations for which the corresponding emission factors were developed (Reference 5). Tables 11.9-4 and 11.9-5 present characteristics of each of these mines. See text for correct use of these "mine-specific" emission factors. The other factors (from Reference 7, except for overburden drilling from Reference 1) can be applied to any western surface coal mine.
[b] Total suspended particulate (TSP) denotes what is measured by a standard high volume sampler (see Section 13.2).
[c] Predictive emission factor equations, which generally provide more accurate estimates of emissions, are presented in Chapter 13.
[d] To estimate wind erosion on a shorter time scale (e. g., worst-case day), see Section 13.2.5.

Table 11.9-5 (Metric And English Units). GENERAL CHARACTERISTICS OF SURFACE COAL MINES REFERRED TO IN TABLE 11.9-4[a]

Mine	Location	Type Of Coal Mined	Terrain	Vegetative Cover	Surface Soil Type And Erodibility Index	Mean Wind Speed		Mean Annual Precipitation	
						m/s	mph	cm	in.
I	N.W. Colorado	Subbitum.	Moderately steep	Moderate, sagebrush	Clayey loamy (71)	2.3	5.1	38	15
II	S.W. Wyoming	Subbitum.	Semirugged	Sparse, sagebrush	Arid soil with clay and alkali or carbonate accumulation (86)	6.0	13.4	36	14
III	S.E. Montana	Subbitum.	Gently rolling to semirugged	Sparse, moderate, prairie grassland	Shallow clay loamy deposits on bedrock (47)	4.8	10.7	28 - 41	11 - 16
IV	Central North Dakota	Lignite	Gently rolling	Moderate, prairie grassland	Loamy, loamy to sandy (71)	5.0	11.2	43	17
V	N.E. Wyoming	Subbitum.	Flat to gently rolling	Sparse, sagebrush	Loamy, sandy, clayey, and clay loamy (102)	6.0	13.4	36	14

[a] Reference 4.

Table 11.9-6 (English Units). OPERATING CHARACTERISTICS OF THE COAL MINES REFERRED TO IN TABLE 11.9-4[a]

Parameter	Required Information	Units	Mine I	Mine II	Mine III	Mine IV	Mine V
Production rate	Coal mined	10^6 ton/yr	1.13	5.0	9.5	3.8	12.0[b]
Coal transport	Avg. unit train frequency	per day	NA	NA	2	NA	2
Stratigraphic data	Overburden thickness	ft	21	80	90	65	35
	Overburden density	lb/yd^3	4000	3705	3000	ND	ND
	Coal seam thicknesses	ft	9,35	15,9	27	2,4,8	70
	Parting thicknesses	ft	50	15	NA	32,16	NA
	Spoils bulking factor	%	22	24	25	20	ND
	Active pit depth	ft	52	100	114	80	105
Coal analysis data	Moisture	%	10	18	24	38	30
	Ash	%, wet	8	10	8	7	6
	Sulfur	%, wet	0.46	0.59	0.75	0.65	0.48
	Heat content	Btu/lb	11000	9632	8628	8500	8020
Surface disposition	Total disturbed land	acre	168	1030	2112	1975	217
	Active pit	acre	34	202	87	ND	71
	Spoils	acre	57	326	144	ND	100
	Reclaimed	acre	100	221	950	ND	100
	Barren land	acre	ND	30	455	ND	ND
	Associated disturbances	acre	12	186	476	ND	46
Storage	Capacity	ton	NA	NA	ND	NA	48000
Blasting	Frequency, total	per week	4	4	3	7	7[b]
	Frequency, overburden	per week	3	0.5	3	NA	7[b]
	Area blasted, coal	ft^2	16000	40000	ND	30000	ND
	Area blasted, overburden	ft^2	20000	ND	ND	NA	ND

[a] Reference 5. NA = not applicable. ND = no data.
[b] Estimate.

11.9.3 Updates Since the Fifth Edition

The Fifth Edition which was released in January 1995 reformatted the section that was dated September 1988. Revisions to this section since these dates are summarized below. For further detail, consult the memoranda describing each supplement or the background report for this section. These and other documents can be found on the CHIEF WEB site (home page http://www.epa.gov/ttn/chief/).

Supplement E

- The predictive equations for emission factors for haul trucks and light/medium duty vehicles were removed and replaced with a footnote refering users to the recently revised unpaved road section in the Miscellaneous Sources chapter.

- The emission factor quality ratings were revised based upon a revised predictive equation and single value criteria.

- The typographical errors for the TSP equation and the omission of the PM-2.5 scaling factor for blasting were corrected.

References For Section 11.9

1. K. Axetell and C. Cowherd, *Improved Emission Factors For Fugitive Dust From Western Surface Coal Mining Sources*, 2 Volumes, EPA Contract No. 68-03-2924, U. S. Environmental Protection Agency, Cincinnati, OH, July 1981.

2. *Reserve Base Of U. S. Coals By Sulfur Content: Part 2, The Western States*, IC8693, Bureau Of Mines, U. S. Department Of The Interior, Washington, DC, 1975.

3. *Bituminous Coal And Lignite Production And Mine Operations - 1978*, DOE/EIA-0118(78), U. S. Department Of Energy, Washington, DC, June 1980.

4. G. E. Muleski, *Update Of AP-42 Emission Factors For Western Surface Coal Mines And Related Sections*, Summary Report, Prepared for Emission Factors And Inventory Group (MD-14), Emissions, Modeling And Analysis Division, Office Of Air Quality, Planning, And Standards, U. S. Environmental Protection Agency, Research Triangle Park, NC 27711.

5. K. Axetell, *Survey Of Fugitive Dust From Coal Mines*, EPA-908/1-78-003, U. S. Environmental Protection Agency, Denver, CO, February 1978.

6. G. E. Muleski, *et al.*, *Surface Coal Mine Emission Factor Field Study*, EPA-454/R-95-010, U. S. Environmental Protection Agency, Research Triangle Park, NC, January 1994.

7. D. L. Shearer, *et al.*, *Coal Mining Emission Factor Development And Modeling Study*, Amax Coal Company, Carter Mining Company, Sunoco Energy Development Company, Mobil Oil Corporation, and Atlantic Richfield Company, Denver, CO, July 1981.

11.19.2 Crushed Stone Processing and Pulverized Mineral Processing

11.19.2.1 Process Description [24, 25]

Crushed Stone Processing

Major rock types processed by the crushed stone industry include limestone, granite, dolomite, traprock, sandstone, quartz, and quartzite. Minor types include calcareous marl, marble, shell, and slate. Major mineral types processed by the pulverized minerals industry, a subset of the crushed stone processing industry, include calcium carbonate, talc, and barite. Industry classifications vary considerably and, in many cases, do not reflect actual geological definitions.

Rock and crushed stone products generally are loosened by drilling and blasting and then are loaded by power shovel or front-end loader into large haul trucks that transport the material to the processing operations. Techniques used for extraction vary with the nature and location of the deposit. Processing operations may include crushing, screening, size classification, material handling and storage operations. All of these processes can be significant sources of PM and PM-10 emissions if uncontrolled.

Quarried stone normally is delivered to the processing plant by truck and is dumped into a bin. A feeder is used as illustrated in Figure 11.19.2-1. The feeder or screens separate large boulders from finer rocks that do not require primary crushing, thus reducing the load to the primary crusher. Jaw, impactor, or gyratory crushers are usually used for initial reduction. The crusher product, normally 7.5 to 30 centimeters (3 to 12 inches) in diameter, and the grizzly throughs (undersize material) are discharged onto a belt conveyor and usually are conveyed to a surge pile for temporary storage or are sold as coarse aggregates.

The stone from the surge pile is conveyed to a vibrating inclined screen called the scalping screen. This unit separates oversized rock from the smaller stone. The undersized material from the scalping screen is considered to be a product stream and is transported to a storage pile and sold as base material. The stone that is too large to pass through the top deck of the scalping screen is processed in the secondary crusher. Cone crushers are commonly used for secondary crushing (although impact crushers are sometimes used), which typically reduces material to about 2.5 to 10 centimeters (1 to 4 inches). The material (throughs) from the second level of the screen bypasses the secondary crusher because it is sufficiently small for the last crushing step. The output from the secondary crusher and the throughs from the secondary screen are transported by conveyor to the tertiary circuit, which includes a sizing screen and a tertiary crusher.

Tertiary crushing is usually performed using cone crushers or other types of impactor crushers. Oversize material from the top deck of the sizing screen is fed to the tertiary crusher. The tertiary crusher output, which is typically about 0.50 to 2.5 centimeters (3/16th to 1 inch), is returned to the sizing screen. Various product streams with different size gradations are separated in the screening operation. The products are conveyed or trucked directly to finished product bins, to open area stock piles, or to other processing systems such as washing, air separators, and screens and classifiers (for the production of manufactured sand).

Some stone crushing plants produce manufactured sand. This is a small-sized rock product with a maximum size of 0.50 centimeters (3/16 th inch). Crushed stone from the tertiary sizing screen is sized in a vibrating inclined screen (fines screen) with relatively small mesh sizes.

Oversized material is processed in a cone crusher or a hammermill (fines crusher) adjusted to produce small diameter material. The output is returned to the fines screen for resizing.

In certain cases, stone washing is required to meet particulate end product specifications or demands.

Pulverized Mineral Processing

Pulverized minerals are produced at specialized processing plants. These plants supply mineral products ranging from sizes of approximately 1 micrometer to more than 75 micrometers aerodynamic diameter. Pharmaceutical, paint, plastics, pigment, rubber, and chemical industries use these products. Due to the specialized characteristics of the mineral products and the markets for these products, pulverized mineral processing plants have production rates that are less than 5% of the production capacities of conventional crushed stone plants. Two alternative processing systems for pulverized minerals are summarized in Figure 11-19.2-2.

In dry processing systems, the mineral aggregate material from conventional crushing and screening operations is subject to coarse and fine grinding primarily in roller mills and/or ball mills to reduce the material to the necessary product size range. A classifier is used to size the ground material and return oversized material that can be pulverized using either wet or dry processes. The classifier can either be associated with the grinding operation, or it can be a stand-alone process unit. Fabric filters control particulate matter emissions from the grinding operation and the classifier. The products are stored in silos and are shipped by truck or in bags.

In wet processing systems, the mineral aggregate material is processed in wet mode coarse and fine grinding operations. Beneficiation processes use flotation to separate mineral impurities. Finely ground material is concentrated and flash dried. Fabric filters are used to control particulate matter emissions from the flash dryer. The product is then stored in silos, bagged, and shipped.

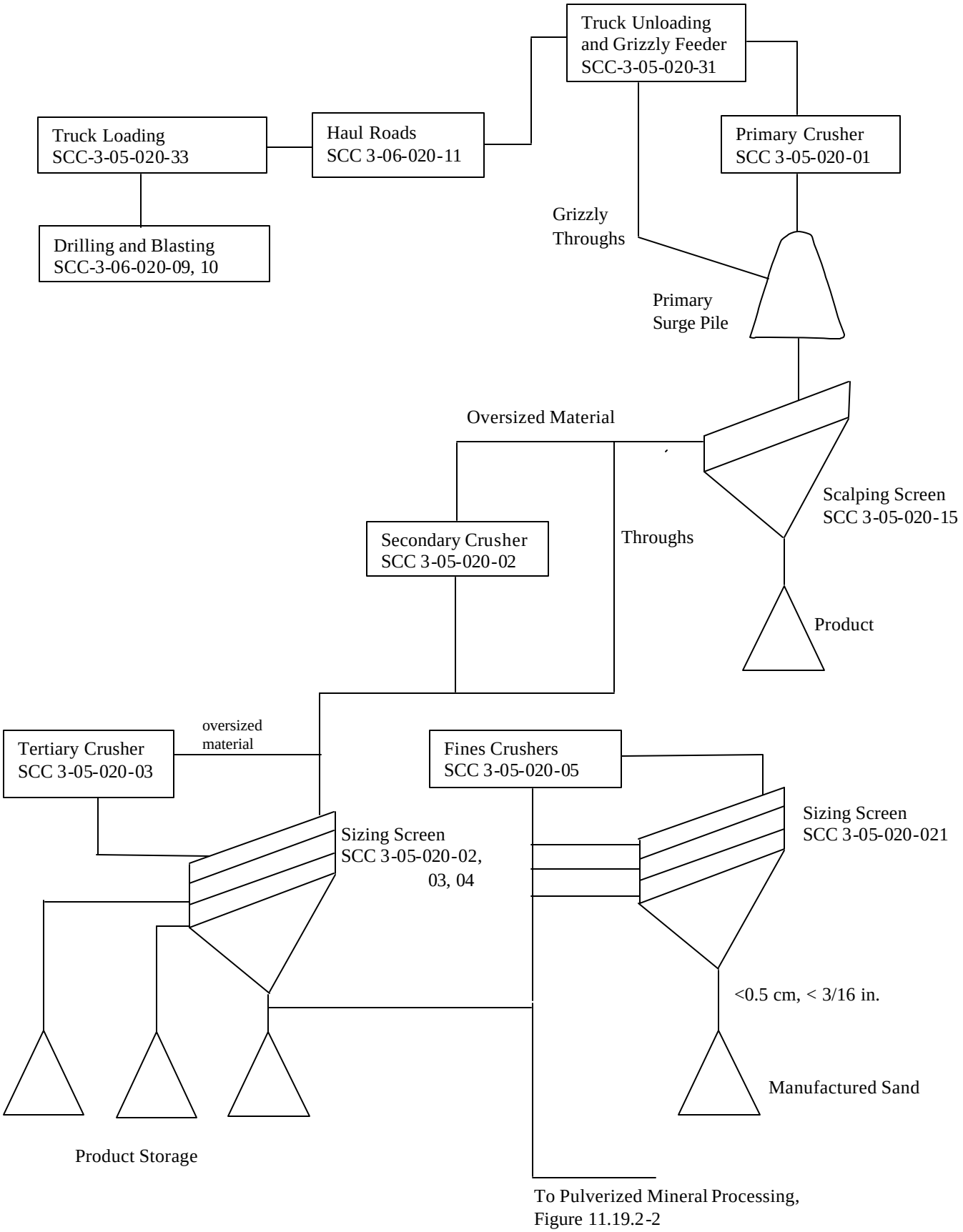


Figure 11.19.2-1. Typical stone processing plant

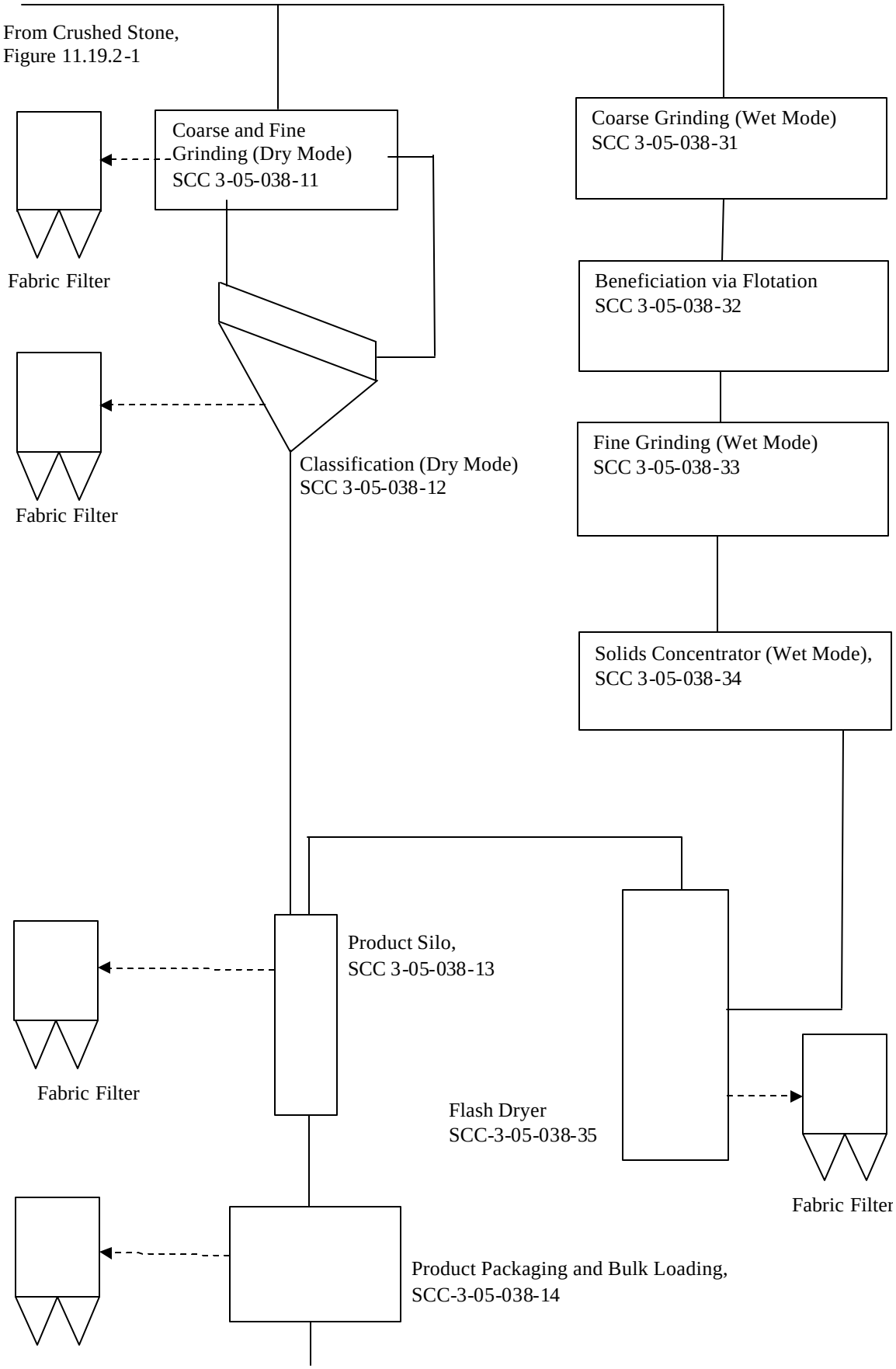


Figure 11.19.2-2 Flowchart for Pulverized Mineral Processing

11.19.2.2 Emissions and Controls [10, 11, 12, 13, 14, and 26]

Crushed Stone Processing

Emissions of PM, PM-10, and PM-2.5 occur from a number of operations in stone quarrying and processing. A substantial portion of these emissions consists of heavy particles that may settle out within the plant. As in other operations, crushed stone emission sources may be categorized as either process sources or fugitive dust sources. Process sources include those for which emissions are amenable to capture and subsequent control. Fugitive dust sources generally involve the reentrainment of settled dust by wind or machine movement. Emissions from process sources should be considered fugitive unless the sources are vented to a baghouse or are contained in an enclosure with a forced-air vent or stack. Factors affecting emissions from either source category include the stone size distribution and the surface moisture content of the stone processed, the process throughput rate, the type of equipment and operating practices used, and topographical and climatic factors.

Of graphical and seasonal factors, the primary variables affecting uncontrolled PM emissions are wind and material moisture content. Wind parameters vary with geographical location, season, and weather. It can be expected that the level of emissions from unenclosed sources (principally fugitive dust sources) will be greater during periods of high winds. The material moisture content also varies with geographical location, season, and weather. Therefore, the levels of uncontrolled emissions from both process emission sources and fugitive dust sources generally will be greater in arid regions of the country than in temperate ones and greater during the summer months because of a higher evaporation rate.

The moisture content of the material processed can have a substantial effect on emissions. This effect is evident throughout the processing operations. Surface wetness causes fine particles to agglomerate on or to adhere to the faces of larger stones, with a resulting dust suppression effect. However, as new fine particles are created by crushing and attrition and as the moisture content is reduced by evaporation, this suppressive effect diminishes and may disappear. Plants that use wet suppression systems (spray nozzles) to maintain relatively high material moisture contents can effectively control PM emissions throughout the process. Depending on the geographical and climatic conditions, the moisture content of mined rock can range from nearly zero to several percent. Because moisture content is usually expressed on a basis of overall weight percent, the actual moisture amount per unit area will vary with the size of the rock being handled. On a constant mass-fraction basis, the per-unit area moisture content varies inversely with the diameter of the rock. The suppressive effect of the moisture depends on both the absolute mass water content and the size of the rock product. Typically, wet material contains >1.5 percent water.

A variety of material, equipment, and operating factors can influence emissions from crushing. These factors include (1) stone type, (2) feed size and distribution, (3) moisture content, (4) throughput rate, (5) crusher type, (6) size reduction ratio, and (7) fines content. Insufficient data are available to present a matrix of rock crushing emission factors detailing the above classifications and variables. Available data indicate that PM-10 and PM-2.5 emissions from limestone and granite processing operations are similar. Therefore, the emission factors developed from the emissions data gathered at limestone and granite processing facilities are considered to be representative of typical crushed stone processing operations. Emission factors for filterable PM, PM-10, and PM-2.5 emissions from crushed stone processing operations are presented in Tables 11.19.2-1 (Metric units) and 11.19.2-2 (English units.)

Table 11.19.2-1 (Metric Units). EMISSION FACTORS FOR CRUSHED STONE PROCESSING OPERATIONS (kg/Mg)[a]

Source [b]	Total Particulate Matter [r,s]	EMISSION FACTOR RATING	Total PM-10	EMISSION FACTOR RATING	Total PM-2.5	EMISSION FACTOR RATING
Primary Crushing (SCC 3-05-020-01)	ND		ND[n]		ND[n]	
Primary Crushing (controlled) (SCC 3-05-020-01)	ND		ND[n]		ND[n]	
Secondary Crushing (SCC 3-05-020-02)	ND		ND[n]		ND[n]	
Secondary Crushing (controlled) (SCC 3-05-020-02)	ND		ND[n]		ND[n]	
Tertiary Crushing (SCC 3-050030-03)	0.0027[d]	E	0.0012[o]	C	ND[n]	
Tertiary Crushing (controlled) (SCC 3-05-020-03)	0.0006[d]	E	0.00027[p]	C	0.00005[q]	E
Fines Crushing (SCC 3-05-020-05)	0.0195[e]	E	0.0075[e]	E	ND	
Fines Crushing (controlled) (SCC 3-05-020-05)	0.0015[f]	E	0.0006[f]	E	0.000035[q]	E
Screening (SCC 3-05-020-02, 03)	0.0125[c]	E	0.0043[l]	C	ND	
Screening (controlled) (SCC 3-05-020-02, 03)	0.0011[d]	E	0.00037[m]	C	0.000025[q]	E
Fines Screening (SCC 3-05-020-21	0.15[g]	E	0.036[g]	E	ND	
Fines Screening (controlled) (SCC 3-05-020-21)	0.0018[g]	E	0.0011[g]	E	ND	
Conveyor Transfer Point (SCC 3-05-020-06)	0.0015[h]	E	0.00055[h]	D	ND	
Conveyor Transfer Point (controlled) (SCC 3-05-020-06)	0.00007[i]	E	2.3×10^{-5}[i]	D	6.5×10^{-6}[q]	E
Wet Drilling - Unfragmented Stone (SCC 3-05-020-10)	ND		4.0×10^{-5}[j]	E	ND	
Truck Unloading - Fragmented Stone (SCC 3-05-020-31)	ND		8.0×10^{-6}[j]	E	ND	
Truck Unloading - Conveyor, crushed stone (SCC 3-05-020-32)	ND		5.0×10^{-5}[k]	E	ND	

a. Emission factors represent uncontrolled emissions unless noted. Emission factors in kg/Mg of material throughput. SCC = Source Classification Code. ND = No data.

b. Controlled sources (with wet suppression) are those that are part of the processing plant that employs current wet suppression technology similar to the study group. The moisture content of the study group without wet suppression systems operating (uncontrolled) ranged from 0.21 to 1.3 percent, and the same facilities operating wet suppression systems (controlled) ranged from 0.55 to 2.88 percent. Due to carry over of the small amount of moisture required, it has been shown that each source, with the exception of crushers, does not need to employ direct water sprays. Although the moisture content was the only variable measured, other process features may have as much influence on emissions from a given source. Visual observations from each source under normal operating conditions are probably the best indicator of which emission factor is most appropriate. Plants that employ substandard control measures as indicated by visual observations should use the uncontrolled factor with appropriate control efficiency that best reflects the effectiveness of the controls employed.

c. References 1, 3, 7, and 8

d. References 3, 7, and 8

e. Reference 4

f. References 4 and 15

g. Reference 4

h. References 5 and 6

i. References 5, 6, and 15

j. Reference 11

k. Reference 12

l. References 1, 3, 7, and 8

m. References 1, 3, 7, 8, and 15

n. No data available, but emission factors for PM-10 for tertiary crushers can be used as an upper limit for primary or secondary crushing

o. References 2, 3, 7, 8

p. References 2, 3, 7, 8, and 15

q. Reference 15

r. PM emission factors are presented based on PM-100 data in the Background Support Document for Section 11.19.2

s. Emission factors for PM-30 and PM-50 are available in Figures 11.19.2-3 through 11.19.2-6.

Table 11.19.2-2 (English Units). EMISSION FACTORS FOR CRUSHED STONE PROCESSING OPERATIONS (lb/Ton)[a]

Source [b]	Total Particulate Matter [r,s]	EMISSION FACTOR RATING	Total PM-10	EMISSION FACTOR RATING	Total PM-2.5	EMISSION FACTOR RATING
Primary Crushing (SCC 3-05-020-01)	ND		ND[n]		ND[n]	
Primary Crushing (controlled) (SCC 3-05-020-01)	ND		ND[n]		ND[n]	
Secondary Crushing (SCC 3-05-020-02)	ND		ND[n]		ND[n]	
Secondary Crushing (controlled) (SCC 3-05-020-02)	ND		ND[n]		ND[n]	
Tertiary Crushing (SCC 3-050030-03)	0.0054[d]	E	0.0024[o]	C	ND[n]	
Tertiary Crushing (controlled) (SCC 3-05-020-03)	0.0012[d]	E	0.00054[p]	C	0.00010[q]	E
Fines Crushing (SCC 3-05-020-05)	0.0390[e]	E	0.0150[e]	E	ND	
Fines Crushing (controlled) (SCC 3-05-020-05)	0.0030[f]	E	0.0012[f]	E	0.000070[q]	E
Screening (SCC 3-05-020-02, 03)	0.025[c]	E	0.0087[l]	C	ND	
Screening (controlled) (SCC 3-05-020-02, 03)	0.0022[d]	E	0.00074[m]	C	0.000050[q]	E
Fines Screening (SCC 3-05-020-21)	0.30[g]	E	0.072[g]	E	ND	
Fines Screening (controlled) (SCC 3-05-020-21)	0.0036[g]	E	0.0022[g]	E	ND	
Conveyor Transfer Point (SCC 3-05-020-06)	0.0030[h]	E	0.00110[h]	D	ND	
Conveyor Transfer Point (controlled) (SCC 3-05-020-06)	0.00014[i]	E	4.6×10^{-5}[i]	D	1.3×10^{-5}[q]	E
Wet Drilling - Unfragmented Stone (SCC 3-05-020-10)	ND		8.0×10^{-5}[j]	E	ND	
Truck Unloading -Fragmented Stone (SCC 3-05-020-31)	ND		1.6×10^{-5}[j]	E	ND	
Truck Unloading - Conveyor, crushed stone (SCC 3-05-020-32)	ND		0.00010[k]	E	ND	

a. Emission factors represent uncontrolled emissions unless noted. Emission factors in lb/Ton of material of throughput. SCC = Source Classification Code. ND = No data.

b. Controlled sources (with wet suppression) are those that are part of the processing plant that employs current wet suppression technology similar to the study group. The moisture content of the study group without wet suppression systems operating (uncontrolled) ranged from 0.21 to 1.3 percent, and the same facilities operating wet suppression systems (controlled) ranged from 0.55 to 2.88 percent. Due to carry over of the small amount of moisture required, it has been shown that each source, with the exception of crushers, does not need to employ direct water sprays. Although the moisture content was the only variable measured, other process features may have as much influence on emissions from a given source. Visual observations from each source under normal operating conditions are probably the best indicator of which emission factor is most appropriate. Plants that employ substandard control measures as indicated by visual observations should use the uncontrolled factor with an appropriate control efficiency that best reflects the effectiveness of the controls employed.

c. References 1, 3, 7, and 8

d. References 3, 7, and 8

e. Reference 4

f. References 4 and 15

g. Reference 4

h. References 5 and 6

i. References 5, 6, and 15

j. Reference 11

k. Reference 12

l. References 1, 3, 7, and 8

m. References 1, 3, 7, 8, and 15

n. No data available, but emission factors for PM-10 for tertiary crushers can be used as an upper limit for primary or secondary crushing

o. References 2, 3, 7, 8

p. References 2, 3, 7, 8, and 15

q. Reference 15

r. PM emission factors are presented based on PM-100 data in the Background Support Document for Section 11.19.2

s. Emission factors for PM-30 and PM-50 are available in Figures 11.19.2-3 through 11.19.2-6.

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Emission factor estimates for stone quarry blasting operations are not presented because of the sparsity and unreliability of available tests. While a procedure for estimating blasting emissions is presented in Section 11.9, Western Surface Coal Mining, that procedure should not be applied to stone quarries because of dissimilarities in blasting techniques, material blasted, and size of blast areas. Emission factors for fugitive dust sources, including paved and unpaved roads, materials handling and transfer, and wind erosion of storage piles, can be determined using the predictive emission factor equations presented in AP-42 Section 13.2.

The data used in the preparation of the controlled PM calculations was derived from the individual A-rated tests for PM-2.5 and PM-10 summarized in the Background Support Document. For conveyor transfer points, the controlled PM value was derived from A-rated PM-2.5, PM-10, and PM data summarized in the Background Support Document.

The extrapolation line was drawn through the PM-2.5 value and the mean of the PM-10 values. PM emission factors were calculated for PM-30, PM-50, and PM-100. Each of these particle size limits is used by one or more regulatory agencies as the definition of total particulate matter. The graphical extrapolations used in calculating the emission factors are presented in Figures 11.19.2-3, -4, -5, and -6.

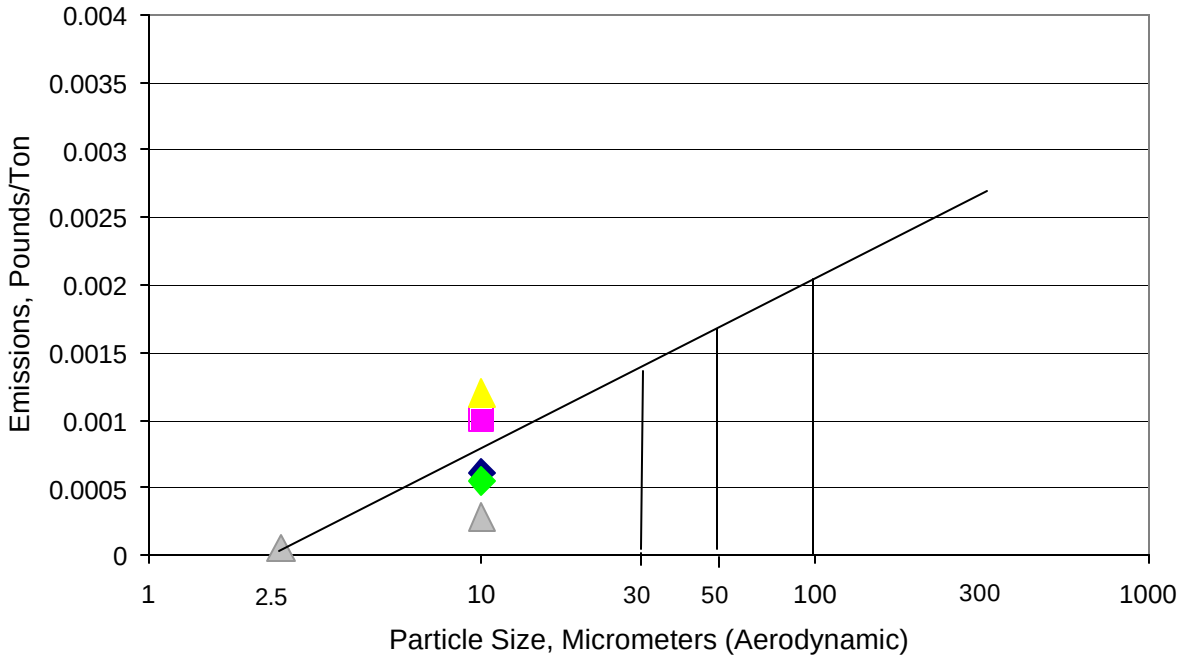


Figure 11-19-3. PM Emission Factor Calculation, Screening (Controlled)

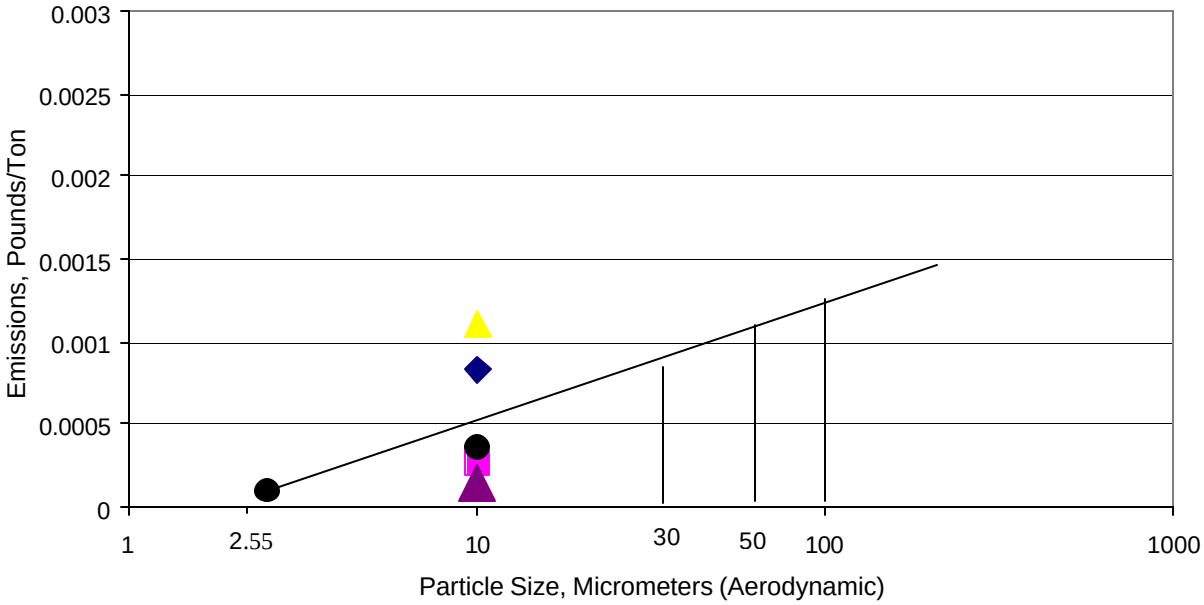


Figure 11.19-4. PM Emission Factor Calculation, Tertiary Crushing (Controlled)

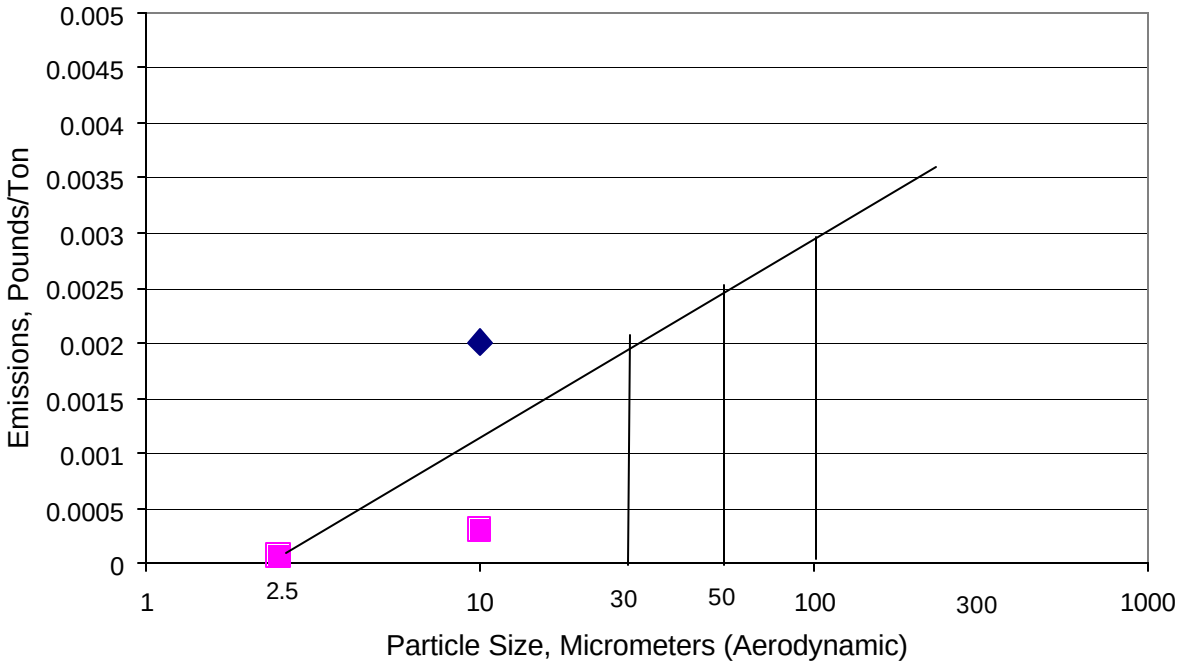


Figure 11-19.5. PM Emission Factor Calculation, Fines Crushing (Controlled)

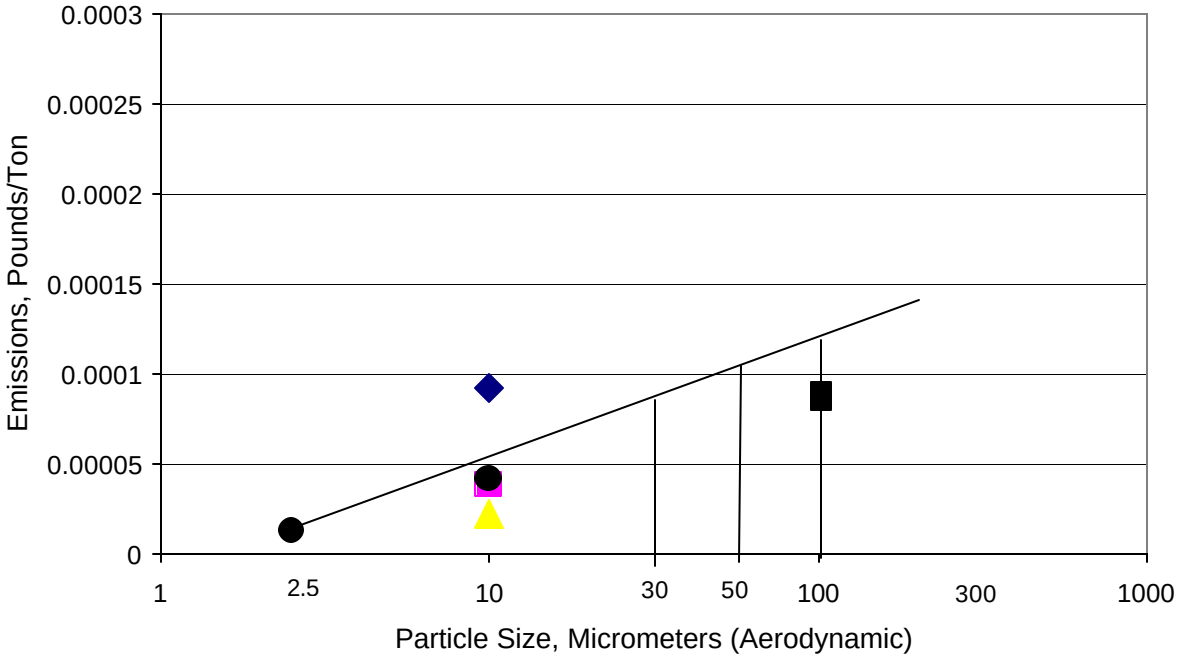


Figure 11.19-6. PM Emission Factor Calculation, Conveyor Transfer Points (Controlled)

The uncontrolled PM emission factors have been calculated from the controlled PM emission factors calculated in accordance with Figures 11.19.2-3 through 11.19.2-6. The PM-10 control efficiencies have been applied to the PM controlled emission factor data to calculate the uncontrolled PM emission rates.

Screening PM-10

Controlled = 0.00073 Lbs./Ton.

Uncontrolled = 0.00865 Lbs./Ton.

Efficiency = 91.6%

Tertiary Crushing PM-10

Controlled = 0.00054

Uncontrolled = 0.00243

Efficiency = 77.7%

Fines Crushing PM-10:

Controlled = 0.0012

Uncontrolled = 0.015

Efficiency = 92.0%

Conveyor Transfer Points PM-10

Controlled = 0.000045

Uncontrolled = 0.0011

Efficiency = 95.9%

The uncontrolled total particulate matter emission factor was calculated from the controlled total particulate matter using Equation 1:

$$\text{Uncontrolled emission factor} = \frac{\text{Controlled total particulate emission factor}}{(100\% - \text{PM-10 Efficiency }\%)/100\%}$$

Equation 1

The Total PM emission factors calculated using Figures 11.19.2-3 through 11.19.2-6 were developed because (1) there are more A-rated test data supporting the calculated values and (2) the extrapolated values provide the flexibility for agencies and source operators to select the most appropriate definition for Total PM. All of the Total PM emission factors have been rated as E due to the limited test data and the need to estimate emission factors using extrapolations of the PM-2.5 and PM-10 data.

Pulverized Mineral Processing

Emissions of particulate matter from dry mode pulverized mineral processing operations are controlled by pulse jet and envelope type fabric filter systems. Due to the low-to-moderate gas temperatures generated by the processing equipment, conventional felted filter media are used. Collection efficiencies for fabric filter-controlled dry process equipment exceed 99.5%. Emission factors for pulverized mineral processing operations are presented in Tables 11.19.2-3 and 11.19.2-4.

Table 11.19.2-3 (Metric Units). EMISSION FACTORS FOR PULVERIZED MINERAL PROCESSING OPERATIONS [a]

Source [b]	Total Particulate Matter	EMISSION FACTOR RATING	Total PM-10	EMISSION FACTOR RATING	Total PM-2.5	EMISSION FACTOR RATING
Grinding (Dry) with Fabric Filter Control (SCC 3-05-038-11)	0.0202	D	0.0169	B	0.0060	B
Classifiers (Dry) with Fabric Filter Control (SCC 3-05-038-12)	0.0112	E	0.0052	E	0.0020	E
Flash Drying with Fabric Filter Control (SCC 3-05-038-35)	0.0134	C	0.0073	C	0.0042	C
Product Storage with Fabric Filter Control (SCC 3-05-38-13)	0.0055	E	0.0008	E	0.0003	E

a. Emission factors represent controlled emissions unless noted. Emission factors are in kg/Mg of material throughput.

b. Date from references 16 through 23

Table 11.19.2-4 (English Units). EMISSION FACTORS FOR PULVERIZED MINERAL PROCESSING OPERATIONS [a]

Source [b]	Total Particulate Matter	EMISSION FACTOR RATING	Total PM-10	EMISSION FACTOR RATING	Total PM-2.5	EMISSION FACTOR RATING
Grinding (Dry) with Fabric Filter Control (SCC 3-05-038-11)	0.0404	D	0.0339	B	0.0121	B
Classifiers (Dry) with Fabric Filter Control (SCC 3-05-038-12)	0.0225	E	0.0104	E	0.0041	E
Flash Drying with Fabric Filter Control (SCC 3-05-038-35)	0.0268	C	0.0146	C	0.0083	C
Product Storage with Fabric Filter Control (SCC 3-05-038-13)	0.0099	E	0.0016	E	0.0006	E

a. Emission factors represent controlled emissions unless noted. Emission factors are in lb/Ton of material throughput.

b. Data from references 16 through 23

References for Section 11.19.2[1]

1. J. Richards, T. Brozell, and W. Kirk, *PM-10 Emission Factors for a Stone Crushing Plant Deister Vibrating Screen,* EPA Contract No. 68-Dl-0055, Task 2.84, U. S. Environmental Protection Agency, Research Triangle Park, NC, February 1992.

2. J. Richards, T. Brozell, and W. Kirk, *PM-10 Emission Factors for a Stone Crushing Plant Tertiary Crusher,* EPA Contract No. 68-D1-0055, Task 2.84, U. S. Environmental Protection Agency, Research Triangle Park, NC, February 1992.

3. W. Kirk, T. Brozell, and J. Richards, *PM-10 Emission Factors for a Stone Crushing Plant Deister Vibrating Screen and Crusher,* National Stone Association, Washington DC, December 1992.

4. T. Brozell, J. Richards, and W. Kirk, *PM-10 Emission Factors for a Stone Crushing Plant Tertiary Crusher and Vibrating Screen,* EPA Contract No. 68-DO-0122, U. S. Environmental Protection Agency, Research Triangle Park, NC, December 1992.

5. T. Brozell, *PM-10 Emission Factors for Two Transfer Points at a Granite Stone Crushing Plant,* EPA Contract No. 68-DO-0122, U. S. Environmental Protection Agency, Research Triangle Park, NC, January 1994.

6. T. Brozell, *PM-10 Emission Factors for a Stone Crushing Plant Transfer Point,* EPA Contract No. 68-DO-0122, U. S. Environmental Protection Agency, Research Triangle Park, NC, February 1993.

7. T. Brozell and J. Richards, *PM-10 Emission Factors for a Limestone Crushing Plant Vibrating Screen and Crusher for Bristol, Tennessee,* EPA Contract No. 68-D2-0163, U. S. Environmental Protection Agency, Research Triangle Park, NC, July 1993.

8. T. Brozell and J. Richards, *PM-10 Emission Factors for a Limestone Crushing Plant Vibrating Screen and Crusher for Marysville, Tennessee,* EPA Contract No. 68-D2-0163, U. S. Environmental Protection Agency, Research Triangle Park, NC, July 1993.

9. *Air Pollution Control Techniques for Nonmetallic Minerals Industry,* EPA-450/3-82-014, U. S. Environmental Protection Agency, Research Triangle Park, NC, August 1982.

10. *Review Emission Data Base and Develop Emission Factors for the Construction Aggregate Industry,* Engineering-Science, Inc., Arcadia, CA, September 1984.

11. P. K. Chalekode *et al., Emissions from the Crushed Granite Industry: State of the Art,* EPA-600/2-78-021, U. S. Environmental Protection Agency, Washington, DC, February 1978.

12. T. R. Blackwood *et al., Source Assessment: Crushed Stone,* EPA-600/2-78-004L, U. S. Environmental Protection Agency, Washington, DC, May 1978.

13. *An Investigation of Particulate Emissions from Construction Aggregate Crushing Operations and Related New Source Performance Standards,* National Crushed Stone Association, Washington, DC, December 1979.

[1] References 1 through 23 are identical to References 1 through 23 in the Background Support Document for AP-42, Section 11.19-2.

14. F. Record and W. T. Harnett, *Particulate Emission Factors for the Construction Aggregate Industry, Draft Report*, GCA-TR-CH-83-02, EPA Contract No. 68-02-3510, GCA Corporation, Chapel Hill, NC, February 1983.

15. T. Brozell, T. Holder, and J. Richards, *Measurement of PM-10 and PM2.5 Emission Factors at a Stone Crushing Plant*, National Stone Association, December 1996.

16. T. Brozell, and J. Richards, *PM_{10}/$PM_{2.5}$ Emission Factor Testing for the Pulverized Mineral Division of the National Stone, Sand and Gravel Association.* Report to the National Stone, Sand and Gravel Association; October 2001.

17. Frank Ward & Company, *A Report of Particulate Source Sampling Performed for Franklin Industrial Minerals Located in Sherwood, Tennessee,* Report to Franklin Industrial Minerals, August 1994.

18. Advanced Industrial Resources, LLC. *Performance Test Report of Baghouse No. 37 at Franklin Industrial Minerals, Report to Franklin Industrial Minerals,* November 1999.

19. Advanced Industrial Resources, LLC. *Performance Test Report of BH-750Limestone System at Franklin Industrial Minerals, Report to Franklin Industrial Minerals,* May 2000.

20. Air Quality Technical Services, *Performance Testing for Flash Dryer #1, Omya, Inc. Plant in Florence, Vermont.* June 1997.

21. Air Quality Technical Services, *Performance Testing for Flash Dryer #2, Omya, Inc. Plant in Florence, Vermont,* March 1998.

22. Air Quality Technical Services. *Performance Testing for Flash Dryer #3, Omya, Inc. Plant in Florence, Vermont,* August 2000.

23. Air Quality Technical Services. *Performance Testing for Flash Dryer #3, Omya, Inc. Plant in Florence, Vermont,* September 2000.

24. *Air Pollution Control Techniques for Nonmetallic Minerals Industry*, EPA-450/3-82-014, U.S. Environmental Protection Agency, Research Triangle Park, NC, August 1982.

25. Written communication from J. Richards, Air Control Techniques, P.C. to B. Shrager, MRI, March 18, 1994.

26. C. Cowherd, Jr. et. al., *Development of Emission Factors For Fugitive Dust Sources*, EPA-450/3-74-037, U.S. Environmental Protection Agency, Research Triangle Park, NC, June 1974.

13.2.1 Paved Roads

13.2.1.1 General

Particulate emissions occur whenever vehicles travel over a paved surface such as a road or parking lot. Particulate emissions from paved roads are due to direct emissions from vehicles in the form of exhaust, brake wear and tire wear emissions and resuspension of loose material on the road surface. In general terms, resuspended particulate emissions from paved roads originate from, and result in the depletion of, the loose material present on the surface (i.e., the surface loading). In turn, that surface loading is continuously replenished by other sources. At industrial sites, surface loading is replenished by spillage of material and trackout from unpaved roads and staging areas. Figure 13.2.1-1 illustrates several transfer processes occurring on public streets.

Various field studies have found that public streets and highways, as well as roadways at industrial facilities, can be major sources of the atmospheric particulate matter within an area.[1-9] Of particular interest in many parts of the United States are the increased levels of emissions from public paved roads when the equilibrium between deposition and removal processes is upset. This situation can occur for various reasons, including application of granular materials for snow and ice control, mud/dirt carryout from construction activities in the area, and deposition from wind and/or water erosion of surrounding unstabilized areas. In the absence of continuous addition of fresh material (through localized track out or application of antiskid material), paved road surface loading should reach an equilibrium value in which the amount of material resuspended matches the amount replenished. The equilibrium surface loading value depends upon numerous factors. It is believed that the most important factors are: mean speed of vehicles traveling the road; the average daily traffic (ADT); the number of lanes and ADT per lane; the fraction of heavy vehicles (buses and trucks); and the presence/absence of curbs, storm sewers and parking lanes.[10]

The particulate emission factors presented in a previous version of this section of AP-42, dated October 2002, implicitly included the emissions from vehicles in the form of exhaust, brake wear, and tire wear as well as resuspended road surface material. EPA included these sources in the emission factor equation for paved roads since the field testing data used to develop the equation included both the direct emissions from vehicles and emissions from resuspension of road dust.

This version of the paved road emission factor equation only estimates particulate emissions from resuspended road surface material[28]. The particulate emissions from vehicle exhaust, brake wear, and tire wear are now estimated separately using EPA's MOVES [29] model. This approach eliminates the possibility of double counting emissions. Double counting results when employing the previous version of the emission factor equation in this section and MOVES to estimate particulate emissions from vehicle traffic on paved roads. It also incorporates the decrease in exhaust emissions that has occurred since the paved road emission factor equation was developed. Earlier versions of the paved road emission factor equation includes estimates of emissions from exhaust, brake wear, and tire wear based on emission rates for vehicles in the 1980 calendar year fleet. The amount of PM released from vehicle exhaust has decreased since 1980 due to lower new vehicle emission standards and changes in fuel characteristics.

13.2.1.2 Emissions And Correction Parameters

Dust emissions from paved roads have been found to vary with what is termed the "silt loading" present on the road surface. In addition, the average weight and speed of vehicles traveling the road influence road dust emissions. The term silt loading (sL) refers to the mass of silt-size material (equal to or less than 75 micrometers [μm] in physical diameter) per unit area of the travel surface. The total road surface dust loading consists of loose material that can be collected by broom sweeping and vacuuming of the traveled portion of the paved road. The silt fraction is determined by measuring the proportion of the loose dry surface dust that passes through a 200-mesh screen, using the ASTM-C-136 method. Silt loading is the product of the silt fraction and the total loading, and is abbreviated "sL". Additional details on the sampling and analysis of such material are provided in AP-42 Appendices C.1 and C.2.

The surface sL provides a reasonable means of characterizing seasonal variability in a paved road emission inventory. In many areas of the country, road surface loadings [11-21] are heaviest during the late winter and early spring months when the residual loading from snow/ice controls is greatest. As noted earlier, once replenishment of fresh material is eliminated, the road surface loading can be expected to reach an equilibrium value, which is substantially lower than the late winter/early spring values.

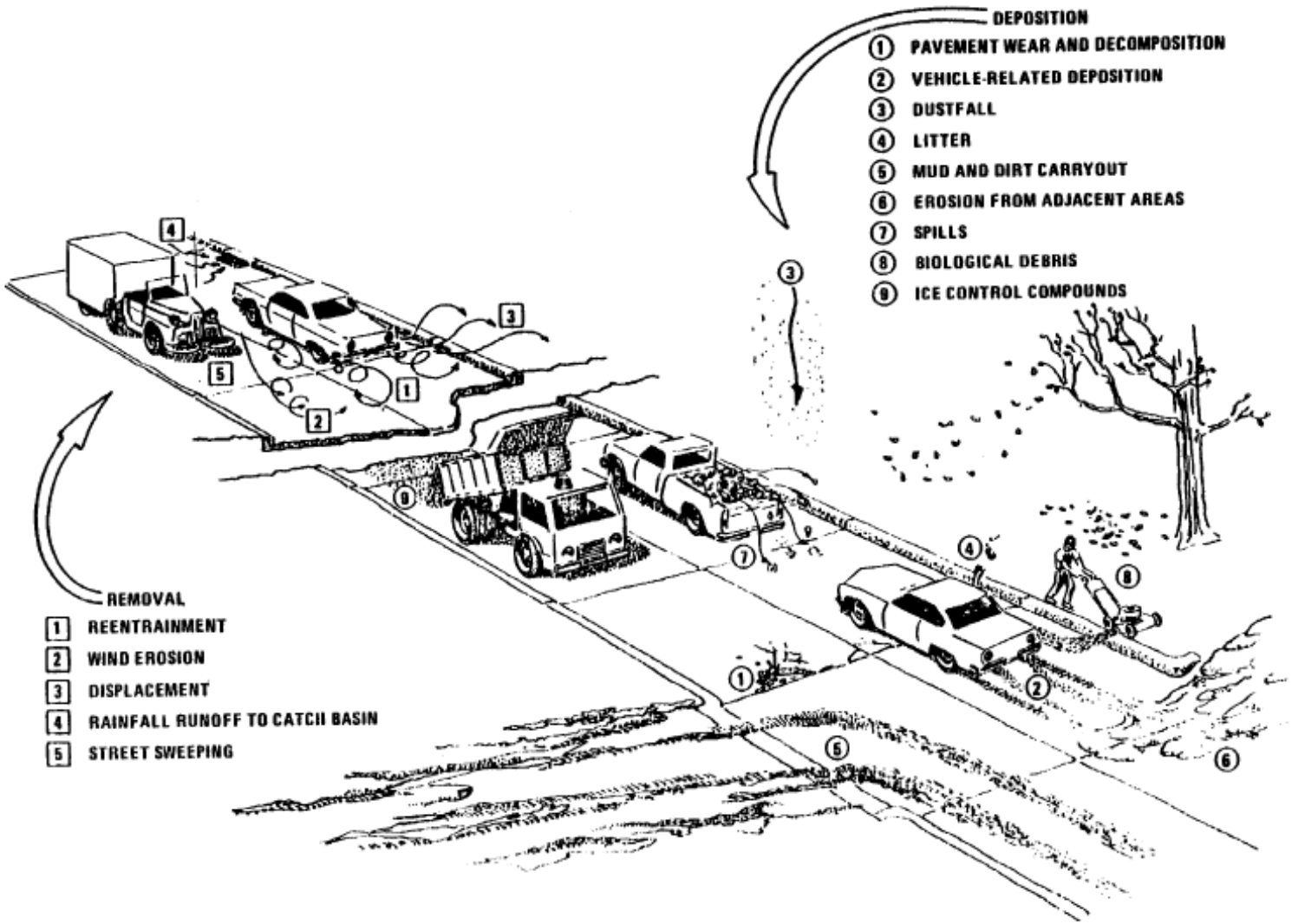


Figure 13.2.1-1. Deposition and removal processes.

13.2.1.3 Predictive Emission Factor Equations[10,29]

The quantity of particulate emissions from resuspension of loose material on the road surface due to vehicle travel on a dry paved road may be estimated using the following empirical expression:

$$E = k\,(sL)^{0.91} \times (W)^{1.02} \qquad (1)$$

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/m^2), and
W = average weight (tons) of the vehicles traveling the road.

It is important to note that Equation 1 calls for the average weight of all vehicles traveling the road. For example, if 99 percent of traffic on the road are 2 ton cars/trucks while the remaining 1 percent consists of 20 ton trucks, then the mean weight "W" is 2.2 tons. More specifically, Equation 1 is *not* intended to be used to calculate a separate emission factor for each vehicle weight class. Instead, only one emission factor should be calculated to represent the "fleet" average weight of all vehicles traveling the road.

The particle size multiplier (k) above varies with aerodynamic size range as shown in Table 13.2.1-1. To determine particulate emissions for a specific particle size range, use the appropriate value of k shown in Table 13.2.1-1.

To obtain the total emissions factor, the emission factors for the exhaust, brake wear and tire wear obtained from either EPA's MOBILE6.2 [27] or MOVES2010 [29] model should be added to the emissions factor calculated from the empirical equation.

Table 13.2.1-1. PARTICLE SIZE MULTIPLIERS FOR PAVED ROAD EQUATION

Size range[a]	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

[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.

Equation 1 is based on a regression analysis of 83 tests for PM-10.[3, 5-6, 8, 27-29, 31-36] Sources tested include public paved roads, as well as controlled and uncontrolled industrial paved roads. The majority of tests involved freely flowing vehicles traveling at constant speed on relatively level roads. However, 22 tests of slow moving or "stop-and-go" traffic or vehicles under load were available for inclusion in the data base.[32-36] Engine exhaust, tire wear and break wear were subtracted from the emissions measured in the test programs prior to stepwise regression to determine Equation 1.[37, 39] The equations retain the quality rating of A (D for PM-2.5), if applied within the range of source conditions that were tested in developing the equation as follows:

Silt loading:	0.03 - 400 g/m^2 0.04 - 570 grains/square foot (ft^2)
Mean vehicle weight:	1.8 - 38 megagrams (Mg) 2.0 - 42 tons
Mean vehicle speed:	1 - 88 kilometers per hour (kph) 1 - 55 miles per hour (mph)

The upper and lower 95% confidence levels of equation 1 for PM_{10} is best described with equations using an exponents of 1.14 and 0.677 for silt loading and an exponents of 1.19 and 0.85 for weight. Users are cautioned that application of equation 1 outside of the range of variables and operating conditions specified above, e.g., application to roadways or road networks with speeds above 55 mph and average vehicle weights of 42 tons, will result in emission estimates with a higher level of uncertainty. In these situations, users are encouraged to consider an assessment of the impacts of the influence of extrapolation to the overall emissions and alternative methods that are equally or more plausible in light of local emissions data and/or ambient concentration or compositional data.

To retain the quality rating for the emission factor equation when it is applied to a specific paved road, it is necessary that reliable correction parameter values for the specific road in question be determined. With the exception of limited access roadways, which are difficult to sample, the collection and use of site-specific silt loading (sL) data for public paved road emission inventories are strongly recommended. The field and laboratory procedures for determining surface material silt content and surface dust loading are summarized in Appendices C.1 and C.2. In the event that site-specific values cannot be obtained, an appropriate value for a paved public road may be selected from the values in Table 13.2.1-2, but the quality rating of the equation should be reduced by 2 levels.

Equation 1 may be extrapolated to average uncontrolled conditions (but including natural mitigation) under the simplifying assumption that annual (or other long-term) average emissions are inversely proportional to the frequency of measurable (> 0.254 mm [0.01 inch]) precipitation by application of a precipitation correction term. The precipitation correction term can be applied on a daily or an hourly basis [26, 38].

For the daily basis, Equation 1 becomes:

$$E_{ext} = [\ k\ (sL)^{0.91} \times (W)^{1.02}\ ]\ (1 - P/4N) \qquad (2)$$

where k, sL, W, and S 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).

Note that the assumption leading to Equation 2 is based on analogy with the approach used to develop long-term average unpaved road emission factors in Section 13.2.2. However, Equation 2 above incorporates an additional factor of "4" in the denominator to account for the fact that paved roads dry more quickly than unpaved roads and that the precipitation may not occur over the complete 24-hour day.

For the hourly basis, equation 1 becomes:

$$E_{ext} = [\ k\ (sL)^{0.91} \times (W)^{1.02}\ ]\ (1 - 1.2P/N) \qquad (3)$$

where k, sL, W, and S 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 hours with at least 0.254 mm (0.01 in) of precipitation during the averaging period, and

N = number of hours in the averaging period (e.g., 8760 for annual, 2124 for season 720 for monthly)

Note: In the hourly moisture correction term (1-1.2P/N) for equation 3, the 1.2 multiplier is applied to account for the residual mitigative effect of moisture. For most applications, this equation will produce satisfactory results. Users should select a time interval to include sufficient "dry" hours such that a reasonable emissions averaging period is evaluated. For the special case where this equation is used to calculate emissions on an hour by hour basis, such as would be done in some emissions modeling situations, the moisture correction term should be modified so that the moisture correction "credit" is applied to the first hours following cessation of precipitation. In this special case, it is suggested that this 20% "credit" be applied on a basis of one hour credit for each hour of precipitation up to a maximum of 12 hours.

Note that the assumption leading to Equation 3 is based on analogy with the approach used to develop long-term average unpaved road emission factors in Section 13.2.2.

Figure 13.2.1-2 presents the geographical distribution of "wet" days on an annual basis for the United States. Maps showing this information on a monthly basis are available in the *Climatic Atlas of the United States*[23] . Alternative sources include other Department of Commerce publications (such as local climatological data summaries). The National Climatic Data Center (NCDC) offers several products that provide hourly precipitation data. In particular, NCDC offers *Solar and Meteorological Surface Observation Network 1961-1990* (SAMSON) CD-ROM, which contains 30 years worth of hourly meteorological data for first-order National Weather Service locations. Whatever meteorological data are used, the source of that data and the averaging period should be clearly specified.

It is emphasized that the simple assumption underlying Equations 2 and 3 has not been verified in any rigorous manner. For that reason, the quality ratings for Equations 2 and 3 should be downgraded one letter from the rating that would be applied to Equation 1.

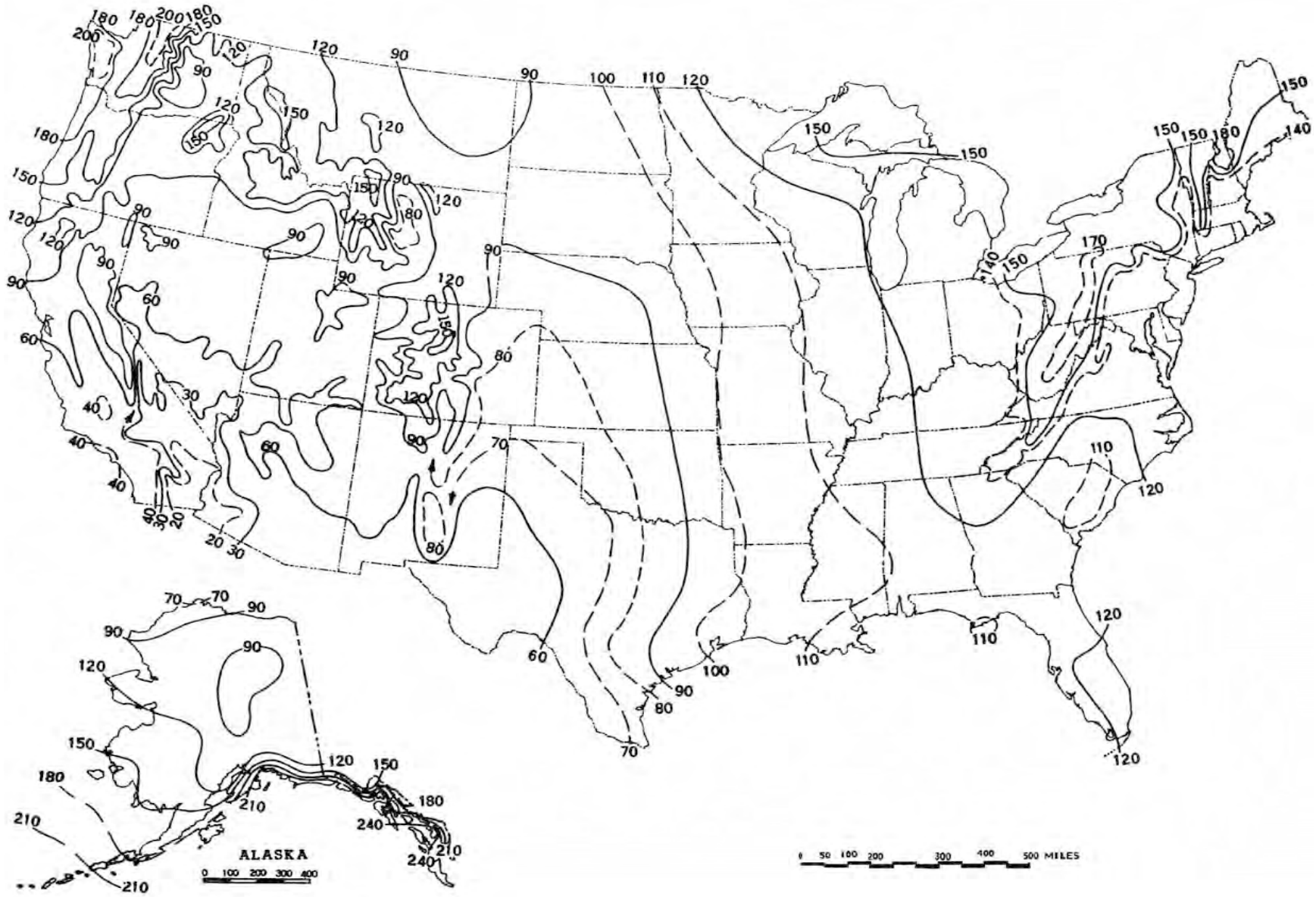


Figure 13.2.1-2. Mean number of days with 0.01 inch or more of precipitation in the United States.

Table 13.2.1-2 presents recommended default silt loadings for normal baseline conditions and for wintertime baseline conditions in areas that experience frozen precipitation with periodic application of antiskid material[24]. The winter baseline is represented as a multiple of the non-winter baseline, depending on the ADT value for the road in question. As shown, a multiplier of 4 is applied for low volume roads (< 500 ADT) to obtain a wintertime baseline silt loading of 4 X 0.6 = 2.4 g/m^2.

Table 13.2.1-2. Ubiquitous Silt Loading Default Values with Hot Spot Contributions from Anti-Skid Abrasives (g/m^2)

ADT Category	< 500	500-5,000	5,000-10,000	> 10,000
Ubiquitous Baseline g/m^2	0.6	0.2	0.06	0.03 0.015 limited access
Ubiquitous Winter Baseline Multiplier during months with frozen precipitation	X4	X3	X2	X1
Initial peak additive contribution from application of antiskid abrasive (g/m^2)	2	2	2	2
Days to return to baseline conditions (assume linear decay)	7	3	1	0.5

It is suggested that an additional (but temporary) silt loading contribution of 2 g/m^2 occurs with each application of antiskid abrasive for snow/ice control. This was determined based on a typical application rate of 500 lb per lane mile and an initial silt content of 1 % silt content. Ordinary rock salt and other chemical deicers add little to the silt loading, because most of the chemical dissolves during the snow/ice melting process.

To adjust the baseline silt loadings for mud/dirt trackout, the number of trackout points is required. It is recommended that in calculating PM_{10} emissions, six additional miles of road be added for each active trackout point from an active construction site, to the paved road mileage of the specified category within the county. In calculating $PM_{2.5}$ emissions, it is recommended that three additional miles of road be added for each trackout point from an active construction site.

It is suggested the number of trackout points for activities other than road and building construction areas be related to land use. For example, in rural farming areas, each mile of paved road would have a specified number of trackout points at intersections with unpaved roads. This value could be estimated from the unpaved road density (mi/sq. mi.).

The use of a default value from Table 13.2.1-2 should be expected to yield only an order-of-magnitude estimate of the emission factor. Public paved road silt loadings are dependent

upon: traffic characteristics (speed, ADT, and fraction of heavy vehicles); road characteristics (curbs, number of lanes, parking lanes); local land use (agriculture, new residential construction) and regional/seasonal factors (snow/ice controls, wind blown dust). As a result, the collection and use of site-specific silt loading data is highly recommended. In the event that default silt loading values are used, the quality ratings for the equation should be downgraded 2 levels.

Limited access roadways pose severe logistical difficulties in terms of surface sampling, and few silt loading data are available for such roads. Nevertheless, the available data do not suggest great variation in silt loading for limited access roadways from one part of the country to another. For annual conditions, a default value of 0.015 g/m^2 is recommended for limited access roadways.[9,22] Even fewer of the available data correspond to worst-case situations, and elevated loadings are observed to be quickly depleted because of high traffic speeds and high ADT rates. A default value of 0.2 g/m^2 is recommended for short periods of time following application of snow/ice controls to limited access roads.[22]

The limited data on silt loading values for industrial roads have shown as much variability as public roads. Because of the variations of traffic conditions and the use of preventive mitigative controls, the data probably do not reflect the full extent of the potential variation in silt loading on industrial roads. However, the collection of site specific silt loading data from industrial roads is easier and safer than for public roads. Therefore, the collection and use of site-specific silt loading data is preferred and is highly recommended. In the event that site-specific values cannot be obtained, an appropriate value for an industrial road may be selected from the mean values given in Table 13.2.1-3, but the quality rating of the equation should be reduced by 2 levels.

The predictive accuracy of Equation 1 requires thorough on-site characterization of road silt loading. Road surface sampling is time-consuming and potentially hazardous because of the need to block traffic lanes. In addition, large number of samples is required to represent spatial and temporal variations across roadway networks. Mobile monitoring is a new alternative silt loading or road dust emission characterization method for either paved or unpaved roads. It utilizes a test vehicle that generates and monitors its own dust plume concentration (mass basis) at a fixed sampling probe location. A calibration factor is needed for each mobile monitoring configuration (test vehicle and sampling system), to convert the relative dust emission intensity to an equivalent silt loading or emission factor. Typically, portable continuous particle concentration monitors do not comply with Federal Reference Method (FRM) standards. Therefore, a controlled study must be performed to correlate the portable monitor response to the road silt loading or size specific particle concentration measured with an approved FRM sampling system. In the calibration tests, multiple test conditions should be performed to provide an average correlation with known precision and to accommodate variations in road silt loading, vehicle speed, road dust characteristics and other road conditions that may influence mobile monitoring measurements or emissions characteristics. Because the paved road dust emissions are also dependent on the average vehicle weight for the road segment, it is important that the weight of the test vehicle correspond closely to the average vehicle weight for the road segment or be adjusted using the average vehicle weight relationship in Equation 1. In summary, it is believed that the Mobile Monitoring Method will provide improved capabilities to provide reliable temporally and spatially resolved silt loading or emissions factors with increased coverage, improved safety, reduced traffic interference and decreased cost.[40, 41, 42]

Table 13.2.1-3 (Metric And English Units). TYPICAL SILT CONTENT AND LOADING VALUES FOR PAVED ROADS AT INDUSTRIAL FACILITIES [a]

Industry	No. of Sites	No. Of Samples	Silt Content (%)		No. of Travel Lanes	Total Loading x 10^{-3}			Silt Loading (g/m^2)	
			Range	Mean		Range	Mean	Units[b]	Range	Mean
Copper smelting	1	3	15.4-21.7	19.0	2	12.9 - 19.5 45.8 - 69.2	15.9 55.4	kg/km lb/mi	188-400	292
Iron and steel production	9	48	1.1-35.7	12.5	2	0.006 - 4.77 0.020 -16.9	0.495 1.75	kg/km lb/mi	0.09-79	9.7
Asphalt batching	1	3	2.6 - 4.6	3.3	1	12.1 - 18.0 43.0 - 64.0	14.9 52.8	kg/km lb/mi	76-193	120
Concrete batching	1	3	5.2 - 6.0	5.5	2	1.4 - 1.8 5.0 - 6.4	1.7 5.9	kg/km lb/mi	11-12	12
Sand and gravel processing	1	3	6.4 - 7.9	7.1	1	2.8 - 5.5 9.9 - 19.4	3.8 13.3	kg/km lb/mi	53-95	70
Municipal solid waste landfill	2	7		-	2	-			1.1-32.0	7.4
Quarry	1	6		-	2	-			2.4-14	8.2
Corn wet mills	3	15		-	2	-			0.05 – 2.9	1.1

[a] References 1-2,5-6,11-13. Values represent samples collected from *industrial* roads. Public road silt loading values are presented in Table-13.2.1-2. Dashes indicate information not available.[b] Multiply entries by 1000 to obtain stated units; kilograms per kilometer (kg/km) and pounds per mile (lb/mi).

13.2.1.4 Controls[6,25]

Because of the importance of the silt loading, control techniques for paved roads attempt either to prevent material from being deposited onto the surface (preventive controls) or to remove from the travel lanes any material that has been deposited (mitigative controls). Covering of loads in trucks, and the paving of access areas to unpaved lots or construction sites, are examples of preventive measures. Examples of mitigative controls include vacuum sweeping, water flushing, and broom sweeping and flushing. Actual control efficiencies for any - of these techniques can be highly variable. Locally measured silt loadings before and after the application of controls is the preferred method to evaluate controls. It is particularly important to note that street sweeping of gutters and curb areas may actually increase the silt loading on the traveled portion of the road. Redistribution of loose material onto the travel lanes will actually produce a short-term increase in the emissions.

In general, preventive controls are usually more cost effective than mitigative controls. The cost-effectiveness of mitigative controls falls off dramatically as the size of an area to be treated increases. The cost-effectiveness of mitigative measures is also unfavorable if only a short period of time is required for the road to return to equilibrium silt loading condition. That is to say, the number and length of public roads within most areas of interest preclude any widespread and routine use of mitigative controls. On the other hand, because of the more limited scope of roads at an industrial site, mitigative measures may be used quite successfully (especially in situations where truck spillage occurs). Note, however, that public agencies could make effective use of mitigative controls to remove sand/salt from roads after the winter ends.

Because available controls will affect the silt loading, controlled emission factors may be obtained by substituting controlled silt loading values into the equation. (Emission factors from controlled industrial roads were used in the development of the equation.) The collection of surface loading samples from treated, as well as baseline (untreated), roads provides a means to track effectiveness of the controls over time. The use of Mobile Monitoring Methodologies provide an improved means to track progress in controlling silt loading values.

13.2.1.5 Changes since Fifth Edition

The following changes were made since the publication of the Fifth Edition of AP-42:

October 2002

1) The particle size multiplier for $PM_{2.5}$ was revised to 25% of PM_{10}. The approximately 55% reduction was a result of emission testing using FRM monitors. The monitoring was specifically intended to evaluate the PM-2.5 component of the emissions.

2) Default silt loading values were included in Table 13.2.1-2 replacing the Tables and Figures containing silt loading statistical information.

3) Editorial changes within the text were made indicating the possible causes of variations in the silt loading between roads within and among different locations. The uncertainty of using the default silt loading value was discussed.

4) Section 13.2.1.1 was revised to clarify the role of dust loading in resuspension. Additional minor text changes were made.

5) Equations 2 and 3, Figure 13.2.1-2, and text were added to incorporate natural mitigation into annual or other long-term average emission factors.

December 2003

1) The emission factor equation was adjusted to remove the component of particulate emissions- from exhaust, brake wear, and tire wear. A parameter C representing these emissions was included in the predictive equation. The parameter C varied with aerodynamic size range of the particulate matter. Table 13.2.1-2 was added to present the new coefficients.

2) The default silt loading values in Table 13.2.1-3 were revised to incorporate the results from a recent analysis of silt loading data.

November 2006

1) The $PM_{2.5}$ particle size multiplier was revised to 15% of PM_{10} as the result of wind tunnel studies of a variety of dust emitting surface materials.

2) References were rearranged and renumbered.

January 2011

1) The empirical predictive equation was revised. The revision is based upon stepwise regression of 83 profile emissions tests and an adjustment of individual test data for the exhaust; break wear and tire wear emissions prior to regression of the data.

2) The C term is removed from the empirical predictive equation and Table 13.2.1-2 with the C term values is removed since the exhaust; break wear and tire wear emissions were no longer part of the regressed data.

3) The $PM_{2.5}$ particle size multiplier was revised to 25% of PM_{10} since the PM_{10} test data used to develop the equation did not meet the necessary PM_{10} concentrations for a ratio of 15%.

4) The lower speed of the vehicle speed range supported by the empirical predictive equation was revised to 1 mph.

5) Information was added on an improved methodology to develop spatially and temporally resolved silt loadings or emissions factors by Mobile Monitoring Methodologies.

References For Section 13.2.1

1. D. R. Dunbar, *Resuspension Of Particulate Matter*, EPA-450/2-76-031, U. S. Environmental Protection Agency, Research Triangle Park, NC, March 1976.

2. R. Bohn, *et al.*, *Fugitive Emissions From Integrated Iron And Steel Plants*, EPA-600/2-78-050, U. S. Environmental Protection Agency, Cincinnati, OH, March 1978.

3. C. Cowherd, Jr., *et al.*, *Iron And Steel Plant Open Dust Source Fugitive Emission Evaluation*, EPA-600/2-79-103, U. S. Environmental Protection Agency, Cincinnati, OH, May 1979.

4. C. Cowherd, Jr., *et al.*, *Quantification Of Dust Entrainment From Paved Roadways*, EPA-450/3-77-027, U. S. Environmental Protection Agency, Research Triangle Park, NC, July 1977.

5. *Size Specific Particulate Emission Factors For Uncontrolled Industrial And Rural Roads*, EPA Contract No. 68-02-3158, Midwest Research Institute, Kansas City, MO, September 1983.

6. T. Cuscino, Jr., *et al.*, *Iron And Steel Plant Open Source Fugitive Emission Control Evaluation*, EPA-600/2-83-110, U. S. Environmental Protection Agency, Cincinnati, OH, October 1983.

7. J. P. Reider, *Size-specific Particulate Emission Factors For Uncontrolled Industrial And Rural Roads*, EPA Contract 68-02-3158, Midwest Research Institute, Kansas City, MO, September 1983.

8. C. Cowherd, Jr., and P. J. Englehart, *Paved Road Particulate Emissions*, EPA-600/7-84-077, U. S. Environmental Protection Agency, Cincinnati, OH, July 1984.

9. C. Cowherd, Jr., and P. J. Englehart, *Size Specific Particulate Emission Factors For Industrial And Rural Roads*, EPA-600/7-85-051, U. S. Environmental Protection Agency, Cincinnati, OH, October 1985.

10. *Emission Factor Documentation For AP-42, Sections 11.2.5 and 11.2.6 — Paved Roads*, EPA Contract No. 68-D0-0123, Midwest Research Institute, Kansas City, MO, March 1993.

11. *Evaluation Of Open Dust Sources In The Vicinity Of Buffalo, New York*, EPA Contract No. 68-02-2545, Midwest Research Institute, Kansas City, MO, March 1979.

12. *PM-10 Emission Inventory Of Landfills In The Lake Calumet Area*, EPA Contract No. 68-02-3891, Midwest Research Institute, Kansas City, MO, September 1987.

13. *Chicago Area Particulate Matter Emission Inventory — Sampling And Analysis*, Contract No. 68-02-4395, Midwest Research Institute, Kansas City, MO, May 1988.

14. *Montana Street Sampling Data*, Montana Department Of Health And Environmental Sciences, Helena, MT, July 1992.

15. *Street Sanding Emissions And Control Study*, PEI Associates, Inc., Cincinnati, OH, October 1989.

16. *Evaluation Of PM-10 Emission Factors For Paved Streets*, Harding Lawson Associates, Denver, CO, October 1991.

17. *Street Sanding Emissions And Control Study*, RTP Environmental Associates, Inc., Denver, CO, July 1990.

18. *Post-storm Measurement Results — Salt Lake County Road Dust Silt Loading Winter 1991/92 Measurement Program,* Aerovironment, Inc., Monrovia, CA, June 1992.

19. Written communication from Harold Glasser, Department of Health, Clark County (NV).

20. *PM-10 Emissions Inventory Data For The Maricopa And Pima Planning Areas,* EPA Contract No. 68-02-3888, Engineering-Science, Pasadena, CA, January 1987.

21. *Characterization Of PM-10 Emissions From Antiskid Materials Applied To Ice- And Snow-Covered Roadways,* EPA Contract No. 68-D0-0137, Midwest Research Institute, Kansas City, MO, October 1992.

22. C. Cowherd, *Background Document for Revisions to Fine Fraction Ratios Used for AP-42 Fugitive Dust Emission Factors.* Prepared by Midwest Research Institute for Western Governors Association, Western Regional Air Partnership, Denver, CO, February 1, 2006.

23. *Climatic Atlas Of The United States, U.S.* Department of Commerce, Washington, D.C., June 1968.

24. C. Cowherd, Jr., *et al., Improved Activity Levels for National Emission Inventories of Fugitive Dust from Paved and Unpaved Roads,* Presented at the 11th International Emission Inventory Conference, Atlanta, Georgia, April 2002.

25. C. Cowherd, Jr., *et al., Control Of Open Fugitive Dust Sources,* EPA-450/3-88-008, U. S. Environmental Protection Agency, Research Triangle Park, NC, September 1988.

26. Written communication (Technical Memorandum) from G. Muleski, Midwest Research Institute, Kansas City, MO, to B. Kuykendal, U. S. Environmental Protection Agency, Research Triangle Park, NC, September 27, 2001.

27. EPA, 2002b. MOBILE6 User Guide, United States Environmental Protection Agency, Office of Transportation and Air Quality. EPA420-R-02-028, October 2002.

28. Written communication (Technical Memorandum) from P. Hemmer, E.H. Pechan & Associates, Inc., Durham, NC to B. Kuykendal, U. S. Environmental Protection Agency, Research Triangle Park, NC, August, 21, 2003.

29. EPA, 2009, MOVES2010 User Guide, United States Environmental Protection Agency, Office of Transportation and Air Quality. EPA420B-09-041, December 2009.

30. *Fugitive Particulate Matter Emissions,* U.S. Environmental Protection Agency, Research Triangle Park, NC, Midwest Research Institute Project No. 4604-06, April 15, 1997.

31. Midwest Research Institute, *Roadway Emissions Field Tests at U.S. Steel's Fairless Works,* U.S. Steel Corporation, Fairless Hills, PA, USX Purchase Order No. 146-0001191-0068, May 1990.

32. *Paved Road Modifications to AP-42, Background Documentation For Corn Refiners Association, Inc. Washington, DC 20006*, Midwest Research Institute Project No. 310842, May 20, 2008.

33. *Emission Tests of Paved Road Traffic at Minnesota Corn Processors Marshall, Minnesota Facility*, McVehil-Monnett Associates, Midwest Research Institute Project No. 310212.1.001, July 6, 2001.

34. *Emission Tests of Paved Road Traffic at Minnesota Corn Processors Columbus, Nebraska Facility*, McVehil-Monnett Associates, Midwest Research Institute Project No. 310212.1.002. July 13, 2001.

35. *Emission Tests of Paved Road Traffic at Cargill Sweeteners North America Blair, Nebraska Facility*, McVehil-Monnett Associates, Midwest Research Institute Project No. 310395.1.001. November 27, 2002.

36. *Emission Tests of Paved Road Traffic at ADM's Marshall, Minnesota Facility*, McVehil-Monnett Associates, Midwest Research Institute Project No. 310479.1.001. December 5, 2003.

37. E-mail communication between Ron Myers of EPA/OAQPS/SPPD/MPG, RTP, NC and Prashanth Gururaja and Ed Glover of EPA/OTAQ/ASD/HDOC re. *Diesel exhaust, tire and brake wear for low speed stop and go traffic*; January 2009 through May 2009.

38. Technical Memorandum from William B. Kuykendal to File, Subject: *Decisions on Final AP-42 Section 13.2.1 "Paved Roads"*, October 10, 2002.

39. E-mail communication between Ron Myers of EPA/OAQPS/SPPD/MPG, RTP, NC and Gary Dolce and Rudolph Kapichak of EPA/OTAQ/ASD/HDOC re. *Paved Road Test Data*; October 12, 2010 through December 16, 2010.

40. C. Cowherd, *Mobile Monitoring Method Specifications*, Prepared by Midwest Research Institute for Clark County Department of Air Quality and Environmental Management, Las Vegas, NV, February 6, 2009.

41. C. Cowherd, *Technical Support Document for Mobile Monitoring Technologies*, Prepared by Midwest Research Institute for Clark County Department of Air Quality and Environmental Management, Las Vegas, NV, January 9, 2009.

42. R. Langston, R. S. Merle Jr., *et al.,Clark County (Nevada) Paved Road Dust Emission Studies in Support of Mobile Monitoring Technologies*, Clark County Department of Air Quality and Environmental Management, Las Vegas, NV, December 22, 2008.

43. Midwest Research Institute; Analysis of the Fine Fraction of Particulate Matter in Fugitive Dust; Western Governors' Association - Western Regional Air Partnership (WRAP); October 12, 2005.

13.2.2 Unpaved Roads

13.2.2.1 General

When a vehicle travels an unpaved road, the force of the wheels on the road surface causes pulverization of surface material. Particles are lifted and dropped from the rolling wheels, and the road surface is exposed to strong air currents in turbulent shear with the surface. The turbulent wake behind the vehicle continues to act on the road surface after the vehicle has passed.

The particulate emission factors presented in the previous draft version of this section of AP-42, dated October 2001, implicitly included the emissions from vehicles in the form of exhaust, brake wear, and tire wear as well as resuspended road surface material[25]. EPA included these sources in the emission factor equation for unpaved public roads (equation 1b in this section) since the field testing data used to develop the equation included both the direct emissions from vehicles and emissions from resuspension of road dust.

This version of the unpaved public road emission factor equation only estimates particulate emissions from resuspended road surface material [23, 26]. The particulate emissions from vehicle exhaust, brake wear, and tire wear are now estimated separately using EPA's MOBILE6.2 [24]. This approach eliminates the possibility of double counting emissions. Double counting results when employing the previous version of the emission factor equation in this section and MOBILE6.2 to estimate particulate emissions from vehicle traffic on unpaved public roads. It also incorporates the decrease in exhaust emissions that has occurred since the unpaved public road emission factor equation was developed. The previous version of the unpaved public road emission factor equation includes estimates of emissions from exhaust, brake wear, and tire wear based on emission rates for vehicles in the 1980 calendar year fleet. The amount of PM released from vehicle exhaust has decreased since 1980 due to lower new vehicle emission standards and changes in fuel characteristics.

13.2.2.2 Emissions Calculation And Correction Parameters[1-6]

The quantity of dust emissions from a given segment of unpaved road varies linearly with the volume of traffic. Field investigations also have shown that emissions depend on source parameters that characterize the condition of a particular road and the associated vehicle traffic. Characterization of these source parameters allow for "correction" of emission estimates to specific road and traffic conditions present on public and industrial roadways.

Dust emissions from unpaved roads have been found to vary directly with the fraction of silt (particles smaller than 75 micrometers [μm] in diameter) in the road surface materials.[1] The silt fraction is determined by measuring the proportion of loose dry surface dust that passes a 200-mesh screen, using the ASTM-C-136 method. A summary of this method is contained in Appendix C of AP-42. Table 13.2.2-1 summarizes measured silt values for industrial unpaved roads. Table 13.2.2-2 summarizes measured silt values for public unpaved roads. It should be noted that the ranges of silt content vary over two orders of magnitude. Therefore, the use of data from this table can potentially introduce considerable error. Use of this data is strongly discouraged when it is feasible to obtain locally gathered data.

Since the silt content of a rural dirt road will vary with geographic location, it should be measured for use in projecting emissions. As a conservative approximation, the silt content of the parent soil in the area can be used. Tests, however, show that road silt content is normally lower than in the surrounding parent soil, because the fines are continually removed by the vehicle traffic, leaving a higher percentage of coarse particles.

Other variables are important in addition to the silt content of the road surface material. For example, at industrial sites, where haul trucks and other heavy equipment are common, emissions are highly correlated with vehicle weight. On the other hand, there is far less variability in the weights of cars and pickup trucks that commonly travel publicly accessible unpaved roads throughout the United States. For those roads, the moisture content of the road surface material may be more dominant in determining differences in emission levels between, for example a hot, desert environment and a cool, moist location.

The PM-10 and TSP emission factors presented below are the outcomes from stepwise linear regressions of field emission test results of vehicles traveling over unpaved surfaces. Due to a limited amount of information available for PM-2.5, the expression for that particle size range has been scaled against the result for PM-10. Consequently, the quality rating for the PM-2.5 factor is lower than that for the PM-10 expression.

Table 13.2.2-1. TYPICAL SILT CONTENT VALUES OF SURFACE MATERIAL ON INDUSTRIAL UNPAVED ROADS[a]

Industry	Road Use Or Surface Material	Plant Sites	No. Of Samples	Silt Content (%)	
				Range	Mean
Copper smelting	Plant road	1	3	16 - 19	17
Iron and steel production	Plant road	19	135	0.2 - 19	6.0
Sand and gravel processing	Plant road	1	3	4.1 - 6.0	4.8
	Material storage area	1	1	-	7.1
Stone quarrying and processing	Plant road	2	10	2.4 - 16	10
	Haul road to/from pit	4	20	5.0-15	8.3
Taconite mining and processing	Service road	1	8	2.4 - 7.1	4.3
	Haul road to/from pit	1	12	3.9 - 9.7	5.8
Western surface coal mining	Haul road to/from pit	3	21	2.8 - 18	8.4
	Plant road	2	2	4.9 - 5.3	5.1
	Scraper route	3	10	7.2 - 25	17
	Haul road (freshly graded)	2	5	18 - 29	24
Construction sites	Scraper routes	7	20	0.56-23	8.5
Lumber sawmills	Log yards	2	2	4.8-12	8.4
Municipal solid waste landfills	Disposal routes	4	20	2.2 - 21	6.4

[a]References 1,5-15.

The following empirical expressions may be used to estimate the quantity in pounds (lb) of size-specific particulate emissions from an unpaved road, per vehicle mile traveled (VMT):

For vehicles traveling on unpaved surfaces at industrial sites, emissions are estimated from the following equation:

$$E = k\,(s/12)^a (W/3)^b \tag{1a}$$

and, for vehicles traveling on publicly accessible roads, dominated by light duty vehicles, emissions may be estimated from the following:

$$E = \frac{k\,(s/12)^a (S/30)^d}{(M/0.5)^c} - C \tag{1b}$$

where k, a, b, c and d are empirical constants (Reference 6) given below and

E = size-specific emission factor (lb/VMT)
s = surface material silt content (%)
W = mean vehicle weight (tons)
M = surface material moisture content (%)
S = mean vehicle speed (mph)
C = emission factor for 1980's vehicle fleet exhaust, brake wear and tire wear.

The source characteristics s, W and M are referred to as correction parameters for adjusting the emission estimates to local conditions. The metric conversion from lb/VMT to grams (g) per vehicle kilometer traveled (VKT) is as follows:

1 lb/VMT = 281.9 g/VKT

The constants for Equations 1a and 1b based on the stated aerodynamic particle sizes are shown in Tables 13.2.2-2 and 13.2.2-4. The PM-2.5 particle size multipliers (k-factors) are taken from Reference 27.

Table 13.2.2-2. CONSTANTS FOR EQUATIONS 1a AND 1b

Constant	Industrial Roads (Equation 1a)			Public Roads (Equation 1b)		
	PM-2.5	PM-10	PM-30*	PM-2.5	PM-10	PM-30*
k (lb/VMT)	0.15	1.5	4.9	0.18	1.8	6.0
a	0.9	0.9	0.7	1	1	1
b	0.45	0.45	0.45	-	-	-
c	-	-	-	0.2	0.2	0.3
d	-	-	-	0.5	0.5	0.3
Quality Rating	B	B	B	B	B	B

*Assumed equivalent to total suspended particulate matter (TSP)
"-" = not used in the emission factor equation

Table 13.2.2-2 also contains the quality ratings for the various size-specific versions of Equation 1a and 1b. The equation retains the assigned quality rating, if applied within the ranges of source conditions, shown in Table 13.2.2-3, that were tested in developing the equation:

Table 13.2.2-3. RANGE OF SOURCE CONDITIONS USED IN DEVELOPING EQUATION 1a AND 1b

Emission Factor	Surface Silt Content, %	Mean Vehicle Weight		Mean Vehicle Speed		Mean No. of Wheels	Surface Moisture Content, %
		Mg	ton	km/hr	mph		
Industrial Roads (Equation 1a)	1.8-25.2	1.8-260	2-290	8-69	5-43	4-17[a]	0.03-13
Public Roads (Equation 1b)	1.8-35	1.4-2.7	1.5-3	16-88	10-55	4-4.8	0.03-13

[a] See discussion in text.

As noted earlier, the models presented as Equations 1a and 1b were developed from tests of traffic on unpaved surfaces. Unpaved roads have a hard, generally nonporous surface that usually dries quickly after a rainfall or watering, because of traffic-enhanced natural evaporation. (Factors influencing how fast a road dries are discussed in Section 13.2.2.3, below.) The quality ratings given above pertain to the mid-range of the measured source conditions for the equation. A higher mean vehicle weight and a higher than normal traffic rate may be justified when performing a worst-case analysis of emissions from unpaved roads.

The emission factors for the exhaust, brake wear and tire wear of a 1980's vehicle fleet (*C*) was obtained from EPA's MOBILE6.2 model [23]. The emission factor also varies with aerodynamic size range

as shown in Table 13.2.2-4

Table 13.2.2-4. EMISSION FACTOR FOR 1980'S VEHICLE FLEET EXHAUST, BRAKE WEAR AND TIRE WEAR

Particle Size Range[a]	*C*, Emission Factor for Exhaust, Brake Wear and Tire Wear[b] lb/VMT
$PM_{2.5}$	0.00036
PM_{10}	0.00047
PM_{30}[c]	0.00047

[a] Refers to airborne particulate matter (PM-x) with an aerodynamic diameter equal to or less than x micrometers.
[b] Units shown are pounds per vehicle mile traveled (lb/VMT).
[c] PM-30 is sometimes termed "suspendable particulate" (SP) and is often used as a surrogate for TSP.

It is important to note that the vehicle-related source conditions refer to the average weight, speed, and number of wheels for all vehicles traveling the road. For example, if 98 percent of traffic on the road are 2-ton cars and trucks while the remaining 2 percent consists of 20-ton trucks, then the mean weight is 2.4 tons. More specifically, Equations 1a and 1b are *not* intended to be used to calculate a separate emission factor for each vehicle class within a mix of traffic on a given unpaved road. That is, in the example, one should *not* determine one factor for the 2-ton vehicles and a second factor for the 20-ton trucks. Instead, only one emission factor should be calculated that represents the "fleet" average of 2.4 tons for all vehicles traveling the road.

Moreover, to retain the quality ratings when addressing a group of unpaved roads, it is necessary that reliable correction parameter values be determined for the road in question. The field and laboratory procedures for determining road surface silt and moisture contents are given in AP-42 Appendices C.1 and C.2. Vehicle-related parameters should be developed by recording visual observations of traffic. In some cases, vehicle parameters for industrial unpaved roads can be determined by reviewing maintenance records or other information sources at the facility.

In the event that site-specific values for correction parameters cannot be obtained, then default values may be used.In the absence of site-specific silt content information, an appropriate mean value from Table 13.2.2-1 may be used as a default value, but the quality rating of the equation is reduced by two letters. Because of significant differences found between different types of road surfaces and between different areas of the country, use of the default moisture content value of 0.5 percent in Equation 1b is discouraged. The quality rating should be downgraded two letters when the default moisture content value is used. (It is assumed that readers addressing industrial roads have access to the information needed to develop average vehicle information in Equation 1a for their facility.)

The effect of routine watering to control emissions from unpaved roads is discussed below in Section 13.2.2.3, “Controls”. However, all roads are subject to some natural mitigation because of rainfall and other precipitation. The Equation 1a and 1b emission factors can be extrapolated to annual

average uncontrolled conditions (but including natural mitigation) under the simplifying assumption that annual average emissions are inversely proportional to the number of days with measurable (more than 0.254 mm [0.01 inch]) precipitation:

$$E_{ext} = E\ [(365 - P)/365] \qquad (2)$$

where:

E_{ext} = annual size-specific emission factor extrapolated for natural mitigation, lb/VMT

E = emission factor from Equation 1a or 1b

P = number of days in a year with at least 0.254 mm (0.01 in) of precipitation (see below)

Figure 13.2.2-1 gives the geographical distribution for the mean annual number of "wet" days for the United States.

Equation 2 provides an estimate that accounts for precipitation on an annual average basis for the purpose of inventorying emissions. It should be noted that Equation 2 does not account for differences in the temporal distributions of the rain events, the quantity of rain during any event, or the potential for the rain to evaporate from the road surface. In the event that a finer temporal and spatial resolution is desired for inventories of public unpaved roads, estimates can be based on a more complex set of assumptions. These assumptions include:

1. The moisture content of the road surface material is increased in proportion to the quantity of water added;
2. The moisture content of the road surface material is reduced in proportion to the Class A pan evaporation rate;
3. The moisture content of the road surface material is reduced in proportion to the traffic volume; and
4. The moisture content of the road surface material varies between the extremes observed in the area. The CHIEF Web site (http://www.epa.gov/ttn/chief/ap42/ch13/related/c13s02-2.html) has a file which contains a spreadsheet program for calculating emission factors which are temporally and spatially resolved. Information required for use of the spreadsheet program includes monthly Class A pan evaporation values, hourly meteorological data for precipitation, humidity and snow cover, vehicle traffic information, and road surface material information.

It is emphasized that <u>the simple assumption underlying Equation 2 and the more complex set of assumptions underlying the use of the procedure which produces a finer temporal and spatial resolution</u> have not been verified in any rigorous manner. For this reason, the quality ratings for either approach should be downgraded one letter from the rating that would be applied to Equation 1.

13.2.2.3 Controls[18-22]

A wide variety of options exist to control emissions from unpaved roads. Options fall into the following three groupings:

1. <u>Vehicle restrictions</u> that limit the speed, weight or number of vehicles on the road;

2. Surface improvement, by measures such as (a) paving or (b) adding gravel or slag to a dirt road; and

3. Surface treatment, such as watering or treatment with chemical dust suppressants.

Available control options span broad ranges in terms of cost, efficiency, and applicability. For example, traffic controls provide moderate emission reductions (often at little cost) but are difficult to enforce. Although paving is highly effective, its high initial cost is often prohibitive. Furthermore, paving is not feasible for industrial roads subject to very heavy vehicles and/or spillage of material in transport. Watering and chemical suppressants, on the other hand, are potentially applicable to most industrial roads at moderate to low costs. However, these require frequent reapplication to maintain an acceptable level of control. Chemical suppressants are generally more cost-effective than water but not in cases of temporary roads (which are common at mines, landfills, and construction sites). In summary, then, one needs to consider not only the type and volume of traffic on the road but also how long the road will be in service when developing control plans.

Vehicle restrictions. These measures seek to limit the amount and type of traffic present on the road or to lower the mean vehicle speed. For example, many industrial plants have restricted employees from driving on plant property and have instead instituted bussing programs. This eliminates emissions due to employees traveling to/from their worksites. Although the heavier average vehicle weight of the busses increases the base emission factor, the decrease in vehicle-miles-traveled results in a lower overall emission rate.

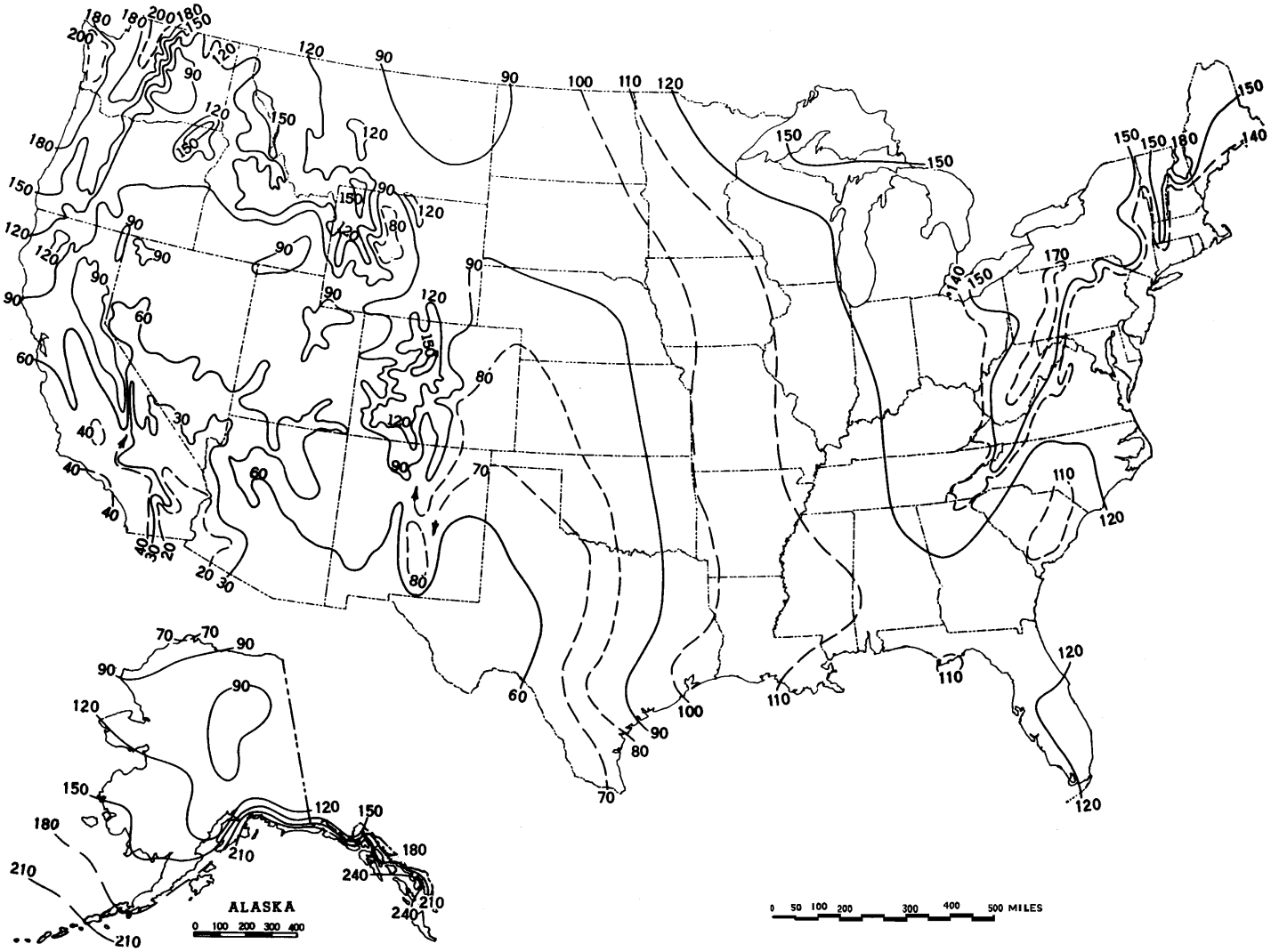


Figure 13.2.2-1. Mean number of days with 0.01 inch or more of precipitation in United States.

Surface improvements. Control options in this category alter the road surface. As opposed to the "surface treatments" discussed below, improvements are relatively "permanent" and do not require periodic retreatment.

The most obvious surface improvement is paving an unpaved road. This option is quite expensive and is probably most applicable to relatively short stretches of unpaved road with at least several hundred vehicle passes per day. Furthermore, if the newly paved road is located near unpaved areas or is used to transport material, it is essential that the control plan address routine cleaning of the newly paved road surface.

The control efficiencies achievable by paving can be estimated by comparing emission factors for unpaved and paved road conditions. The predictive emission factor equation for paved roads, given in Section 13.2.1, requires estimation of the silt loading on the traveled portion of the paved surface, which in turn depends on whether the pavement is periodically cleaned. Unless curbing is to be installed, the effects of vehicle excursion onto unpaved shoulders (berms) also must be taken into account in estimating the control efficiency of paving.

Other improvement methods cover the road surface with another material that has a lower silt content. Examples include placing gravel or slag on a dirt road. Control efficiency can be estimated by comparing the emission factors obtained using the silt contents before and after improvement. The silt content of the road surface should be determined after 3 to 6 months rather than immediately following placement. Control plans should address regular maintenance practices, such as grading, to retain larger aggregate on the traveled portion of the road.

Surface treatments refer to control options which require periodic reapplication. Treatments fall into the two main categories of (a) "wet suppression" (i. e., watering, possibly with surfactants or other additives), which keeps the road surface wet to control emissions and (b) "chemical stabilization/ treatment", which attempts to change the physical characteristics of the surface. The necessary reapplication frequency varies from several minutes for plain water under summertime conditions to several weeks or months for chemical dust suppressants.

Watering increases the moisture content, which conglomerates particles and reduces their likelihood to become suspended when vehicles pass over the surface. The control efficiency depends on how fast the road dries after water is added. This in turn depends on (a) the amount (per unit road surface area) of water added during each application; (b) the period of time between applications; (c) the weight, speed and number of vehicles traveling over the watered road during the period between applications; and (d) meteorological conditions (temperature, wind speed, cloud cover, etc.) that affect evaporation during the period.

Figure 13.2.2-2 presents a simple bilinear relationship between the instantaneous control efficiency due to watering and the resulting increase in surface moisture. The moisture ratio "M" (i.e., the x-axis in Figure 13.2.2-2) is found by dividing the surface moisture content of the watered road by the surface moisture content of the uncontrolled road. As the watered road surface dries, both the ratio M and the predicted instantaneous control efficiency (i.e., the y-axis in the figure) decrease. The figure shows that between the uncontrolled moisture content and a value twice as large, a small increase in moisture content results in a large increase in control efficiency. Beyond that, control efficiency grows slowly with increased moisture content.

Given the complicated nature of how the road dries, characterization of emissions from watered roadways is best done by collecting road surface material samples at various times between water truck passes. (Appendices C.1 and C.2 present the sampling and analysis procedures.) The moisture content measured can then be associated with a control efficiency by use of Figure 13.2.2-2. Samples that reflect average conditions during the watering cycle can take the form of either a series of samples between water applications or a single sample at the midpoint. It is essential that samples be collected during periods with active traffic on the road. Finally, because of different evaporation rates, it is recommended that samples be collected at various times during the year. If only one set of samples is to be collected, these must be collected during hot, summertime conditions.

When developing watering control plans for roads that do not yet exist, it is strongly recommended that the moisture cycle be established by sampling similar roads in the same geographic area. If the moisture cycle cannot be established by similar roads using established watering control plans, the more complex methodology used to estimate the mitigation of rainfall and other precipitation can be used to estimate the control provided by routine watering. An estimate of the maximum daytime Class A pan evaporation (based upon daily evaporation data published in the monthly Climatological Data for the state by the National Climatic Data Center) should be used to insure that adequate watering capability is available during periods of highest evaporation. The hourly precipitation values in the spreadsheet should be replaced with the equivalent inches of precipitation (where the equivalent of 1 inch of precipitation is provided by an application of 5.6 gallons of water per square yard of road). Information on the long term average annual evaporation and on the percentage that occurs between May and October was published in the Climatic Atlas (Reference 16). Figure 13.2.2-3 presents the geographical distribution for "Class A pan evaporation" throughout the United States. Figure 13.2.2-4 presents the geographical distribution of the percentage of this evaporation that occurs between May and October. The U. S. Weather Bureau Class A evaporation pan is a cylindrical metal container with a depth of 10 inches and a diameter of 48 inches. Periodic measurements are made of the changes of the water level.

The above methodology should be used <u>only for prospective analyses</u> and for designing watering programs for existing roadways. The quality rating of an emission factor for a watered road that is based on this methodology should be downgraded two letters. Periodic road surface samples should be collected and analyzed to verify the efficiency of the watering program.

As opposed to watering, chemical dust suppressants have much less frequent reapplication requirements. These materials suppress emissions by changing the physical characteristics of the existing road surface material. Many chemical unpaved road dust suppressants form a hardened surface that binds particles together. After several applications, a treated road often resembles a paved road except that the surface is not uniformly flat. Because the improved surface results in more grinding of small particles, the silt content of loose material on a highly controlled surface may be substantially higher than when the surface was uncontrolled. For this reason, the models presented as Equations 1a and 1b cannot be used to estimate emissions from chemically stabilized roads. Should the road be allowed to return to an

uncontrolled state with no visible signs of large-scale cementing of material, the Equation 1a and 1b emission factors could then be used to obtain conservatively high emission estimates.

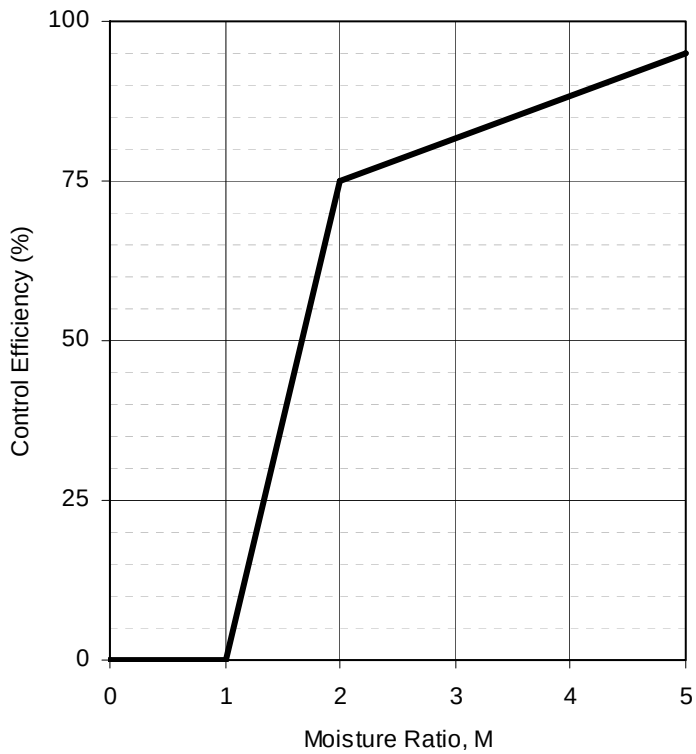


Figure 13.2.2-2. Watering control effectiveness for unpaved travel surfaces

The control effectiveness of chemical dust suppressants appears to depend on (a) the dilution rate used in the mixture; (b) the application rate (volume of solution per unit road surface area); (c) the time between applications; (d) the size, speed and amount of traffic during the period between applications; and (e) meteorological conditions (rainfall, freeze/thaw cycles, etc.) during the period. Other factors that affect the performance of dust suppressants include other traffic characteristics (e. g., cornering, track-on from unpaved areas) and road characteristics (e. g., bearing strength, grade). The variabilities in the above factors and differences between individual dust control products make the control efficiencies of chemical dust suppressants difficult to estimate. Past field testing of emissions from controlled unpaved roads has shown that chemical dust suppressants provide a PM-10 control efficiency of about 80 percent when applied at regular intervals of 2 weeks to 1 month.

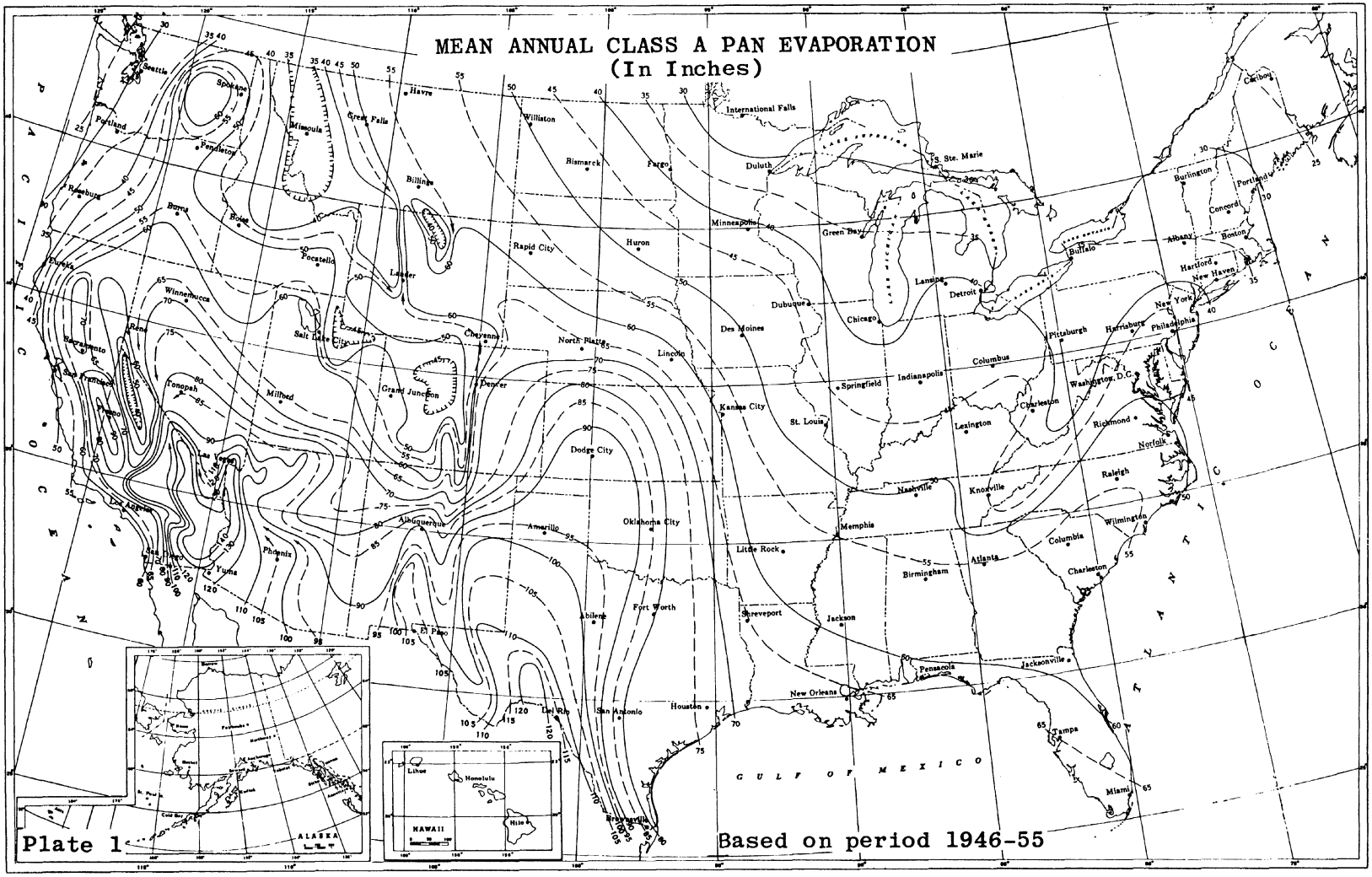


Figure 13.2.2-3. Annual evaporation data.

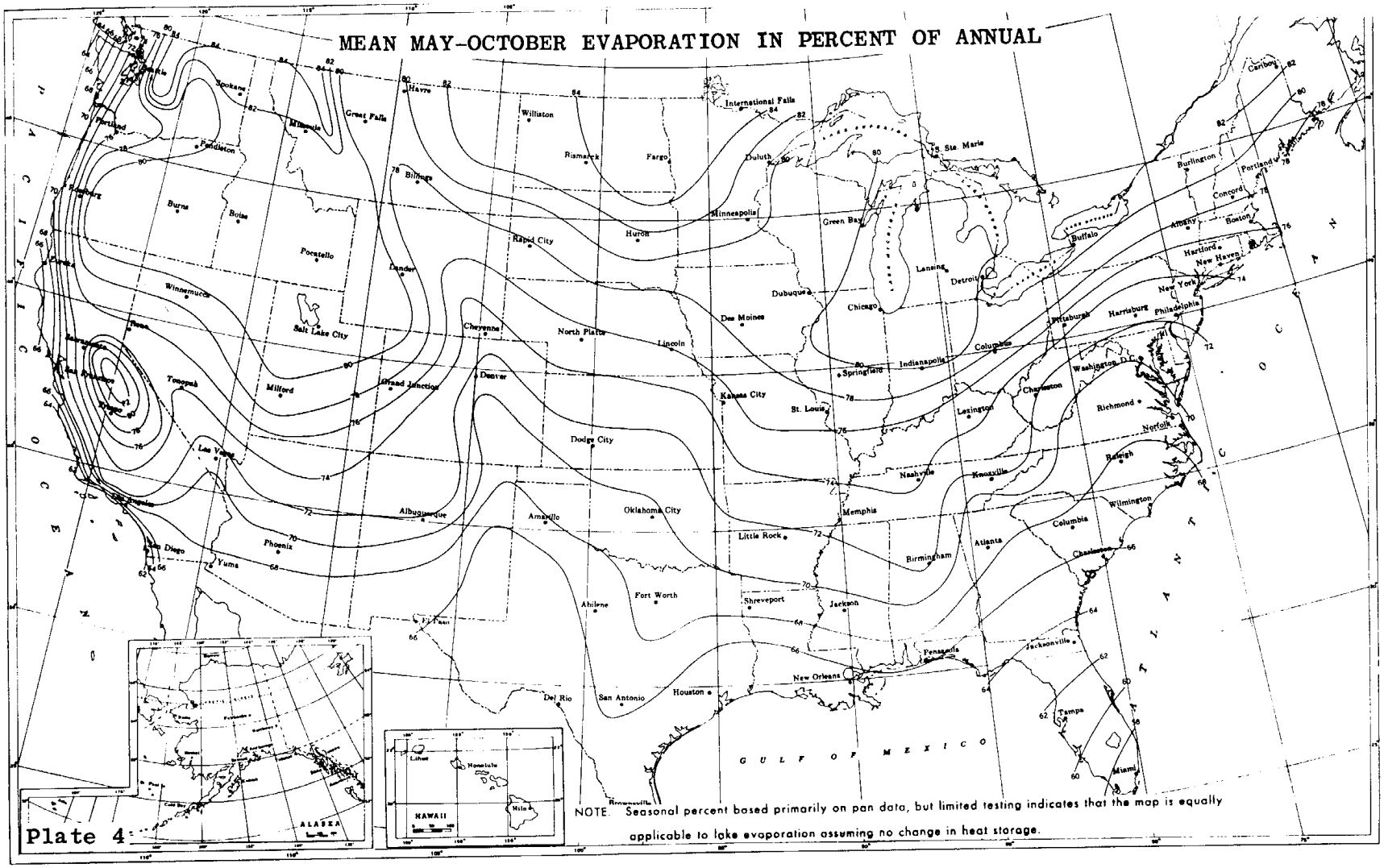


Figure 13.2.2-4. Geographical distribution of the percentage of evaporation occurring between May and October.

Petroleum resin products historically have been the dust suppressants (besides water) most widely used on industrial unpaved roads. Figure 13.2.2-5 presents a method to estimate average control efficiencies associated with petroleum resins applied to unpaved roads.[20] Several items should be noted:

1. The term "ground inventory" represents the total volume (per unit area) of petroleum resin concentrate (*not solution*) applied since the start of the dust control season.

2. Because petroleum resin products must be periodically reapplied to unpaved roads, the use of a time-averaged control efficiency value is appropriate. Figure 13.2.2-5 presents control efficiency values averaged over two common application intervals, 2 weeks and 1 month. Other application intervals will require interpolation.

3. Note that zero efficiency is assigned until the ground inventory reaches 0.05 gallon per square yard (gal/yd^2). Requiring a minimum ground inventory ensures that one must apply a reasonable amount of chemical dust suppressant to a road before claiming credit for emission control. Recall that the ground inventory refers to the amount of petroleum resin concentrate rather than the total solution.

As an example of the application of Figure 13.2.2-5, suppose that Equation 1a was used to estimate an emission factor of 7.1 lb/VMT for PM-10 from a particular road. Also, suppose that, starting on May 1, the road is treated with 0.221 gal/yd^2 of a solution (1 part petroleum resin to 5 parts water) on the first of each month through September. Then, the average controlled emission factors, shown in Table 13.2.2-5, are found.

Table 13.2-2-5. EXAMPLE OF AVERAGE CONTROLLED EMISSION FACTORS FOR SPECIFIC CONDITIONS

Period	Ground Inventory, gal/yd^2	Average Control Efficiency, %[a]	Average Controlled Emission Factor, lb/VMT
May	0.037	0	7.1
June	0.073	62	2.7
July	0.11	68	2.3
August	0.15	74	1.8
September	0.18	80	1.4

[a] From Figure 13.2.2-5, $\leq$10 µm. Zero efficiency assigned if ground inventory is less than 0.05 gal/yd^2. 1 lb/VMT = 281.9 g/VKT. 1 gal/yd^2 = 4.531 L/m^2.

Besides petroleum resins, other newer dust suppressants have also been successful in controlling emissions from unpaved roads. Specific test results for those chemicals, as well as for petroleum resins and watering, are provided in References 18 through 21.

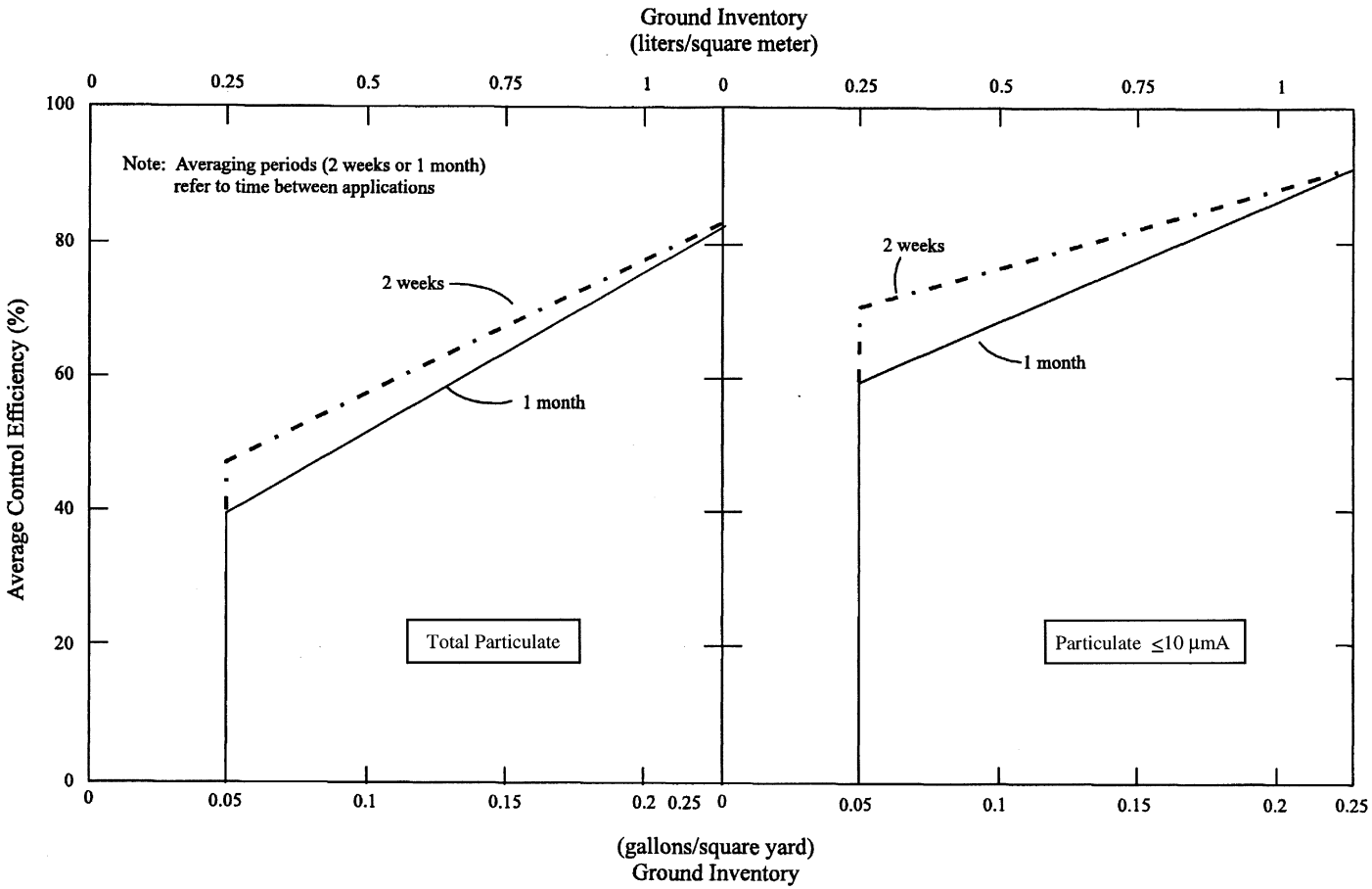


Figure 13.2.2-5. Average control efficiencies over common application intervals.

13.2.2.4 Updates Since The Fifth Edition

The Fifth Edition was released in January 1995. Revisions to this section since that date are summarized below. For further detail, consult the background report for this section (Reference 6).

October 1998 (Supplement E)– This was a major revision of this section. Significant changes to the text and the emission factor equations were made.

October 2001 – Separate emission factors for unpaved surfaces at industrial sites and publicly accessible roads were introduced. Figure 13.2.2-2 was included to provide control effectiveness estimates for watered roads.

December 2003 – The public road emission factor equation (equation 1b) was adjusted to remove the component of particulate emissions from exhaust, brake wear, and tire wear. The parameter C in the new equation varies with aerodynamic size range of the particulate matter. Table 13.2.2-4 was added to present the new coefficients.

January 2006 – The PM-2.5 particle size multipliers (i.e., factors) in Table 13.2.2-2 were modified and the quality ratings were upgraded from C to B based on the wind tunnel studies of a variety of dust emitting surface materials.

References For Section 13.2.2

1. C. Cowherd, Jr., *et al.*, *Development Of Emission Factors For Fugitive Dust Sources*, EPA-450/3-74-037, U. S. Environmental Protection Agency, Research Triangle Park, NC, June 1974.

2. R. J. Dyck and J. J. Stukel, "Fugitive Dust Emissions From Trucks On Unpaved Roads", *Environmental Science And Technology, 10*(10):1046-1048, October 1976.

3. R. O. McCaldin and K. J. Heidel, "Particulate Emissions From Vehicle Travel Over Unpaved Roads", Presented at the 71st Annual Meeting of the Air Pollution Control Association, Houston, TX, June 1978.

4. C. Cowherd, Jr, *et al.*, *Iron And Steel Plant Open Dust Source Fugitive Emission Evaluation*, EPA-600/2-79-013, U. S. Environmental Protection Agency, Cincinnati, OH, May 1979.

5. G. Muleski, *Unpaved Road Emission Impact*, Arizona Department of Environmental Quality, Phoenix, AZ, March 1991.

6. *Emission Factor Documentation For AP-42, Section 13.2.2, Unpaved Roads, Final Report*, Midwest Research Institute, Kansas City, MO, September 1998.

7. T. Cuscino, Jr., *et al.*, *Taconite Mining Fugitive Emissions Study*, Minnesota Pollution Control Agency, Roseville, MN, June 1979.

8. *Improved Emission Factors For Fugitive Dust From Western Surface Coal Mining Sources*, 2 Volumes, EPA Contract No. 68-03-2924, Office of Air Quality Planning and Standards, U. S. Environmental Protection Agency, Research Triangle Park, NC.

9. T. Cuscino, Jr., *et al.*, *Iron And Steel Plant Open Source Fugitive Emission Control Evaluation*, EPA-600/2-83-110, U. S. Environmental Protection Agency, Cincinnati, OH, October 1983.

10. *Size Specific Emission Factors For Uncontrolled Industrial And Rural Roads*, EPA Contract No. 68-02-3158, Midwest Research Institute, Kansas City, MO, September 1983.

11. C. Cowherd, Jr., and P. Englehart, *Size Specific Particulate Emission Factors For Industrial And Rural Roads*, EPA-600/7-85-038, U. S. Environmental Protection Agency, Cincinnati, OH, September 1985.

12. *PM-10 Emission Inventory Of Landfills In The Lake Calumet Area*, EPA Contract 68-02-3891, Work Assignment 30, Midwest Research Institute, Kansas City, MO, September 1987.

13. *Chicago Area Particulate Matter Emission Inventory — Sampling And Analysis*, EPA Contract No. 68-02-4395, Work Assignment 1, Midwest Research Institute, Kansas City, MO, May 1988.

14. *PM-10 Emissions Inventory Data For The Maricopa And Pima Planning Areas*, EPA Contract No. 68-02-3888, Engineering-Science, Pasadena, CA, January 1987.

15. *Oregon Fugitive Dust Emission Inventory*, EPA Contract 68-D0-0123, Midwest Research Institute, Kansas City, MO, January 1992.

16. *Climatic Atlas Of The United States*, U. S. Department Of Commerce, Washington, DC, June 1968.

17. National Climatic Data Center, *Solar And Meteorological Surface Observation Network 1961-1990*; 3 Volume CD-ROM. Asheville, NC, 1993.

18. C. Cowherd, Jr. *et al.*, *Control Of Open Fugitive Dust Sources*, EPA-450/3-88-008, U. S. Environmental Protection Agency, Research Triangle Park, NC, September 1988.

19. G. E. Muleski, *et al.*, *Extended Evaluation Of Unpaved Road Dust Suppressants In The Iron And Steel Industry*, EPA-600/2-84-027, U. S. Environmental Protection Agency, Cincinnati, OH, February 1984.

20. C. Cowherd, Jr., and J. S. Kinsey, *Identification, Assessment And Control Of Fugitive Particulate Emissions*, EPA-600/8-86-023, U. S. Environmental Protection Agency, Cincinnati, OH, August 1986.

21. G. E. Muleski and C. Cowherd, Jr., *Evaluation Of The Effectiveness Of Chemical Dust Suppressants On Unpaved Roads*, EPA-600/2-87-102, U. S. Environmental Protection Agency, Cincinnati, OH, November 1986.

22. *Fugitive Dust Background Document And Technical Information Document For Best Available Control Measures*, EPA-450/2-92-004, Office Of Air Quality Planning And Standards, U. S. Environmental Protection Agency, Research Triangle Park, NC, September 1992.

23. Written communication (Technical Memorandum) from P. Hemmer, E.H. Pechan & Associates, Inc., Durham, NC to B. Kuykendal, U. S. Environmental Protection Agency, Research Triangle Park, NC, August, 21, 2003.

24. MOBILE6 User Guide, United States Environmental Protection Agency, Office of Transportation and Air Quality. EPA420-R-02-028, October 2002.

25. Written communication (Technical Memorandum) from G. Muleski, Midwest Research Institute, Kansas City, MO, to B. Kuykendal, U. S. Environmental Protection Agency, Research Triangle Park, NC, Subject "Unpaved Roads", September 27, 2001.

26. Written communication (Technical Memorandum) from W. Kuykendal, U. S. Environmental Protection Agency, to File, Subject "Decisions on Final AP-42 Section 13.2.2 Unpaved Roads", November 24, 2003.

27. C. Cowherd, *Background Document for Revisions to Fine Fraction Ratios &sed for AP-42 Fugitive Dust Emission Factors*. Prepared by Midwest Research Institute for Western Governors Association, Western Regional Air Partnership, Denver, CO, February 1, 2006.

13.2.4 Aggregate Handling And Storage Piles

13.2.4.1 General

Inherent in operations that use minerals in aggregate form is the maintenance of outdoor storage piles. Storage piles are usually left uncovered, partially because of the need for frequent material transfer into or out of storage.

Dust emissions occur at several points in the storage cycle, such as material loading onto the pile, disturbances by strong wind currents, and loadout from the pile. The movement of trucks and loading equipment in the storage pile area is also a substantial source of dust.

13.2.4.2 Emissions And Correction Parameters

The quantity of dust emissions from aggregate storage operations varies with the volume of aggregate passing through the storage cycle. Emissions also depend on 3 parameters of the condition of a particular storage pile: age of the pile, moisture content, and proportion of aggregate fines.

When freshly processed aggregate is loaded onto a storage pile, the potential for dust emissions is at a maximum. Fines are easily disaggregated and released to the atmosphere upon exposure to air currents, either from aggregate transfer itself or from high winds. As the aggregate pile weathers, however, potential for dust emissions is greatly reduced. Moisture causes aggregation and cementation of fines to the surfaces of larger particles. Any significant rainfall soaks the interior of the pile, and then the drying process is very slow.

Silt (particles equal to or less than 75 micrometers [μm] in diameter) content is determined by measuring the portion of dry aggregate material that passes through a 200-mesh screen, using ASTM-C-136 method.[1] Table 13.2.4-1 summarizes measured silt and moisture values for industrial aggregate materials.

Table 13.2.4-1. TYPICAL SILT AND MOISTURE CONTENTS OF MATERIALS AT VARIOUS INDUSTRIES[a]

Industry	No. Of Facilities	Material	Silt Content (%)			Moisture Content (%)		
			No. Of Samples	Range	Mean	No. Of Samples	Range	Mean
Iron and steel production	9	Pellet ore	13	1.3 - 13	4.3	11	0.64 - 4.0	2.2
		Lump ore	9	2.8 - 19	9.5	6	1.6 - 8.0	5.4
		Coal	12	2.0 - 7.7	4.6	11	2.8 - 11	4.8
		Slag	3	3.0 - 7.3	5.3	3	0.25 - 2.0	0.92
		Flue dust	3	2.7 - 23	13	1	—	7
		Coke breeze	2	4.4 - 5.4	4.9	2	6.4 - 9.2	7.8
		Blended ore	1	—	15	1	—	6.6
		Sinter	1	—	0.7	0	—	—
		Limestone	3	0.4 - 2.3	1.0	2	ND	0.2
Stone quarrying and processing	2	Crushed limestone	2	1.3 - 1.9	1.6	2	0.3 - 1.1	0.7
		Various limestone products	8	0.8 - 14	3.9	8	0.46 - 5.0	2.1
Taconite mining and processing	1	Pellets	9	2.2 - 5.4	3.4	7	0.05 - 2.0	0.9
		Tailings	2	ND	11	1	—	0.4
Western surface coal mining	4	Coal	15	3.4 - 16	6.2	7	2.8 - 20	6.9
		Overburden	15	3.8 - 15	7.5	0	—	—
		Exposed ground	3	5.1 - 21	15	3	0.8 - 6.4	3.4
Coal-fired power plant	1	Coal (as received)	60	0.6 - 4.8	2.2	59	2.7 - 7.4	4.5
Municipal solid waste landfills	4	Sand	1	—	2.6	1	—	7.4
		Slag	2	3.0 - 4.7	3.8	2	2.3 - 4.9	3.6
		Cover	5	5.0 - 16	9.0	5	8.9 - 16	12
		Clay/dirt mix	1	—	9.2	1	—	14
		Clay	2	4.5 - 7.4	6.0	2	8.9 - 11	10
		Fly ash	4	78 - 81	80	4	26 - 29	27
		Misc. fill materials	1	—	12	1	—	11

[a] References 1-10. ND = no data.

13.2.4.3 Predictive Emission Factor Equations

Total dust emissions from aggregate storage piles result from several distinct source activities within the storage cycle:

1. Loading of aggregate onto storage piles (batch or continuous drop operations).
2. Equipment traffic in storage area.
3. Wind erosion of pile surfaces and ground areas around piles.
4. Loadout of aggregate for shipment or for return to the process stream (batch or continuous drop operations).

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 stacker is an example of a continuous drop operation.

The quantity of particulate emissions generated by either type of drop operation, per kilogram (kg) (ton) of material transferred, may be estimated, with a rating of A, using the following empirical expression:[11]

$$E = k(0.0016) \frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}} \text{ (kg/megagram [Mg])}$$

$$E = k(0.0032) \frac{\left(\frac{U}{5}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}} \text{ (pound [lb]/ton)} \qquad (1)$$

where:

E = emission factor
k = particle size multiplier (dimensionless)
U = mean wind speed, meters per second (m/s) (miles per hour [mph])
M = material moisture content (%)

The particle size multiplier in the equation, k, varies with aerodynamic particle size range, as follows:

Aerodynamic Particle Size Multiplier (k) For Equation 1				
< 30 µm	< 15 µm	< 10 µm	< 5 µm	< 2.5 µm
0.74	0.48	0.35	0.20	0.053[a]

[a] Multiplier for < 2.5 µm taken from Reference 14.

The equation retains the assigned quality rating if applied within the ranges of source conditions that were tested in developing the equation, as follows. Note that silt content is included, even though silt content does not appear as a correction parameter in the equation. While it is reasonable to expect that silt content and emission factors are interrelated, no significant correlation between the 2 was found during the derivation of the equation, probably because most tests with high silt contents were conducted under lower winds, and vice versa. It is recommended that estimates from the equation be reduced 1 quality rating level if the silt content used in a particular application falls outside the range given:

Ranges Of Source Conditions For Equation 1			
Silt Content (%)	Moisture Content (%)	Wind Speed	
		m/s	mph
0.44 - 19	0.25 - 4.8	0.6 - 6.7	1.3 - 15

To retain the quality rating of the equation when it is applied to a specific facility, reliable correction parameters must be determined for specific sources of interest. The field and laboratory procedures for aggregate sampling are given in Reference 3. In the event that site-specific values for

correction parameters cannot be obtained, the appropriate mean from Table 13.2.4-1 may be used, but the quality rating of the equation is reduced by 1 letter.

For emissions from equipment traffic (trucks, front-end loaders, dozers, etc.) traveling between or on piles, it is recommended that the equations for vehicle traffic on unpaved surfaces be used (see Section 13.2.2). For vehicle travel between storage piles, the silt value(s) for the areas among the piles (which may differ from the silt values for the stored materials) should be used.

Worst-case emissions from storage pile areas occur under dry, windy conditions. Worst-case emissions from materials-handling operations may be calculated by substituting into the equation appropriate values for aggregate material moisture content and for anticipated wind speeds during the worst case averaging period, usually 24 hours. The treatment of dry conditions for Section 13.2.2, vehicle traffic, "Unpaved Roads", follows the methodology described in that section centering on parameter p. A separate set of nonclimatic correction parameters and source extent values corresponding to higher than normal storage pile activity also may be justified for the worst-case averaging period.

13.2.4.4 Controls[12-13]

Watering and the use of chemical wetting agents are the principal means for control of aggregate storage pile emissions. Enclosure or covering of inactive piles to reduce wind erosion can also reduce emissions. Watering is useful mainly to reduce emissions from vehicle traffic in the storage pile area. Watering of the storage piles themselves typically has only a very temporary slight effect on total emissions. A much more effective technique is to apply chemical agents (such as surfactants) that permit more extensive wetting. Continuous chemical treating of material loaded onto piles, coupled with watering or treatment of roadways, can reduce total particulate emissions from aggregate storage operations by up to 90 percent.[12]

References For Section 13.2.4

1. C. Cowherd, Jr., *et al., Development Of Emission Factors For Fugitive Dust Sources*, EPA-450/3-74-037, U. S. Environmental Protection Agency, Research Triangle Park, NC, June 1974.

2. R. Bohn, *et al., Fugitive Emissions From Integrated Iron And Steel Plants*, EPA-600/2-78-050, U. S. Environmental Protection Agency, Cincinnati, OH, March 1978.

3. C. Cowherd, Jr., *et al., Iron And Steel Plant Open Dust Source Fugitive Emission Evaluation*, EPA-600/2-79-103, U. S. Environmental Protection Agency, Cincinnati, OH, May 1979.

4. *Evaluation Of Open Dust Sources In The Vicinity Of Buffalo, New York*, EPA Contract No. 68-02-2545, Midwest Research Institute, Kansas City, MO, March 1979.

5. C. Cowherd, Jr., and T. Cuscino, Jr., *Fugitive Emissions Evaluation*, MRI-4343-L, Midwest Research Institute, Kansas City, MO, February 1977.

6. T. Cuscino, Jr., *et al., Taconite Mining Fugitive Emissions Study*, Minnesota Pollution Control Agency, Roseville, MN, June 1979.

7. *Improved Emission Factors For Fugitive Dust From Western Surface Coal Mining Sources*, 2 Volumes, EPA Contract No. 68-03-2924, PEDCo Environmental, Kansas City, MO, and Midwest Research Institute, Kansas City, MO, July 1981.

8. *Determination Of Fugitive Coal Dust Emissions From Rotary Railcar Dumping*, TRC, Hartford, CT, May 1984.

9. *PM-10 Emission Inventory Of Landfills In the Lake Calumet Area*, EPA Contract No. 68-02-3891, Midwest Research Institute, Kansas City, MO, September 1987.

10. *Chicago Area Particulate Matter Emission Inventory — Sampling And Analysis*, EPA Contract No. 68-02-4395, Midwest Research Institute, Kansas City, MO, May 1988.

11. *Update Of Fugitive Dust Emission Factors In AP-42 Section 11.2*, EPA Contract No. 68-02-3891, Midwest Research Institute, Kansas City, MO, July 1987.

12. G. A. Jutze, *et al.*, *Investigation Of Fugitive Dust Sources Emissions And Control*, EPA-450/3-74-036a, U. S. Environmental Protection Agency, Research Triangle Park, NC, June 1974.

13. C. Cowherd, Jr., *et al.*, *Control Of Open Fugitive Dust Sources*, EPA-450/3-88-008, U. S. Environmental Protection Agency, Research Triangle Park, NC, September 1988.

14. C. Cowherd, *Background Document for Revisions to Fine Fraction Ratios &sed for AP-42 Fugitive Dust Emission Factors*. Prepared by Midwest Research Institute for Western Governors Association, Western Regional Air Partnership, Denver, CO, February 1, 2006.

13.2.5 Industrial Wind Erosion

13.2.5.1 General[1-3]

Dust emissions may be generated by wind erosion of open aggregate storage piles and exposed areas within an industrial facility. These sources typically are characterized by nonhomogeneous surfaces impregnated with nonerodible elements (particles larger than approximately 1 centimeter [cm] in diameter). Field testing of coal piles and other exposed materials using a portable wind tunnel has shown that (a) threshold wind speeds exceed 5 meters per second (m/s) (11 miles per hour [mph]) at 15 cm above the surface or 10 m/s (22 mph) at 7 m above the surface, and (b) particulate emission rates tend to decay rapidly (half-life of a few minutes) during an erosion event. In other words, these aggregate material surfaces are characterized by finite availability of erodible material (mass/area) referred to as the erosion potential. Any natural crusting of the surface binds the erodible material, thereby reducing the erosion potential.

13.2.5.2 Emissions And Correction Parameters

If typical values for threshold wind speed at 15 cm are corrected to typical wind sensor height (7 - 10 m), the resulting values exceed the upper extremes of hourly mean wind speeds observed in most areas of the country. In other words, mean atmospheric wind speeds are not sufficient to sustain wind erosion from flat surfaces of the type tested. However, wind gusts may quickly deplete a substantial portion of the erosion potential. Because erosion potential has been found to increase rapidly with increasing wind speed, estimated emissions should be related to the gusts of highest magnitude.

The routinely measured meteorological variable that best reflects the magnitude of wind gusts is the fastest mile. This quantity represents the wind speed corresponding to the whole mile of wind movement that has passed by the 1 mile contact anemometer in the least amount of time. Daily measurements of the fastest mile are presented in the monthly Local Climatological Data (LCD) summaries. The duration of the fastest mile, typically about 2 minutes (for a fastest mile of 30 mph), matches well with the half-life of the erosion process, which ranges between 1 and 4 minutes. It should be noted, however, that peak winds can significantly exceed the daily fastest mile.

The wind speed profile in the surface boundary layer is found to follow a logarithmic distribution:

$$u(z) = \frac{u*}{0.4} \ln \frac{z}{z_o} \qquad (z > z_o) \tag{1}$$

where:

u = wind speed, cm/s
u^* = friction velocity, cm/s
z = height above test surface, cm
z_o = roughness height, cm
0.4 = von Karman's constant, dimensionless

The friction velocity (u^*) is a measure of wind shear stress on the erodible surface, as determined from the slope of the logarithmic velocity profile. The roughness height (z_o) is a measure of the roughness of the exposed surface as determined from the y intercept of the velocity profile, i. e., the height at which the wind speed is zero. These parameters are illustrated in Figure 13.2.5-1 for a roughness height of 0.1 cm.

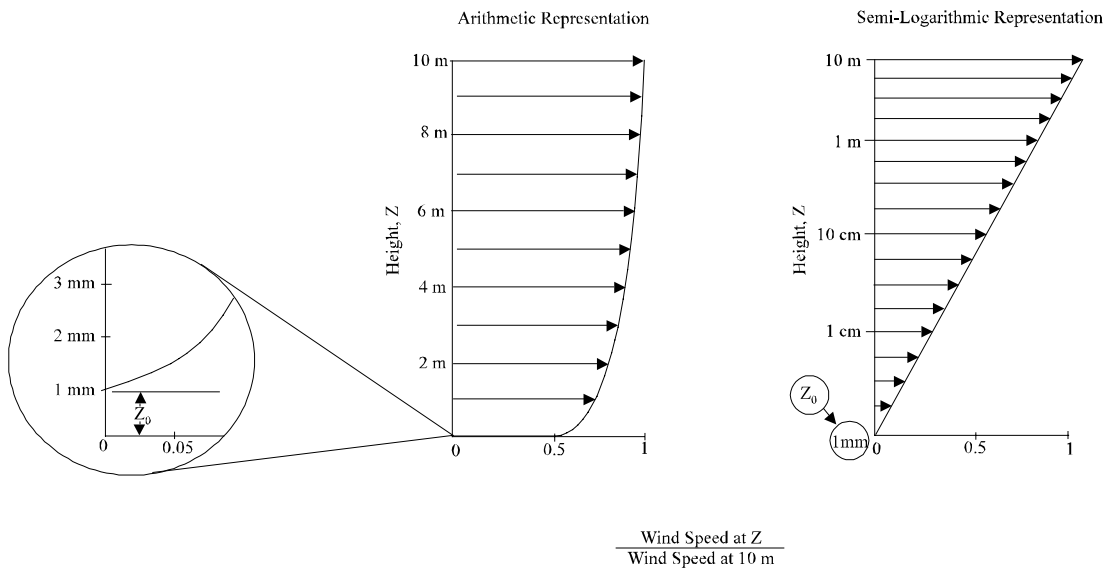


Figure 13.2.5-1. Illustration of logarithmic velocity profile.

Emissions generated by wind erosion are also dependent on the frequency of disturbance of the erodible surface because each time that a surface is disturbed, its erosion potential is restored. A disturbance is defined as an action that results in the exposure of fresh surface material. On a storage pile, this would occur whenever aggregate material is either added to or removed from the old surface. A disturbance of an exposed area may also result from the turning of surface material to a depth exceeding the size of the largest pieces of material present.

13.2.5.3 Predictive Emission Factor Equation[4]

The emission factor for wind-generated particulate emissions from mixtures of erodible and nonerodible surface material subject to disturbance may be expressed in units of grams per square meter (g/m^2) per year as follows:

$$\text{Emission factor} = k \sum_{i=1}^{N} P_i \qquad (2)$$

where:

k = particle size multiplier
N = number of disturbances per year
P_i = erosion potential corresponding to the observed (or probable) fastest mile of wind for the ith period between disturbances, g/m^2

The particle size multiplier (k) for Equation 2 varies with aerodynamic particle size, as follows:

Aerodynamic Particle Size Multipliers For Equation 2			
30 µm	<15 µm	<10 µm	<2.5 µm
1.0	0.6	0.5	0.075[a]

This distribution of particle size within the under 30 micrometer (µm) fraction is comparable to the distributions reported for other fugitive dust sources where wind speed is a factor. This is illustrated, for example, in the distributions for batch and continuous drop operations encompassing a number of test aggregate materials (see Section 13.2.4).

In calculating emission factors, each area of an erodible surface that is subject to a different frequency of disturbance should be treated separately. For a surface disturbed daily, N = 365 per year, and for a surface disturbance once every 6 months, N = 2 per year.

The erosion potential function for a dry, exposed surface is:

$$P = 58\,(u^* - u_t^*)^2 + 25\,(u^* - u_t^*)$$
$$P = 0 \text{ for } u^* \le u_t^* \qquad (3)$$

where:

u^* = friction velocity (m/s)
u_t = threshold friction velocity (m/s)

Because of the nonlinear form of the erosion potential function, each erosion event must be treated separately.

Equations 2 and 3 apply only to dry, exposed materials with limited erosion potential. The resulting calculation is valid only for a time period as long or longer than the period between disturbances. Calculated emissions represent intermittent events and should not be input directly into dispersion models that assume steady-state emission rates.

For uncrusted surfaces, the threshold friction velocity is best estimated from the dry aggregate structure of the soil. A simple hand sieving test of surface soil can be used to determine the mode of the surface aggregate size distribution by inspection of relative sieve catch amounts, following the procedure described below.

FIELD PROCEDURE FOR DETERMINATION OF THRESHOLD FRICTION VELOCITY
(from a 1952 laboratory procedure published by W. S. Chepil):

1. Prepare a nest of sieves with the following openings: 4 mm, 2 mm, 1 mm, 0.5 mm, and 0.25 mm. Place a collector pan below the bottom (0.25 mm) sieve.

2. Collect a sample representing the surface layer of loose particles (approximately 1 cm in depth, for an encrusted surface), removing any rocks larger than about 1 cm in average physical diameter. The area to be sampled should be not less than 30 cm by 30 cm.

3. Pour the sample into the top sieve (4-mm opening), and place a lid on the top.

4. Move the covered sieve/pan unit by hand, using a broad circular arm motion in the horizontal plane. Complete 20 circular movements at a speed just necessary to achieve some relative horizontal motion between the sieve and the particles.

5. Inspect the relative quantities of catch within each sieve, and determine where the mode in the aggregate size distribution lies, i. e., between the opening size of the sieve with the largest catch and the opening size of the next largest sieve.

6. Determine the threshold friction velocity from Table 13.2.5-1.

The results of the sieving can be interpreted using Table 13.2.5-1. Alternatively, the threshold friction velocity for erosion can be determined from the mode of the aggregate size distribution using the graphical relationship described by Gillette.[5-6] If the surface material contains nonerodible elements that are too large to include in the sieving (i. e., greater than about 1 cm in diameter), the effect of the elements must be taken into account by increasing the threshold friction velocity.[10]

Table 13.2.5-1 (Metric Units). FIELD PROCEDURE FOR DETERMINATION OF THRESHOLD FRICTION VELOCITY

Tyler Sieve No.	Opening (mm)	Midpoint (mm)	u_t^* (cm/s)
5	4		
9	2	3	100
16	1	1.5	76
32	0.5	0.75	58
60	0.25	0.375	43

Threshold friction velocities for several surface types have been determined by field measurements with a portable wind tunnel. These values are presented in Table 13.2.5-2.

Table 13.2.5-2 (Metric Units). THRESHOLD FRICTION VELOCITIES

Material	Threshold Friction Velocity (m/s)	Roughness Height (cm)	Threshold Wind Velocity At 10 m (m/s)	
			z_o = Act	z_o = 0.5 cm
Overburden[a]	1.02	0.3	21	19
Scoria (roadbed material)[a]	1.33	0.3	27	25
Ground coal (surrounding coal pile)[a]	0.55	0.01	16	10
Uncrusted coal pile[a]	1.12	0.3	23	21
Scraper tracks on coal pile[a,b]	0.62	0.06	15	12
Fine coal dust on concrete pad[c]	0.54	0.2	11	10

[a] Western surface coal mine. Reference 2.
[b] Lightly crusted.
[c] Eastern power plant. Reference 3.

The fastest mile of wind for the periods between disturbances may be obtained from the monthly LCD summaries for the nearest reporting weather station that is representative of the site in question.[7] These summaries report actual fastest mile values for each day of a given month. Because the erosion potential is a highly nonlinear function of the fastest mile, mean values of the fastest mile are inappropriate. The anemometer heights of reporting weather stations are found in Reference 8, and should be corrected to a 10-m reference height using Equation 1.

To convert the fastest mile of wind (u^+) from a reference anemometer height of 10 m to the equivalent friction velocity (u^*), the logarithmic wind speed profile may be used to yield the following equation:

$$u^* = 0.053\ u_{10}^+ \tag{4}$$

where:

u^* = friction velocity (m/s)

u_{10}^+ = fastest mile of reference anemometer for period between disturbances (m/s)

This assumes a typical roughness height of 0.5 cm for open terrain. Equation 4 is restricted to large relatively flat piles or exposed areas with little penetration into the surface wind layer.

If the pile significantly penetrates the surface wind layer (i. e., with a height-to-base ratio exceeding 0.2), it is necessary to divide the pile area into subareas representing different degrees of exposure to wind. The results of physical modeling show that the frontal face of an elevated pile is exposed to wind speeds of the same order as the approach wind speed at the top of the pile.

For 2 representative pile shapes (conical and oval with flattop, 37-degree side slope), the ratios of surface wind speed (u_s) to approach wind speed (u_r) have been derived from wind tunnel studies.[9] The results are shown in Figure 13.2.5-2 corresponding to an actual pile height of 11 m, a reference (upwind) anemometer height of 10 m, and a pile surface roughness height (z_o) of 0.5 cm. The measured surface winds correspond to a height of 25 cm above the surface. The area fraction within each contour pair is specified in Table 13.2.5-3.

Table 13.2.5-3. SUBAREA DISTRIBUTION FOR REGIMES OF u_s/u_r[a]

Pile Subarea	Percent Of Pile Surface Area			
	Pile A	Pile B1	Pile B2	Pile B3
0.2a	5	5	3	3
0.2b	35	2	28	25
0.2c	NA	29	NA	NA
0.6a	48	26	29	28
0.6b	NA	24	22	26
0.9	12	14	15	14
1.1	NA	NA	3	4

[a] NA = not applicable.

The profiles of u_s/u_r in Figure 13.2.5-2 can be used to estimate the surface friction velocity distribution around similarly shaped piles, using the following procedure:

1. Correct the fastest mile value (u^+) for the period of interest from the anemometer height (z) to a reference height of 10 m u^+_{10} using a variation of Equation 1:

$$u^+_{10} = u^+ \frac{\ln (10/0.005)}{\ln (z/0.005)} \qquad (5)$$

where a typical roughness height of 0.5 cm (0.005 m) has been assumed. If a site-specific roughness height is available, it should be used.

2. Use the appropriate part of Figure 13.2.5-2 based on the pile shape and orientation to the fastest mile of wind, to obtain the corresponding surface wind speed distribution (u_s^+)

$$u_s^+ = \frac{(u_s)}{u_r} \quad u^+_{10} \qquad (6)$$

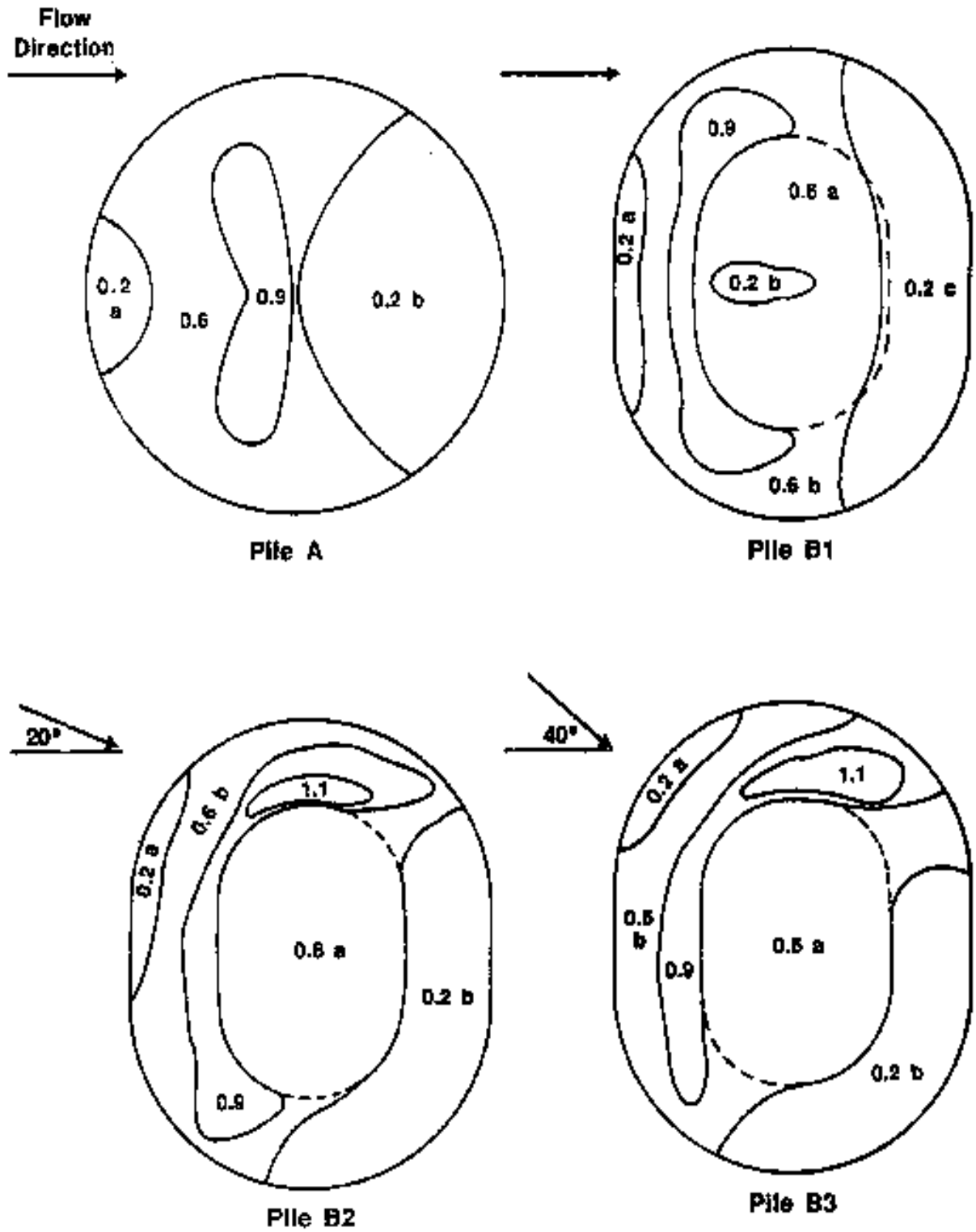


Figure 13.2.5-2. Contours of normalized surface windspeeds, u_s/u_r.

3. For any subarea of the pile surface having a narrow range of surface wind speed, use a variation of Equation 1 to calculate the equivalent friction velocity (u^*):

$$u^* = \frac{0.4u_s^+}{\frac{25}{\ln 0.5}} = 0.10u_s^+ \qquad (7)$$

From this point on, the procedure is identical to that used for a flat pile, as described above.

Implementation of the above procedure is carried out in the following steps:

1. Determine threshold friction velocity for erodible material of interest (see Table 13.2.5-2 or determine from mode of aggregate size distribution).

2. Divide the exposed surface area into subareas of constant frequency of disturbance (N).

3. Tabulate fastest mile values (u^+) for each frequency of disturbance and correct them to 10 m (u^+_{10}) using Equation 5.5

4. Convert fastest mile values (u_{10}) to equivalent friction velocities (u^*), taking into account (a) the uniform wind exposure of nonelevated surfaces, using Equation 4, or (b) the nonuniform wind exposure of elevated surfaces (piles), using Equations 6 and 7.

5. For elevated surfaces (piles), subdivide areas of constant N into subareas of constant u^* (i. e., within the isopleth values of u_s/u_r in Figure 13.2.5-2 and Table 13.2.5-3) and determine the size of each subarea.

6. Treating each subarea (of constant N and u^*) as a separate source, calculate the erosion potential (P_i) for each period between disturbances using Equation 3 and the emission factor using Equation 2.

7. Multiply the resulting emission factor for each subarea by the size of the subarea, and add the emission contributions of all subareas. Note that the highest 24-hour (hr) emissions would be expected to occur on the windiest day of the year. Maximum emissions are calculated assuming a single event with the highest fastest mile value for the annual period.

The recommended emission factor equation presented above assumes that all of the erosion potential corresponding to the fastest mile of wind is lost during the period between disturbances. Because the fastest mile event typically lasts only about 2 minutes, which corresponds roughly to the half-life for the decay of actual erosion potential, it could be argued that the emission factor overestimates particulate emissions. However, there are other aspects of the wind erosion process that offset this apparent conservatism:

1. The fastest mile event contains peak winds that substantially exceed the mean value for the event.

2. Whenever the fastest mile event occurs, there are usually a number of periods of

slightly lower mean wind speed that contain peak gusts of the same order as the fastest mile wind speed.

Of greater concern is the likelihood of overprediction of wind erosion emissions in the case of surfaces disturbed infrequently in comparison to the rate of crust formation.

13.2.5.4 Example 1: Calculation for wind erosion emissions from conically shaped coal pile

A coal burning facility maintains a conically shaped surge pile 11 m in height and 29.2 m in base diameter, containing about 2000 megagrams (Mg) of coal, with a bulk density of 800 kilograms per cubic meter ($kg/m^{3)}$ (50 pounds per cubic feet [lb/ft^3]). The total exposed surface area of the pile is calculated as follows:

Coal is added to the pile by means of a fixed stacker and reclaimed by front-end loaders operating

$$
\begin{aligned}
S &= \pi r \sqrt{r^2 + h^2} \\
&= 3.14(14.6)\sqrt{(14.6)^2 + (11.0)^2} \\
&= 838\ m^2
\end{aligned}
$$

at the base of the pile on the downwind side. In addition, every 3 days 250 Mg (12.5 percent of the stored capacity of coal) is added back to the pile by a topping off operation, thereby restoring the full capacity of the pile. It is assumed that (a) the reclaiming operation disturbs only a limited portion of the surface area where the daily activity is occurring, such that the remainder of the pile surface remains intact, and (b) the topping off operation creates a fresh surface on the entire pile while restoring its original shape in the area depleted by daily reclaiming activity.

Because of the high frequency of disturbance of the pile, a large number of calculations must be made to determine each contribution to the total annual wind erosion emissions. This illustration will use a single month as an example.

Step 1: In the absence of field data for estimating the threshold friction velocity, a value of 1.12 m/s is obtained from Table 13.2.5-2.

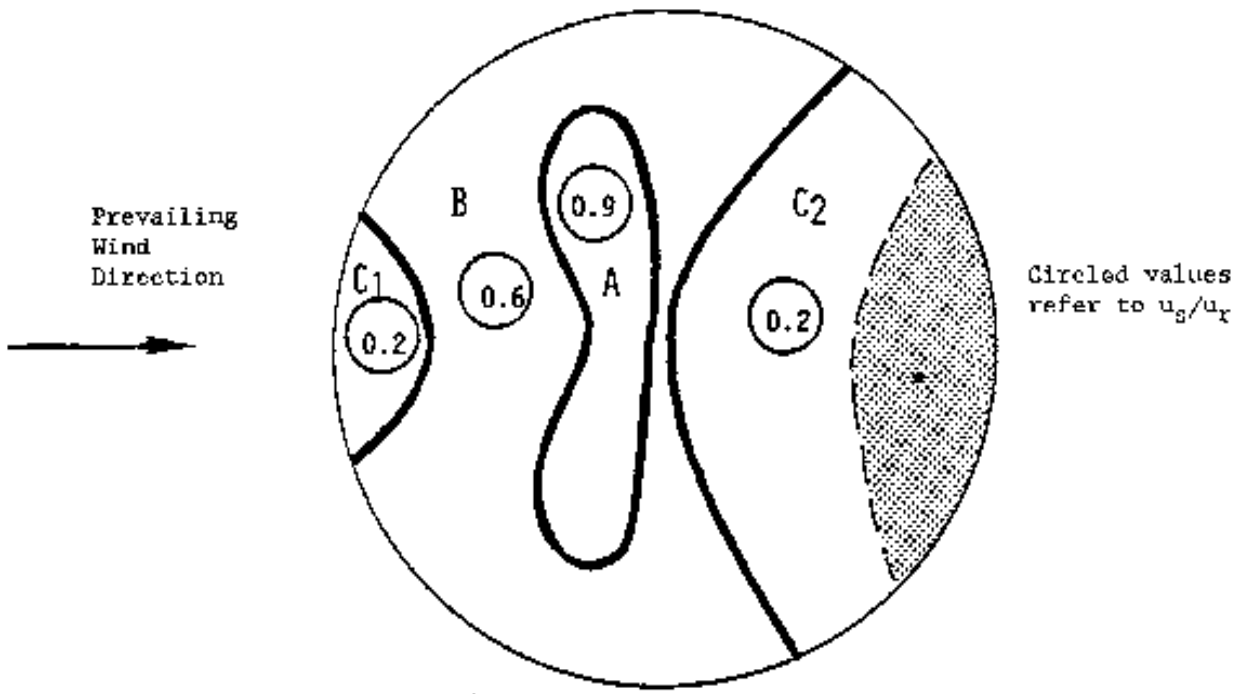
Step 2: Except for a small area near the base of the pile (see Figure 13.2.5-3), the entire pile surface is disturbed every 3 days, corresponding to a value of N = 120 per year. It will be shown that the contribution of the area where daily activity occurs is negligible so that it does not need to be treated separately in the calculations.

Step 3: The calculation procedure involves determination of the fastest mile for each period of disturbance. Figure 13.2.5-4 shows a representative set of values (for a 1-month period) that are assumed to be applicable to the geographic area of the pile location. The values have been separated into 3-day periods, and the highest value in each period is indicated. In this example, the anemometer height is 7 m, so that a height correction to 10 m is needed for the fastest mile values. From Equation 5,

$$u_{10}^{+} = u_{7}^{+} \left(\frac{\ln (10/0.005)}{\ln (7/0.005)} \right)$$

$$u_{10}^{+} = 1.05\ u_{7}^{+}$$

Step 4: The next step is to convert the fastest mile value for each 3-day period into



* A portion of C_2 is disturbed daily by reclaiming activities.

Area ID	$\frac{u_s}{u_r}$	Pile Surface %	Pile Surface Area (m^2)
A	0.9	12	101
B	0.6	48	402
$C_1 + C_2$	0.2	40	335
		Total	838

Figure 13.2.5-3. Example 1: Pile surface areas within each wind speed regime.

Local Climatological Data

Monthly Summary

Wind						
			Fastest Mile			
Resultant Dir.	Resultant Speed M.P.H.	Average Speed M.P.H.	Speed M.P.H.	Direction		Date
13	14	15	16	17		22
30	5.3	6.9	9	36		1
01	10.5	10.6	14	01		2
10	2.4	6.0	10	02		3
13	11.0	11.4	16	13		4
12	11.3	11.9	15	11		5
20	11.1	19.0	29	30		6
29	19.6	19.8	30	30		7
29	10.9	11.2	17	30		8
22	3.0	8.1	15	13		9
14	14.6	15.1	23	12		10
29	22.3	23.3	31	29		11
17	7.9	13.5	23	17		12
21	7.7	15.5	18	18		13
10	4.5	9.6	22	13		14
10	6.7	8.8	13	11		15
01	13.7	13.8	21	36		16
33	11.2	11.5	15	34		17
27	4.3	5.8	12	31		18
32	9.3	10.2	14	35		19
24	7.5	7.8	16	24		20
22	10.3	10.6	16	20		21
32	17.1	17.3	25	32		22
29	2.4	8.5	14	13		23
07	5.9	8.8	15	02		24
34	11.3	11.7	17	32		25
31	12.1	12.2	16	32		26
30	8.3	8.5	16	26		27
30	8.2	8.3	13	32		28
33	5.0	6.6	10	32		29
34	3.1	5.2	9	31		30
29	4.9	5.5	8	25		31
For the Month:						
30	3.3	11.1	31	29		
——	——	——	Date: 11			

Figure 13.2.5-4. Example daily fastest miles wind for periods of interest.

equivalent friction velocities for each surface wind regime (i. e., u_s/u_r ratio) of the pile, using Equations 6 and 7. Figure 13.2.5-3 shows the surface wind speed pattern (expressed as a fraction of the approach wind speed at a height of 10 m). The surface areas lying within each wind speed regime are tabulated below the figure.

The calculated friction velocities are presented in Table 13.2.5-4. As indicated, only 3 of the periods contain a friction velocity which exceeds the threshold value of 1.12 m/s for an uncrusted coal pile. These 3 values all occur within the u_s/u_r = 0.9 regime of the pile surface.

Table 13.2.5-4 (Metric And English Units). EXAMPLE 1:
CALCULATION OF FRICTION VELOCITIES

3-Day Period	u_7^+		u_{10}^+		$u^* = 0.1u^+$ (m/s) s		
	mph	m/s	mph	m/s	u_s/u_r: 0.2	u_s/u_r: 0.6	u_s/u_r: 0.9
1	14	6.3	15	6.6	0.13	0.40	0.59
2	29	13.0	31	13.7	0.27	0.82	1.23
3	30	13.4	32	14.1	0.28	0.84	1.27
4	31	13.9	33	14.6	0.29	0.88	1.31
5	22	9.8	23	10.3	0.21	0.62	0.93
6	21	9.4	22	9.9	0.20	0.59	0.89
7	16	7.2	17	7.6	0.15	0.46	0.68
8	25	11.2	26	11.8	0.24	0.71	1.06
9	17	7.6	18	8.0	0.16	0.48	0.72
10	13	5.8	14	6.1	0.12	0.37	0.55

Step 5: This step is not necessary because there is only 1 frequency of disturbance used in the calculations. It is clear that the small area of daily disturbance (which lies entirely within the u_s/u_r = 0.2 regime) is never subject to wind speeds exceeding the threshold value.

Steps 6 and 7: The final set of calculations (shown in Table 13.2.5-5) involves the tabulation and summation of emissions for each disturbance period and for the affected subarea. The erosion potential (P) is calculated from Equation 3.

For example, the calculation for the second 3-day period is:

$$P = 58(u^* - u_t^*)^2 + 25(u^* - u_t^*)$$

$$P_2 = 58(1.23 - 1.12)^2 + 25(1.23 - 1.12)$$

$$= 0.70 + 2.75 = 3.45 \text{ g/m}^2$$

Table 13.2.5-5 (Metric Units). EXAMPLE 1: CALCULATION OF PM-10 EMISSIONS[a]

3-Day Period	u^* (m/s)	$u^* - u_t^*$ (m/s)	P (g/m^2)	ID	Pile Surface Area (m^2)	kPA (g)
2	1.23	0.11	3.45	A	101	170
3	1.27	0.15	5.06	A	101	260
4	1.31	0.19	6.84	A	101	350
TOTAL						780

[a] Where $u_t^* = 1.12$ m/s for uncrusted coal and k = 0.5 for PM-10.

The emissions of particulate matter greater than 10 µm (PM-10) generated by each event are found as the product of the PM-10 multiplier (k = 0.5), the erosion potential (P), and the affected area of the pile (A).

As shown in Table 13.2.5-5, the results of these calculations indicate a monthly PM-10 emission total of 780 g.

13.2.5.5 Example 2: Calculation for wind erosion from flat area covered with coal dust

A flat circular area 29.2 m in diameter is covered with coal dust left over from the total reclaiming of a conical coal pile described in the example above. The total exposed surface area is calculated as follows:

$$s = \frac{\pi}{4} d^2 = 0.785 (29.2)^2 = 670 \text{ m}^2$$

This area will remain exposed for a period of 1 month when a new pile will be formed.

Step 1: In the absence of field data for estimating the threshold friction velocity, a value of 0.54 m/s is obtained from Table 13.2.5-2.

Step 2: The entire surface area is exposed for a period of 1 month after removal of a pile and N = 1/yr.

Step 3: From Figure 13.2.5-4, the highest value of fastest mile for the 30-day period (31 mph) occurs on the 11th day of the period. In this example, the reference anemometer height is 7 m, so that a height correction is needed for the fastest mile value. From Step 3 of the previous example, $u^+_{10} = 1.05\ u^+_7$, so that $u^+_{10} = 33$ mph.

Step 4: Equation 4 is used to convert the fastest mile value of 14.6 m/s (33 mph) to an equivalent friction velocity of 0.77 m/s. This value exceeds the threshold friction velocity from Step 1 so that erosion does occur.

Step 5: This step is not necessary, because there is only 1 frequency of disturbance for the entire source area.

Steps 6 and 7: The PM-10 emissions generated by the erosion event are calculated as the product of the PM-10 multiplier (k = 0.5), the erosion potential (P) and the source area (A). The erosion potential is calculated from Equation 3 as follows:

$$P = 58(u^* - u_t^*)^2 + 25(u^* - u_t^*)$$

$$P = 58(0.77 - 0.54)^2 + 25(0.77 - 0.54)$$

$$= 3.07 + 5.75$$

$$= 8.82 \text{ g/m}^2$$

Thus the PM-10 emissions for the 1-month period are found to be:

$$E = (0.5)(8.82 \text{ g/m}^2)(670 \text{ m}^2)$$

$$= 3.0 \text{ kg}$$

References For Section 13.2.5

1. C. Cowherd, Jr., "A New Approach To Estimating Wind Generated Emissions From Coal Storage Piles", Presented at the APCA Specialty Conference on Fugitive Dust Issues in the Coal Use Cycle, Pittsburgh, PA, April 1983.

2. K. Axtell and C. Cowherd, Jr., *Improved Emission Factors For Fugitive Dust From Surface Coal Mining Sources*, EPA-600/7-84-048, U. S. Environmental Protection Agency, Cincinnati, OH, March 1984.

3. G. E Muleski, "Coal Yard Wind Erosion Measurement", Midwest Research Institute, Kansas City, MO, March 1985.

4. *Update Of Fugitive Dust Emissions Factors In AP-42 Section 11.2 — Wind Erosion*, MRI No. 8985-K, Midwest Research Institute, Kansas City, MO, 1988.

5. W. S. Chepil, "Improved Rotary Sieve For Measuring State And Stability Of Dry Soil Structure", *Soil Science Society Of America Proceedings*, *16*:113-117, 1952.

6. D. A. Gillette, *et al.*, "Threshold Velocities For Input Of Soil Particles Into The Air By Desert Soils", *Journal Of Geophysical Research*, *85*(C10):5621-5630.

7. Local Climatological Data, National Climatic Center, Asheville, NC.

8. M. J. Changery, *National Wind Data Index Final Report*, HCO/T1041-01 UC-60, National Climatic Center, Asheville, NC, December 1978.

9. B. J. B. Stunder and S. P. S. Arya, "Windbreak Effectiveness For Storage Pile Fugitive Dust Control: A Wind Tunnel Study", *Journal Of The Air Pollution Control Association*, *38*:135-143, 1988.

10. C. Cowherd, Jr., *et al.*, *Control Of Open Fugitive Dust Sources*, EPA 450/3-88-008, U. S. Environmental Protection Agency, Research Triangle Park, NC, September 1988.

11. C. Cowherd, *Background Document for Revisions to Fine Fraction Ratios Used for AP-42 Fugitive Dust Emission Factors.* Prepared by Midwest Research Institute for Western Governors Association, Western Regional Air Partnership, Denver, CO, February 1, 2006.

JANUARY 2011
LOCAL CLIMATOLOGICAL DATA
NOAA, National Climatic Data Center

ALBUQUERQUE, NM
ALBUQUERQUE INTL SUNPORT AIRPORT (KABQ)
Lat:35 ° 02'N Long: 106° 36'W Elev (Ground) 5310 Feet
Time Zone : MOUNTAIN WBAN: 23050 ISSN#: 0198-3482

Date	Temperature °F MAXIMUM	MINIMUM	AVERAGE	DEP FROM NORMAL	AVERAGE DEW PT	AVERAGE WET BULB	Deg Days BASE 65° HEATING	COOLING	WEATHER	SNOW/ICE ON GND(IN) 0500 LST DEPTH	1100 LST WATER-EQUIV	PRECIPITATION ON GND(IN) 2400 LST SNOW-FALL	2400 LST WATER EQUIV	PRESSURE (INCHES OF HG) AVERAGE STATION	AVERAGE SEA LEVEL	WIND SPEED = MPH DIR = TENS OF DEGREES RESULTANT SPEED	RES DIR	AVERAGE SPEED	MAXIMUM 3-SEC SPEED	DIR	2-MIN SPEED	DIR	Date
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
01	26	8*	17*	-17	1	13	48	0		0		0.0	0.00	24.83	30.31	5.2	33	7.3	22	02	18	01	01
02	34	10	22	-12	2	16	43	0	HZ	0		0.0	0.00	24.86	30.36	2.8	36	3.5	14	34	12	35	02
03	41	20	31	-3	9	22	34	0		0		0.0	0.00	24.73	30.14	1.4	02	3.0	12	33	10	33	03
04	44	19	32	-3	17	25	33	0	RA SN FG	0		T	T	24.79	30.18	5.9	34	6.9	37*	32	29*	33	04
05	43	23	33	-2	16	26	32	0		0		0.0	0.00	24.89	30.30	8.6	35	8.9	24	35	20	01	05
06	44	23	34	-1	15	27	31	0		0		0.0	0.00	24.88	30.29	7.1	36	7.9	18	34	15	02	06
07	49	27	38	3	17	29	27	0		0		0.0	0.00	24.69	30.04	5.3	36	5.9	16	01	14	01	07
08	48	23	36	1	20	29	29	0		0		0.0	0.00	24.50	29.81	2.5	36	4.9	16	02	13	02	08
09	52	24	38	3	19	30	27	0		0		0.0	0.00	24.49	29.77	1.5	23	4.9	24	34	18	36	09
10	37	21	29	-6	11	23	36	0		0		0.0	0.00	24.74	30.07	9.5	36	12.4	28	35	23	36	10
11	37	14	26	-9	-2	18	39	0		0		0.0	0.00	24.99	30.46	3.0	35	4.4	15	34	13	35	11
12	44	24	34	-1	4	23	31	0		0		0.0	0.00	24.99	30.41	1.5	34	2.8	10	33	8	34	12
13	50	22	36	1	15	29	29	0		0		0.0	0.00	24.94	30.34	5.7	35	6.3	22	31	17	31	13
14	50	28	39	4	23	32	26	0		0		0.0	0.00	24.88	30.21	6.9	35	7.9	32	34	25	33	14
15	51	24	38	3	22	32	27	0		0		0.0	0.00	24.86	30.22	2.3	36	5.0	21	33	16	33	15
16	54	27	41	6	22	34	24	0		0		0.0	0.00	24.75	30.07	5.8	36	6.4	31	02	25	02	16
17	63*	34	49*	14	27	39	16	0		0		0.0	0.00	24.65	29.90	7.0	35	8.4	35	32	28	31	17
18	58	36	47	11	20	36	18	0		0		0.0	0.00	24.72	29.96	6.7	35	8.2	25	34	20	34	18
19	59	31	45	9	16	33	20	0		0		0.0	0.00	24.57		3.8	31	9.3			21	30	19
20	48	33	41	5	13	29	24	0		0		0.0	0.00	24.82		4.5	01	8.3			21	34	20
21	51	29	40	4	12	29	25	0		0		0.0	0.00	24.76	30.09	9.0	34	9.9	33	35	24	01	21
22	53	23	38	2	15	30	27	0		0		0.0	0.00	24.63	29.94	3.6	34	5.1	20	36	15	01	22
23	48	32	40	4	16	31	25	0		0		0.0	0.00	24.75	30.05	5.3	36	7.3	23	35	18	35	23
24	44	24	34	-3	14	27	31	0	SN	0		T	T	24.75	30.08	5.0	07	7.5	26	07	22	08	24
25	45	22	34	-3	12	26	31	0		0		0.0	0.00	24.78	30.17	0.3	13	2.6	13	34	10	33	25
26	48	26	37	0	9	27	28	0		0		0.0	0.00	24.86	30.22	4.1	35	5.4	15	31	12	01	26
27	52	22	37	0	13	28	28	0		0		0.0	0.00	24.89	30.27	1.2	01	2.8	13	36	10	36	27
28	54	27	41	4	16	31	24	0		0		0.0	0.00	24.79	30.13	0.7	04	3.2	10	21	8	20	28
29	59	26	43	5	16	32	22	0		0		0.0	0.00	24.70	29.99	1.4	34	4.7	22	32	17	32	29
30	57	27	42	4	13	31	23	0		0		0.0	0.00	24.68	29.97	2.4	21	4.7	18	28	15	30	30
31	49	28	39	1	24	33	26	0	TS RA SN BR	T		T	0.07	24.55	29.80	2.6	33	7.5	31	28	25	28	31
	48.1	24.4	36.3	¤	14.4	28.1	28.5	0.0	<MONTHLY AVERAGES | TOTALS>			T	0.07	24.75	30.07	3.8	35	6.2	<MONTHLY AVERAGES				
	0.5	0.6	0.6		<DEPARTURE FROM NORMAL>								-0.42	SUNSHINE, CLOUD, & VISIBILITY TABLES ON PAGE 3									

DEGREE DAYS

	MONTHLY TOTAL	MONTHLY DEPARTURE	SEASON TO DATE TOTAL	SEASON TO DATE DEPARTURE
HEATING :	884	-30	2356	-347
COOLING :	0	0	0	0

GREATEST 24-HR PRECIPITATION : 0.07 DATE : 31
GREATEST 24-HR SNOWFALL : T DATE : 31+
GREATEST SNOW DEPTH : T DATE : 31

SEA LEVEL PRESSURE		DATE	TIME
MAXIMUM :	30.56	11	0856
MIMIMUM :	29.68	31	1356

NUMBER OF DAYS WITH			
MAXIMUM TEMP >= 90 : 0	MINIMUM TEMP <= 32 : 28	PRECIPITATION >= 0.01 INCH: 1
MAXIMUM TEMP <= 32 : 1	MINIMUM TEMP <= 0 : 0	PRECIPITATION >= 0.10 INCH: 0
THUNDERSTORMS : 1	HEAVY FOG : 0	SNOWFALL >= 1.0 INCH : 0

JANUARY 2011
ALBUQUERQUE, NM

FEBRUARY 2011
LOCAL CLIMATOLOGICAL DATA
NOAA, National Climatic Data Center

ALBUQUERQUE, NM
ALBUQUERQUE INTL SUNPORT AIRPORT (KABQ)
Lat:35 ° 02'N Long: 106° 36'W Elev (Ground) 5310 Feet
Time Zone : MOUNTAIN WBAN: 23050 ISSN#: 0198-3482

Date	Temperature °F MAXIMUM	MINIMUM	AVERAGE	DEP FROM NORMAL	AVERAGE DEW PT	AVERAGE WET BULB	Deg Days BASE 65° HEATING	COOLING	WEATHER	SNOW/ICE ON GND(IN) 0500 LST DEPTH	1100 LST WATER-EQUIV	PRECIPITATION ON GND(IN) 2400 LST SNOW-FALL	2400 LST WATER EQUIV	PRESSURE (INCHES OF HG) AVERAGE STATION	AVERAGE SEA LEVEL	WIND SPEED = MPH DIR = TENS OF DEGREES RESULTANT SPEED	RES DIR	AVERAGE SPEED	MAXIMUM 3-SEC SPEED	DIR	2-MIN SPEED	DIR	Date
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
01	28	4	16	-22	6	12	49	0	SN FZFG BR HZ BLSN	1		0.8	0.04	24.63	30.06	25.6	09	25.9	44	10	37	10	01
02	9	1	5*	-34	-9	1	60	0	BLSN	0		0.0	0.00	24.89	30.50	20.4	10	20.9	43	11	35	10	02
03	18	-7*	6	-33	-4	4	59	0		0		0.0	0.00	24.89	30.53	0.5	16	5.1	16	01	12	17	03
04	34	7	21	-18	7	18	44	0		0		0.0	0.00	24.78	30.28	2.1	19	3.3	14	17	13	17	04
05	48	19	34	-5	18	27	31	0		0		0.0	0.00	24.60	29.96	4.3	31	6.4	32	31	26	30	05
06	44	23	34	-5	8	26	31	0		0		0.0	0.00	24.76	30.08	10.6	32	11.9	43	33	29	31	06
07	46	18	32	-8	15	26	33	0		0		0.0	0.00	24.74	30.14	4.6	17	5.5	23	18	16	18	07
08	52	18	35	-5	17	28	30	0		0		0.0	0.00	24.51	29.79	3.7	29	12.6	40	25	31	25	08
09	34	11	23	-17	2	16	42	0		0		0.0	0.00	24.82	30.27	4.7	35	5.2	18	35	15	36	09
10	41	12	27	-13	1	20	38	0		0		0.0	0.00	24.79	30.22	4.6	34	6.5	22	01	16	34	10
11	51	24	38	-3	8	26	27	0		0		0.0	0.00	24.92	30.31	6.7	36	7.1	18	33	15	32	11
12	55	19	37	-4	11	29	28	0		0		0.0	0.00	25.01	30.41	1.8	36	3.0	20	34	15	34	12
13	62	26	44	3	11	32	21	0		0		0.0	0.00	24.89	30.23	0.7	36	3.8	13	36	10	36	13
14	63	37	50	9	13	35	15	0		0		0.0	0.00	24.85	30.13	1.5	08	6.5	18	23	16	24	14
15	64	33	49	7	9	34	16	0		0		0.0	0.00	24.80	30.06	0.8	11	2.7	12	01	9	16	15
16	70	33	52	10	14	37	13	0		0		0.0	0.00	24.63	29.86	1.4	26	4.6	20	18	15	19	16
17	64	36	50	8	21	39	15	0		0		0.0	0.00	24.65	29.84	4.9	28	8.1	35	29	29	28	17
18	66	32	49	7	18	38	16	0		0		0.0	0.00	24.76	30.01	3.4	21	7.1	29	21	23	18	18
19	70*	45	58*	16	24	41	7	0	RA DU BLDU	0		0.0	T	24.62	29.83	8.5	19	11.2	77*	23	48*	23	19
20	51	37	44	1	24	36	21	0	RA	0		0.0	T	24.54	29.75	9.2	30	10.9	32	29	26	29	20
21	50	29	40	-3	12	29	25	0		0		0.0	0.00	24.63	29.93	1.8	29	4.2	18	22	15	22	21
22	57	27	42	-1	8	30	23	0		0		0.0	0.00	24.64	29.92	1.0	34	2.9	20	22	14	22	22
23	58	30	44	1	11	33	21	0		0		0.0	0.00	24.60	29.85	3.3	24	6.4	37	31	25	31	23
24	52	33	43	-1	15	33	22	0		0		0.0	0.00	24.65	29.90	8.2	27	9.6	32	28	26	29	24
25	61	30	46	2	12	33	19	0		0		0.0	0.00	24.62	29.88	5.2	22	7.7	33	25	25	26	25
26	64	37	51	7	-3	33	14	0		0		0.0	0.00	24.47	29.68	8.7	19	10.3	35	22	28	19	26
27	48	26	37	-7	7	29	28	0	RA VCBLDU	0		0.0	T	24.48	29.68	8.4	25	12.7	41	28	33	28	27
28	55	22	39	-5	9	28	26	0		0		0.0	0.00	24.90	30.27	2.3	14	3.3	13	17	9	18	28
	50.5	23.6	37.1	¤	10.2	27.6	27.6	0.0	<MONTHLY AVERAGES | TOTALS>			0.8	0.04	24.71	30.05	0.4	25	8.1	<MONTHLY AVERAGES				
	-4.1	-4.6	-4.3		<DEPARTURE FROM NORMAL>								-0.40	SUNSHINE, CLOUD, & VISIBILITY TABLES ON PAGE 3									

DEGREE DAYS

	MONTHLY TOTAL	MONTHLY DEPARTURE	SEASON TO DATE TOTAL	SEASON TO DATE DEPARTURE
HEATING :	774	104	3130	-243
COOLING :	0	0	0	0

GREATEST 24-HR PRECIPITATION : 0.04 DATE : 01
GREATEST 24-HR SNOWFALL : 0.8 DATE : 01
GREATEST SNOW DEPTH : 1 DATE : 01

SEA LEVEL PRESSURE		DATE	TIME
MAXIMUM :	30.64	03	0758
MIMIMUM :	29.45	27	0556

NUMBER OF DAYS WITH ->

MAXIMUM TEMP >= 90 :	0	MINIMUM TEMP <= 32 :	20	PRECIPITATION >= 0.01 INCH:	1
MAXIMUM TEMP <= 32 :	3	MINIMUM TEMP <= 0 :	1	PRECIPITATION >= 0.10 INCH:	0
THUNDERSTORMS :	0	HEAVY FOG :	0	SNOWFALL >= 1.0 INCH :	0

FEBRUARY 2011
ALBUQUERQUE, NM

MARCH 2011
LOCAL CLIMATOLOGICAL DATA
NOAA, National Climatic Data Center

ALBUQUERQUE, NM
ALBUQUERQUE INTL SUNPORT AIRPORT (KABQ)
Lat:35 ° 02'N Long: 106° 36'W Elev (Ground) 5310 Feet
Time Zone : MOUNTAIN WBAN: 23050 ISSN#: 0198-3482

Date	Temperature °F MAXIMUM	MINIMUM	AVERAGE	DEP FROM NORMAL	AVERAGE DEW PT	AVERAGE WET BULB	Deg Days BASE 65° HEATING	COOLING	WEATHER	SNOW/ICE ON GND(IN) 0500 LST DEPTH	1100 LST WATER-EQUIV	PRECIPITATION ON GND(IN) 2400 LST SNOW-FALL	2400 LST WATER EQUIV	PRESSURE (INCHES OF HG) AVERAGE STATION	AVERAGE SEA LEVEL	WIND SPEED = MPH DIR = TENS OF DEGREES RESULTANT SPEED	RES DIR	AVERAGE SPEED	MAXIMUM 3-SEC SPEED	DIR	2-MIN SPEED	DIR	Date
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
01	62	27	45	0	4	31	20	0		0		0.0	0.00	24.84	30.17	0.7	09	4.0	13	03	12	03	01
02	71	34	53	8	9	37	12	0		0		0.0	0.00	24.79	30.04	3.5	30	5.2	28	26	23	27	02
03	70	39	55	10	17	39	10	0		0		0.0	0.00	24.70	29.91	4.7	27	7.3	31	24	24	24	03
04	57	36	47	2	18	36	18	0		0		0.0	0.00	24.80	30.02	12.3	32	14.1	44	30	33	31	04
05	54	26*	40*	-6	16	32	25	0		0		0.0	0.00	24.91	30.26	2.8	12	6.1	18	07	16	08	05
06	61	33	47	1	13	35	18	0		0		0.0	0.00	24.61	29.87	5.9	19	7.2	28	19	15	20	06
07	62	42	52	6	20	38	13	0	RA BLDU VCBLDU	0		0.0	T	24.40	29.55	7.8	23	10.2	59*	21	40	23	07
08	53	35	44	-2	20	35	21	0	RA	0		0.0	T	24.63	29.85	9.4	31	12.6	31	31	25	30	08
09	62	33	48	2	10	34	17	0		0		0.0	0.00	24.95	30.26	10.7	34	11.2	29	31	22	33	09
10	65	33	49	2	15	35	16	0		0		0.0	0.00	24.93	30.23	0.4	02	3.0	13	32	9	30	10
11	75	39	57	10	5	37	8	0		0		0.0	0.00	24.74	29.97	0.5	21	4.6	28	26	21	25	11
12	73	43	58	11	6	38	7	0		0		0.0	0.00	24.71	29.90	3.7	24	6.9	30	24	24	24	12
13	67	45	56	9	11	39	9	0		0		0.0	0.00	24.82	30.02	8.8	33	10.9	37	34	26	31	13
14	68	38	53	5	13	37	12	0		0		0.0	0.00	24.83	30.08	1.0	02	5.3	20	36	16	36	14
15	67	38	53	5	16	39	12	0		0		0.0	0.00	24.78	30.00	1.8	07	3.4	12	06	10	06	15
16	78*	41	60	12	17	41	5	0		0		0.0	0.00	24.73	29.92	3.5	28	8.0	31	25	26	25	16
17	76	50	63	15	19	44	2	0		0		0.0	0.00	24.76	29.91	6.5	25	9.1	28	28	23	25	17
18	74	46	60	11	17	42	5	0		0		0.0	0.00	24.80	29.98	5.0	15	7.4	33	08	29	09	18
19	75	51	63	14	14	43	2	0		0		0.0	0.00	24.68	29.84	2.8	21	11.6	35	08	29	09	19
20	73	37	55	6	-3	37	10	0		0		0.0	0.00	24.70	29.89	6.2	18	7.9	32	18	25	17	20
21	74	44	59	10	3	39	6	0	VCBLDU	0		0.0	0.00	24.55	29.71	16.0	20	17.9	51	18	40*	22	21
22	58	40	49	0	16	36	16	0	RA	0		0.0	T	24.63	29.81	13.3	28	15.3	43	28	37	28	22
23	62	30	46	-4	7	33	19	0		0		0.0	0.00	24.69	29.96	1.3	07	2.4	13	04	9	04	23
24	67	37	52	2	8	36	13	0		0		0.0	0.00	24.58	29.78	6.6	28	9.6	46	29	33	28	24
25	70	35	53	3	11	36	12	0		0		0.0	0.00	24.55	29.75	5.5	25	9.1	35	27	28	28	25
26	64	38	51	1	21	39	14	0		0		0.0	0.00	24.54	29.72	4.4	26	7.9	28	18	22	27	26
27	69	47	58	7	16	40	7	0		0		0.0	0.00	24.55	29.72	6.7	25	9.3	26	26	21	27	27
28	72	41	57	6	15	40	8	0		0		0.0	0.00	24.57	29.73	7.9	25	9.5	32	25	25	25	28
29	66	45	56	5	0	37	9	0		0		0.0	0.00	24.70	29.89	8.4	34	9.9	28	30	22	29	29
30	67	39	53	2	9	38	12	0		0		0.0	0.00	24.68	29.88	11.7	33	12.6	36	34	29	33	30
31	76	49	63*	11	23	44	2	0		0		0.0	0.00	24.68	29.86	12.2	32	13.4	32	33	26	31	31
	67.4	39.1	53.3	¤	12.5	37.6	11.6	0.0	<MONTHLY AVERAGES | TOTALS>			0.0	T	24.70	29.92	3.5	28	8.8	<MONTHLY AVERAGES				
	5.0	5.4	5.2		<—— DEPARTURE FROM NORMAL ——>								-0.61	SUNSHINE, CLOUD, & VISIBILITY TABLES ON PAGE 3									

DEGREE DAYS

	MONTHLY TOTAL	MONTHLY DEPARTURE	SEASON TO DATE TOTAL	SEASON TO DATE DEPARTURE
HEATING :	360	-165	3490	-408
COOLING :	0	0	0	0

GREATEST 24-HR PRECIPITATION : T DATE : 22+
GREATEST 24-HR SNOWFALL : 0.0 DATE :
GREATEST SNOW DEPTH : 0 DATE :

SEA LEVEL PRESSURE		DATE	TIME
MAXIMUM :	30.45	05	0826
MIMIMUM :	29.37	07	1556

NUMBER OF DAYS WITH ->

MAXIMUM TEMP >= 90 :	0	MINIMUM TEMP <= 32 :	3	PRECIPITATION >= 0.01 INCH:	0
MAXIMUM TEMP <= 32 :	0	MINIMUM TEMP <= 0 :	0	PRECIPITATION >= 0.10 INCH:	0
THUNDERSTORMS :	0	HEAVY FOG :	0	SNOWFALL >= 1.0 INCH :	0

MARCH 2011 ALBUQUERQUE, NM

APRIL 2011
LOCAL CLIMATOLOGICAL DATA
NOAA, National Climatic Data Center

ALBUQUERQUE, NM
ALBUQUERQUE INTL SUNPORT AIRPORT (KABQ)
Lat:35 ° 02'N Long: 106° 36'W Elev (Ground) 5310 Feet
Time Zone : MOUNTAIN WBAN: 23050 ISSN#: 0198-3482

Date	Temperature °F MAXIMUM	MINIMUM	AVERAGE	DEP FROM NORMAL	AVERAGE DEW PT	AVERAGE WET BULB	Deg Days BASE 65° HEATING	COOLING	WEATHER	SNOW/ICE ON GND(IN) 0500 LST DEPTH	1100 LST WATER-EQUIV	PRECIPITATION ON GND(IN) 2400 LST SNOW-FALL	2400 LST WATER EQUIV	PRESSURE (INCHES OF HG) AVERAGE STATION	AVERAGE SEA LEVEL	WIND SPEED = MPH DIR = TENS OF DEGREES RESULTANT SPEED	RES DIR	AVERAGE SPEED	MAXIMUM 3-SEC SPEED	DIR	MAXIMUM 2-MIN SPEED	DIR	Date
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
01	81	45	63	11	12	43	2	0		0		0.0	0.00	24.70	29.84	4.1	34	6.7	35	36	23	35	01
02	83	47	65	13	13	43	0	0		0		0.0	0.00	24.63	29.76	3.9	26	6.9	26	28	21	29	02
03	76	44	60	7	21	44	5	0	HZ BLDU VCBLDU	0		0.0	0.00	24.53	29.62	12.5	27	19.6	60*	28	44	27	03
04	60	34	47	-6	0	31	18	0		0		0.0	0.00	24.84	30.11	10.6	34	12.6	38	31	28	31	04
05	75	41	58	5	5	38	7	0		0		0.0	0.00	24.70	29.91	1.8	24	6.6	21	20	17	19	05
06	74	56	65	12	19	44	0	0		0		0.0	0.00	24.63	29.78	9.6	28	11.7	38	28	30	28	06
07	71	50	61	8	28	45	4	0	TSRA RA	0		0.0	0.03	24.52	29.67	7.4	24	9.1	44	24	28	27	07
08	73	46	60	7	19	42	5	0		0		0.0	0.00	24.49	29.62	14.6	18	15.8	43	17	35	17	08
09	69	41	55	1	24	42	10	0	DU BLDU	0		0.0	0.00	24.50	29.63	14.9	22	20.4	52	19	40	22	09
10	55	33	44*	-10	10	32	21	0		0		0.0	0.00	24.73	29.99	12.4	30	13.8	38	28	29	30	10
11	66	31*	49	-5	6	35	16	0		0		0.0	0.00	24.87	30.15	0.6	33	5.5	24	34	17	34	11
12	73	44	59	4	7	39	6	0		0		0.0	0.00	24.69	29.89	1.2	18	4.9	17	22	13	19	12
13	74	41	58	3	9	39	7	0		0		0.0	0.00	24.64	29.81	6.4	24	9.3	26	27	22	26	13
14	63	46	55	0	5	36	10	0	VCBLDU	0		0.0	0.00	24.66	29.84	17.8	30	19.1	48	29	39	29	14
15	68	43	56	1	-5	36	9	0		0		0.0	0.00	24.78	30.00	14.5	33	15.6	38	33	31	32	15
16	75	37	56	0	4	39	9	0		0		0.0	0.00	24.68	29.88	1.0	34	4.7	20	27	15	31	16
17	82	44	63	7	17	44	2	0		0		0.0	0.00	24.58	29.70	8.5	27	10.4	41	28	30	27	17
18	83	53	68	12	18	46	0	3		0		0.0	0.00	24.51	29.60	12.7	26	15.6	41	28	31	27	18
19	78	57	68	12	25	47	0	3		0		0.0	0.00	24.59	29.68	7.2	28	10.6	36	29	25	28	19
20	79	51	65	8	18	45	0	0		0		0.0	0.00	24.67	29.81	6.5	18	8.1	35	18	26	18	20
21	80	58	69*	12	17	46	0	4		0		0.0	0.00	24.62	29.72	13.2	26	14.2	41	27	31	27	21
22	78	55	67	10	18	45	0	2		0		0.0	0.00	24.57	29.68	9.9	26	11.4	37	28	29	27	22
23	70	51	61	4	22	44	4	0	RA BLDU	0		0.0	T	24.58	29.70	5.0	20	8.2	52	19	31	18	23
24	72	53	63	6	24	44	2	0	RA	0		0.0	T	24.55	29.67	9.6	27	12.5	47	25	35	25	24
25	70	45	58	0	25	43	7	0		0		0.0	0.00	24.52	29.67	10.4	30	13.1	37	34	29	29	25
26	65	44	55	-4	22	40	10	0	VCBLDU	0		0.0	0.00	24.44	29.57	19.1	31	20.8	54	31	44*	31	26
27	62	37	50	-9	6	34	15	0		0		0.0	0.00	24.75	29.99	14.4	34	14.9	43	32	33	31	27
28	73	35	54	-5	7	38	11	0		0		0.0	0.00	24.76	30.01	0.8	18	5.8	22	17	17	17	28
29	83*	48	66	7	7	43	0	1	VCBLDU	0		0.0	0.00	24.50	29.60	12.6	25	15.8	49	28	38	27	29
30	66	43	55	-5	4	35	10	0		0		0.0	0.00	24.59	29.75	11.5	34	13.2	37	32	25	34	30
	72.6	45.1	58.9	¤	13.6	40.7	6.3	0.4	<MONTHLY AVERAGES | TOTALS>			0.0	0.03	24.63	29.79	6.6	28	11.9	<MONTHLY AVERAGES				
	2.0	4.6	3.3		<—— DEPARTURE FROM NORMAL ——>								-0.47	SUNSHINE, CLOUD, & VISIBILITY TABLES ON PAGE 3									

DEGREE DAYS

	MONTHLY TOTAL	MONTHLY DEPARTURE	SEASON TO DATE TOTAL	SEASON TO DATE DEPARTURE
HEATING :	190	-104	3680	-512
COOLING :	13	7	13	7

GREATEST 24-HR PRECIPITATION : 0.03 DATE : 07
GREATEST 24-HR SNOWFALL : 0.0 DATE :
GREATEST SNOW DEPTH : 0 DATE :

SEA LEVEL PRESSURE		DATE	TIME
MAXIMUM :	30.28	11	0856
MIMIMUM :	29.43	29	1456

NUMBER OF -> DAYS WITH			
MAXIMUM TEMP >= 90 : 0	MINIMUM TEMP <= 32 : 1	PRECIPITATION >= 0.01 INCH: 1
MAXIMUM TEMP <= 32 : 0	MINIMUM TEMP <= 0 : 0	PRECIPITATION >= 0.10 INCH: 0
THUNDERSTORMS : 1	HEAVY FOG : 0	SNOWFALL >= 1.0 INCH : 0

MAY 2011
LOCAL CLIMATOLOGICAL DATA
NOAA, National Climatic Data Center

ALBUQUERQUE, NM
ALBUQUERQUE INTL SUNPORT AIRPORT (KABQ)
Lat:35 ° 02'N Long: 106° 36'W Elev (Ground) 5310 Feet
Time Zone : MOUNTAIN WBAN: 23050 ISSN#: 0198-3482

Date	Temperature °F MAXIMUM	MINIMUM	AVERAGE	DEP FROM NORMAL	AVERAGE DEW PT	AVERAGE WET BULB	Deg Days BASE 65° HEATING	COOLING	WEATHER	SNOW/ICE ON GND(IN) 0500 LST DEPTH	1100 LST WATER-EQUIV	PRECIPITATION ON GND(IN) 2400 LST SNOW-FALL	2400 LST WATER EQUIV	PRESSURE (INCHES OF HG) AVERAGE STATION	AVERAGE SEA LEVEL	WIND SPEED = MPH DIR = TENS OF DEGREES RESULTANT SPEED	RES DIR	AVERAGE SPEED	MAXIMUM 3-SEC SPEED	DIR	2-MIN SPEED	DIR	Date
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
01	50	37	44*	-16	24	35	21	0	RA SN BR BLDU	0		T	T	24.73	29.99	17.2	10	19.1	47	11	38	11	01
02	57	32*	45	-15	19	35	20	0		0		0.0	0.00	24.96	30.29	1.8	33	4.3	20	09	16	33	02
03	68	35	52	-8	9	36	13	0		0		0.0	0.00	24.93	30.22	2.3	20	5.1	18	18	14	18	03
04	82	44	63	2	7	41	2	0		0		0.0	0.00	24.81	30.01	2.0	25	7.8	39	23	28	24	04
05	78	50	64	3	15	43	1	0		0		0.0	0.00	24.83	30.00	1.6	05	5.4	21	09	17	09	05
06	85	51	68	7	12	45	0	3		0		0.0	0.00	24.67	29.80	4.1	27	8.1	36	25	26	24	06
07	87	52	70	8	6	44	0	5		0		0.0	0.00	24.63	29.73	2.8	21	6.2	29	29	22	24	07
08	85	51	68	6	1	43	0	3		0		0.0	0.00	24.54	29.63	6.9	22	8.5	33	22	25	26	08
09	82	50	66	4	9	43	0	1	BLDU VCBLDU	0		0.0	0.00	24.44	29.52	13.5	21	17.0	52*	19	38	22	09
10	77	48	63	0	22	44	2	0	RA	0		0.0	T	24.46	29.55	6.3	24	11.8	48	18	33	19	10
11	65	38	52	-11	28	41	13	0	RA	0		0.0	T	24.62	29.79	9.1	27	11.0	38	31	30	31	11
12	74	42	58	-5	26	45	7	0		0		0.0	0.00	24.76	29.95	11.0	31	12.0	33	30	26	30	12
13	79	46	63	0	24	46	2	0		0		0.0	0.00	24.79	29.96	3.1	12	8.4	35	12	26	12	13
14	82	55	69	5	22	46	0	4		0		0.0	0.00	24.66	29.79	14.2	12	17.8	41	09	32	09	14
15	79	51	65	1	25	47	0	0	BLDU	0		0.0	0.00	24.68	29.81	14.2	10	16.1	46	09	35	09	15
16	83	53	68	3	14	45	0	3		0		0.0	0.00	24.61	29.72	6.3	17	9.7	37	17	29	17	16
17	73	50	62	-3	16	43	3	0		0		0.0	0.00	24.52		9.0	26	10.2	36	26	23	25	17
18	75	49	62	-3	29	45	3	0	RA VCBLDU	0		0.0	0.03	24.42	29.51	8.1	26	13.6	40	27	31	27	18
19	62	43	53	-12	32	42	12	0	RA	0		0.0	0.02	24.54	29.71	3.7	31	9.7	28	28	23	28	19
20	67	39	53	-13	29	43	12	0	RA	0		0.0	T	24.64	29.84	7.2	29	10.1	39	29	28	29	20
21	76	43	60	-6	29	46	5	0		0		0.0	0.00	24.67	29.84	6.9	32	8.6	32	33	25	31	21
22	81	48	65	-2	27	47	0	0		0		0.0	0.00	24.63	29.75	1.9	27	7.3	32	22	25	22	22
23	82	51	67	0	19	46	0	2		0		0.0	0.00	24.58	29.69	6.8	19	9.0	35	19	23	17	23
24	74	56	65	-3	20	44	0	0		0		0.0	0.00	24.59	29.69	15.3	28	17.2	49	28	40*	29	24
25	81	49	65	-3	19	45	0	0		0		0.0	0.00	24.75	29.90	6.5	32	8.1	30	31	24	34	25
26	89	55	72	4	19	47	0	7		0		0.0	0.00	24.65	29.77	7.3	27	10.6	36	28	29	28	26
27	93	61	77	9	19	50	0	12		0		0.0	0.00	24.58	29.64	11.2	27	11.9	36	26	29	27	27
28	93*	65	79*	10	23	51	0	14		0		0.0	0.00	24.48	29.50	11.0	24	13.0	37	27	28	26	28
29	90	61	76	7	18	49	0	11		0		0.0	0.00	24.42	29.42	16.1	20	17.1	48	21	36	22	29
30	78	60	69	0	17	47	0	4		0		0.0	0.00	24.63	29.69	11.5	27	15.9	43	32	33	29	30
31	87	50	69	-1	8	44	0	4		0		0.0	0.00	24.88	30.04	2.3	21	8.9	31	21	22	21	31
	77.9	48.9	63.4	¤	18.9	44.1	3.7	2.4	<MONTHLY AVERAGES | TOTALS>			T	0.05	24.60	29.72	3.5	24	11.0	<MONTHLY AVERAGES				
	-1.8	-0.8	-1.3		<—— DEPARTURE FROM NORMAL ——>								-0.55	SUNSHINE, CLOUD, & VISIBILITY TABLES ON PAGE 3									

DEGREE DAYS

	MONTHLY TOTAL	MONTHLY DEPARTURE	SEASON TO DATE TOTAL	SEASON TO DATE DEPARTURE
HEATING :	116	31	3796	-481
COOLING :	73	3	86	10

GREATEST 24-HR PRECIPITATION : 0.05 DATE : 18-19
GREATEST 24-HR SNOWFALL : T DATE : 01
GREATEST SNOW DEPTH : 0 DATE :

SEA LEVEL PRESSURE		DATE	TIME
MAXIMUM :	30.36	02	0856
MIMIMUM :	29.33	18	1456

NUMBER OF DAYS WITH ->

MAXIMUM TEMP >= 90 :	3	MINIMUM TEMP <= 32 :	1	PRECIPITATION >= 0.01 INCH:	2
MAXIMUM TEMP <= 32 :	0	MINIMUM TEMP <= 0 :	0	PRECIPITATION >= 0.10 INCH:	0
THUNDERSTORMS :	0	HEAVY FOG :	0	SNOWFALL >= 1.0 INCH :	0

MAY 2011 ALBUQUERQUE, NM

JUNE 2011
LOCAL CLIMATOLOGICAL DATA
NOAA, National Climatic Data Center

ALBUQUERQUE, NM
ALBUQUERQUE INTL SUNPORT AIRPORT (KABQ)
Lat:35 ° 02'N Long: 106° 36'W Elev (Ground) 5310 Feet
Time Zone : MOUNTAIN WBAN: 23050 ISSN#: 0198-3482

Date	Temperature °F MAXIMUM	MINIMUM	AVERAGE	DEP FROM NORMAL	AVERAGE DEW PT	AVERAGE WET BULB	Deg Days BASE 65° HEATING	COOLING	WEATHER	SNOW/ICE ON GND(IN) 0500 LST DEPTH	1100 LST WATER-EQUIV	PRECIPITATION ON GND(IN) 2400 LST SNOW-FALL	2400 LST WATER EQUIV	PRESSURE (INCHES OF HG) AVERAGE STATION	AVERAGE SEA LEVEL	WIND SPEED = MPH DIR = TENS OF DEGREES RESULTANT SPEED	RES DIR	AVERAGE SPEED	MAXIMUM 3-SEC SPEED	DIR	2-MIN SPEED	DIR	Date
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
01	94	62	78	7	35	56	0	13		0		0.0	0.00	24.77	29.86	9.9	19	12.6	40	19	33	17	01
02	93	67	80	9	25	53	0	15	FU	0		0.0	0.00	24.67	29.72	10.8	20	12.5	37	18	29	18	02
03	92	59	76	5	20	50	0	11	FU	0		0.0	0.00	24.70	29.77	7.7	19	10.2	43	19	30	17	03
04	93	62	78	7	28	53	0	13	FU	0		0.0	0.00	24.83	29.91	6.4	14	9.4	36	13	31	12	04
05	91	64	78	6	37	55	0	13	FU BLDU	0		0.0	0.00	24.86	29.97	2.0	15	11.0	41	27	35	09	05
06	93	66	80	7	33	54	0	15	FU	0		0.0	0.00	24.71	29.80	7.7	21	9.7	40	27	31	27	06
07	92	58	75	2	14	48	0	10	HZ FU	0		0.0	0.00	24.67	29.73	1.6	27	5.6	24	29	22	29	07
08	94	57	76	3	5	47	0	11	FU	0		0.0	0.00	24.65	29.72	4.7	20	6.7	37	22	26	22	08
09	88	55*	72	-2	5	46	0	7	FU	0		0.0	0.00	24.70	29.78	3.4	26	6.3	25	26	20	25	09
10	89	59	74	0	6	46	0	9		0		0.0	0.00	24.68	29.76	0.5	19	6.6	23	24	18	24	10
11	90	59	75	1	9	48	0	10	FU	0		0.0	0.00	24.66	29.73	3.7	20	6.0	26	22	21	24	11
12	93	60	77	3	9	48	0	12	FU	0		0.0	0.00	24.68	29.74	7.4	18	8.6	38	14	29	18	12
13	94	61	78	3	6	48	0	13	FU	0		0.0	0.00	24.72	29.79	3.7	22	6.5	33	22	25	22	13
14	91	57	74	-1	10	48	0	9		0		0.0	0.00	24.75	29.83	6.0	33	10.1	31	30	26	27	14
15	93	61	77	2	21	51	0	12		0		0.0	0.00	24.67	29.73	0.6	19	5.1	18	17	14	17	15
16	95	71	83	8	16	52	0	18	FU	0		0.0	0.00	24.57	29.58	8.8	25	11.1	37	27	25	25	16
17	94	62	78	2	13	50	0	13		0		0.0	0.00	24.64	29.67	9.2	25	10.9	35	29	28	28	17
18	94	62	78	2	6	48	0	13		0		0.0	0.00	24.67	29.73	8.9	26	10.8	39	27	29	26	18
19	94	59	77	1	14	49	0	12	FU BLDU	0		0.0	0.00	24.52	29.54	10.3	26	14.8	51*	34	38*	34	19
20	83	57	70*	-6	31	50	0	5	TS RA	0		0.0	T	24.60	29.67	10.8	32	12.2	33	30	26	31	20
21	89	59	74	-2	26	51	0	9		0		0.0	0.00	24.70	29.79	6.0	33	8.0	30	30	18	32	21
22	94	62	78	2	24	52	0	13		0		0.0	0.00	24.75	29.81	2.6	11	4.6	26	08	22	08	22
23	99	64	82	5	19	52	0	17		0		0.0	0.00	24.70	29.74	3.2	19	7.5	26	18	21	27	23
24	100	65	83	6	19	53	0	18		0		0.0	0.00	24.66	29.69	3.8	26	7.6	32	30	25	28	24
25	99	69	84	7	22	54	0	19		0		0.0	0.00	24.68	29.70	5.0	27	8.1	32	29	25	27	25
26	100*	65	83	6	24	54	0	18		0		0.0	0.00	24.69	29.72	6.1	23	10.7	39	27	32	28	26
27	98	70	84	7	30	56	0	19		0		0.0	0.00	24.75	29.79	7.7	12	11.5	40	10	32	09	27
28	97	70	84*	7	40	58	0	19	FU VCBLDU	0		0.0	0.00	24.81	29.86	1.3	19	9.4	39	27	30	26	28
29	96	69	83	5	36	57	0	18		0		0.0	0.00	24.75	29.80	8.4	20	11.5	33	21	28	22	29
30	97	69	83	5	38	57	0	18	RA	0		0.0	T	24.71	29.76	9.4	18	11.8	35	18	30	18	30
	93.6	62.7	78.2	¤	20.7	51.5	0.0	13.4	< MONTHLY AVERAGES | TOTALS >			0.0	T	24.70	29.76	3.7	22	9.2	< MONTHLY AVERAGES				
	3.4	3.3	3.4		← DEPARTURE FROM NORMAL →								-0.65	SUNSHINE, CLOUD, & VISIBILITY TABLES ON PAGE 3									

DEGREE DAYS

	MONTHLY TOTAL	MONTHLY DEPARTURE	SEASON TO DATE TOTAL	SEASON TO DATE DEPARTURE
HEATING :	0	-4	3796	-485
COOLING :	402	105	488	115

GREATEST 24-HR PRECIPITATION : T DATE : 30+
GREATEST 24-HR SNOWFALL : 0.0 DATE :
GREATEST SNOW DEPTH : 0 DATE :

SEA LEVEL PRESSURE		DATE	TIME
MAXIMUM :	30.06	05	0756
MIMIMUM :	29.36	19	1656

NUMBER OF DAYS WITH →

MAXIMUM TEMP >= 90 :	26	MINIMUM TEMP <= 32 :	0	PRECIPITATION >= 0.01 INCH:	0
MAXIMUM TEMP <= 32 :	0	MINIMUM TEMP <= 0 :	0	PRECIPITATION >= 0.10 INCH:	0
THUNDERSTORMS :	1	HEAVY FOG :	0	SNOWFALL >= 1.0 INCH :	0

JUNE 2011 ALBUQUERQUE, NM

JULY 2011
LOCAL CLIMATOLOGICAL DATA
NOAA, National Climatic Data Center

ALBUQUERQUE, NM
ALBUQUERQUE INTL SUNPORT AIRPORT (KABQ)
Lat:35° 2'N Long: 106° 36'W Elev (Ground) 5310 Feet
Time Zone : MOUNTAIN WBAN: 23050 ISSN#: 0198-3482

Date	Temperature °F MAXIMUM	MINIMUM	AVERAGE	DEP FROM NORMAL	AVERAGE DEW PT	AVERAGE WET BULB	Deg Days BASE 65° HEATING	COOLING	WEATHER	SNOW/ICE ON GND(IN) 0500 LST DEPTH	1100 LST WATER-EQUIV	PRECIPITATION ON GND(IN) 2400 LST SNOW-FALL	2400 LST WATER EQUIV	PRESSURE (INCHES OF HG) AVERAGE STATION	AVERAGE SEA LEVEL	WIND SPEED = MPH DIR = TENS OF DEGREES RESULTANT SPEED	RES DIR	AVERAGE SPEED	MAXIMUM 3-SEC SPEED	DIR	2-MIN SPEED	DIR	Date
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
01	97	67	82	4	36	57	0	17		0		0.0	0.00	24.73	29.79	0.4	10	5.7	26	20	23	19	01
02	93	73	83	5	44	60	0	18	TS TSRA RA	0		0.0	T	24.81	29.86	3.7	08	8.5	43	09	37	08	02
03	94	69	82	4	46	60	0	17	RA FU	0		0.0	T	24.81	29.88	5.0	10	10.1	43	08	36	08	03
04	96	68	82	4	42	59	0	17		0		0.0	0.00	24.77	29.84	1.5	12	6.3	36	14	25	15	04
05	94	69	82	4	40	58	0	17		0		0.0	0.00	24.78	29.84	2.9	23	5.5	24	21	18	20	05
06	95	72	84	6	38	58	0	19		0		0.0	0.00	24.80	29.85	6.1	20	8.7	24	22	18	23	06
07	97	70	84	6	39	59	0	19		0		0.0	0.00	24.75	29.80	4.1	19	5.0	22	18	17	19	07
08	97	70	84	6	40	59	0	19		0		0.0	0.00	24.71	29.75	2.4	25	6.9	29	21	21	21	08
09	97	68	83	5	45	60	0	18	RA DU BLDU	0		0.0	T	24.73	29.77	3.9	28	8.0	39	28	33	28	09
10	96	68	82	4	46	61	0	17	TS TSRA RA	0		0.0	T	24.71	29.76	0.7	05	5.9	26	35	21	35	10
11	95	65	80	2	51	61	0	15	RA	0		0.0	T	24.76	29.83	2.0	14	8.5	38	29	33	29	11
12	89	61*	75*	-4	52	61	0	10		0		0.0	0.00	24.77	29.87	4.3	24	6.6	28	26	23	24	12
13	93	68	81	2	49	61	0	16	RA	0		0.0	T	24.72	29.78	4.3	17	5.8	28	13	22	13	13
14	90	69	80	1	47	60	0	15		0		0.0	0.00	24.69	29.75	5.3	18	7.5	21	20	17	19	14
15	95	67	81	2	39	58	0	16		0		0.0	0.00	24.68	29.73	4.4	16	6.3	20	18	16	18	15
16	97	74	86*	7	44	60	0	21		0		0.0	0.00	24.74	29.77	7.3	15	9.0	30	13	25	13	16
17	95	74	85	6	48	62	0	20		0		0.0	0.00	24.83	29.89	7.4	14	11.1	39	14	24	12	17
18	95	75	85	6	50	63	0	20	TS TSRA RA	0		0.0	0.03	24.84	29.92	2.2	12	6.9	38	14	29	13	18
19	97	68	83	4	45	60	0	18	BLDU VCBLDU	0		0.0	0.00	24.79	29.87	1.7	27	6.9	40	24	31	26	19
20	97	70	84	5	50	62	0	19	TS TSRA RA VCBLDU	0		0.0	0.11	24.75	29.81	1.4	05	6.3	45	09	37	08	20
21	96	69	83	4	53	63	0	18	RA SQ VCBLDU	0		0.0	T	24.71	29.78	2.4	22	6.0	45	27	40	25	21
22	94	73	84	5	53	63	0	19	TS TSRA RA	0		0.0	0.14	24.70	29.76	0.7	10	5.8	30	12	25	11	22
23	97	71	84	5	54	63	0	19	RA BLDU	0		0.0	T	24.76	29.83	6.8	09	9.2	54*	08	44*	08	23
24	96	69	83	4	53	63	0	18	TS TSRA RA	0		0.0	0.04	24.86	29.94	2.2	12	7.3	36	02	24	36	24
25	90	67	79	0	55	64	0	14	TS RA	0		0.0	0.07	24.82	29.92	4.0	12	7.9	28	15	25	08	25
26	93	68	81	3	53	63	0	16	RA FU	0		0.0	T	24.73	29.79	2.6	28	7.8	31	33	24	35	26
27	93	65	79	1	51	62	0	14		0		0.0	0.00	24.73	29.80	2.7	31	5.2	25	30	17	31	27
28	97*	67	82	4	50	61	0	17		0		0.0	0.00	24.76	29.83	5.8	08	9.6	37	08	32	08	28
29	90	73	82	4	52	62	0	17	RA	0		0.0	T	24.86	29.94	9.4	09	11.3	29	11	26	13	29
30	92	69	81	3	51	62	0	16	RA	0		0.0	T	24.88	29.99	2.4	09	7.7	43	08	36	08	30
31	91	67	79	1	55	62	0	14	TS RA	0		0.0	T	24.91	30.03	2.8	05	12.0	45	08	38	08	31
	94.5	69.1	81.8	¤	47.5	60.9	0.0	17.1	<MONTHLY AVERAGES | TOTALS>			0.0	0.39	24.77	29.84	1.8	14	7.6	<MONTHLY AVERAGES				
	2.2	4.4	3.3		<DEPARTURE FROM NORMAL>								-0.88	SUNSHINE, CLOUD, & VISIBILITY TABLES ON PAGE 3									

DEGREE DAYS

	MONTHLY TOTAL	MONTHLY DEPARTURE	SEASON TO DATE TOTAL	SEASON TO DATE DEPARTURE
HEATING :	0	0	0	0
COOLING :	530	113	1018	228

GREATEST 24-HR PRECIPITATION : 0.14 DATE : 22
GREATEST 24-HR SNOWFALL : 0.0 DATE :
GREATEST SNOW DEPTH : 0 DATE :

SEA LEVEL PRESSURE		DATE	TIME
MAXIMUM :	30.10	31	2156
MIMIMUM :	29.64	22	1705

NUMBER OF DAYS WITH ->

MAXIMUM TEMP >= 90 :	30	MINIMUM TEMP <= 32 :	0	PRECIPITATION >= 0.01 INCH:	5
MAXIMUM TEMP <= 32 :	0	MINIMUM TEMP <= 0 :	0	PRECIPITATION >= 0.10 INCH:	2
THUNDERSTORMS :	8	HEAVY FOG :	0	SNOWFALL >= 1.0 INCH :	0

AUGUST 2011
LOCAL CLIMATOLOGICAL DATA
NOAA, National Climatic Data Center

ALBUQUERQUE, NM
ALBUQUERQUE INTL SUNPORT AIRPORT (KABQ)
Lat:35° 2'N Long: 106° 36'W Elev (Ground) 5310 Feet
Time Zone : MOUNTAIN WBAN: 23050 ISSN#: 0198-3482

Date	Temperature °F MAXIMUM	MINIMUM	AVERAGE	DEP FROM NORMAL	AVERAGE DEW PT	AVERAGE WET BULB	Deg Days BASE 65° HEATING	COOLING	WEATHER	SNOW/ICE ON GND(IN) 0500 LST DEPTH	1100 LST WATER-EQUIV	PRECIPITATION ON GND(IN) 2400 LST SNOW-FALL	2400 LST WATER EQUIV	PRESSURE (INCHES OF HG) AVERAGE STATION	AVERAGE SEA LEVEL	WIND SPEED = MPH DIR = TENS OF DEGREES RESULTANT SPEED	RES DIR	AVERAGE SPEED	MAXIMUM 3-SEC SPEED	DIR	2-MIN SPEED	DIR	Date
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
01	92	65	79	1	54	63	0	14	VCBLDU	0		0.0	0.00	24.88	29.99	3.7	29	6.9	33	28	29	28	01
02	93	66	80	2	52	63	0	15		0		0.0	0.00	24.80	29.88	0.5	12	6.2	35	08	30	08	02
03	94	68	81	3	55	63	0	16	TS TSRA RA	0		0.0	0.12	24.81	29.89	2.4	06	8.1	41	16	31	16	03
04	92	68	80	2	52	63	0	15		0		0.0	0.00	24.79	29.89	0.8	27	3.7	25	24	22	24	04
05	94	72	83	5	52	63	0	18	TS RA	0		0.0	T	24.79	29.87	2.0	12	6.4	39	15	31	15	05
06	96	68	82	4	48	61	0	17		0		0.0	0.00	24.78	29.86	1.7	19	4.9	18	16	14	16	06
07	99*	71	85*	8	38	58	0	20		0		0.0	0.00	24.75	29.79	2.4	32	5.1	20	27	15	28	07
08	98	68	83	6	20	53	0	18		0		0.0	0.00	24.73	29.77	4.6	34	5.9	26	29	21	31	08
09	98	69	84	7	23	53	0	19		0		0.0	0.00	24.71	29.75	1.7	30	6.1	21	36	17	35	09
10	96	67	82	5	42	59	0	17	TS TSRA RA	0		0.0	T	24.70	29.73	2.4	36	6.3	36	33	25	33	10
11	94	73	84	7	49	62	0	19	RA	0		0.0	T	24.73	29.78	2.1	26	7.2	29	22	23	21	11
12	97	70	84	7	49	62	0	19	TS	0		0.0	0.00	24.75	29.80	3.3	15	6.8	25	09	20	15	12
13	92	73	83	6	51	62	0	18	RA	0		0.0	T	24.83	29.90	3.2	09	11.6	32	08	25	09	13
14	91	68	80	3	49	61	0	15		0		0.0	0.00	24.82	29.92	2.9	19	7.4	23	18	18	18	14
15	92	69	81	5	52	62	0	16		0		0.0	0.00	24.75	29.82	6.1	19	7.6	25	21	21	24	15
16	94	68	81	5	49	62	0	16	TS	0		0.0	0.00	24.79	29.85	5.2	12	7.5	24	08	21	08	16
17	90	70	80	4	55	63	0	15	TS RA SQ VCBLDU	0		0.0	T	24.90	29.99	7.6	08	12.7	41	13	36	14	17
18	92	67	80	4	55	63	0	15	TS TSRA RA	0		0.0	T	24.83	29.94	1.1	32	4.9	26	32	22	31	18
19	90	68	79	3	54	63	0	14	RA	0		0.0	T	24.75	29.83	2.5	28	5.3	23	35	18	30	19
20	89	67	78	2	56	64	0	13	TS TSRA RA	0		0.0	T	24.78	29.86	6.1	05	11.2	36	08	30	08	20
21	87	64*	76*	1	58	64	0	11	TS TSRA RA BR	0		0.0	0.32	24.86	29.96	6.0	08	9.7	29	28	25	28	21
22	92	67	80	5	55	64	0	15		0		0.0	0.00	24.83	29.94	2.8	33	4.4	16	35	13	01	22
23	97	70	84	9	49	62	0	19		0		0.0	0.00	24.78	29.85	1.0	01	4.9	17	35	12	16	23
24	95	67	81	6	50	62	0	16	TS TSRA RA SQ	0		0.0	0.23	24.81	29.88	1.2	04	7.9	47	09	39	09	24
25	93	66	80	5	54	63	0	15	TS TSRA RA VCBLDU	0		0.0	0.15	24.87	29.97	2.9	11	7.3	47	16	38	16	25
26	93	65	79	5	49	62	0	14		0		0.0	0.00	24.88	29.97	0.9	02	4.1	24	14	22	14	26
27	95	73	84	10	48	62	0	19		0		0.0	0.00	24.85	29.93	2.6	04	6.4	29	01	23	02	27
28	96	72	84	10	50	63	0	19	TS TSRA RA	0		0.0	T	24.78	29.84	2.4	03	5.1	36	02	31	02	28
29	94	69	82	8	53	63	0	17	TS TSRA RA SQ VCBLDU	0		0.0	0.11	24.75	29.83	1.3	30	8.7	63*	29	45*	29	29
30	97	68	83	9	44	60	0	18		0		0.0	0.00	24.71	29.78	0.8	24	4.8	20	31	14	29	30
31	96	68	82	9	45	59	0	17	RA VCBLDU	0		0.0	T	24.76	29.82	2.0	24	6.6	45	27	36	27	31
	93.8	68.5	81.2	¤	48.7	61.5	0.0	16.4	< MONTHLY AVERAGES | TOTALS >			0.0	0.93	24.79	29.87	0.6	06	6.8	< MONTHLY AVERAGES				
	4.8	5.3	5.1		<—— DEPARTURE FROM NORMAL ——>								-0.80	SUNSHINE, CLOUD, & VISIBILITY TABLES ON PAGE 3									

DEGREE DAYS

	MONTHLY TOTAL	MONTHLY DEPARTURE	SEASON TO DATE TOTAL	SEASON TO DATE DEPARTURE
HEATING :	0	0	0	0
COOLING :	509	166	1527	394

GREATEST 24-HR PRECIPITATION : 0.38 DATE : 24-25
GREATEST 24-HR SNOWFALL : 0.0 DATE :
GREATEST SNOW DEPTH : 0 DATE :

SEA LEVEL PRESSURE		DATE	TIME
MAXIMUM :	30.09	17	2013
MIMIMUM :	29.66	10	1556

NUMBER OF DAYS WITH ->

MAXIMUM TEMP >= 90 : 29	MINIMUM TEMP <= 32 : 0	PRECIPITATION >= 0.01 INCH: 5
MAXIMUM TEMP <= 32 : 0	MINIMUM TEMP <= 0 : 0	PRECIPITATION >= 0.10 INCH: 5
THUNDERSTORMS : 13	HEAVY FOG : 0	SNOWFALL >= 1.0 INCH : 0

SEPTEMBER 2011
LOCAL CLIMATOLOGICAL DATA
NOAA, National Climatic Data Center

ALBUQUERQUE, NM
ALBUQUERQUE INTL SUNPORT AIRPORT (KABQ)
Lat:35° 2'N Long: 106° 36'W Elev (Ground) 5310 Feet
Time Zone : MOUNTAIN WBAN: 23050 ISSN#: 0198-3482

Date	Temperature °F MAXIMUM	MINIMUM	AVERAGE	DEP FROM NORMAL	AVERAGE DEW PT	AVERAGE WET BULB	Deg Days BASE 65° HEATING	COOLING	WEATHER	SNOW/ICE ON GND(IN) 0500 LST DEPTH	1100 LST WATER-EQUIV	PRECIPITATION ON GND(IN) 2400 LST SNOW-FALL	2400 LST WATER EQUIV	PRESSURE (INCHES OF HG) AVERAGE STATION	AVERAGE SEA LEVEL	WIND SPEED = MPH DIR = TENS OF DEGREES RESULTANT SPEED	RES DIR	AVERAGE SPEED	MAXIMUM 3-SEC SPEED	DIR	2-MIN SPEED	DIR	Date
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
01	94*	68	81*	8	52	62	0	16	TS TSRA RA	0		0.0	0.08	24.80	29.89	0.8	34	7.3	33	21	25	14	01
02	92	63	78	5	51	62	0	13		0		0.0	0.00	24.75	29.84	1.5	31	3.6	16	01	13	02	02
03	93	66	80	7	47	60	0	15	TS TSRA RA	0		0.0	0.01	24.76	29.83	4.5	07	9.9	41	12	36	12	03
04	79	66	73	0	51	59	0	8	RA	0		0.0	T	24.89	30.02	17.2	10	17.5	43	09	33	09	04
05	82	62	72	0	47	57	0	7		0		0.0	0.00	24.87	30.02	3.9	11	7.8	24	08	21	08	05
06	85	65	75	3	53	60	0	10	TS TSRA RA	0		0.0	0.08	24.86	29.98	2.7	19	5.5	26	17	23	17	06
07	82	62	72	0	54	60	0	7	TS RA	0		0.0	0.08	24.91	30.07	6.5	09	7.9	38	09	31	08	07
08	79	59	69	-2	38	52	0	4		0		0.0	0.00	24.94	30.11	9.2	11	12.7	31	08	25	08	08
09	73	58	66	-5	47	54	0	1	RA	0		0.0	0.05	24.88	30.04	12.0	08	14.9	35	08	29	08	09
10	74	60	67	-4	47	55	0	2	RA	0		0.0	T	24.89	30.07	12.4	09	13.0	31	09	28	08	10
11	81	57	69	-2	46	56	0	4	TSRA RA	0		0.0	T	24.93	30.10	2.6	34	4.9	24	29	20	31	11
12	79	56	68	-3	48	56	0	3		0		0.0	0.00	24.95	30.13	1.5	24	5.3	22	19	18	19	12
13	82	55	69	-1	47	56	0	4	TS RA	0		0.0	0.02	24.87	30.04	2.7	27	4.9	31	19	26	19	13
14	78	58	68	-2	50	56	0	3	TS TSRA RA BR	0		0.0	0.07	24.81	29.96	0.6	09	7.4	46	19	32	11	14
15	73	57	65	-4	50	56	0	0	TSRA RA	0		0.0	0.01	24.78	29.95	1.7	18	7.0	33	18	28	18	15
16	79	51*	65*	-4	47	55	0	0		0		0.0	0.00	24.78	29.95	0.6	30	5.8	29	23	21	23	16
17	79	58	69	0	46	55	0	4	TS TSRA RA	0		0.0	T	24.81	29.97	2.0	34	6.4	33	32	25	32	17
18	81	54	68	0	41	53	0	3		0		0.0	0.00	24.90	30.07	5.5	34	6.2	29	32	21	32	18
19	83	55	69	1	40	53	0	4	TS TSRA RA	0		0.0	T	24.87	30.03	1.2	01	4.7	43	23	29	22	19
20	86	57	72	4	34	52	0	7		0		0.0	0.00	24.81	29.93	1.6	01	3.7	26	08	21	09	20
21	84	62	73	5	37	52	0	8	TS TSRA RA	0		0.0	T	24.82	29.95	3.2	07	9.3	55*	29	45*	29	21
22	81	56	69	2	35	51	0	4		0		0.0	0.00	24.89	30.05	5.2	08	8.2	37	09	30	09	22
23	86	52	69	3	28	49	0	4		0		0.0	0.00	24.91	30.07	1.6	36	3.1	13	35	12	33	23
24	87	53	70	4	20	47	0	5		0		0.0	0.00	24.80	29.94	4.3	34	6.1	23	29	18	29	24
25	87	54	71	5	21	48	0	6		0		0.0	0.00	24.73	29.84	1.6	28	4.1	24	27	18	27	25
26	88	55	72	6	30	50	0	7		0		0.0	0.00	24.75	29.86	2.1	20	4.7	18	29	15	28	26
27	85	62	74	8	35	52	0	9	TS RA	0		0.0	T	24.83	29.96	5.9	06	8.8	36	09	29	09	27
28	88	56	72	7	33	52	0	7		0		0.0	0.00	24.81	29.94	4.2	34	5.4	17	35	14	01	28
29	89	60	75	11	32	51	0	10	RA SQ VCBLDU	0		0.0	T	24.88	30.01	9.5	10	14.2	46	14	36	14	29
30	79	58	69	5	34	50	0	4		0		0.0	0.00	24.94	30.13	7.1	10	9.3	41	08	33	10	30
	82.9	58.5	70.7	¤	41.4	54.4	0.0	6.0	<MONTHLY AVERAGES | TOTALS>			0.0	0.40	24.84	29.99	2.7	08	7.7	<MONTHLY AVERAGES				
	0.7	2.5	1.6		<—— DEPARTURE FROM NORMAL ——>								-0.67	SUNSHINE, CLOUD, & VISIBILITY TABLES ON PAGE 3									

DEGREE DAYS

	MONTHLY TOTAL	MONTHLY DEPARTURE	SEASON TO DATE TOTAL	SEASON TO DATE DEPARTURE
HEATING :	0	-29	0	-29
COOLING :	179	31	1706	425

GREATEST 24-HR PRECIPITATION : 0.16 DATE : 06-07
GREATEST 24-HR SNOWFALL : 0.0 DATE :
GREATEST SNOW DEPTH : 0 DATE :

SEA LEVEL PRESSURE		DATE	TIME
MAXIMUM :	30.25	30	0911
MIMIMUM :	29.74	25	1654

NUMBER OF DAYS WITH ->

MAXIMUM TEMP >= 90 :	3	MINIMUM TEMP <= 32 :	0	PRECIPITATION >= 0.01 INCH:	8
MAXIMUM TEMP <= 32 :	0	MINIMUM TEMP <= 0 :	0	PRECIPITATION >= 0.10 INCH:	0
THUNDERSTORMS :	12	HEAVY FOG :	0	SNOWFALL >= 1.0 INCH :	0

SEPTEMBER 2011
ALBUQUERQUE, NM

OCTOBER 2011
LOCAL CLIMATOLOGICAL DATA
NOAA, National Climatic Data Center

ALBUQUERQUE, NM
ALBUQUERQUE INTL SUNPORT AIRPORT (KABQ)
Lat:35° 2'N Long: 106° 36'W Elev (Ground) 5310 Feet
Time Zone : MOUNTAIN WBAN: 23050 ISSN#: 0198-3482

Date	Temperature °F MAXIMUM	MINIMUM	AVERAGE	DEP FROM NORMAL	AVERAGE DEW PT	AVERAGE WET BULB	Deg Days BASE 65° HEATING	COOLING	WEATHER	SNOW/ICE ON GND(IN) 0500 LST DEPTH	1100 LST WATER-EQUIV	PRECIPITATION ON GND(IN) 2400 LST SNOW-FALL	2400 LST WATER EQUIV	PRESSURE (INCHES OF HG) AVERAGE STATION	AVERAGE SEA LEVEL	WIND SPEED = MPH DIR = TENS OF DEGREES RESULTANT SPEED	RES DIR	AVERAGE SPEED	MAXIMUM 3-SEC SPEED	DIR	2-MIN SPEED	DIR	Date
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
01	80	57	69*	5	33	50	0	4		0		0.0	0.00	24.89	30.06	3.9	18	5.7	18	22	14	21	01
02	79	57	68	5	39	52	0	3		0		0.0	0.00	24.90	30.06	2.7	21	4.3	30	22	25	22	02
03	76	55	66	3	44	54	0	1	TS TSRA RA	0		0.0	0.04	24.86	30.05	2.3	15	6.4	32	16	26	15	03
04	65	52	59	-3	50	53	6	0	RA BR	0		0.0	0.41	24.80	29.99	2.4	36	5.7	31	26	24	26	04
05	67	51	59	-3	46	52	6	0	TS TSRA RA BR	0		0.0	0.57	24.67	29.86	3.7	17	7.2	23	20	17	17	05
06	74	48	61	-1	36	47	4	0		0		0.0	0.00	24.55	29.68	6.1	21	16.5	43	19	36	19	06
07	59	41	50	-11	41	44	15	0	RA BR	0		0.0	0.42	24.66	29.88	3.1	34	7.5	25	31	21	30	07
08	59	38	49	-12	32	41	16	0		0		0.0	0.00	24.74	29.99	2.5	33	6.8	20	30	16	30	08
09	61	45	53	-7	33	43	12	0		0		0.0	0.00	24.78	30.02	3.1	07	6.3	21	09	17	08	09
10	68	44	56	-4	33	45	9	0		0		0.0	0.00	24.74	29.97	0.5	07	4.1	17	22	10	21	10
11	76	47	62	3	31	46	3	0		0		0.0	0.00	24.68	29.86	5.0	33	8.0	30	31	24	29	11
12	75	47	61	2	29	46	4	0		0		0.0	0.00	24.79	29.97	4.6	34	5.7	16	36	13	34	12
13	76	45	61	2	28	46	4	0		0		0.0	0.00	24.78		0.2	16	1.2	15	26	10	26	13
14	80	48	64	6	26	46	1	0		0		0.0	0.00	24.78	29.95	3.2	31	4.6	30	29	22	31	14
15	81	51	66	8	31	48	0	1		0		0.0	0.00	24.83	30.01	1.9	04	4.0	15	35	12	36	15
16	83*	48	66	9	30	48	0	1		0		0.0	0.00	24.80	29.97	1.5	09	3.5	14	02	12	02	16
17	76	51	64	7	24	45	1	0		0		0.0	0.00	24.78	29.94	6.8	31	12.1	41	32	32	31	17
18	68	45	57	1	30	44	8	0		0		0.0	0.00	24.89	30.12	2.8	05	6.0	18	08	16	08	18
19	68	43	56	0	29	43	9	0		0		0.0	0.00	24.81	30.05	0.9	18	5.1	20	19	15	19	19
20	77	45	61	5	24	44	4	0		0		0.0	0.00	24.79	29.98	1.3	01	4.3	21	30	13	34	20
21	76	46	61	6	22	43	4	0		0		0.0	0.00	24.86	30.07	1.4	31	3.4	17	30	14	30	21
22	76	44	60	5	21	43	5	0		0		0.0	0.00	24.86	30.06	3.5	32	4.7	23	31	18	31	22
23	75	46	61	7	25	43	4	0		0		0.0	0.00	24.88	30.09	1.3	02	3.5	12	30	9	31	23
24	77	47	62	8	28	46	3	0		0		0.0	0.00	24.83	30.03	3.3	21	7.3	29	21	23	18	24
25	73	54	64	11	39	51	1	0	RA	0		0.0	T	24.76	29.92	3.0	32	8.2	30	31	23	32	25
26	73	40	57	4	39	47	8	0	TS TSRA RA	0		0.0	0.04	24.63	29.81	6.5	10	14.1	46*	09	36*	09	26
27	52	37	45*	-7	31	38	20	0	RA	0		0.0	T	24.78	30.05	4.6	07	6.9			24	08	27
28	61	37	49	-3	30	40	16	0		0		0.0	0.00	24.91	30.21	1.5	33	3.5	13	33	9	32	28
29	66	36*	51	-1	25	40	14	0		0		0.0	0.00	24.83	30.10	3.0	36	3.7	24	35	18	35	29
30	67	43	55	4	22	40	10	0		0		0.0	0.00	24.90	30.14	2.2	36	4.5	17	34	13	35	30
31	70	42	56	5	24	41	9	0		0		0.0	0.00	24.82	30.07	1.7	05	3.5	14	36	12	36	31
	71.4	46.1	58.8	¤	31.5	45.5	6.3	0.3	< MONTHLY AVERAGES | TOTALS >			0.0	1.48	24.82	30.03	0.7	35	6.1	< MONTHLY AVERAGES				
	0.7	2.3	1.5		<—— DEPARTURE FROM NORMAL ——>								0.48	SUNSHINE, CLOUD, & VISIBILITY TABLES ON PAGE 3									

DEGREE DAYS

	MONTHLY TOTAL	MONTHLY DEPARTURE	SEASON TO DATE TOTAL	SEASON TO DATE DEPARTURE
HEATING :	196	-52	196	-81
COOLING :	10	1	1716	426

GREATEST 24-HR PRECIPITATION : 0.98 DATE : 04-05
GREATEST 24-HR SNOWFALL : 0.0 DATE :
GREATEST SNOW DEPTH : 0 DATE :

SEA LEVEL PRESSURE		DATE	TIME
MAXIMUM :	30.28	28	0856
MIMIMUM :	29.56	06	1356

NUMBER OF DAYS WITH ->

MAXIMUM TEMP >= 90 :	0	MINIMUM TEMP <= 32 :	0	PRECIPITATION >= 0.01 INCH:	5
MAXIMUM TEMP <= 32 :	0	MINIMUM TEMP <= 0 :	0	PRECIPITATION >= 0.10 INCH:	3
THUNDERSTORMS :	3	HEAVY FOG :	0	SNOWFALL >= 1.0 INCH :	0

OCTOBER 2011
ALBUQUERQUE, NM

NOVEMBER 2011
LOCAL CLIMATOLOGICAL DATA
NOAA, National Climatic Data Center

ALBUQUERQUE, NM
ALBUQUERQUE INTL SUNPORT AIRPORT (KABQ)
Lat:35° 2'N Long: 106° 36'W Elev (Ground) 5310 Feet
Time Zone : MOUNTAIN WBAN: 23050 ISSN#: 0198-3482

Date	Temperature °F MAXIMUM	MINIMUM	AVERAGE	DEP FROM NORMAL	AVERAGE DEW PT	AVERAGE WET BULB	Deg Days BASE 65° HEATING	COOLING	WEATHER	SNOW/ICE ON GND(IN) 0500 LST DEPTH	1100 LST WATER-EQUIV	PRECIPITATION ON GND(IN) 2400 LST SNOW-FALL	2400 LST WATER EQUIV	PRESSURE (INCHES OF HG) AVERAGE STATION	AVERAGE SEA LEVEL	WIND SPEED = MPH DIR = TENS OF DEGREES RESULTANT SPEED	RES DIR	AVERAGE SPEED	MAXIMUM 3-SEC SPEED	DIR	2-MIN SPEED	DIR	Date
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
01	72*	42	57*	7	21	41	8	0		0		0.0	0.00	24.67	29.86	4.1	18	5.1	23	19	16	19	01
02	59	38	49	-1	18	35	16	0		0		0.0	0.00	24.92	30.17	5.7	36	10.8	37	35	26	34	02
03	54	30	42	-7	17	32	23	0		0		0.0	0.00	24.92	30.27	0.7	17	3.8	15	20	10	19	03
04	64	40	52	3	21	39	13	0		0		0.0	0.00	24.62	29.88	5.1	16	7.7	32	17	25	17	04
05	56	38	47	-1	25	38	18	0	RA VCBLDU	0		0.0	0.08	24.51	29.69	14.2	23	18.1	43*	24	32	28	05
06	52	29	41	-7	23	34	24	0		0		0.0	0.00	24.68	29.97	1.4	15	4.4	17	19	14	19	06
07	55	35	45	-3	26	36	20	0	RA	0		0.0	0.01	24.62	29.88	3.6	26	7.6	40	18	33	17	07
08	49	32	41	-6	24	33	24	0	SN	0		T	T	24.81	30.12	3.1	33	7.9	24	32	20	33	08
09	51	30	41	-6	22	32	24	0		0		0.0	0.00	25.04	30.42	4.4	34	4.9	15	33	13	34	09
10	53	27	40	-6	18	31	25	0		0		0.0	0.00	25.01	30.40	0.6	10	3.0	9	24	7	24	10
11	50	32	41	-5	17	33	24	0		0		0.0	0.00	24.76	30.08	2.6	14	4.4	15	19	13	18	11
12	65	39	52	6	23	39	13	0		0		0.0	0.00	24.65	29.87	5.9	23	8.9	32	28	24	28	12
13	55	44	50	5	32	42	15	0	RA	0		0.0	T	24.63	29.83	8.3	21	9.2	31	27	21	25	13
14	59	37	48	3	30	39	17	0		0		0.0	0.00	24.62	29.86	2.6	24	6.1	23	24	18	24	14
15	59	33	46	2	25	37	19	0		0		0.0	0.00	24.65	29.91	1.9	34	3.8	22	34	16	33	15
16	57	36	47	3	14	34	18	0		0		0.0	0.00	24.83	30.10	6.0	34	6.9	26	34	22	34	16
17	56	30	43	-1	17	33	22	0		0		0.0	0.00	24.83	30.15	1.5	07	5.7	16	36	14	36	17
18	63	35	49	6	21	36	16	0		0		0.0	0.00	24.60	29.86	3.3	17	5.9	21	27	16	29	18
19	61	40	51	8	21	38	14	0		0		0.0	0.00	24.62	29.82	5.3	19	6.5	17	23	14	18	19
20	63	47	55	12	25	41	10	0	RA	0		0.0	T	24.73	29.94	5.3	18	6.9	29	24	18	17	20
21	58	38	48	6	32	40	17	0	RA	0		0.0	T	24.75	30.00	2.8	33	5.1	39	28	33*	28	21
22	58	30	44	2	30	38	21	0		0		0.0	0.00	24.94	30.26	1.7	29	4.5	17	31	15	31	22
23	60	33	47	6	24	36	18	0		0		0.0	0.00	24.93	30.25	1.5	36	3.7	13	35	10	36	23
24	57	34	46	5	24	36	19	0	RA	0		0.0	T	24.79	30.08	0.6	18	4.7	38	18	29	17	24
25	55	44	50	9	35	42	15	0	RA	0		0.0	0.04	24.65	29.88	5.8	30	14.5	37	17	29	18	25
26	49	30	40	-1	12	31	25	0		0		0.0	0.00	25.01	30.33	7.6	35	9.2	41	33	31	34	26
27	51	26*	39*	-1	8	28	26	0		0		0.0	0.00	25.08	30.48	1.1	35	2.7	13	01	9	31	27
28	59	31	45	5	13	33	20	0		0		0.0	0.00	24.93	30.26	3.3	01	4.7	17	02	14	32	28
29	60	37	49	9	17	35	16	0		0		0.0	0.00	24.92	30.21	1.3	01	3.9	18	09	15	09	29
30	57	29	43	4	18	33	22	0		0		0.0	0.00	24.70	30.00	3.7	16	4.6	16	18	13	17	30
	57.2	34.9	46.1	¤	21.8	35.8	18.7	0.0	<MONTHLY AVERAGES | TOTALS>			T	0.13	24.78	30.06	1.2	25	6.5	<MONTHLY AVERAGES				
	0.1	3.3	1.7		<DEPARTURE FROM NORMAL>								-0.49	SUNSHINE, CLOUD, & VISIBILITY TABLES ON PAGE 3									

DEGREE DAYS

	MONTHLY TOTAL	MONTHLY DEPARTURE	SEASON TO DATE TOTAL	SEASON TO DATE DEPARTURE
HEATING :	562	-52	758	-133
COOLING :	0	0	1716	426

GREATEST 24-HR PRECIPITATION : 0.08 DATE : 05
GREATEST 24-HR SNOWFALL : T DATE : 08
GREATEST SNOW DEPTH : 0 DATE :

SEA LEVEL PRESSURE		DATE	TIME
MAXIMUM :	30.60	27	0900
MIMIMUM :	29.47	05	0556

NUMBER OF DAYS WITH ->

MAXIMUM TEMP >= 90 :	0	MINIMUM TEMP <= 32 :	12
MAXIMUM TEMP <= 32 :	0	MINIMUM TEMP <= 0 :	0
THUNDERSTORMS :	0	HEAVY FOG :	0

PRECIPITATION >= 0.01 INCH:	3
PRECIPITATION >= 0.10 INCH:	0
SNOWFALL >= 1.0 INCH :	0

NOVEMBER 2011
ALBUQUERQUE, NM

DECEMBER 2011
LOCAL CLIMATOLOGICAL DATA
NOAA, National Climatic Data Center

ALBUQUERQUE, NM
ALBUQUERQUE INTL SUNPORT AIRPORT (KABQ)
Lat:35° 2'N Long: 106° 36'W Elev (Ground) 5310 Feet
Time Zone : MOUNTAIN WBAN: 23050 ISSN#: 0198-3482

Date	Temperature °F MAXIMUM	MINIMUM	AVERAGE	DEP FROM NORMAL	AVERAGE DEW PT	AVERAGE WET BULB	Deg Days BASE 65° HEATING	COOLING	WEATHER	SNOW/ICE ON GND(IN) 0500 LST DEPTH	1100 LST WATER-EQUIV	PRECIPITATION ON GND(IN) 2400 LST SNOW-FALL	2400 LST WATER EQUIV	PRESSURE (INCHES OF HG) AVERAGE STATION	AVERAGE SEA LEVEL	WIND SPEED = MPH DIR = TENS OF DEGREES RESULTANT SPEED	RES DIR	AVERAGE SPEED	MAXIMUM 3-SEC SPEED	DIR	2-MIN SPEED	DIR	Date
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
01	53	32	43	4	19	33	22	0	VCBLDU	0		0.0	0.00	24.68	29.93	29.8	09	30.8	69*	08	54*	09	01
02	40	30	35	-4	24	30	30	0	SN BR	0		0.2	0.03	24.68	30.04	14.4	09	14.9	49	09	40	09	02
03	39	26	33	-5	29	31	32	0	DZ SN FG+ FG FZFG BCFG BR	1		0.7	0.10	24.65	29.98	4.5	18	5.9	25	21	21	22	03
04	37	26	32	-6	25	29	33	0	SN FG+ FZFG BR	T		0.2	T	24.69	30.07	3.8	11	5.0	36	08	28	09	04
05	27	14	21	-17	11	17	44	0	SN	1		1.0	0.02	24.82	30.25	19.7	09	20.0	46	08	37	09	05
06	30	9*	20*	-18	7	16	45	0	SN	0		T	T	24.89	30.40	4.2	34	5.4	22	34	16	33	06
07	38	17	28	-9	12	21	37	0		0		0.0	0.00	24.89	30.37	0.4	01	4.5	13	35	10	16	07
08	45	19	32	-5	17	25	33	0		0		0.0	0.00	24.79	30.20	0.7	25	2.6	12	14	9	15	08
09	45	24	35	-2	18	27	30	0		0		0.0	0.00	24.91	30.31	4.1	35	6.0	22	36	16	34	09
10	42	22	32	-5	18	26	33	0		0		0.0	0.00	24.92	30.35	1.7	01	3.8	13	02	9	36	10
11	42	20	31	-6	21	27	34	0		0		0.0	0.00	24.75	30.15	1.3	23	2.3	14	20	10	21	11
12	36	28	32	-4	28	31	33	0	RA SN FG+ FG BCFG BR HZ FU	0		T	0.24	24.70	30.07	3.5	34	4.8	17	05	15	05	12
13	46	35	41	5	37	39	24	0	RA FG+ FG BR	0		0.0	0.13	24.65	29.96	0.2	29	4.8	29	22	22	24	13
14	45	33	39	3	29	34	26	0	RA SN BR	0		T	0.10	24.75	30.05	3.7	27	7.1	18	26	15	26	14
15	43	26	35	-1	22	29	30	0		0		0.0	0.00	24.86	30.23	6.9	09	9.2	26	11	18	08	15
16	45	25	35	-1	21	29	30	0		0		0.0	0.00	24.96	30.36	4.3	36	5.6	18	09	15	09	16
17	48	26	37	1	20	30	28	0		0		0.0	0.00	25.00	30.41	4.6	35	4.7	16	35	14	35	17
18	45	28	37	2	28	33	28	0	RA	0		0.0	0.01	24.75	30.11	1.4	17	3.6	14	19	13	19	18
19	38	32	35	0	33	33	30	0	RA SN FG+ FG BCFG BR	0		1.4	0.56	24.54	29.82	0.8	23	4.3	18	03	16	03	19
20	38	26	32	-3	29	31	33	0	FG+ FZFG BR	1		0.0	0.00	24.68	30.04	1.4	14	3.5	13	14	10	14	20
21	41	23	32	-3	27	30	33	0	FG+ FZFG BR	0		0.0	0.00	24.60	29.95	2.9	16	3.5	12	16	9	16	21
22	41	24	33	-2	24	28	32	0	SN BLSN	0		0.7	0.01	24.75	30.10	12.7	10	13.9	51	08	40	08	22
23	36	23	30	-5	17	24	35	0	SN	1		0.1	T	24.94	30.38	6.0	05	10.6	43	07	35	07	23
24	38	18	28	-7	14	22	37	0		0		0.0	0.00	25.01	30.49	3.7	36	5.4	20	01	15	01	24
25	36	17	27	-8	16	23	38	0		0		0.0	0.00	25.00	30.48	0.6	27	3.6	12	36	10	35	25
26	43	16	30	-5	17	25	35	0		0		0.0	0.00	24.89	30.32	1.2	27	1.6	9	28	8	23	26
27	45	21	33	-2	19	26	32	0		0		0.0	0.00	24.90	30.32	1.6	18	3.1	9	20	8	12	27
28	51	25	38	3	17	30	27	0		0		0.0	0.00	24.92	30.30	1.1	30	4.3	13	01	10	01	28
29	56	27	42	8	19	32	23	0		0		0.0	0.00	24.81	30.14	1.1	36	2.5	10	04	9	05	29
30	57	27	42	8	26	35	23	0		0		0.0	0.00	24.81	30.14	2.5	15	3.0	13	15	10	15	30
31	61*	32	47*	13	22	35	18	0		0		0.0	0.00	24.86	30.15	2.2	36	9.4	31	34	21	35	31
	42.8	24.2	33.5	¤	21.5	28.4	31.2	0.0	< MONTHLY AVERAGES | TOTALS >			4.3	1.20	24.96	30.19	2.7	08	6.8	< MONTHLY AVERAGES				
	-5.1	0.0	-2.6		<—— DEPARTURE FROM NORMAL ——>								0.71	SUNSHINE, CLOUD, & VISIBILITY TABLES ON PAGE 3									

DEGREE DAYS

	MONTHLY TOTAL	MONTHLY DEPARTURE	SEASON TO DATE TOTAL	SEASON TO DATE DEPARTURE
HEATING :	968	70	1726	-63
COOLING :	0	0	1716	426

GREATEST 24-HR PRECIPITATION : 0.57 DATE : 18-19
GREATEST 24-HR SNOWFALL : 1.4 DATE : 19
GREATEST SNOW DEPTH : 1 DATE : 23+

SEA LEVEL PRESSURE		DATE	TIME
MAXIMUM :	30.60	25	1002
MIMIMUM :	29.70	19	0756

NUMBER OF DAYS WITH ->

MAXIMUM TEMP >= 90 :	0	MINIMUM TEMP <= 32 :	29	PRECIPITATION >= 0.01 INCH:	9
MAXIMUM TEMP <= 32 :	2	MINIMUM TEMP <= 0 :	0	PRECIPITATION >= 0.10 INCH:	5
THUNDERSTORMS :	0	HEAVY FOG :	7	SNOWFALL >= 1.0 INCH :	2

DECEMBER 2011
ALBUQUERQUE, NM

Wind Erosion Calculation Sheet for Temporary Stockpile

Calculations based on:

Disturbed Area:	8330	meter^2	flat pile	2	Acres
Frequency of Distubance:	Total Pile 14 Day Disturbance				
Roughness length:	0.3	cm			
Threshold Friction Velocity:	1.02	m/s			

Met Data: One year of maximum 2-minute mile data from Albuquerque Airport, 2011

Methodology: AP42 13.2.5

Zo	0.3
u*t =	1.02
area (m2)	8330

	TSP	PM10	PM2.5
g	153697.2	76848.58	11527.29
lbs	338.8385	169.4193	25.41289
tons	0.169419	0.08471	0.012706

Wind Erosion Calculation Sheet for Waste Stockpile

Calculations based on:

Disturbed Area:	17569	meter^2	flat pile	4	Acres
Frequency of Distubance:	Total Pile 14 Day Disturbance				
Roughness length:	0.3	cm			
Threshold Friction Velocity:	1.02	m/s			

Met Data: One year of maximum 2-minute mile data from Albuquerque Airport, 2011

Methodology: AP42 13.2.5

Zo	0.3
u*t =	1.02
area (m2)	17569

	TSP	PM10	PM2.5
g	324166.3	162083.2	24312.47
lbs	714.6524	357.3262	53.59893
tons	0.357326	0.178663	0.026799

Wind Erosion Calculation Sheet for Tailings Area

Calculations based on:

Disturbed Area:	1364145	meter^2	flat pile	337	Acres
Frequency of Distubance:	Total Area 7 Day Disturbance				
Roughness length:	0.3	cm			
Threshold Friction Velocity:	1.12	m/s			

Met Data: One year of maximum 2-minute mile data from Albuquerque Airport, 2011

Methodology: AP42 13.2.5

Zo	0.3
u*t =	1.12
area (m2)	1364145

	TSP	PM10	PM2.5
g	8060686	4030343	604551.5
lbs	17770.47	8885.236	1332.785
tons	8.885236	4.442618	0.666393

ICP Ochoa Polyhalite Plant - Wind Erosion Calculation Totals

				Uncontrolled						Controlled					
				TSP		PM10		PM2.5		TSP		PM10		PM2.5	
Emission Unit ID	**Source Description**	**Rated Capacity**	**Emission Calculation Method**	**(lbs/hr)**	**TPY**	**(lbs/hr)**	**TPY**	**(lbs/hr)**	**TPY**	**(lbs/hr)**	**TPY**	**(lbs/hr)**	**TPY**	**(lbs/hr)**	**TPY**
	Temporary Polyhalite Stockpile Wind Erosion	8,330 sqmeters	AP42-13.2.5-2	0.039	0.17	0.019	0.085	0.0029	0.013	0.039	0.17	0.019	0.085	0.0029	0.013
	Waste Stockpile Wind Erosion	17,569 sqmeters	AP42-13.2.5-2	0.082	0.36	0.041	0.18	0.0061	0.027	0.082	0.36	0.041	0.18	0.0061	0.027
	Tailings Area Wind Erosion	1,364,145 sqmeters	AP42-13.2.5-2	2.0	8.9	1.0	4.4	0.15	0.67	2.0	8.9	1.0	4.4	0.15	0.67
				2.1	**9.4**	**1.1**	**4.7**	**0.16**	**0.71**	**2.1**	**9.4**	**1.1**	**4.7**	**0.16**	**0.71**

Mojave Desert Air Quality Management District
Antelope Valley Air Pollution Control District

Emissions Inventory Guidance

Mineral Handling and Processing Industries

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I. Reason for Guidance

The mineral handling and processing industry is the Mojave Desert Air Quality Management District's (District) dominant industry in terms of emissions, number of permit units, and revenue. The mineral industry performs a number of characteristic operations associated with extracting minerals from the Earth's crust and processing them. Aside from equipment and material differences, these operations and processes are essentially the same from facility to facility. Accordingly, the District has prepared this document to ensure that these common operations and processes have their emissions estimated consistently throughout the region.

Why is the District concerned with consistency? Two reasons: accuracy and fairness. The District emissions inventory as a whole will be more accurate if every process of a given type has its emissions estimated using the same methodology (as opposed to a myriad methods of unknown or questioned accuracy). Actions taken by the District that depend on the emissions inventory (such as attainment plans and the rules that implement them) will be fairly applied if all processes are represented in the emissions inventory to the same extent.

This attempt to impose regularity and claim to improve accuracy should not be construed as a criticism of existing inventories or methodologies. On the contrary, District staff greatly appreciates the efforts of the many individuals who have created the existing methodologies and used them to estimate emissions. Nor does District staff claim to have the most accurate inventory; rather, District staff are attempting to establish a minimum level of known accuracy. Methods more accurate than those presented herein will be accepted.

II. Background

Federal and State law requires air districts to prepare and maintain as accurate and current an emissions inventory as possible. This inventory must include criteria (oxides of nitrogen, volatile organic compounds, carbon monoxide, oxides of sulfur, particulate matter, and lead), hazardous, and toxic air pollutants. The emissions inventory is used to determine attainment strategies, progress towards clean air goals, and air quality relative to other districts.

III. Approach of this Guidance

This guidance will present methodologies for a large number of emissions-generating operations and processes. The methodologies will be provided with several levels of increasing complexity and accuracy; each level of increased complexity will require greater input (and effort) from the user. In practice, this means that an equation is provided for each process, with a variety of default equation inputs specified. At the lowest level of complexity, an emission factor is specified that can simply be multiplied by a process activity rate.

The greatest level of complexity and accuracy involves the use of data from a source test (if feasible). Of course, the District would prefer all emission inventories to be based on source test results or continuous emission monitor (CEMS) data. This is not feasible due to obvious cost and time constraints. However, a properly performed and documented source test (and/or CEMS data) provides the greatest accuracy possible, and represents a method that will always be accepted in lieu of a methodology presented herein. Other methods may be accepted, if they have been documented and approved by the District.

This guidance document is accompanied by a set of electronic spreadsheets that contains each of the equations used in these methodologies. This allows the user to 'plug-in' her local values and calculates her local result.

IV. Source Test Data

For a source test to be used to generate an emission factor, it must include additional emissions- and activity-related information. The following can be considered required supplemental elements for a source test report that is submitted to support or generate a set of equipment-specific emission factors.

A. <u>Process flow diagram</u> that specifies pickup points
B. <u>Control equipment description</u> that defines operational parameters during test (such as water use or pressure drop).
C. <u>Throughput</u> during test in hourly units (or shorter term units), including a discussion of maximum design throughput, average throughput, and actual throughput during the test.
D. <u>Exhaust concentrations and mass emission rates</u>, including front half, back half, and total

emissions. The concentrations and mass rates should identify values for total hydrocarbon, reactive organic gases and volatile organic compounds. The concentrations and mass rates should also identify values for total suspended particulate, particulate 10 microns and less, and particulate 2.5 microns and less.

V. Calculation Spreadsheet Accessory

An accessory spreadsheet has been prepared for this document. The spreadsheet contains each of the equations referenced in the guidance. The equations are programmed into input and output spreadsheet cells to assist the user. The spreadsheet was prepared in Microsoft Excel, and two versions are available. The spreadsheet is titled "Mineral Guidance Equations" and is in Microsoft Excel 97 format. The version titled "Mineral Guidance Equations 95" is in Microsoft Excel 95 format.

The spreadsheet is in the format of a multiple-worksheet workbook, with a separate worksheet for each method (the worksheets have individual tabs at the lower left). Those values which can be entered by the user are defined in dark blue, and the cells in which the values can be typed have a turquoise background. Selected turquoise cells may have a value pre-entered; these values are the District default values, and can be replaced by a known local value. After all necessary turquoise cells have a value, the results of the equation are automatically calculated (the user may need to hit the 'enter' key after entering the last value). In each case the calculated values are displayed in units of pounds and tons of the applicable pollutants.

Please contact District emissions inventory staff if you encounter any problems or errors with the calculation spreadsheet accessory.

VI. Methods

Each method will be presented in the same format. The method will begin with a detailed discussion of the processes and operations for which it is an applicable emissions estimation methodology. The method itself will then be provided, beginning with the most conservative and least complex version, and followed by increasingly complex and data-intensive versions. Each method will culminate with the complete equation (where possible), for which the user has the option of providing all inputs. The District has prepared tables calculating likely values for various common inputs. Each method contains a discussion of applicable control strategies (where possible), and appropriate calculation methods for those. Each method concludes with a source reference.

A. Blast Hole Drilling

This procedure applies to the drilling of charge holes for open pit or open shelf blasting. Note that the activity input for the equation requires the total amount of material shifted, including, topsoil, overburden and ore. Blast hole drilling is often performed by portable internal combustion engine powered drills; exhaust emissions from this equipment are not accounted for by this method. Such exhaust emissions should be estimated using methods presented elsewhere.

"Shifted" is defined as loosened sufficiently to require removal or further handling.

Least Complex:

Assume negligible particulate emissions from blast hole drilling. This can only be assumed by facilities shifting less than 50,000 tons per year of ore, overburden and topsoil combined.

Intermediate Complexity:

This method employs a conservative factor times the total amount of material shifted by blasting.

$$E = E_f \times Q$$

E = Particulate matter emissions rate in pounds per year
E_f = Emission factor in units of pounds of particulate per ton shifted by blasting
Q = Amount of material of all types shifted by blasting during the year in tons

TSP E_f = 0.001 pounds/ton
PM_{10} E_f = 0.0008 pounds/ton
$PM_{2.5}$ E_f = 0.0008 pounds/ton

Blast Hole Drilling Table 1 -- Blasting Activity Based Emissions									
Activity in tons (yearly)	50000	75000	100000	125000	150000	175000	200000	225000	250000
TSP Emissions (tons)	0.03	0.04	0.05	0.06	0.08	0.09	0.10	0.11	0.13
PM10 Emissions (tons)	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.10
PM2.5 Emissions (tons)	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.10

Most Complex:

This method requires an estimate of the number of shot holes drilled on an annual basis.

$$E = E_f \times N$$

E = Particulate matter emissions rate in pounds per year
E_f = Emission factor in units of pounds of particulate per hole drilled
N = Number of blast holes drilled per year

TSP E_f = 1.3 pounds/hole
PM_{10} E_f = 0.68 pounds/hole
$PM_{2.5}$ E_f = 0.68 pounds/hole

Blast Hole Drilling Table 2 -- Drilling Activity Based Emissions														
Number of Holes (yearly)	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400
TSP Emissions (tons)	0.07	0.13	0.20	0.26	0.33	0.39	0.46	0.52	0.59	0.65	0.72	0.78	0.85	0.91
PM10 Emissions (tons)	0.03	0.07	0.10	0.14	0.17	0.20	0.24	0.27	0.30	0.34	0.37	0.41	0.44	0.47
PM2.5 Emissions (tons)	0.03	0.07	0.10	0.14	0.17	0.20	0.24	0.27	0.30	0.34	0.37	0.41	0.44	0.47

Control Techniques:

None are presently quantified. The methods assume a wet drilling operation. Enclosures, air return or other control strategies can be employed for an estimated control efficiency, subject to District review and approval.

Source:

The intermediate complexity method employs a low confidence emission factor presented in Chapter 15 of the Air & Waste Management Association Air Pollution Engineering Manual, 1992 edition (Stone and Quarrying Processing). The high complexity method employs a relatively highly rated emission factor derived from overburden drilling operations at western surface coal mines presented in §11.9 of USEPA's AP-42 (January 1995 reformatted version).

B. Dust Entrainment from Blasting

This procedure applies to the fracturing and loosening of topsoil, ore, overburden and substrate in open pits and open shelves through the use of explosives. Note that activity rates for this method require the total amount of material shifted through the use of blasting, including topsoil, overburden and ore. "Shifted" is defined as loosened sufficiently to require removal or further handling.

Least Complex:

This method employs a conservative factor times the total amount of material shifted by blasting.

$$E = E_f \times B$$

E = Particulate matter emissions rate in pounds per year
E_f = Emission factor in units of pounds of particulate per ton shifted by blasting
B = Amount of material of all types shifted by blasting during the year in tons

E_f (TSP) = 0.16 pounds/ton
E_f (PM_{10}) = 0.08 pounds/ton
E_f ($PM_{2.5}$) = 0.08 pounds/ton

Blasting Table 1 -- Weight Based Emissions									
Activity in tons (yearly)	50000	75000	100000	125000	150000	175000	200000	225000	250000
TSP Emissions (tons)	4	6	8	10	12	14	16	18	20
PM10 Emissions (tons)	2	3	4	5	6	7	8	9	10
PM2.5 Emissions (tons)	2	3	4	5	6	7	8	9	10

Most Complex:

This method requires information on the horizontal area shifted by blasting, and the number of such blasts performed during the year. This method cannot be used if blasting depth exceeds 70 feet.

$$E = k \times N \times 0.0005 \times A^{1.5}$$

E = Particulate matter emissions rate in pounds per year
k = Particulate matter size factor
N = Number of blasts per year
A = Horizontal area shifted by each blast in square feet

k (TSP) = 1.00
k (PM_{10}) = 0.52
k ($PM_{2.5}$) = 0.52

Blasting Table 2 -- Area Based TSP Emissions in tons per year							
	Number of Weekly Blasts						
Typical Shelf Area	1	2	3	4	5	6	7
1000	0.41	0.82	1.23	1.64	2.06	2.47	2.88
1500	0.76	1.51	2.27	3.02	3.78	4.53	5.29
2000	1.16	2.33	3.49	4.65	5.81	6.98	8.14
2500	1.63	3.25	4.88	6.50	8.12	9.75	11.38
3000	2.14	4.27	6.41	8.54	10.68	12.82	14.95
3500	2.69	5.38	8.08	10.77	13.46	16.15	18.84
4000	3.29	6.58	9.87	13.16	16.44	19.73	23.02

Blasting Table 3 -- Area Based PM10 and PM2.5 Emissions in tpy							
	Number of Weekly Blasts						
Typical Shelf Area	1	2	3	4	5	6	7
1000	0.21	0.43	0.64	0.86	1.07	1.28	1.50
1500	0.39	0.79	1.18	1.57	1.96	2.36	2.75
2000	0.60	1.21	1.81	2.42	3.02	3.63	4.23
2500	0.84	1.69	2.54	3.38	4.23	5.07	5.92
3000	1.11	2.22	3.33	4.44	5.55	6.66	7.78
3500	1.40	2.80	4.20	5.60	7.00	8.40	9.80
4000	1.71	3.42	5.13	6.84	8.55	10.26	11.97

Control Techniques:

None are presently quantified. The method does not assume any emission reducing procedures. Certain control techniques are available, such as blast blankets. Control strategies can be employed for an estimated control efficiency, subject to District review and approval.

Source:

The most complex method employs a poorly rated emission factor derived from blasting operations at western surface coal mines presented in §11.9 of USEPA's AP-42 (January 1995 reformatted version).

C. Criteria Emissions from Blasting Explosives

This procedure estimates the criteria pollutants generated by the detonation of explosives for blasting. This is a "least complex" method that multiplies an emission factor by the total amount of explosives detonated in a year.

$$E = E_f \times A$$

E = Pollutant emissions rate in pounds per year
E_f = Emission factor in units of pounds of pollutant per ton of explosive detonated
A = Amount of explosive detonated throughout the year in tons

Explosives Table 1 -- Emission Factors				
Explosive Type	Composition	CO	NOx	TOG
Black Powder	Potassium nitrate, charcoal and sulfur	170	---	4.2
Smokeless Powder	Nitrocellulose	77	---	1.1
Dynamite, straight	Nitroglycerine, sodium nitrate, wood pulp, calcium carbonate	281	---	2.5
Dynamite, ammonia	Nitroglycerine, ammonium nitrate, sodium nitrate, wood pulp	63	---	1.3
Dynamite, gelatin	Nitroglycerine	104	53	0.7
ANFO	Ammonium nitrate, fuel oil	67	17	---
TNT	Trinitrotoluene	796	---	14.3
RDX	Cyclotrimethylenetrinitroamine	196	---	---
PETN	Pentaerythritol tetranitrate	297	---	---

Note that VOC emissions are considered negligible for all explosives. TSP, PM_{10} and $PM_{2.5}$ emissions are subsumed within the dust entrainment estimations.

Source:

This method is presented in §13.3 of USEPA's AP-42 (January 1995 reformatted version).

D. Bulldozing, Scraping and Grading of Materials

This procedure applies to the bulldozing, scraping and grading of topsoil, overburden, waste material, and ore through the use of heavy equipment such as bulldozers, graders, scrapers, etc. This procedure does not apply to the lifting and dumping of said materials; such lifting and dumping emissions should be estimated using methods presented elsewhere.

Least Complex:

This method applies a conservative factor times the annual hours of operation.

$$E = E_f \times T$$

E = Particulate matter emissions rate in pounds per year
E_f = Emission factor in units of pounds of particulate per hour of operation
T = Annual activity in hours

TSP E_f = 886 pounds/hour
PM_{10} E_f = 431 pounds/hour
$PM_{2.5}$ E_f = 132 pounds/hour

(These emission factors were calculated using the defaults given in the Most Complex section)

Bulldozing Table 1 - Time Based Emissions					
Activity in hours (yearly)	1040	2080	2920	6240	8760
TSP Emissions (tons)	460.72	921.44	1293.56	2764.32	3880.68
PM10 Emissions (tons)	224.12	448.24	629.26	1344.72	1887.78
PM2.5 Emissions (tons)	68.64	137.28	192.72	411.84	578.16

Most Complex:

This method presents an equation requiring inputs for the moisture content and silt content of the material being moved, as well as an estimate of the total amount of material moved.

$$E = E_f \times T \qquad E_f = 2.76 \times k \times \frac{s^{1.5}}{M^{1.4}}$$

E = Particulate matter emissions rate in pounds per year
E_f = Emission factor in pounds per hour of operation
T = Extent of material moving operation in hours per year
k = Particulate aerodynamic factor (see below)
s = Average silt content in percent (%)
M = Average moisture content of material in percent (%)

k (TSP) = 0.74 (dimensionless)
k (PM_{10}) = 0.36
k ($PM_{2.5}$) = 0.11

Conservative silt content default is 30 percent
Conservative moisture content default is 0.5 percent

Bulldozing Table 2 -- Emission Factor (Ef) for Total Suspended Particulates (TSP)							
	Moisture Content (%)						
Silt Content (%)	0.25	0.50	0.75	1.00	1.50	2.00	2.50
0.50	5.0290	1.9056	1.0802	0.7221	0.4093	0.2736	0.2002
1.00	14.2241	5.3899	3.0553	2.0424	1.1577	0.7739	0.5663
5.00	159.0303	60.2612	34.1594	22.8347	12.9440	8.6527	6.3311
10.00	449.8055	170.4444	96.6173	64.5864	36.6111	24.4737	17.9071
15.00	826.3455	313.1264	177.4974	118.6527	67.2589	44.9610	32.8974
20.00	1272.2422	482.0896	273.2751	182.6778	103.5519	69.2219	50.6489
25.00	1778.0125	673.7407	381.9135	255.3000	144.7182	96.7406	70.7840
30.00	2337.2581	885.6552	502.0384	335.6006	190.2370	127.1688	93.0479
50.00	5028.9787	1905.6266	1080.2146	722.0974	409.3248	273.6238	200.2072
70.00	8330.5150	3156.6749	1789.3780	1196.1561	678.0475	453.2584	331.6438

Bulldozing Table 3 -- Emission Factor (Ef) for PM10							
	Moisture Content (%)						
Silt Content (%)	0.25	0.50	0.75	1.00	1.50	2.00	2.50
0.50	2.4465	0.9271	0.5255	0.3513	0.1991	0.1331	0.0974
1.00	6.9198	2.6221	1.4864	0.9936	0.5632	0.3765	0.2755
5.00	77.3661	29.3163	16.6181	11.1088	6.2971	4.2094	3.0800
10.00	218.8243	82.9189	47.0030	31.4204	17.8108	11.9061	8.7116
15.00	402.0059	152.3318	86.3501	57.7229	32.7206	21.8729	16.0041
20.00	618.9286	234.5301	132.9446	88.8703	50.3766	33.6755	24.6400
25.00	864.9790	327.7658	185.7958	124.2000	70.4034	47.0630	34.4354
30.00	1137.0445	430.8593	244.2349	163.2651	92.5477	61.8659	45.2666
50.00	2446.5302	927.0616	525.5098	351.2906	199.1310	133.1143	97.3981
70.00	4052.6830	1535.6797	870.5082	581.9138	329.8609	220.5041	161.3402

Bulldozing Table 4 -- Emission Factor (Ef) for PM2.5							
	Moisture Content (%)						
Silt Content (%)	0.25	0.50	0.75	1.00	1.50	2.00	2.50
0.50	0.7476	0.2833	0.1606	0.1073	0.0608	0.0407	0.0298
1.00	2.1144	0.8012	0.4542	0.3036	0.1721	0.1150	0.0842
5.00	23.6396	8.9577	5.0777	3.3944	1.9241	1.2862	0.9411
10.00	66.8630	25.3363	14.3620	9.6007	5.4422	3.6380	2.6619
15.00	122.8351	46.5458	26.3847	17.6376	9.9979	6.6834	4.8902
20.00	189.1171	71.6620	40.6220	27.1548	15.3928	10.2897	7.5289
25.00	264.2992	100.1507	56.7709	37.9500	21.5122	14.3804	10.5219
30.00	347.4303	131.6514	74.6273	49.8866	28.2785	18.9035	13.8314
50.00	747.5509	283.2688	160.5724	107.3388	60.8456	40.6738	29.7605
70.00	1238.3198	469.2355	265.9886	177.8070	100.7908	67.3762	49.2984

Control Techniques:

Water spray is commonly used to reduce fugitive dust from this type of activity. Water spray essentially increases the moisture content of the material. Therefore, to take credit for the use of

water spray as an emissions control technique, measure the moisture content of the material when being actively moistened and use this value in the method.

Particulate emissions can also be reduced through the use of wind screens or enclosures (on a relatively small scale). The District assumes that complete coverage by wind screens (on the windward side) will provide a control efficiency of 75 percent.

$$E_c = E \times \left(\frac{100 - C}{100} \right)$$

E_c	=	Controlled emissions
E	=	Uncontrolled emissions
C	=	Control efficiency in percent (%)

Source:

The method is derived from the Western Surface Coal Mining discussion in §11.9 of USEPA's AP-42 (January 1995 reformatted version).

E. Material Handling Operations

This procedure applies to the handling of materials in batches and conveyor belts, including loading, unloading, transferring and dropping. "Materials" include topsoil, overburden, waste material and ore. This procedure specifically applies to the operation of heavy equipment such as front end loaders and shovels as well as conveyor belts. This procedure is intended to be applied to each material handling point. This means that each batch drop should be counted. For example, a loader dropping a quantity of material into a temporary storage pile, then dropping into a dump truck, then the dump truck dumping into a long term storage pile would be three separate operations which should be separately accounted for.

Least Complex:

This method multiplies a conservative factor by the total amount of material moved in a year.

$$E = E_f \times Q$$

E = Particulate matter emissions rate in pounds per year
E_f = Emission factor in units of pounds of particulate per ton handled
Q = Quantity of material handled per year in tons

TSP E_f = 0.029 pounds/ton
PM_{10} E_f = 0.014 pounds/ton
$PM_{2.5}$ E_f = 0.004 pounds/ton

(These emission factors were calculated using the defaults given in the Most Complex section)

Material Handling Table 1 - Weight Based Emissions											
Activity in tons (yearly)	10000	20000	30000	40000	50000	60000	70000	80000	90000	100000	110000
TSP Emissions (tons)	0.15	0.29	0.44	0.58	0.73	0.87	1.02	1.16	1.31	1.45	1.60
PM10 Emissions (tons)	0.07	0.14	0.21	0.28	0.35	0.42	0.49	0.56	0.63	0.70	0.77
PM2.5 Emissions (tons)	0.06	0.11	0.17	0.22	0.28	0.33	0.39	0.44	0.50	0.55	0.61

Most Complex:

This method presents an equation requiring inputs for the mean wind speed at the handling site, moisture content of the material being moved, and an estimate of the total amount of material handled.

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

E = Particulate matter emissions rate in pounds per year
E_f = Emission factor in pounds per ton handled
Q = Quantity of material handled per year in tons
k = Particulate aerodynamic factor (see below)

U = Mean wind speed in miles per hour
M = Average moisture content of material handled in percent (%)

k (TSP) = 0.74 (dimensionless)
k (PM_{10}) = 0.36
k ($PM_{2.5}$) = 0.11

Conservative mean wind speed default is 7.7 mph
Conservative moisture content default is 0.5 percent

Material Handling Table 2 -- Emission Factor (Ef) for TSP							
	Wind Speed (mph)						
Moisture Content (%)	5.0	7.5	10.0	12.5	15.0	20.0	25.0
0.25	0.0435	0.0737	0.1072	0.1432	0.1815	0.2639	0.3527
0.50	0.0165	0.0279	0.0406	0.0543	0.0688	0.1000	0.1336
0.75	0.0093	0.0158	0.0230	0.0308	0.0390	0.0567	0.0758
1.00	0.0062	0.0106	0.0154	0.0206	0.0261	0.0379	0.0506
1.50	0.0035	0.0060	0.0087	0.0117	0.0148	0.0215	0.0287
2.00	0.0024	0.0040	0.0058	0.0078	0.0099	0.0144	0.0192
2.50	0.0017	0.0029	0.0043	0.0057	0.0072	0.0105	0.0140

Material Handling Table 3 -- Emission Factor (Ef) for PM10							
	Wind Speed (mph)						
Moisture Content (%)	5.0	7.5	10.0	12.5	15.0	20.0	25.0
0.25	0.0212	0.0359	0.0521	0.0697	0.0883	0.1284	0.1716
0.50	0.0080	0.0136	0.0198	0.0264	0.0335	0.0486	0.0650
0.75	0.0045	0.0077	0.0112	0.0150	0.0190	0.0276	0.0369
1.00	0.0030	0.0052	0.0075	0.0100	0.0127	0.0184	0.0246
1.50	0.0017	0.0029	0.0042	0.0057	0.0072	0.0104	0.0140
2.00	0.0012	0.0020	0.0028	0.0038	0.0048	0.0070	0.0093
2.50	0.0008	0.0014	0.0021	0.0028	0.0035	0.0051	0.0068

Material Handling Table 4 -- Emission Factor (Ef) for PM2.5							
	Wind Speed (mph)						
Moisture Content (%)	5.0	7.5	10.0	12.5	15.0	20.0	25.0
0.25	0.0065	0.0110	0.0159	0.0213	0.0270	0.0392	0.0524
0.50	0.0025	0.0042	0.0060	0.0081	0.0102	0.0149	0.0199
0.75	0.0014	0.0024	0.0034	0.0046	0.0058	0.0084	0.0113
1.00	0.0009	0.0016	0.0023	0.0031	0.0039	0.0056	0.0075
1.50	0.0005	0.0009	0.0013	0.0017	0.0022	0.0032	0.0043
2.00	0.0004	0.0006	0.0009	0.0012	0.0015	0.0021	0.0029
2.50	0.0003	0.0004	0.0006	0.0008	0.0011	0.0016	0.0021

Control Techniques:

Water spray is commonly used to reduce fugitive dust from this type of activity. Water spray essentially increases the moisture content of the material. Therefore, to take credit for the use of water spray as an emissions control technique, measure the moisture content of the material when being actively moistened and use this value in the method.

Some materials and process lines are exposed and lose moisture rapidly. Measuring moisture content at a given point in the process line will not accurately reflect the control efficiency of the wet suppression. In these cases, refer to the following table.

Material Handling Table 5 -- Control Techniques		
Control Technique	Control Efficiency (%)	Discussion
Water Spray (Application Point)	75	
Chemical Additive (Application Point)	85	
Water Spray (Downstream Effect)	75-(5*n)	n = number of transfer points from initial application
Chemical Additive (Downstream Effect)	85-(5*n)	
Conveyor with Half Cover	50	Covers less than 60 percent of conveyor
Conveyor with Three Quarter Cover	70	Covers less than 85 percent of conveyor
Conveyor with Full Cover	85	Completely covers conveyor width
Baghouse with Multiple Pickups	95	Baghouse must meet minimum flow standard given in Table 6
Baghouse with Single Pickup (Unenclosed)	97	
Baghouse with Single Pickup (Partial Enclosure)	98	
Baghouse with Single Pickup (Full Enclosure)	99	
Baghouse with Single Pickup (Attached)	99.5	

Material Handling Table 6 -- Required Baghouse Flow Ratios (in cfm/sq ft)																			
	Type of Material																		
Type of Baghouse/ Filter Cloth	Alumina	Bauxite	Carbon Black	Cement	Clay	Feldspar	Fly Ash	Graphite	Gypsum	Iron Oxide	lead Oxide	Lime	Limestone	Quartz	Rock Dust	Sand	Silica	Slate	Talc
Shaker/Woven or Reverse Air/Woven	2.5	2.5	1.5	2.0	2.5	2.2	2.5	2.0	2.0	2.5	2.0	2.5	2.7	2.8	3.0	2.5	2.5	3.5	2.5
Pulse Jet/Felt or Reverse Air/Felt	8	8	5	8	9	9	8	8	10	7	6	10	8	8	9	10	7	12	10

Note that higher baghouse control efficiencies can be justified with source tests, permit conditions and/or design factors.

Particulate emissions can also be reduced through the use of wind screens or enclosures (on a relatively small scale). The District assumes that complete coverage by wind screens (on the windward side) will provide a control efficiency of 75 percent.

Once the control efficiency of the applicable control technique is known, the following equation is used to determine the "controlled" emissions from the operation or process:

$$E_c = E \times \left(\frac{100 - C}{100} \right)$$

E_c = Controlled emissions
E = Uncontrolled emissions
C = Control efficiency in percent (%)

Source:

The method is presented in the Aggregate Handling and Storage Pile discussion in §13.2.4 of USEPA's AP-42 (January 1995).

F. Material Crushing and Screening Operations

This procedure applies to the crushing and screening of materials. This is effectively a "least complex" method that multiplies an emission factor by annual throughput. This method applies to each occurrence of a crushing or screening operation; in a process line with primary crushing and a screen, secondary crushing and a screen, and tertiary crushing followed by a screen, this method should be applied six times (to six potentially different throughputs).

$$E = E_f \times T$$

E = Particulate matter emissions rate in pounds per year
E_f = Emission factor in units of pounds of particulate per ton of throughput
T = Throughput of material processed per year in tons

Material Crushing and Screening Table 1 -- Emission Factors			
	Emission Factor		
Processing Device	TSP	PM10	PM2.5
Dry Primary or Secondary Crushing	0.280	0.017	0.005
Wet Primary or Secondary Crushing	0.018	0.001	0.001
Tertiary Crushing	1.850	0.112	0.035
Dry Screening	0.160	0.120	0.038
Wet Screening	neg	neg	neg

Note: "neg" indicates negligible emissions.

Control Techniques:

Please refer to the control techniques discussion in the Material Handling Operations section.

Source:

The method is derived from the Sand and Gravel Processing discussion in the Air & Waste Management Association Air Pollution Engineering Manual (1992 edition).

G. Wind Erosion From Stockpiles

This procedure applies to wind erosion from open storage piles.

Least Complex:

This method employs a conservative emission factor multiplied by the surface area of a stockpile.

$$E = E_f \times A$$

E = Particulate matter emissions rate in tons per year
E_f = Emission factor in units of tons of particulate per surface acre
A = Exposed surface area of stockpile in acres

TSP E_f = 8.10 tons/acre
PM_{10} E_f = 4.05 tons/acre
$PM_{2.5}$ E_f = 1.62 tons/acre

(These emission factors were calculated using the defaults given in the Most Complex section)

Stockpile Table 1 -- Area Based Emissions								
Area (acres)	0.02	0.11	0.23	0.46	1.00	2.00	5.00	10.00
Area (square feet)	1000	5000	10000	20000	43560	87120	217800	435600
TSP Emissions (tons)	0.19	0.93	1.86	3.72	8.10	16.20	40.50	81.00
PM10 Emissions (tons)	0.09	0.46	0.93	1.86	4.05	8.10	20.25	40.50
PM2.5 Emissions (tons)	0.04	0.19	0.37	0.74	1.62	3.24	8.10	16.20

Most Complex:

This method presents an equation requiring inputs for the silt content of the stockpiled material, the average number of days during the year in question that experienced at least 0.01 inches of precipitation, the percentage of time during the year that the unobstructed wind speed exceeded 12 mph, and the exposed surface area of the stockpile.

$$E = E_f \times A \qquad E_f = J \times 1.7 \times \frac{sL}{1.5} \times \frac{(365 - P)}{235} \times \frac{I}{15} \times \frac{365}{2000}$$

E = Particulate matter emissions rate in tons per year
E_f = Emission factor in tons per acre
A = Exposed surface area of stockpile in acres
J = Particulate aerodynamic factor (see below)
sL = Average silt loading of storage pile in percent (%), see below
P = Average number of days during the year with at least 0.01 inches of precipitation
I = Percentage of time with unobstructed wind speed >12 mph in percent (%)

J (TSP) = 1.0
J (PM_{10}) = 0.5
J ($PM_{2.5}$) = 0.2

Conservative silt loading default is 30 percent
Conservative days with precipitation default is 20
Conservative windy hours default is 13.3 percent

Stockpile Table 2 -- Silt Content Percentages	
Stockpile Material	Silt Content (%)
Limestone	0.5
Crushed Limestone	1.5
Asphalt Batching	5.0
Coal	6.0
Concrete Batching	6.0
Sand and Gravel Processing	8.0
Overburden	10.0
Blend Ore and Dirt	15.0
Flue Dust	20.0
Inorganic Minerals	30.0

Stockpile Table 3 -- TSP Emissions for P = 20 days with >=0.01 inches								
I (% of winds > than 12 mph)	Silt Content (%)							
	0.5	1.0	5.0	10.0	15.0	20.0	25.0	30.0
5	0.051	0.101	0.506	1.012	1.518	2.024	2.530	3.036
10	0.101	0.202	1.012	2.024	3.036	4.049	5.061	6.073
15	0.152	0.304	1.518	3.036	4.555	6.073	7.591	9.109
20	0.202	0.405	2.024	4.049	6.073	8.097	10.122	12.146

Stockpile Table 4 -- PM10 Emissions for P = 20 days with >=0.01 inches								
I (% of winds > than 12 mph)	Silt Content (%)							
	0.5	1.0	5.0	10.0	15.0	20.0	25.0	30.0
5	0.025	0.051	0.253	0.506	0.759	1.012	1.265	1.518
10	0.051	0.101	0.506	1.012	1.518	2.024	2.530	3.036
15	0.076	0.152	0.759	1.518	2.277	3.036	3.796	4.555
20	0.101	0.202	1.012	2.024	3.036	4.049	5.061	6.073

Stockpile Table 5 -- PM2.5 Emissions for P = 20 days with >=0.01 inches								
I (% of winds > than 12 mph)	Silt Content (%)							
	0.5	1.0	5.0	10.0	15.0	20.0	25.0	30.0
5	0.010	0.020	0.101	0.202	0.304	0.405	0.506	0.607
10	0.020	0.040	0.202	0.405	0.607	0.810	1.012	1.215
15	0.030	0.061	0.304	0.607	0.911	1.215	1.518	1.822
20	0.040	0.081	0.405	0.810	1.215	1.619	2.024	2.429

Control Techniques:

Fugitive particulate emissions from storage piles can be reduced through the use of water spray (by increasing the moisture content of the material). The following table presents the required minimum water application rates to achieve a given control efficiency. Water application or use records must accompany any watering control efficiency claim.

Stockpiles Table 6 -- Watering Control Efficiency (%)	
Desired Efficiency (%)	Daily Water Application Rate (gal/acre)
50	1703
60	2390
70	3396
80	5083
85	6506
90	8892
95	14279

Stockpile fugitive particulate emissions can also be reduced through the use of wind screens or enclosures. The District assumes that complete coverage by wind screens (on the windward side) will provide a control efficiency of 75 percent.

Once the control efficiency of the applicable control technique is known, the following equation is used to determine the "controlled" emissions from the operation or process:

$$E_c = E \times \left(\frac{100 - C}{100} \right)$$

E_c = Controlled emissions
E = Uncontrolled emissions
C = Control efficiency in percent (%)

Source:

The method is derived from the Fugitive Emissions discussion in the Air & Waste Management Association Air Pollution Engineering Manual (1992 edition).

H. Stationary Equipment Exhaust

This procedure estimates exhaust from a wide variety of fuel-burning stationary equipment used in the mineral industry. This is a "least complex" method that multiplies an emission factor by annual fuel use, and should be used only if source test or manufacturer guaranteed emissions data is not available for the equipment in question. This method requires fuel type and annual fuel use as inputs. Boilers, Space Heaters, Generic Industrial Process Heaters, Internal Combustion Engines, and Gas Turbines are covered by this method.

$$E = E_f \times F$$

E = Pollutant emissions rate in pounds per year
E_f = Emission factor in units of pounds of pollutant per unit of fuel use
F = Annual fuel consumption in millions of cubic feet (MMCF) for natural gas or 1000's of gallons for gasoline, diesel or propane

Stationary Equipment Table 1 -- Emission Factors

Equipment Type	Fuel Type	Fuel Units	TOG	ROG	CO	NOx	SOx	TSP	PM10
Boiler >100 MMBTU/hr	Natural Gas	MMCF	3.18	1.40	40.0	550.0	0.60	3.00	3.00
Boiler 10-100 MMBTU/hr	Natural Gas	MMCF	6.36	2.80	35.0	140.0	0.60	3.00	3.00
Boiler <10 MMBTU/hr	Natural Gas	MMCF	12.05	5.30	20.0	100.0	0.60	3.00	3.00
Boiler, Cogeneration	Natural Gas	MMCF	3.18	1.40	40.0	275.0	0.60	3.00	3.00
Boiler	Fuel Oil #2, 0.5% S	1000 gal	0.21	0.20	5.0	20.0	71.80	2.00	1.95
	Fuel Oil #2, 0.05% S	1000 gal	0.21	0.20	5.0	20.0	7.18	2.00	1.95
	Propane or LPG	1000 gal	0.65	0.60	1.8	8.8	1.50	0.26	0.26
Space Heater	Natural Gas	MMCF	12.05	5.30	20.0	100.0	0.60	3.00	3.00
	Fuel Oil #2, 0.5% S	1000 gal	0.74	0.70	5.0	18.0	72.00	2.50	2.44
	Fuel Oil #2, 0.05% S	1000 gal	0.74	0.70	5.0	18.0	7.20	2.50	2.44
	Propane or LPG	1000 gal	0.69	0.63	2.0	7.5	1.50	1.85	1.85
Generic Industrial Process Heater	Natural Gas	MMCF	12.05	5.30	20.0	100.0	0.60	3.00	2.85
	Fuel Oil #2, 0.5% S	1000 gal	0.21	0.20	5.0	20.0	53.50	2.00	1.95
	Fuel Oil #2, 0.05% S	1000 gal	0.21	0.20	5.0	20.0	5.35	2.00	1.95
	Propane or LPG	1000 gal	0.65	0.60	1.8	8.8	1.50	0.26	0.25
Internal Combustion Engine	Natural Gas	MMCF	799.42	187.06	430.0	3400.0	0.60	10.00	9.94
	Fuel Oil #2, 0.5% S	1000 gal	37.42	33.08	102.0	469.0	15.60	33.50	32.70
	Fuel Oil #2, 0.05% S	1000 gal	37.42	33.08	102.0	469.0	1.56	33.50	32.70
	Propane or LPG	1000 gal	800.39	187.29	129.0	139.0	0.35	5.00	4.97
	Gasoline	1000 gal	164.13	148.96	3940.0	102.0	5.31	6.47	6.43
Gas Turbine, Cogeneration	Natural Gas	MMCF	66.54	15.57	115.0	413.0	0.60	14.00	13.92
Gas Turbine	Natural Gas	MMCF	121.50	28.43	115.0	413.0	0.60	14.00	13.92
	Fuel Oil #2, 0.5% S	1000 gal	5.56	4.92	15.4	67.8	70.00	5.00	4.88
	Fuel Oil #2, 0.05% S	1000 gal	5.56	4.92	15.4	67.8	7.00	5.00	4.88

Note that, for the above table, the ROG emission factors can be used as VOC emission factors, and the PM_{10} emission factors can be used as $PM_{2.5}$ emission factors.

Source:

These generic factors are derived from a variety of sources (primarily USEPA's AP-42).

I. Mobile Equipment and Vehicular Exhaust

This procedure estimates the exhaust and brake wear emissions from a variety of mobile equipment common in the mineral industry. Note that this method estimates exhaust from mobile equipment only, and dust entrainment due to the travel of mobile equipment on paved and unpaved surfaces should be estimated using the methods presented elsewhere in this document. This is effectively a "least complex" method that multiplies a conservative emission factor by annual activity in hours of use, fuel consumption in 1000's of gallons, or travel in 1000's of miles.

$$E = E_f \times A$$

E = Pollutant emissions rate in pounds per year
E_f = Emission factor in units of pounds of pollutant per unit of activity
A = Annual activity consumption in 1000's of horsepower-hours, 1000's of gallons of diesel fuel burned, or 1000's of vehicle miles traveled

Mobile Equipment Table 1 -- Emission Factors

Equipment Type	Activity Type	Activity Units	TOG	ROG	CO	NOx	SOx	TSP	PM10
Heavy Duty Diesel Off Road	Hours of Operation	1000 hp-hr	2.42	2.34	7.5	24.3	2.91	1.54	1.53
Heavy Duty Gasoline Off Road	Hours of Operation	1000 hp-hr	16.53	15.99	474.0	9.9	2.82	0.13	0.13
Miscellaneous Natural Gas or Propane Off Road	Hours of Operation	1000 hp-hr	10.40	10.06	275.6	11.9	1.50	0.13	0.13
Locomotives	Fuel Burned	1000 gal	36.00	34.46	115.0	659.0	47.35	15.50	14.88
Light Duty Gasoline On or Off Road	Distance Traveled	1000 vmt	2.92	2.67	18.8	2.3	0.12	0.47	0.21
Heavy Duty Diesel On Road	Distance Traveled	1000 vmt	4.21	4.10	17.4	29.1	0.94	4.62	4.02

Note that, for the above table, the ROG emission factors can be used as VOC emission factors, and the PM_{10} emission factors can be used as $PM_{2.5}$ emission factors.

Control Techniques:

None are presently quantified.

Source:

This method is consists of fleet average emission factors derived from the District emission inventory.

J. Dust Entrainment from Paved Roads

This procedure applies to all traffic on paved roads. This procedure estimates the dust entrainment due to vehicular travel on paved surfaces. Vehicular exhaust emissions should be estimated using methods presented elsewhere.

Least Complex:

This method consists of multiplying a conservative default emission factor for a typical haul truck operating on a material laden surface by an estimate of that haul trucks annual activity in vehicle mile traveled.

$$E = E_f \times V$$

E = Particulate matter emissions rate in pounds per year
E_f = Emission factor in units of pounds of pollutant per mile traveled
V = Annual travel in units of vehicle miles traveled

E_f (TSP) = 55 pounds/mile traveled
E_f (PM_{10}) = 11 pounds/mile traveled
E_f ($PM_{2.5}$) = 3 pounds/mile traveled
(These emission factors were calculated using the defaults given in the Most Complex section)

Paved Roads Table 1 -- Activity Based Emissions									
Activity (miles traveled)	500	1000	5000	10000	20000	50000	100000	150000	200000
TSP Emissions (tons)	13.75	27.50	137.50	275	550	1375	2750	4125	5500
PM10 Emissions (tons)	2.75	5.50	27.50	55	110	275	550	825	1100
PM2.5 Emissions (tons)	0.75	1.50	7.50	15	30	75	150	225	300

Most Complex:

This method calculates a vehicle-specific emission factor based on paved surface silt loading and vehicle weight, and multiplies it by annual vehicular activity in miles traveled.

$$E = E_f \times V \qquad E_f = k \times \left(\frac{sL}{2}\right)^{0.65} \times \left(\frac{W}{3}\right)^{1.5}$$

E = Particulate matter emissions rate in pounds per year
E_f = Emission factor in units of pounds of pollutant per mile traveled
V = Annual travel in units of vehicle miles traveled
k = Aerodynamic particle size multiplier (see below)
sL = Roadway silt loading, in grams per square meter
W = Mean vehicle weight in tons

k (TSP) = 0.082

$k\ (PM_{10})$ = 0.016
$k\ (PM_{2.5})$ = 0.004

Conservative silt loading default is 100 grams per square meter
Conservative mean vehicle weight default is 42 tons

Paved Roads Table 2 -- Default Silt Loadings	
Paved Surface	Silt Loading (g/m2)
Freeway or High Traffic	0.1
Low Traffic Road	0.4
Municipal Solid Waste Landfill	7
Quarry	8
Concrete Batching	12
Sand and Gravel Processing	70
Industrial Site	100
Asphalt Batching	120

Paved Roads Table 3 -- Emission Factors (Ef) for TSP							
Silt Loading (g/m2)	Mean Vehicle Weight (W) in tons						
	2.5	5.0	10.0	15.0	25.0	50.0	100.0
0.4	0.02	0.06	0.18	0.32	0.69	1.96	5.54
1.0	0.04	0.11	0.32	0.58	1.26	3.56	10.06
1.5	0.05	0.15	0.41	0.76	1.64	4.63	13.09
5.0	0.11	0.32	0.91	1.66	3.58	10.12	28.63
10.0	0.18	0.50	1.42	2.61	5.62	15.88	44.92
15.0	0.23	0.65	1.85	3.40	7.31	20.67	58.47
25.0	0.32	0.91	2.58	4.73	10.19	28.81	81.49
50.0	0.51	1.43	4.04	7.43	15.98	45.21	127.88
100.0	0.79	2.24	6.35	11.66	25.08	70.94	200.66
150.0	1.03	2.92	8.26	15.17	32.65	92.34	261.17
200.0	1.24	3.52	9.96	18.29	39.36	111.32	314.87

Paved Roads Table 4 -- Emission Factors (Ef) for PM10							
Silt Loading (g/m2)	Mean Vehicle Weight (W) in tons						
	2.5	5.0	10.0	15.0	25.0	50.0	100.0
0.4	0.00	0.01	0.03	0.06	0.14	0.38	1.08
1.0	0.01	0.02	0.06	0.11	0.25	0.69	1.96
1.5	0.01	0.03	0.08	0.15	0.32	0.90	2.55
5.0	0.02	0.06	0.18	0.32	0.70	1.97	5.59
10.0	0.03	0.10	0.28	0.51	1.10	3.10	8.77
15.0	0.05	0.13	0.36	0.66	1.43	4.03	11.41
25.0	0.06	0.18	0.50	0.92	1.99	5.62	15.90
50.0	0.10	0.28	0.79	1.45	3.12	8.82	24.95
100.0	0.15	0.44	1.24	2.27	4.89	13.84	39.15
150.0	0.20	0.57	1.61	2.96	6.37	18.02	50.96
200.0	0.24	0.69	1.94	3.57	7.68	21.72	61.44

Paved Roads Table 5 -- Emission Factors (Ef) for PM2.5							
Silt Loading (g/m2)	Mean Vehicle Weight (W) in tons						
	2.5	5.0	10.0	15.0	25.0	50.0	100.0
0.4	0.001	0.003	0.009	0.016	0.034	0.096	0.270
1.0	0.002	0.005	0.016	0.029	0.061	0.173	0.491
1.5	0.003	0.007	0.020	0.037	0.080	0.226	0.639
5.0	0.006	0.016	0.044	0.081	0.175	0.494	1.396
10.0	0.009	0.024	0.069	0.127	0.274	0.775	2.191
15.0	0.011	0.032	0.090	0.166	0.357	1.008	2.852
25.0	0.016	0.044	0.126	0.231	0.497	1.405	3.975
50.0	0.025	0.070	0.197	0.362	0.780	2.205	6.238
100.0	0.039	0.109	0.310	0.569	1.224	3.461	9.788
150.0	0.050	0.142	0.403	0.740	1.592	4.504	12.740
200.0	0.061	0.172	0.486	0.892	1.920	5.430	15.360

Control Techniques:

Several control techniques are effective in reducing dust entrainment emissions from paved surfaces. Broom sweeping provides a 20 percent control effectiveness. Vacuum sweeping with at least a 12,000 cfm blower provides 45 percent control effectiveness (30 percent for PM_{10} and $PM_{2.5}$). Water flushing can also be used, but at least 0.48 gallons per square yard (or 8448 gallons per mile of 30 foot road) must be used to qualify for the following control efficiencies:

Paved Road Table 6 -- Water Flushing Control Efficiency		
Method	Control Efficiency (%)	Discussion
Water flushing	69-(0.231*V)	V is the number of vehicle passes since the last water flush
Water flushing followed by sweeping	96-(0.263*V)	

Once the control efficiency of the applicable control technique is known, the following equation is used to determine the "controlled" emissions from the operation or process:

$$E_c = E \times \left(\frac{100 - C}{100} \right)$$

E_c = Controlled emissions
E = Uncontrolled emissions
C = Control efficiency in percent (%)

Source:

These methods were derived from the Paved Roads discussion in §13.2.1 of USEPA's AP-42 (October 1997 version).

K. Dust Entrainment from Unpaved Roads

This procedure applies to all traffic on unpaved roads. This procedure estimates the dust entrainment due to vehicular travel on unpaved surfaces. Vehicular exhaust emissions should be estimated using methods presented elsewhere.

Least Complex:

This method consists of a conservative default emission factor (based on average vehicle weight in tons) multiplied by an estimate of annual vehicular activity in miles traveled.

$$E = E_f \times V$$

E = Particulate matter emissions rate in pounds per year
E_f = Emission factor in units of pounds of particulate per mile traveled
V = Annual travel in units of vehicle miles traveled
(These emission factors were calculated using the defaults given in the Most Complex section)

Unpaved Road Table 1 -- Default Emission Factors (Ef) in pounds/vmt								
Average weight (tons):	3	5	10	20	50	100	150	200
TSP Emission Factor	9.33	12.04	17.03	24.08	38.08	53.85	65.96	76.16
PM10 Emission Factor	2.43	2.97	3.93	5.18	7.47	9.86	11.60	13.01
PM2.5 Emission Factor	0.35	0.43	0.57	0.76	1.09	1.44	1.69	1.90

Most Complex:

This method calculates a vehicle specific emission factor based on unpaved surface silt content in percent, average vehicle weight in tons, and unpaved surface moisture content in percent, and multiplies it by annual vehicular activity in miles traveled.

$$E = E_f \times V$$

$$E_{f(TSP)} = 10 \times \left(\frac{s}{12}\right)^{0.8} \times \left(\frac{W}{3}\right)^{0.5} \times \left(\frac{M}{0.2}\right)^{-0.4}$$

$$E_{f(PM_{10})} = 2.6 \times \left(\frac{s}{12}\right)^{0.8} \times \left(\frac{W}{3}\right)^{0.4} \times \left(\frac{M}{0.2}\right)^{-0.3}$$

$$E_{f(PM_{2.5})} = 0.38 \times \left(\frac{s}{12}\right)^{0.8} \times \left(\frac{W}{3}\right)^{0.4} \times \left(\frac{M}{0.2}\right)^{-0.3}$$

E = Particulate matter emissions rate in pounds per year
E_f = Emission factor in units of pounds of pollutant per mile traveled
V = Annual travel in units of vehicle miles traveled (vmt)
s = Unpaved surface silt content in percent (%)
W = Average vehicle weight in tons

M = Unpaved surface moisture content in percent (%)

Unpaved Roads Table 2 -- Default Silt Content	
Source	Silt Loading (%)
Sand & gravel plant road	5
Landfill road	6
Rural road (gravel/crushed limestone surface)	6
Industrial haul road	8
Construction site scraper route	9
Stone quarrying and processing plant road	10
Rural road (dirt surface)	11
Coal mine scraper route	17
Coal mine freshly graded haul road	24

Conservative default silt content is 11 percent
Conservative default surface moisture content is 0.2 percent
Default average vehicle speed is assumed to be at least 15 mph

Control Techniques:

Several techniques are used to reduce fugitive dust emissions from vehicular travel on unpaved roads. The equation suggests that reducing travel, speed, and vehicle weight will directly reduce emissions. In addition, changing the nature of the unpaved surface can reduce emissions, as can be seen from the default silt loading table. Chemical stabilization is often used, but the control efficiency of chemical stabilization is very dependent on the material used and how it is applied; consult with the vendor and the District to derive a control efficiency for chemical stabilization (no control efficiency will be allowed for calcium chloride). Watering is the most common control technique for unpaved roads. What follows is an equation to calculate the control efficiency for a given water application rate:

$$C_f = 100 - \left(0.0012 \times \frac{A \times D \times T}{I}\right)$$

C_f = Control efficiency of watering application in percent
A = Average annual class A pan evaporation in inches
D = Average hourly traffic rate in vehicles per hour
T = Time between water applications in hours
I = Water application intensity in gallons per square yard

Conservative average annual evaporation is 75 inches
Conservative time between applications is 3 hours
Conservative watering intensity is 0.11 gal/yd^2 or 1936 gallons per mile of 30 foot road
(These defaults equate to no control efficiency for 41 vehicles per hour)

Once the control efficiency of the applicable control technique is known, the following equation

is used to determine the "controlled" emissions from the operation or process:

$$E_c = E \times \left(\frac{100 - C}{100} \right)$$

E_c	=	Controlled emissions
E	=	Uncontrolled emissions
C	=	Control efficiency in percent (%)

Source:

These methods are presented in the Unpaved Roads discussion (§13.2.2) in USEPA's AP-42 (September 1998).

L. Wind Erosion from Unpaved Operational Areas and Roads

This procedure applies to actively disturbed unpaved areas, specifically including plant or operational areas (such as quarries) and roads. Actively disturbed is defined as being disturbed by man's activity at least once per day. This procedure estimates the particulate emissions from these areas due to wind erosion. Particulate emissions due to actual vehicular travel on these areas should be estimated using methods presented elsewhere.

Least Complex:

This method multiplies a conservative emission factor by the amount of disturbed area.

$$E = E_f \times A$$

E = Particulate matter emission rate in tons per year
E_f = Emission factor in tons per acre (see below)
A = Disturbed area in acres

E_f (TSP) = 16 tons/acre
E_f (PM_{10}) = 8 tons/acre
E_f ($PM_{2.5}$) = 3.2 tons/acre

(These emission factors were calculated using the defaults given in the Intermediate Complexity section)

Wind Erosion Table 1 -- Area Based Emissions							
Area Disturbed (acres)	1	2	5	10	20	50	100
TSP Emissions (tons)	16	32	80	160	320	800	1600
PM10 Emissions (tons)	8	16	40	80	160	400	800
PM2.5 Emissions (tons)	3.2	6.4	16	32	64	160	320

Intermediate Complexity:

This method presents an equation requiring inputs for the fraction of vegetative cover on the disturbed area, mean wind speed in meters per second, threshold value of wind speed in meters per second (a derived value), and a correction factor (a derived value). The derived values can be estimated from tables presented below.

$$E = k \times E_f \times A \qquad Ef = 2.814 \times (1 - v) \times \left(\frac{u}{u_t}\right)^3 \times C(x) \qquad u_t = u_t^* \times u^*$$

E = Particulate matter emission rate in tons per year
k = Particulate aerodynamic factor (see below)
E_f = Emission factor in tons per acre
A = Disturbed area in acres
v = Amount of vegetative cover as a fraction
u = Mean wind speed in meters per second

u_t = Threshold value of wind speed in meters per second (calculated)
C(x) = Correction factor (see Table 4 below)
u^*_t = Threshold friction velocity in meters per second (see Table 2 below)
u* = Ratio of wind speed to friction velocity

k (TSP) = 1.0
k (PM_{10}) = 0.5
k ($PM_{2.5}$) = 0.2

Wind Erosion Table 2 -- Threshold Friction Velocity		
Area Use	Typical friction velocity particle size (mm)	Threshold friction velocity (m/s)
Mine tailings	0.05	0.14
Abandoned agricultural land	0.10	0.25
Construction site	0.11	0.26
Disturbed desert	0.20	0.33
Scrub desert	0.30	0.38
Coal dust	0.60	0.52
Active agricultural land	0.60	0.52
Coal pile	1.00	0.64

Wind Erosion Table 3 -- Ratio of wind speed to friction velocity		
Area use	Typical roughness height (cm)	Ratio
Open space	2	15.0
Light industrial	35	8.0
Moderate industrial	70	6.5
Heavy industrial	100	5.0

$$x = 0.886 \times \frac{u_t}{u}$$

Wind Erosion Table 4 -- C(x) Correction Factor																		
x	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0
C(x)	1.91	1.90	1.89	1.86	1.83	1.77	1.70	1.60	1.48	1.33	1.20	1.05	0.90	0.78	0.62	0.50	0.40	0.29

Conservative default for mean wind speed is 2.36 m/s (7.7 mph)
Conservative default for roughness height is 70 cm (medium industry)
Conservative default for particle size is 0.1 mm (abandoned ag. land)

Most Complex:

This method presents an additional equation that is used as an alternative depending on the nature of the surface being eroded. Erodible surfaces can be characterized as “limited” or “unlimited” reservoirs of erodible material. The following table determines the type of surface and the appropriate equation:

Wind Erosion Table 5 -- Limited vs Unlimited		
Variable	Reservoir Type Limited	Unlimited
Surface cover	Stones and/or clumps of vegetation	Bare with finely divided materials such as sand or soil
Threshold Frictional Velocity	Greater than 75 cm/s with particle size 1.5 mm or greater	Equal to or less than 75 cm/s with particle size less than 1.5 mm
Surface crust	Crust thicker than 0.25 inch and not easily crumbled between fingers (modulus of rupture > one bar)	Crust less than 0.25 inch or easily crumbled between fingers

If the surface in question is best characterized as an "unlimited" reservoir, use the moderate complexity method above.

The method for limited reservoirs involves a summation of the particulate emissions from each individual day in the year, based on each day's maximum wind speed in meters per second and the friction velocity of the surface in question. Those days without sufficient wind speed are ignored.

$$E = \frac{k \times \sum_{i=1}^{N} \left(9.813 \times A \times \left(58 \times (u_i - u_t)^2 + 25 \times (u_i - u_t)\right)\right)}{2000} \qquad u_i = 0.056 \times u_d$$

E	=	Particulate emissions in tons per year
k	=	Particulate aerodynamic multiplier (see below)
N	=	Number of days that daily maximum wind speed exceeded equivalent threshold friction velocity (threshold friction velocity multiplied by 17.9)
A	=	Disturbed area in acres (disturbed on a daily basis)
u_i	=	Friction velocity (at surface) in meters per second
u_t	=	Threshold friction velocity in meters per second (see Table 2)
u_d	=	Maximum wind speed of the *i*th day in meters/second (tower measurement)

k (TSP)	=	1.0
k (PM_{10})	=	0.5
k ($PM_{2.5}$)	=	0.2

Control Techniques:

Water spray is commonly used to reduce fugitive dust from unpaved surfaces. Water spray essentially increases the moisture content of the material. The control discussion presented in the previous section (unpaved roads) includes a method for estimating the control efficiency of watering. Other forms of stabilization can be used to reduce the erodibility of the unpaved surface and/or increase its threshold frictional velocity. For the most part, these control techniques will require case-by-case analysis, and review and approval of the District.

Once the control efficiency of the applicable control technique is known, the following equation is used to determine the "controlled" emissions from the operation or process:

$$E_c = E \times \left(\frac{100 - C}{100} \right)$$

E_c	=	Controlled emissions
E	=	Uncontrolled emissions
C	=	Control efficiency in percent (%)

Source:

These methods are presented in the Industrial Wind Erosion discussion (§13.2.5) in USEPA's AP-42 (January 1995).

Maximizing the Value of Flotation Chemicals Technology

MATERIAL SAFETY DATA SHEET

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME:	**Flottec PAX Collector**
SYNONYMS:	Potassium Amyl Xanthate, Potassium Isoamyl Xanthate
CHEMICAL FAMILY:	Alkyl xanthate salt
MOLECULAR FORMULA:	C6H12OS2K
MOLECULAR WEIGHT	203.4
MANUFACTURER:	Flottec, LLC • 338 West Main Street • Boonton, New Jersey 07005 • USA
PRODUCT INFORMATION:	Tel: +1.973.588.4717 • Fax: +1.973.588.4719 • Web Site: www.flottec.com
EMERGENCY PHONE:	CHEMTREC • North America: +1.800.424.9300 • International: +1.703.527.3887
ISSUE DATE:	November 1, 2009

2. COMPOSITION/INFORMATION ON INGREDIENTS

OSHA REGULATED COMPONENTS

COMPONENT	CAS No.	% (w/w)	OSHA (PEL)	ACGIH (TLV)	Carcinogen
Potassium sulfide	1312-73-8	~ 1	Not established	Not established	-
Carbonodithioic acid, O-(3-methylbutyl) ester, potassium salt	1928-70-1	> 90	Not established	Not established	-
Potassium hydroxide	1310-58-3	0 - 1	2 mg/m³ (Ceiling)	2 mg/m³ (Ceiling)	-

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

APPEARANCE AND ODOR

Color: Yellow-green
Appearance: Pellets, flakes, or powder
Odor: Disagreeable

STATEMENT OF HAZARD

DANGER! **SELF-HEATING MATERIAL**
MAY BE SPONTANEOUSLY COMBUSTIBLE
MAY FORM EXPLOSIVE DUST-AIR MIXTURES
HARMFUL IF ABSORBED THROUGH SKIN
DUST IRRITATING
CAUSES EYE AND SKIN IRRITATION

POTENTIAL HEALTH EFFECTS

EFFECTS / ROUTES OF EXPOSURE

The acute oral (rat) LD50 and dermal (rabbit) LD50 values are estimated to be >1,000 mg/kg and >500 mg/kg, respectively. Skin or eye contact with solutions of this product may cause moderate skin and eye irritation. Airborne dust may cause significant eye, skin or respiratory tract irritation. Refer to Section 11 for toxicology information on the regulated components of this product.

4. FIRST AID MEASURES

INGESTION:	If swallowed, call a physician immediately. Only induce vomiting at the instruction of a physician. Never give anything by mouth to an unconscious person.
SKIN CONTACT:	Remove contaminated clothing and shoes without delay. Wash immediately with plenty of water. Do not reuse contaminated clothing without laundering. Get medical attention if pain or irritation persists after washing or if signs and symptoms of overexposure appear.
EYE CONTACT:	Rinse immediately with plenty of water for at least 15 minutes. Obtain medical attention immediately.
INHALATION:	Remove to fresh air. If breathing is difficult, give oxygen. Obtain medical advice if there are persistent symptoms.

5. FIREFIGHTING MEASURES.

EXTINGUISHING MEDIA AND FIRE FIGHTING INSTRUCTIONS

Extinguishing Media:	Use carbon dioxide, dry chemical or large quantities of water.
Protective Equipment:	Firefighters, and others exposed, wear self-contained breathing apparatus. Wear full firefighting protective clothing. See MSDS Section 8 (Exposure Controls/Personal Protection).
Special Hazards:	Solid xanthates are stable when kept cool and dry. Exposure to heat and moisture can cause decomposition to flammable and explosive vapor of carbon disulfide. Since xanthates decompose in solution, even at room temperature, fire and explosion hazards can develop with aging.

6. ACCIDENTAL RELEASE MEASURES

PERSONAL PRECAUTIONS:	Where exposure level is not known, wear approved, positive pressure, self-contained respirator. Where exposure level is known, wear approved respirator suitable for level of exposure. Refer to Section 8 (Exposure Controls/Personal Protection) for appropriate personal protective equipment.
METHODS FOR CLEAN UP:	Sweep up into containers for disposal. Flush spill area with water.
ENVIRONMENTAL PRECAUTIONS:	Dispose of in accordance with EPA rules and regulations.

7. HANDLING AND STORAGE

HANDLING

Precautionary Measures :	Avoid excessive heat or moisture. Avoid contact with eyes, skin and clothing. Avoid breathing dust. Keep container closed. Wash thoroughly after handling. Use non-sparking tools and do not smoke when opening drum. Use with adequate ventilation. Contains finely divided material. Dust suspended in air may ignite with static discharge, sparks or flame. Equipment, including venting systems, should be grounded. Provide adequate ventilation in areas of use to remove dust. Wash contaminated clothing before reuse.
Special Handling Statements :	Minimize dust. Special precautions against fire and explosion must be observed in (1) pumping xanthate solutions, (2) draining mobile tanks, (3) cleaning mobile tanks, and (4) performing maintenance work on storage tanks and pipelines leading to and from tanks. Use non-sparking tools and do not smoke when opening drums of xanthate. DUST EXPLOSION HAZARD CLASS - 2 Handling of material should be in accordance with standards for venting of deflagrations (e.g. NFPA-68). If handled with flammable or combustible materials the explosion hazard may increase
STORAGE	Heating or overexposure to moisture of solid xanthates or heating or aging of xanthate solutions causes some decomposition to poisonous and flammable carbon disulfide. Storage tanks should have certain design features for maximum safety, and the vapor space should be free of sources of ignition.
Storage Temperature:	Store at <32.2 - 10 °C 90 - 50 °F **Reason:** Safety

8. EXPOSURE CONTROLS AND PERSONAL PROTECTION

ENGINEERING MEASURES	Where this material is not used in a closed system, good enclosure and local exhaust ventilation should be provided to control exposure.

PERSONAL PROTECTIVE EQUIPMENT

RESPIRATORY PROTECTION:	Where exposures are below the established exposure limit, no respiratory protection is required. Where exposures exceed the established exposure limit, use respiratory protection recommended for the material and level of exposure.
EYE PROTECTION:	Wear eye/face protection such as chemical splash proof goggles or face shield. Eyewash equipment and safety shower should be provided in areas of potential exposure.
SKIN PROTECTION:	Avoid skin contact. Wear impermeable gloves and suitable protective clothing.
ADDITIONAL ADVICE:	Food, beverage and tobacco products should not be carried, stored or consumed where this material is used. Before eating, drinking, or smoking, wash face and hands with soap and water.

9. PHYSICAL AND CHEMICAL PROPERTIES

COLOR:	Yellow-green
APPEARANCE:	Pellets, flakes, or powder
ODOR:	Disagreeable
BOILING POINT:	Not applicable
MELTING POINT:	491 - 536°F; 255 - 280°C
VAPOR PRESSURE:	Not applicable
SPECIFIC GRAVITY:	Not available
VAPOR DENSITY:	Not applicable
% VOLATILE (BY WT.):	~ 1.5
pH:	Not applicable
SATURATION IN AIR (% by Vol):	Not applicable
EVAPORATION RATE:	Not applicable
SOLUBILITY IN WATER:	35 g/100 g at 20°C
VOLATILE ORGANIC CONTENT:	Not available
FLASH POINT:	Not applicable
FLAMMABLE LIMITS (% BY VOL.):	Not applicable
AUTO IGNITION TEMPERATURE:	>248°F; 120°C (value for carbon disulfide)
DECOMPOSITION TEMPERATURE:	>267.8 - 536°F; 131 - 280°C
PARTIAL COEFFICIENT (n-octanol/water):	Not available
ODOR THRESHOLD:	See Section 2 for exposure limits

10. STABILITY AND REACTIVITY

STABILITY:	Stable
CONDITIONS TO AVOID:	Containers filled with this product should be kept closed when not in use. Keep container in a cool, well-ventilated area. Exposure of the solid xanthate to heat or moisture and heating or aging of xanthate solutions. Avoid prolonged exposure to heat; avoid strong acids, alkalies and oxidizing agents. Keep water and moist air out of container.
POLYMERIZATION:	Will not occur
CONDITIONS TO AVOID:	None known
MATERIALS TO AVOID:	Strong oxidizing agents, acidic material. High temperatures
HAZARDOUS DECOMPOSITION PRODUCTS:	Carbon disulfide, carbon monoxide, carbon dioxide, oxides of sulfur (includes sulfur di and tri oxides), hydrogen sulfide

11. TOXICOLOGICAL INFORMATION

Toxicological information for the product is found under SECTION 3: HAZARDS IDENTIFICATION
Toxicological information on the regulated components of this product is as follows:

Potassium hydroxide has an acute oral (rat) LD50 value of 273 mg/kg. Acute overexposure to potassium hydroxide or dusts causes severe respiratory irritation. Potassium hydroxide is severely irritating to the eyes and skin.

Potassium sulfide may cause eye and skin irritation. Under acidic conditions, potassium sulfide can decompose to produce flammable poisonous hydrogen sulfide gas.

Potassium 3 methyl butyl xanthate has an estimated acute oral (rat) LD50 and acute dermal (rabbit) LD50 values of > 1,000 mg/kg and > 500 mg/kg, respectively, based on similar materials. Direct contact with this material may cause moderate eye and skin irritation. Airborne dust may cause significant eye, skin or respiratory tract irritation.

California Proposition 65 Warning (applicable in California only) - This product contains (a) chemical(s) known to the State of California to cause birth defects or other reproductive harm.

12. ECOLOGICAL INFORMATION

Toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.
This material is not readily biodegradable.
All ecological information provided was conducted on a structurally similar product.

ALGAE TEST RESULTS

Test	Duration	Procedure	Species	Results	

FISH TEST RESULTS

Test	Duration	Procedure	Species	Results	
Acute toxicity, freshwater (OECD 203)	96 hr.	-	Rainbow Trout (Oncorhyncus mykiss)	> 10 – 100 mg/l	LC50

INVERTEBRATE TEST RESULTS

Test	Duration	Procedure	Species	Results	
Acute Immobilization (OECD 202)	48 hr.	-	Water Flea (Daphnia magna)	>1 - 10 mg/l	EC50

ACCUMULATION TEST RESULTS

Test	Duration	Procedure	Species	Results	

DEGRADATION

Test	Duration	Procedure	Results
Biodegradability	-	-	< 70 %
COMMENTS:	Information based on structurally similar material		

13. DISPOSAL CONSIDERATIONS

RECOMMENDATIONS FOR THE PRODUCT:	In accordance with regulations for special waste, product must be taken, after pretreatment, to an authorized special waste incineration plant.
RECOMMENDATIONS FOR PACKAGING:	Packaging that cannot be cleaned should be disposed of like the product.
RECOMMENDED CLEANSING AGENT:	Water

14. Transportation Information

This section provides basic shipping classification information.
Refer to appropriate transportation regulations for specific requirements.

U.S. DOT				
PROPER SHIPPING NAME:	XANTHATES			
HAZARD CLASS	4.2			
PACKING GROUP:	II			
UN/ID NUMBER:	UN3342			
TRANSPORT LABEL REQUIRED:	Spontaneously Combustible Marine Pollutant			
TECHNICAL NAME (N.O.S.):	Contains potassium amyl xanthate			
HAZARDOUS SUBSTANCE:	Not applicable			
COMMENTS:	Marine Pollutants - DOT requirements specific to Marine Pollutants do not apply to non-bulk packagings transported by motor vehicles, rail cars or aircraft.			
TRANSPORT CANADA				
PROPER SHIPPING NAME:	XANTHATES			
HAZARD CLASS	4.2			
PACKING GROUP:	II			
UN/ID NUMBER:	3342			
TRANSPORT LABEL REQUIRED:	Spontaneously Combustible Marine Pollutant			
TECHNICAL NAME (N.O.S.):	Contains potassium amyl xanthate			
ICAO/IATA				
PROPER SHIPPING NAME:	XANTHATES			
HAZARD CLASS:	4.2			
PACKING GROUP:	II			
UN NUMBER:	3342			
TRANSPORT LABEL REQUIRED:	Spontaneously Combustible			
PACKING INSTRUCTIONS/ MAXIMUM NET QUANTITY:	PASSENGER AIRCRAFT	415	15 kg	
	CARGO AIRCRAFT	417	50 kg	
TECHNICAL NAME (N.O.S.):	Contains potassium amyl xanthate			
IMO				
PROPER SHIPPING NAME:	XANTHATES			
HAZARD CLASS:	4.2			
UN NUMBER:	3342			
PACKING GROUP:	II			
TRANSPORT LABEL REQUIRED:	Spontaneously Combustible Marine Pollutant			
TECHNICAL NAME (N.O.S.):	Contains potassium amyl xanthate			

15. REGULATORY INFORMATION

INVENTORY INFORMATION

United States (USA)	All components of this product are included on the TSCA Chemical Inventory or are not required to be listed on the TSCA Chemical Inventory.
Canada	This product contains components not on the Domestic Substances List. These components are on the Non-Domestic Substances List.
European Union (EU)	All components of this product are included in the European Inventory of Existing Chemical Substances (EINECS) in compliance with Council Directive 67/548/EEC and its amendments.
Australia	All components of this product are included in the Australian Inventory of Chemical Substances (AICS) or are not required to be listed on AICS.
China	All components of this product are included on the Chinese inventory or are not required to be listed on the Chinese inventory.
Japan	All components of this product are included on the Japanese (ENCS) inventory or are not required to be listed on the Japanese inventory.
Korea	All components of this product are NOT included on the Korean (ECL) inventory.
Philippines	All components of this product are NOT included on the Philippine (PICCS) inventory.

OTHER ENVIRONMENTAL INFORMATION

The following components of this product may be subject to reporting requirements pursuant to Section 313 of CERCLA (40 CFR 372), Section 12(b) of TSCA, or may be subject to release reporting requirements (40 CFR 307, 40 CFR 311, etc.) See Section 13 for information on waste classification and waste disposal of this product.

Component	CAS NO.	% (w/w)	TPQ (lbs)	RQ (lbs)	S313	TSCA 12B
Carbon disulfide	75-15-0	~ 0.001	10,000	100	YES	YES

PRODUCT CLASSIFICATION UNDER SECTION 311 OF SARA

ACUTE (Y)	CHRONIC (N)	FIRE (Y)	REACTIVE (Y)	PRESSURE (N)

16. OTHER INFORMATION

NFPA HAZARD RATING
(National Fire Protection Association)

HEALTH - 2 -	Materials that, under emergency conditions, can cause temporary incapacitation or residual injury.
FIRE - 1 -	Materials that must be preheated before ignition can occur.
REACTIVITY - 1 -	Materials that in themselves are normally stable, but that can become unstable at elevated temperatures and pressures.

REASON FOR REVISION: New format; Revised all sections

Prepared By: F. Cappuccitti **Revised By:** R. Nix

IMPORTANT: The above information is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warrant, expressed or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular uses.

Maximizing the Value of Flotation Chemicals Technology

MATERIAL SAFETY DATA SHEET

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME:	**Flottec 2041 Collector**
SYNONYMS:	None
CHEMICAL FAMILY:	Phoshorordithioate salt
MOLECULAR FORMULA:	Mixture
MOLECULAR WEIGHT	Mixture
MANUFACTURER:	Flottec, LLC • 338 West Main Street • Boonton, New Jersey 07005 • USA
PRODUCT INFORMATION:	Tel: +1.973.588.4717 • Fax: +1.973.588.4719 • Web Site: www.flottec.com
EMERGENCY PHONE:	CHEMTREC • North America: +1.800.424.9300 • International: +1.703.527.3887
ISSUE DATE:	November 1, 2009

2. COMPOSITION/INFORMATION ON INGREDIENTS

OSHA REGULATED COMPONENTS

COMPONENT	CAS No.	% (w/w)	OSHA (PEL)	ACGIH (TLV)	Carcinogen
Sodium hydroxide	1310-73-2	0.5 – 1.0	2 mg/m³ (ceiling)	-	-
Water	7732-18-5	~ 50.0	Not established	-	-
Sodium di sec butyl-dithiophosphate	33619-92-0	35.0 – 50.0	Not established	-	-

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW

APPEARANCE AND ODOR

Color: Yellow-brown
Appearance: Liquid
Odor: Slight sulfur odor, alcohol

STATEMENT OF HAZARD

DANGER! CAUSES EYE BURNS AND SKIN IRRITATION

POTENTIAL HEALTH EFFECTS

EFFECTS / ROUTES OF EXPOSURE

The acute oral (rat) LD50 and dermal (rabbit) LD50 values are 4,060 mg/kg and 5,000 mg/kg, respectively. Marked irritation and skin corrosion were produced during primary irritation studies with rabbits. Contact with acid may cause liberation of hydrogen sulfide. Hydrogen sulfide has a strong rotten-egg odor, however, some people are unable to smell the gas and exposure will deaden the sense of smell. Therefore, odor is an unreliable indicator of exposure. Repeated or prolonged dermal contact with this material may cause severe allergic skin reactions. Such allergic reactions may be incapacitating for an extended period of time. Overexposure to hydrogen sulfide gas may cause severe eye or respiratory tract irritation, rapid development of coma and respiratory failure. Low levels of hydrogen sulfide may cause headache, dizziness, staggering gait, neurological damage and gastritis. Refer to Section 11 for toxicology information on the regulated components of this product.

4. FIRST AID MEASURES

INGESTION:	If swallowed, call a physician immediately. Only induce vomiting at the instruction of a physician. Never give anything by mouth to an unconscious person.
SKIN CONTACT:	Take off immediately all contaminated clothing. Wear impermeable gloves. Wash immediately with plenty of water and soap. Pay particular attention to skin crevices, nail folds, etc. Do not reuse contaminated clothing without laundering. Do not reuse contaminated leatherwear.
EYE CONTACT:	In case of eye contact, immediately irrigate with plenty of water for 15 minutes. Obtain medical attention without delay.
INHALATION:	Remove to fresh air. If breathing is difficult, give oxygen. Obtain medical advice if there are persistent symptoms.

5. FIREFIGHTING MEASURES.

EXTINGUISHING MEDIA AND FIRE FIGHTING INSTRUCTIONS

Extinguishing Media:	Use water spray or fog, carbon dioxide or dry chemical to extinguish fires
Protective Equipment:	Firefighters, and others exposed, wear self-contained breathing apparatus. Wear full firefighting protective clothing. See MSDS Section 8 (Exposure Controls/Personal Protection).
Special Hazards:	Sulfur dioxide or hydrogen sulfide may be formed under fire conditions. Do not flush to sewer which may contain acid. This could result in generation of toxic and explosive hydrogen sulfide gas.

6. ACCIDENTAL RELEASE MEASURES

PERSONAL PRECAUTIONS:	Where exposure level is not known, wear approved, positive pressure, self-contained respirator. Where exposure level is known, wear approved respirator suitable for level of exposure. In addition to the protective clothing/equipment in Section 8, wear impervious boots and rain suit.
METHODS FOR CLEAN UP:	Cover spills with some inert absorbent material; sweep up and place in a waste disposal container. Flush area with water.
ENVIRONMENTAL PRECAUTIONS:	Dispose of in accordance with EPA rules and regulations.

7. HANDLING AND STORAGE

HANDLING

Precautionary Measures :	Do not get in eyes, on skin or on clothing. Wash thoroughly after handling.
Special Handling Statements :	This product should not be mixed with acids since evolution of toxic and explosive hydrogen sulfide gas could result. This precaution does not, of course, apply to addition of this reagent to flotation pulps in amounts customarily used in flotation.
STORAGE	None
Storage Temperature:	**Reason:**

8. EXPOSURE CONTROLS AND PERSONAL PROTECTION

ENGINEERING MEASURES	Utilize a closed system process where feasible. Where this material is not used in a closed system, good enclosure and local exhaust ventilation should be provided to control exposure.

PERSONAL PROTECTIVE EQUIPMENT

RESPIRATORY PROTECTION:	Where exposures are below the established exposure limit, no respiratory protection is required. Where exposures exceed the established exposure limit, use respiratory protection recommended for the material and level of exposure.
EYE PROTECTION:	Wear eye/face protection such as chemical splash proof goggles or face shield. Eyewash equipment and safety shower should be provided in areas of potential exposure.
SKIN PROTECTION:	Avoid skin contact. Wear impermeable gloves and suitable protective clothing.
ADDITIONAL ADVICE:	Food, beverage and tobacco products should not be carried, stored or consumed where this material is used. Before eating, drinking, or smoking, wash face and hands with soap and water.

9. PHYSICAL AND CHEMICAL PROPERTIES

COLOR:	Amber to dark brown
APPEARANCE:	Liquid
ODOR:	Slight sulfur, alcohol
BOILING POINT:	Not Available
MELTING POINT:	Not applicable
VAPOR PRESSURE:	Similar to water at 25°C
SPECIFIC GRAVITY:	1.126 at 25°C
VAPOR DENSITY:	Similar to water
% VOLATILE (BY WT.):	<50 (water)
pH:	>11 (minimum)
SATURATION IN AIR (% by Vol):	Similar to water
EVAPORATION RATE:	Similar to water
SOLUBILITY IN WATER:	Complete
VOLATILE ORGANIC CONTENT:	Not available
FLASH POINT:	>200°F; 93°C, Setaflash Closed Cup
FLAMMABLE LIMITS (% BY VOL.):	Not available
AUTO IGNITION TEMPERATURE:	Not available
DECOMPOSITION TEMPERATURE:	Not available
PARTIAL COEFFICIENT (n-octanol/water):	Not available
ODOR THRESHOLD:	See Section 2 for exposure limits

10. STABILITY AND REACTIVITY

STABILITY:	Stable
CONDITIONS TO AVOID:	None known
POLYMERIZATION:	Will not occur
CONDITIONS TO AVOID:	None known
MATERIALS TO AVOID:	This product contains a neutralized dithio acid. Avoid contact with strong oxidizing agents and mineral acids.
HAZARDOUS DECOMPOSITION PRODUCTS:	Carbon dioxide, carbon monoxide; oxides of sulfur (includes sulfur di and tri oxides), oxides of phosphorus, hydrogen sulfide

11. TOXICOLOGICAL INFORMATION

Toxicological information for the product is found under SECTION 3: HAZARDS IDENTIFICATION
Toxicological information on the regulated components of this product is as follows:

Acute overexposure to sodium hydroxide mists or dusts causes severe respiratory irritation. A solution of sodium hydroxide can produce irreversible damage to eyes and skin.

Sodium di sec butyl dithiophosphate has estimated acute oral (rat) and dermal (rabbit) LD50 values of greater than 5000 mg/kg and 2000 mg/kg, respectively. Direct contact with sodium di sec butyl dithiophosphate can cause eye burns and skin corrosion.

12. ECOLOGICAL INFORMATION

The ecological assessment for this material is based on an evaluation of its components.
This material is not readily biodegradable
This material is not classified as dangerous for the environment.

ALGAE TEST RESULTS

Test	Duration	Procedure	Species	Results	

FISH TEST RESULTS

Test	Duration	Procedure	Species	Results	
Acute toxicity, freshwater (OECD 203)	96 hr.		Rainbow Trout (Oncorhyncus mykiss)	1149 mg/l	LC50
Acute toxicity, freshwater (OECD 203)	96 hr.		Chinook Salmon (Oncorhyncus tshawytscha)	152 mg/l	LC50

INVERTEBRATE TEST RESULTS

Test	Duration	Procedure	Species	Results	

ACCUMULATION TEST RESULTS

Test	Duration	Procedure	Species	Results	

DEGRADATION

Test	Duration	Procedure	Results
Closed Bottle (OECD 301D)	28 day	Ready biodegradability	20.4 %
COMMENTS:			

13. DISPOSAL CONSIDERATIONS

RECOMMENDATIONS FOR THE PRODUCT:	In accordance with regulations for special waste, product must be taken, after pretreatment, to an authorized special waste incineration plant.
RECOMMENDATIONS FOR PACKAGING:	Packaging that cannot be cleaned should be disposed of like the product.
RECOMMENDED CLEANSING AGENT:	Water

14. Transportation Information

This section provides basic shipping classification information.
Refer to appropriate transportation regulations for specific requirements.

U.S. DOT				
PROPER SHIPPING NAME:	CAUSTIC ALKALI LIQUID, N.O.S.			
HAZARD CLASS	8			
PACKING GROUP:	II			
UN/ID NUMBER:	UN1719			
TRANSPORT LABEL REQUIRED:	CORROSIVE			
TECHNICAL NAME (N.O.S.):	Contains dithiophosphate salt			
HAZARDOUS SUBSTANCE:	Not applicable			
COMMENTS:	-			
TRANSPORT CANADA				
PROPER SHIPPING NAME:	CAUSTIC ALKALI LIQUID, N.O.S.			
HAZARD CLASS	8			
PACKING GROUP:	II			
UN/ID NUMBER:	1719			
TRANSPORT LABEL REQUIRED:	CORROSIVE			
TECHNICAL NAME (N.O.S.):	Contains dithiophosphate salt			
ICAO/IATA				
PROPER SHIPPING NAME:	CAUSTIC ALKALI LIQUID, N.O.S.			
HAZARD CLASS:	8			
PACKING GROUP:	II			
UN NUMBER:	1719			
TRANSPORT LABEL REQUIRED:	CORROSIVE			
PACKING INSTRUCTIONS/ MAXIMUM NET QUANTITY:	PASSENGER AIRCRAFT	809	1L	
	CARGO AIRCRAFT	813	30L	
TECHNICAL NAME (N.O.S.):	Contains dithiophosphate salt			
IMO				
PROPER SHIPPING NAME:	CAUSTIC ALKALI LIQUID, N.O.S.			
HAZARD CLASS:	8			
UN NUMBER:	1719			
PACKING GROUP:	II			
TRANSPORT LABEL REQUIRED:	CORROSIVE			
TECHNICAL NAME (N.O.S.):	Contains dithiophosphate salt			

Maximizing the Value of Flotation Chemicals Technology

15. REGULATORY INFORMATION

INVENTORY INFORMATION

United States (USA)	This product is manufactured in compliance with all provisions of the Toxic Substances Control Act, 15 U.S.C. 2601 et. seq.
Canada	Components of this product have been reported to Environment Canada in accordance with Sections 66 and/or 81 of the Canadian Environmental Protection Act (1999), and are included on the Domestic Substance List.
European Union (EU)	All Components o this product are included in the European Inventory of Existing Chemical Substance (EINECS) in compliance with Council Directive 67/548/EEC and its amendments.
Australia	All components of this product are included in the Australian Inventory of Chemical Substances (AICS)
China	All components of his product are included on the Chinese inventory or are not required to be listed on the Chinese inventory.
Japan	All components of his product are included on the Japanese (ENCS) inventory or are not required to be listed on the Japanese inventory.
Korea	All components of his product are included on the Korean (ECL) inventory or are not required to be listed on the Korean inventory.
Philippines	All components of this product are NOT included on the Philippine (PICCS) inventory.

OTHER ENVIRONMENTAL INFORMATION

The following components of this product may be subject to reporting requirements pursuant to Section 313 of CERCLA (40 CFR 372), Section 12(b) of TSCA, or may be subject to release reporting requirements (40 CFR 307, 40 CFR 311, etc.) See Section 13 for information on waste classification and waste disposal of this product.

Component	CAS NO.	% (w/w)	TPQ (lbs)	RQ (lbs)	S313	TSCA 12B
This product does not contain any components regulated under these sections of the EPA						

PRODUCT CLASSIFICATION UNDER SECTION 311 OF SARA

ACUTE (Y)	CHRONIC (N)	FIRE (N)	REACTIVE (N)	PRESSURE (N)

16. OTHER INFORMATION

NFPA HAZARD RATING
(National Fire Protection Association)

HEALTH - 3 -	Materials that, under emergency conditions, can cause serious or permanent injury.
FIRE - 1 -	Materials that must be preheated before ignition can occur.
REACTIVITY - 0 -	Materials which in themselves are normally stable, even under fire exposure conditions.

REASON FOR REVISION: New format; Revised all sections

Prepared By: F. Cappuccitti **Revised By:** R. Nix

IMPORTANT: The above information is believed to be accurate and represents the best information currently available to us. However, we make no warranty of merchantability or any other warrant, expressed or implied, with respect to such information, and we assume no liability resulting from its use. Users should make their own investigations to determine the suitability of the information for their particular uses.

Haltermann
A Division of Monument Chemical

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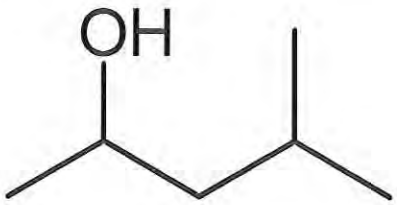
Product Safety Bulletin



Methyl Isobutyl Carbinol (MIBC)

PRODUCT OVERVIEW

Methyl Isobutyl Carbinol (MIBC) is a clear, colorless liquid.

MIBC exposure is possible in both industrial and consumer applications. Occupational exposure limits have been established to control the allowable amount of exposure in workplace settings.

Consumer exposure, generally infrequent and short in duration, is also highly dependent upon the conditions under which MIBC is used. See Health Information.

MIBC does not cause adverse health or environmental effects at levels typically found in the workplace or in the environment.

OTHER NAMES

CAS 108-11-2
4-Methylpentan-2-ol
Methyl amyl alcohol
1,3-Dimethylbutanol
2-Pentanol, 4-methyl-
4-Methyl-2-pentyl alcohol
Isobutylmethylmethanol
MIBC
Isobutyl methyl carbinol
EINECS No: 203-551-7
2-Methyl-4-pentanol
4-Methyl-2-amyl alcohol
Isobutylmethylcarbinol
Methyl amyl alcohol

TYPICAL PROPERTIES

Molecular Weight	$C_6H_{14}O$
Empirical Formula	102.2 g/mol
Appearance	Colorless Liquid
Boiling Point @ 760mm Hg	Boiling Point: 131.7°C (269.1°F)
Freezing Point	Freezing Point: -90°C (-130°F)
Flash Point – Closed Cup	Flash Point: 40.5°C (105°F)
Autoignition Temperature	305°C
Density @ 20°C	0.81 g/cm^3
Vapor Pressure @ 20°C	0.42 kPa
Evaporation Rate (n-butyl acetate = 1) (ether = 1)	 0.28 66
Solubility @ 20°C (in water) (water in)	 1.6% m/m 6.3% m/m
Surface Tension @ 20°C	23 mN/m
Refractive Index @ 20°C	1.410
Viscosity @ 20°C	5.2 mPa·s
Lower Explosive Limit	1.0 v/v/%
Upper Explosive Limit	5.5 v/v%
Conductivity @ 20°C	0.3 µS/m
Dielectric Constant @ 20°C	10.4
Specific Heat @ 20°C	2.4 kJ/kg/°C
Heat of Vaporization @ Tboil	413 kJ/kg
Heat of Combustion (net) @ 25°C	36000 kJ/kg
Odor Threshold	1.1 ppm

Note: The properties reported above are typical physical properties. Haltermann in no way guarantees that the product from any particular lot will conform exactly to the given values.

PRODUCT USES

MIBC is primarily used (~70%) in the production of lube oil additives and for antiwear and corrosion inhibitors.

The second largest use of MIBC (~20%) is as a flotation frother for treating copper ores, coal and tar sand mining. In mining frother applications, MIBC is used in the ppm range, with usual concentrations less than 1000 ppm and in many cases in the hundreds of ppm range (100 - 600 ppm).

The remaining production is primarily for its use as an additive to surface coatings as a solvent to maintain binder softness until the binder fuses.

HEALTH INFORMATION

Anesthetic effects can be expected at high vapor concentrations. Vapor concentrations of 50 ppm for 15 minutes are irritating to the eyes, nose and throat. The ACGIH TLV-TWA for MIBC is 25 ppm (104 mg/m^3) and the TLV-STEL is 40 ppm (167 mg/m^3). The 4-hour LC_{50} for MIBC was > 16 mg/L (3776 ppm).

MIBC has minimal acute toxicity by oral and dermal routes of exposure. The acute oral and dermal LD_{50} values for MIBC are 2260 - 2970 $^{mg}/_{kg}$ and 2870 $^{mg}/_{kg}$, respectively.

There are no known sensitization or cancer hazards.

POTENTIAL FOR EXPOSURE

There is a potential for occupational and consumer exposure through inhalation and skin contact although exposures through inhalation are expected to be low due to the low vapor pressure.

Based on the uses for MIBC the public could be exposed through:

- **Workplace exposure** – With the exception of the use in tar sand mining, frothers are used in closed systems and only catastrophic failure results in any appreciable exposure. In tar sand mining, the MIBC is added to the tar sand and the sand is spread out and allowed to dry. The majority of MIBC from this use is volatilized to the air. Exposure (in the ppm range) is typically limited to the equipment operator pushing the sand. MIBC used as an intermediate in the manufacture of lube oil additives is blended with other alcohols and reacted. Normally these reactors are closed systems and exposure is limited to upsets or catastrophic failure of the reactor.

- **Consumer use of products containing MIBC** –Minimal exposure to vapors from the use of MIBC as a solvent in coating applications may also occur. Overall, consumer exposure to MIBC is expected to be negligible.

- **Environmental releases** – MIBC can enter the environment as emissions from its manufacture and use as a frother. 94% is biodegraded within 20 days.

  Chemical manufacturers are committed to operating in an environmentally responsible manner everywhere business is done. Efforts are guided by in-depth scientific understanding of the environmental impact of operations, as well as the social and economic needs of the communities. Industrial spills or releases are rare; however a spill may pose a significant flammability issue.

REGULATORY STATUS

Refer to the JHL Material Safety Data sheet for more specific information.

MIBC is not subject to the reporting requirement of CERCLA.

MIBC is not SARA Section 313 chemical.

MIBC is on the U.S. TSCA list and is included in the EEC's EINECS, Canadian DSL, Australian and Japanese chemical inventories.

STORAGE AND HANDLING

General industry practice is to store MIBC in carbon steel vessels.

MIBC should be stored only in tightly closed, properly vented containers away from heat, sparks, open flame or strong oxidizing agents.

Provided proper storage and handling precautions are taken, expect MIBC to be technically stable for at least 12 months.

Handle empty containers carefully. Combustible residue remains after emptying.

Undue exposure or spillage should be strictly avoided as a matter of good practice. Refer to the Material Safety Data Sheet for more specific information.

ADDITIONAL INFORMATION

Johann Haltermann Ltd. MIBC MSDS
OECD SIDS Assessment for MIBC

The information in this Product Safety Bulletin is made without warranty. Johann Haltermann, Ltd. disclaims any liability in connection with the use of this information, and does not warranty against infringement by reason of the use of any of its products in combination with other materials in any process.

acc@pta

Material Safety Data Sheet

Accepta 2081

Date issued: 01-06-2004

1. IDENTIFICATION OF THE PREPARATION AND OF THE COMPANY

Product Name:	ACCEPTA 2081
Application:	Flocculant water treatment
Company Identification:	Accepta Ltd. Quay West Trafford Wharf Road Manchester M17 1HH United Kingdom
Office telephone number:	+44 (0) 161 240 2100
Office fax number:	+44 (0) 870 135 6389
Emergency Telephone Number:	+44 (0) 161 240 2100

2. COMPOSITION/INFORMATION ON INGREDIENTS

CHEMICAL DESCRIPTION:
Water, Polymer, Inorganic salt(s).

HAZARDOUS INGREDIENTS:

CAS NO.	EINECS NO.	CHEMICAL NAME	WT %	SYMBOL	R-PHRASES

This product is not classified as hazardous (European Directive 88/379/EEC, 1999/45/EC)

3. HAZARD IDENTIFICATION

HUMAN HEALTH HAZARDS - ACUTE:
INHALATION:
May cause irritation of mucous membranes.
SKIN CONTACT:
Can cause mild irritation.
EYE CONTACT:
Can cause moderate irritation.
INGESTION:
There may be irritation to the gastro-intestinal tract with nausea and vomiting.
PHYSICAL AND CHEMICAL HAZARDS:
Can react violently with alkalis and oxidising agents.

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Material Safety Data Sheet

Accepta 2081

Date issued: 01-06-2004

4. FIRST AID MEASURES

INHALATION: Remove to fresh air, rest, treat symptomatically. Obtain medical attention.

SKIN CONTACT: Remove contaminated clothing. Wash off affected area immediately with plenty of water. If skin irritation persists, obtain medical attention.

EYE CONTACT: Immediately gently irrigate with clean water for at least 15 minutes. Move eyeball and keep eyelids wide open and apart whilst irrigating. Obtain medical attention.

INGESTION: Do not induce vomiting without medical advice. If conscious wash out mouth and give 500ml of water to drink. Obtain medical attention.

5. FIRE FIGHTING MEASURES

EXTINGUISHING MEDIA:
Not expected to burn. Use extinguishing media appropriate for surrounding fire.
FIRE AND EXPLOSION HAZARD
Oxides of nitrogen, Oxides of sulphur, Oxides of carbon, Hydrogen chloride, Ammonia (under fire conditions).
SPECIAL PROTECTIVE EQUIPMENT FOR FIRE FIGHTING:
In case of fire, wear a full face positive-pressure self contained breathing apparatus and protective suit. Water mist may be used to cool closed containers.

6. ACCIDENTAL RELEASE MEASURES

PERSONAL PRECAUTIONS:
Avoid contact with skin and eyes. In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. After contact with skin, wash immediately with plenty of water. Use personal protective equipment recommended in Section 8.
Spill may be slippery.

ENVIRONMENTAL PRECAUTIONS:
Do not allow to enter sewers or water courses. If spillage does enter sewers or water courses, immediately inform the appropriate water authorities

METHODS FOR CLEANING UP:
Contain and absorb with sand or vermiculite and mix well. Collect up and remove to a safe place until disposal. Wash site of spillage thoroughly with water. Assistance can be obtained from waste disposal companies. Use of alkaline absorbent materials will generate ammonia. Do not mix with any bleaches or oxidising agents.

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7. HANDLING AND STORAGE

HANDLING:
Avoid contact with skin and eyes. Use with adequate ventilation. Avoid generating aerosols and mists

STORAGE CONDITIONS:
Protect from freezing. Keep container tightly closed. Storage for more than 6 months is not recommended. Avoid temperatures greater than >40 °C. Store away from direct sunlight. It is recommended to store the product inside during all four seasons.

CONSTRUCTION MATERIAL COMPATIBILITY. Compatible with:
PVC, polypropylene, polyurethane, polyethylene, hypalon, buna-N, teflon, viton, vinyl, fibre glass 411, Plasite 4005, 6000 and 7122, neoprene.

8. EXPOSURE CONTROL/PERSONAL PROTECTION

OCCUPATIONAL EXPOSURE LIMITS
None
ENGINEERING MEASURES
Not normally needed. Local exhaust ventilation is recommended where significant mists, vapours or aerosols are generated.
RESPIRATORY PROTECTION:
Respiratory protection not normally needed. If significant mists, vapours or aerosols are generated an approved respirator is recommended, filter-type A.
HAND PROTECTION:
PVC gloves. Nitrile gloves. Most glove materials are of low chemical resistance. Replace gloves regularly.
SKIN PROTECTION:
Standard protective clothing.
EYE PROTECTION:
Chemical splash goggles.
HYGIENE RECOMMENDATIONS:
Keep an eye wash fountain available. Keep a safety shower available. Wash hands at breaks and at the end of the shift. If clothing is contaminated, remove clothing and thoroughly wash the affected area. Launder contaminated clothing before reuse.

9. PHYSICAL AND CHEMICAL PROPERTIES

NOTE: These physical properties are typical values for this product
FORM: Liquid
COLOUR: White - Opaque
ODOUR: None
VALUE UNIT TEST METHOD
BOILING POINT: 120 °C
FLASH POINT: NA
RELATIVE DENSITY: 1.21-1.23 (20 °C)
SOLUBILITY IN WATER: Complete
pH (25 °C) 3.0-4.2
VISCOSITY (25 °C) <700 cps
FREEZING POINT: -10 °C
FREEZE- THAW RECOVERY: Complete
Abbreviation: NE = not evaluated, NA = not applicable, NR = not relevant

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10. STABILITY AND REACTIVITY

STABILITY:
Stable under ambient conditions.
CONDITIONS TO AVOID:
Extremes of temperature: <-10 °C and > 40 °C.
MATERIALS TO AVOID:
Can react violently with alkalis and oxidising agents.
HAZARDOUS DECOMPOSITION PRODUCTS:
Oxides of nitrogen, Oxides of sulphur, Oxides of carbon, Hydrogen chloride, Ammonia (under fire conditions).

11. TOXICOLOGICAL INFORMATION

Please refer to section 3 for hazards identification.
ACUTE TOXICITY DATA:
ACUTE LETHALITY VALUES:
Oral (mouse) LD_{50} = 7500 mg/kg
PRIMARY (DRAIZE TEST) SKIN/EYE
Primary skin irritation: No

12. ECOLOGICAL INFORMATION

PERSISTENCY AND DEGRADATION:
Biological Oxygen Demand (BOD_5): 9700 mg/l
Chemical Oxygen Demand (COD): 130000 mg/l
TOC: 65000 mg/l
The product is not expected to be readily biodegradable.
MOBILITY AND BIOACCUMULATION POTENTIAL:
No bioaccumulation expected
ADDITIONAL ECOLOGICAL DATA:
AOX information: Product contains no organic halogens

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Material Safety Data Sheet

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13. DISPOSAL CONSIDERATIONS

Via authorized contractor. If this product becomes a waste, the final user must define and assign the
appropriate European Waste Catalogue code.
NATIONAL REGULATIONS UK
In accordance with the Environmental Protection (Duty of Care) Regulations 1991.

14. TRANSPORT INFORMATION

Class: Not regulated

15. REGULATORY INFORMATION

CLASSIFICATION:
HAZARD SYMBOL: Not applicable
Contains: --
RISK PHRASES:
This product is not classified as hazardous (European Directive 88/379/EEC, 1999/45/EC)
SAFETY PHRASES:
S24/25 Avoid contact with skin and eyes. S26 In case of contact with eyes, rinse immediately with plenty of
water and seek medical advice. S28 After contact with skin, wash immediately with plenty of water. S36/37/39
Wear suitable protective clothing, gloves and eye/face protection.
Safety data sheet available for professional user on request.
NATIONAL REGULATIONS GERMANY
VbF-Klasse: None
WHG-WGK: 2 Classification according VwVwS v. 17.05.99, Anhang 4
StörfallVO: /12.BImSchV.Liste d. Anh. II): -
TA-Luft: -
Hinweise zur Beschäftigungsbeschränkung: None
NATIONAL REGULATIONS UK
COSHH regulations apply.
NATIONAL REGULATIONS SWITZERLAND
BAGT-Nr: 616200
Toxic class: frei

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Date issued: 01-06-2004

16. OTHER INFORMATION

Emergency Telephone Number +44 (0) 161 240 2100

Health	2
Fire	3
Reactivity	2
Personal Protection	E

Material Safety Data Sheet
Sodium hydrosulfite MSDS

Section 1: Chemical Product and Company Identification

Product Name: Sodium hydrosulfite

Catalog Codes: SLS3463, SLS1246

CAS#: 7775-14-6

RTECS: JP2100000

TSCA: TSCA 8(b) inventory: Sodium hydrosulfite

CI#: Not applicable.

Synonym: Blankit; Burmol; Hydros; Hydrosulfite R Conc; V-Brite B; Vatrolite; Sodium Dithionite; Sodium Hyposulfite; Disodium dithionite; Disodium hydrosulfite

Chemical Name: Dithionous acid, disodium salt

Chemical Formula: Na2S2O4

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Sodium hydrosulfite	7775-14-6	100

Toxicological Data on Ingredients: Sodium hydrosulfite: ORAL (LD50): Acute: >500 mg/kg [Rat]. DERMAL (LD50): Acute: >10000 mg/kg [Rabbit].

Section 3: Hazards Identification

Potential Acute Health Effects:
Hazardous in case of eye contact (irritant), of ingestion. Slightly hazardous in case of skin contact (irritant), of inhalation.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. Repeated or prolonged exposure is not known to aggravate medical condition.

Section 4: First Aid Measures

Eye Contact:

Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Cold water may be used. Get medical attention.

Skin Contact:
Wash with soap and water. Cover the irritated skin with an emollient. Get medical attention if irritation develops. Cold water may be used.

Serious Skin Contact: Not available.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: Not available.

Flash Points: Not available.

Flammable Limits: Not available.

Products of Combustion: Some metallic oxides.

Fire Hazards in Presence of Various Substances:
Highly flammable in presence of open flames and sparks, of heat. Slightly flammable to flammable in presence of moisture. Non-flammable in presence of shocks.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
Flammable solid. Spontaneously combustible material. Do not use water or foam. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use DRY chemical powder. Use water spray or fog. Cool containing vessels with water jet in order to prevent pressure build-up, autoignition or explosion.

Special Remarks on Fire Hazards:
Burns slowly, about like sulfur. Heats spontaneously in contact with moisture and air. May ignite nearby combustible materials. Vigourously supports combustion. Sodium Dithionite + Sodium Chlorite causes ignition of the latter. Reacts on exposure to moist air form toxic and corrosive fumes with the generation of heat and risk of combustion.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Use appropriate tools to put the spilled solid in a convenient waste disposal container.

Large Spill:

Spontaneously combustible solid. Oxidizing material. Stop leak if without risk. Do not get water inside container. Avoid contact with a combustible material (wood, paper, oil, clothing...). Keep substance damp using water spray. Do not touch spilled material. Use water spray curtain to divert vapor drift. Cover with dry earth, sand or other non-combustible material. Prevent entry into sewers, basements or confined areas. Prevent entry into sewers, basements or confined areas; dike if needed. Eliminate all ignition sources. Call for assistance on disposal.

Section 7: Handling and Storage

Precautions:
Keep away from heat. Keep away from sources of ignition. Keep away from direct sunlight or strong incandescent light. Ground all equipment containing material. Do not ingest. Do not breathe dust. Avoid contact with eyes. Avoid shock and friction. Wear suitable protective clothing. If ingested, seek medical advice immediately and show the container or the label. Keep away from incompatibles such as oxidizing agents, acids, moisture.

Storage:
Store in a segregated and approved area. Keep in a cool and ventilated area away from combustible materials. Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Separate from acids, alkalies, reducing agents and combustibles. Avoid all possible sources of ignition (spark or flame).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection:
Splash goggles. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits: Not available.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid. (Solid powder.)

Odor: Characteristic. Sulfurous. (Slight.)

Taste: Not available.

Molecular Weight: 174.11 g/mole

Color: White. Grayish white.

pH (1% soln/water): Not available.

Boiling Point: Not available.

Melting Point: Decomposition temperature: 20°C (68°F)

Critical Temperature: Not available.

Specific Gravity: 0.8 - 1.02(Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: Not available.

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: See solubility in water.

Solubility:
Soluble in cold water. Slightly soluble in alcohol.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Heat (above 50 deg. C) moisture, air, moist air, incompatible materials.

Incompatibility with various substances:
Reactive with acids, moisture. The product may undergo hazardous decomposition, condensation or polymerization, it may react violently with water to emit toxic gases or it may become self-reactive under conditions of shock or increase in temperature or pressure.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Air sensitive. Oxidizes in air(more readily so in the presence of moisture or when in solution) to bisulfite and aquires an acid reaction. It is a strong reducing agent and reacts violently with oxidants. Reacts with acids to form sulfur oxides. Thermal decompositon occurs violently at 190 deg. C. Avoid contact wtih oxidizing agents such as peroxides, potassium chlorate, and potassium permanganate. .

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Inhalation. Ingestion.

Toxicity to Animals:
Acute oral toxicity (LD50): >500 mg/kg [Rat]. Acute dermal toxicity (LD50): >10000 mg/kg [Rabbit].

Chronic Effects on Humans: Not available.

Other Toxic Effects on Humans:
Hazardous in case of ingestion. Slightly hazardous in case of skin contact (irritant), of inhalation.

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects: Skin: Causes skin irritation. Contact dermatitis may develop in sensitive individuals. Causes eye irritation and possible eye damage. Inhalation: It can irritate the respiratory tract (nose, throat, lungs)and cause wheezing, and/or shortness of breath. Ingestion: May be harmful if ingested. It can cause gastrointestinal tract irritation with nausea, abdominal pain, vomiting, and diarrhea. It may also affect behavior/central nervous system and cause headache, irritability, restlessness, and convulsions. Ingestion of large amounts may also cause hypotension, and cardiovascular collapse. Hypersensitivity reactions, occurring more frequently in asthmatics, may produce bronchoconstriction, diaphoresis, flushing, tachypnea, dyspnea, rhinorrhea, urticaria, tachycardia, hypotension and anaphylaxis. Chronic Potential Health Effects: Skin: Prolonged contact may cause skin irritation.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: CLASS 4.2: Spontaneously combustible substance.

Identification: : Sodium dithionate UNNA: 1384 PG: II

Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
Connecticut hazardous material survey.: Sodium hydrosulfite Rhode Island RTK hazardous substances: Sodium hydrosulfite Pennsylvania RTK: Sodium hydrosulfite Massachusetts RTK: Sodium hydrosulfite New Jersey: Sodium hydrosulfite TSCA 8(b) inventory: Sodium hydrosulfite

Other Regulations: EINECS: This product is on the European Inventory of Existing Commercial Chemical Substances.

Other Classifications:

WHMIS (Canada):
CLASS B-6: Reactive and very flammable material. CLASS F: Dangerously reactive material.

DSCL (EEC):
R7- May cause fire. R22- Harmful if swallowed. R31- Contact with acids liberates toxic gas. S7/8- Keep container tightly closed and dry. S26- In case of contact with eyes, rinse immediately with plenty of water and seek medical advice. S28- After contact with skin, wash immediately with plenty of water. S43- In case of fire, never use water.

HMIS (U.S.A.):

Health Hazard: 2

Fire Hazard: 3

Reactivity: 2

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 2

Flammability: 1

Reactivity: 2

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

References:
-Hawley, G.G.. The Condensed Chemical Dictionary, 11e ed., New York N.Y., Van Nostrand Reinold, 1987. -SAX, N.I. Dangerous Properties of Indutrial Materials. Toronto, Van Nostrand Reinold, 6e ed. 1984. -The Sigma-Aldrich Library of Chemical Safety Data, Edition II. -Guide de la loi et du rÃ¨glement sur le transport des marchandises dangeureuses au canada. Centre de conformitÃ© internatinal LtÃ©e. 1986.

Other Special Considerations: Not available.

Created: 10/10/2005 08:27 PM

Last Updated: 11/01/2010 12:00 PM

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VICTORY ENERGY CUSTOMER SPEC SHEET

Customer: CI Potash
Reference: VS-6-82 sat

Date: 08/09/2013
Quote Number: VE-6336 NG Rev1

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PREDICTED PERFORMANCE

LOAD		DESIGN	LOAD 1	LOAD 2	LOAD 3
Outlet Steam Flow,	(lbs/hr)	126572	94929	63286	31643
Fuel/Firing Conditions -					
Fuel Fired		Natural Gas	Natural Gas	Natural Gas	Natural Gas
Excess Air,	(%)	15.00	15.00	15.00	15.00
Flue Gas Recirc.,	(%)	12.00	12.00	12.00	12.00
Steam/Water Conditions -					
Steam Temp @ NRV Outlet	(deg F)	367.2	366.6	366.2	366.0
Steam Pres @ NRV Outlet	(psig)	150.0	150.0	150.0	150.0
Boiler Saturation Temp.	(deg F)	370.6	368.6	367.1	366.2
Boiler Operating Press.	(psig)	160.0	155.6	152.5	150.6
Econ. Water Exit Temp,	(deg F)	272.7	265.0	257.4	251.7
Feedwater Inlet Temp,	(deg F)	200.0	200.0	200.0	200.0
Flow Quantities -					
Percent Blowdown,	(%)	1.00	1.00	1.00	1.00
Blowdown Flow,	(lbs/hr)	1,279	959	639	320
Feedwater Flow,	(lbs/hr)	127,851	95,888	63,925	31,963
Fuel Flow,	(lbs/hr)	7,146	5,322	3,532	1,772
Combustion Air Flow,	(lbs/hr)	131,179	97,700	64,847	32,528
Flue Gas Flow LVG System,	(lbs/hr)	138,324	103,022	68,380	34,300
Flue Gas Recirc. Flow,	(lbs/hr)	16,599	12,363	8,206	4,116
Flue Gas Flow w/Recirc.,	(lbs/hr)	154,923	115,385	76,585	38,416
Air/Gas Temperatures -					
Ambient Air Temp.,	(deg F)	80.0	80.0	80.0	80.0
Comb. Air/FGR Mixture,	(deg F)	106.6	103.0	99.8	96.9
Adiabatic Flame Temp,	(deg F)	3,257.0	3,255.2	3,253.6	3,252.1
Flame Temp w/ Recirc.,	(deg F)	2,981.7	2,977.0	2,972.8	2,969.0
Effec. Furnace Gas Temp,	(deg F)	2,297	2,173	1,997	1,701
Furnace Exit Gas Temp,	(deg F)	2,216	2,080	1,886	1,562
Boiler Exit Gas Temp,	(deg F)	522	472	423	382
Gas Temp. LVG Economizer,	(deg F)	300	271	244	221
Flue Gas Recirc. Temp.	(deg F)	300	271	244	221
System Efficiency -					
Dry Gas Losses,	(%)	4.15	3.60	3.09	2.65
Water From Fuel Fired,	(%)	10.61	10.48	10.36	10.26
Moisture in Air Losses,	(%)	0.13	0.11	0.09	0.08
Radiation Loss,	(%)	0.46	0.61	0.90	1.75
Manufactures Margin,	(%)	1.00	1.00	1.00	1.00
Total Heat Losses,	(%)	16.35	15.79	15.45	15.73
Boiler Efficiency,	(%)	83.65	84.21	84.55	84.27
HHV Heat Input By Fuel,	(mmbtu/hr)	155.867	116.088	77.052	38.650
System Draft Losses -					
Fan Inlet:					
Silencer,	(inwc)	2.00	1.17	0.54	0.14
Fan Inlet Ducts,	(inwc)	0.50	0.29	0.14	0.04

Fan Outlet:					
Fan Outlet Ducts,	(inwc)	0.50	0.29	0.14	0.04
Burner,	(inwc)	7.50	4.39	2.04	0.54
Convection Zone,	(inwc)	16.72	9.16	3.97	0.97
Economizer,	(inwc)	0.88	0.49	0.22	0.06
Outlet Gas Ducts,	(inwc)	0.50	0.29	0.14	0.04
Total Draft Losses,	(inwc)	28.59	16.08	7.18	1.82
Furnace Performance -					
Heat Available,	(mmbtu/hr)	139.328	103.920	69.068	34.686
Heat Absorbed in Furn,	(mmbtu/hr)	40.561	35.270	28.086	17.798
Liberation Rate,	(btu/hr-ft^3)	83036	61844	41048	20590
Furnace Release Rate,	(btu/hr-ft2)	129494	96505	64092	32165
Residence Time,	(sec)	0.667	0.938	1.515	3.434
Convection Zone Performance -					
Gas Mass Velocity	(lb/hr-ft2)	9,079	6,762	4,488	2,251
Gas Velocity at Inlet,	(ft/sec)	177.74	125.64	77.04	33.31
Heat Absorbed in Conv.,	(mmbtu/hr)	81.73	57.16	34.01	13.43
Economizer Performance -					
Gas Mass Velocity	(lb/hr-ft2)	4,998	3,722	2,470	1,239
Gas Velocity at Inlet	(ft/sec)	35.92	25.37	15.96	7.63
Water Flow Through Econ,	(lb/hr)	127,851	95,888	63,925	31,963
Water Mass Velocity,	(lb/sec-ft2)	312.24	234.18	156.12	78.06
Feedwater Pressure Drop,	(psi)	7.09	4.03	1.82	0.48
Heat Absorbed in Econ.,	(mmbtu/hr)	9.40	6.30	3.70	1.67

PHYSICAL DESIGN

Furnace Design Data -		
Proj. Radiant HT,	(ft2)	1083
Effective Radiant HT,	(ft2)	960
Convection Zone Design Data -		
Conv. Heating Surface	(ft2)	6478
Economizer Design Data -		
Economizer Heating Surface	(ft2)	7683

Fuel Analysis -		
Fuel Type		Gaseous
Fuel Name		Natural Gas
Mol. Weight	(lb/mol)	17.37
Specific Gravity		0.5998
Density	(lb/ft3)	0.0451

Fuel Constituents -		By Volume	By Weight
CH4	(%)	90.0000	83.1042
C2H6	(%)	5.0000	8.8339
N2	(%)	5.0000	8.0619

High Heating Value	(btu/lb)	21,813.1
Low Heating Value	(btu/lb)	19,667.0

IC Potash Corp
c/o Novopro
1350 Sherbrooke West, Suite 600
Montreal, QC H3G 1J1
Canada

BOI-12-177 – COMMERCIAL PROPOSAL

SNC Lavalin Inc. Project No. 510315-P-53520

THREE (3) INTEGRATED DRYER/CALCINER/COOLER SYSTEMS

for

Polyhalite

IC Potash - Ochoa Project
Hobbs, NM

Attention: Mr. Mazi Rejaee (mazi@novopro.ca)		
Submitted By: Gregory See Hoye (gregory.see.hoye@gea.com)		
Market Manager: Francis Chartrand (francis.chartrand@gea.com)		
Issue	Date	Update
0	May 8, 2013	First Issue
1	August 14, 2013	Revised design basis and operating requirements
2	August 23, 2013	Three (3) systems instead of four & higher total solids throughput

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1.0 CLARIFICATIONS TO PROPOSAL

1.1. GEA Barr-Rosin Dryer/Calciner/Cooler – Summary

2 1. As part of SNC-Lavalin RFQ No. 510315-P-53520 for the IC Potash – Ochoa Project, GEA Barr-Rosin would propose four (4) fluid bed calcining systems for Polyhalite to process the total specified design solids feed capacity of 500 STPH. Each system would include drying, dehydration, calcining, and cooling functions in an integrated system. The final product would have a final temperature of ≤248ºF.

2 2. The Rev.2 proposal has been revised to reflect the following proposed system updates:
   - In an attempt to further reduce the CAPEX of the project, the originally proposed offer of four (4) parallel systems has been reduced to three (3) larger systems to meet the same total capacity, i.e. 33% more capacity.
   - Based on an e-mail clarification of August 16, 2013, the capacity has also been increased from 500 STPH design wet feed rate (450 STPH dry solids feed rate) to 555 STPH design wet feed rate (500 STPH dry solids feed rate). All technical data presented in this proposal is based on the increased rate. A revised price has also been provided based on this higher capacity.
   - Based on a subsequent e-mail clarification on August 23, 2013, the design feed rate was re-confirmed to be 509 STPH wet feed rate (459 STPH dry solids feed rate). Due to time constraints to re-issue new calculations, the technical data has not been revised. However, an approximate price for the lower capacity has been provided for reference.

   All other design features remain unchanged from the previous proposal.

2 3. The Rev.2 clarifications (based on the higher capacities) have changed the size of the proposed systems in relation to the following design changes:
   - Fluid Bed Dryer/Calciner Size: increases from 95'-0" long to 143'-0" long
   - Fluid Bed Cooler Size: increases from 38'-0 long to 61'-0" long
   - Cooling Coils Requirement: remains unchanged from a total requirement perspective (since overall cooling water flowrate remains unchanged), though each system will require 33% coils coils due to the reduction in total parallel lines.

1 4. The Rev.1 Proposal had been revised to reflect the following clarifications as discussed during the meeting in Denver, CO at IC Potash on July 12, 2013:
   - The calcination energy has been reduced to a combined 188BTU/lb for the dehydration (bound moisture) and calcination (molecular reordering) processes, down from 233 BTU/lb which represents a **20% reduction** in heat requirement.
   - The specific heat capacity of the Polyhalite solids has been increased to 0.25BTU/lb.ºF from 0.17 BTU/lb.ºF, which results in a **47% increase** in heat requirement.
   - The dryer zone inlet temperature has been raised from 1200ºF to 1500ºF to enable higher energy efficiency/lower airflow requirement. This improved efficiency, together with some other minor optimizations in the assumed operating parameters, provides another **30% reduction** in heat requirement.
   - The cooling water availability has been revised to 1MMlb/hr with a limited temperature increase from 150ºF to 210ºF, thereby accounting for 60MM BTU/hr cooling duty. This clarification results in a larger cooling surface area requirement.
   - The front-end drying zone of the fluid bed would feature a 16" static bed depth, reduced from 24" deep, to enable a reasonable fluidizing fan selection with respect to pressure rise and high-temperature operation for integration with the cooler exhaust air. This bed depth would be suitably deep for absorption of potential feed upsets.
   - The dehydration/calcination zone would also have a 16" static bed depth to ensure a specified residence time of 15 minutes.
   - The fluid bed cooler would have a static bed depth of 18" to enable sufficient immersion of the cooling water tubes in the fluidizing product. This bed depth has been reduced from 24" due to the reduction in the available cooling water and therefore the reduction in required cooling tubes.

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- Final product cooled temperature has been clarified to be 248ºF, an increase from the previously-specified 200ºF.

Note: based on the above parameter changes that affect the heat requirements, the energy consumption reduces by 3% in comparison to the previous proposal.

1 5. The Rev.1 clarifications have reduced the size and cost of the proposed systems in relation to the following design changes:

- Fluid Bed Design: the heated lower plenums would feature a non-washable refractory-lined design since washability is not a necessary feature, allowing a higher inlet temperature operation.
- Fluid Bed Dryer/Calciner Size: reduces to 95'-0" long from 120'-0" long
- Fluid Bed Cooler Size: increases to 38'-0 long from 25'-0" long
- Cooling Coils Requirement: reduced according to the limited water availability and duty
- Simpler Air Handling Configuration: combined exhaust/recirculation gases for higher efficiency reduces the number of cyclones, fans, air heaters, and ductwork.
- Fans Selections: lower airflows, less fluidizing bed depth, and simpler configuration allow standard designs for high-temperature operation, lower pressure drop requirements, and reduced motor power consumption.
- Integrated Cooler Exhaust: reduces the bleed-off gases sent to atmosphere, thereby reducing the size of the baghouse dust collector.

Note: other configurations, heat recovery methods, and/or integration options could also be investigated, including the use of hot oil heat recovery coils, if additional cost/size reduction are needed.

1 6. The proposed systems would feature Partial Gas Recycle (PGR) configuration with cooler exhaust integration for energy conservation and high operating thermal efficiency enabling the following advantages in comparison to a more traditional open-circuit (OC) configuration:

- Reduced energy consumption by up to 20-25%
- Continuously improving thermal efficiency at various turndown conditions through increase in recycled hot gas for every downward step in capacity
- Optimized combustion control for maximum thermal efficiency by minimizing the fresh air intake with a PLC-based combustion control system (CCS) for fuel/air ratio control.
- Smaller bleed-off gas stream (about 45%-50% smaller at design conditions) consisting only of combustion products, evaporated vapours, unused exhaust gases, and system leaks
- Minimized size of the downstream gas-cleaning system yielding overall capital cost-savings.

1 7. The fluid bed cooling section would operate with embedded cooling tubes. The cooling fluid would be a source of cooling water at 150ºF at a maximum availability 1MM lb/hr to be split to all four (4) systems, yielding a maximum water outlet temperature of 210ºF.

8. The GEA Barr-Rosin rectangular fluid bed design would be used in the heated applications, and would feature the following key benefits:

- True plug flow design: the fluid bed geometry promotes true plug flow to prevent bulk solids mixing, ensuring discharge of only the hottest/driest product after achieving a constant residence time.
- Perforated bedplate: the specially-designed high-temperature bedplate would prevent product back-sifting to the lower plenum while offering a robust construction for operation at high temperature.
- Expanded upper canopy: the gradual plenum expansion in the vertical direction would result in the most aggressive fluidizing layer near the bedplate to avoid lump formation and system upsets, while the reduced velocity near the air exhaust would minimize product elutriation.

9. The GEA Barr-Rosin rectangular fluid bed cooler design with embedded cooling tubes would be used for the cooler section, and would feature the following key benefits:

- Removable coils: the removable heat transfer surfaces in a drawer-style pull-out design facilitates maintenance and repair work. External tube access also allows better and more complete cleanability. The

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coil design/construction would have a high degree of robustness to prevent warping/damage during external handling.

- True plug flow design: the fluid bed geometry promotes true plug flow to prevent bulk solids mixing, ensuring discharge of only the coolest product after achieving a constant residence time.
- Perforated directional bedplate: the bedplate design would prevent material build-up and product back-sifting to the lower plenum while directing the airflow to promote bulk product flow.
- Expanded upper canopy: the gradual plenum expansion in the vertical direction would result in the most aggressive fluidizing layer near the bedplate to avoid lump formation and system upsets, while the reduced velocity near the air exhaust would minimize product elutriation.

10. The hot fluid bed zones would feature the following design considerations:
    - The fluid bed would be designed to provide intimate gas contact between individual solid and air particles in crossflow for efficient heat and mass transfer.
    - ⚠1 The heated zones (dryer and calcination) would be high-temperature designs featuring refractory-lined lower plena to enable operation at 1500℉ inlet tem perature for high-efficiency operation.
    - ⚠1 The fluid bed would operate with a 16” deep static depth of material for robustness against process upset conditions and to absorb variations in feed rate and moisture content, while ensuring sufficient residence time for calcination.
    - The fluid bed discharge section would feature a product discharge hood complete with underflow gate valve to control bed depth and product residence time, while facilitating lump management.
    - ⚠1 The fluid bed upper plenum and expanded canopy would be fabricated in ¼” thick SS309 construction to provide optimum wear-resistance and corrosion-resistance from contact with wet feed material, and would be designed to elutriate the fine particles with the exhaust airstream to the cyclones or baghouse.
    - ⚠1 The perforated bedplate would feature SS304 construction (with under-grid supports in 253MA) to resist high-temperature operation and corrosion from wet feed contact. The robust design, construction, and support structure would also enable heavy-duty operation while facilitating thermal expansion of the unit while preventing product backflow into the lower plenum.

11. The fluid bed cooling zone would be fabricated with thick-gauge construction for optimum wear-resistance. Please also note the following design considerations:
    - The proposed rectangular fluid bed unit would provide constant residence time, even product temperature, true plug flow, and intimate gas contact with individually fluidized particles in the crossflow for high-efficiency operation.
    - ⚠1 The fluid bed lower and upper plenums would be fabricated of carbon steel construction.
    - ⚠1 The perforated bedplate would feature SS304 construction with a robust design, construction, and support structure to enable heavy-duty operation while facilitating thermal expansion of the unit while preventing product backflow into the lower plenum.
    - The bed depth and residence time would be controlled with an adjustable underflow gate valve.
    - Multi-pass coils of embedded tubes in **SS316** construction would provide some conduction cooling using cooling water. The removable drawer-style pull-out coil design would facilitate maintenance, and each individual coil bundle would be independently accessible/removable.
    - The proposed drying system would operate at near-atmospheric pressure in the fluid bed to minimize in-leaks of ambient air, and would be controlled by a balanced-draft system produced by a system of forced and induced draft fans.

    Note: The ancillary equipment required to supply the cooling fluid would be provided by others. This equipment may include recirculation pumps, heat exchangers, pipework, valves, filters, traps, etc. GEA Barr-Rosin would provide flow specifications and additional engineering support to enable local supply of this equipment.

12. The fluid bed system would be supplied with the following ancillary equipment to complete the overall system:

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- Natural Gas Air Heaters for PGR: specially-designed GEA Barr-Rosin air heater systems for PGR application would feature an Ultra Low NOx pre-mix type burner and multi-stage recirculation concept for safe, efficient, and reliable dryer operation under PGR configuration in the Potash industry, particularly due to the recirculating stream laden with dust.
- System of Fans: multiple sets of combustion air, recirculation air, cooling air, and cooler exhaust air fans operating under a balanced-draft push-pull configuration in each zone would be included to supply the required airflow for the various functions, while enabling controlled operation at near-atmospheric pressure in each fluid bed zone to minimize in-leaks of ambient air.
- Recirculation Cyclones: multiple sets of high-efficiency cyclones in each zone would act as the dust collection devices for the elutriated fines, and would be fabricated in carbon steel construction with a replaceable inlet section in Hardox450 construction for optimal wear-resistance. Complete with dedicated discharge rotary valves.
- Interconnecting Ductwork: predominantly fabricated in carbon steel construction, with high-temperature SS309 or refractory-lined ducts where necessary, a set of ductwork would connect the fluid bed ancillary components into a complete system. Includes a non-free-standing stack.

13. A baghouse dust collector would be supplied for final gas-cleaning prior to discharge of off-gases.
14. Each system would feature a dedicated bleed-off fan installed downstream of the baghouse dust collector to discharge the off-gases to atmosphere.
15. A stand-alone PLC-based control system for the overall system with field instrumentation would be included, complete with NEMA-4X local control panel. GEA Barr-Rosin would also supply the following documents, as part of the basic Engineering Package:
    - Start-Up, Shut-Down, and emergency procedures
    - Control Philosophy
    - Process & Instrumentation Diagram
    - Instrumentation List and Locations
    - Safety Interlocks and Alarm Sequences

    Installation of the control system and field instrumentation including electrical wiring would be by others according to GEA Barr-Rosin specifications.
16. All electric motors required for the proposed GEA Barr-Rosin equipment would be included. However, all motor control centers (MCC) and variable frequency drives (VFD) would be excluded from the scope of supply to enable local supply by others.
17. Thermal Insulation and cladding to ensure thermal efficiency of the system and for personnel protection would be supplied by others to enable cost-savings associated with a GEA Barr-Rosin markup. GEA Barr-Rosin would provide insulation specifications and installation instructions to facilitate procurement by others.
18. GEA Barr-Rosin would investigate local fabrication upon shop qualification to minimize freight costs.
19. All material handling conveyors, unless specifically mentioned, to feed/discharge/connect the proposed systems are excluded from the scope of supply but could be included in GBRI scope upon request.
20. Steelwork and foundation design, including platforms, walkways, stairs, ladders, and handrails, would be excluded from the GEA Barr-Rosin scope of supply to enable local supply by others.
21. The current proposal would be subject to mutual Terms & Conditions to be agreed between GEA Barr-Rosin and SNC-Lavalin/IC Potash. The GEA Barr-Rosin Standard Terms & Conditions could serve as a basis for the current project.

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1.2. Partial Reference List – Potash Industry

Provided below is a brief reference list of GEA Barr-Rosin equipment for potash applications. These units process potash similar to this proposed application:

Agrium Inc.	Vanscoy, SK – two (2) Fluid Bed Dryers – three (3) Rotary Conditioners
BHP Billiton	Jansen, SK – two (2) PGR Fluid Bed Dryers for Standard Product Potash – two (2) Direct Contact Column Coolers w/embedded tubes – one (1) Rotary Conditioner – one (1) Fluid Bed Dryer/Cooler (evaporative cooling)
Intrepid Potash	Carlsbad, NM – one (1) Fluid Bed Drying System for Coarse Langbeinite
Mosaic Co.	Carlsbad, NM – one (1) Rotary Conditioner for Granular Potash – one (1) Fluid Bed Dryer for Granular Potash Esterhazy, SK (K1 Facility) – one (1) Rotary Conditioner for Granular Potash – one (1) Fluid Bed Dryer for Granular Potash Esterhazy, SK (K2 Facility) – one (1) Rotary Conditioner for Granular Potash – one (1) Fluid Bed Dryer for Granular Potash – one (1) Fluid Bed Dryer for Standard Potash Colonsay ,SK – one (1) Rotary Conditioner for Granular Potash – one (1) Fluid Bed Dryer for Granular Potash – one (1) Fluid Bed Dryer for Standard Potash
Potash Corp. of Saskatchewan	Allan, SK – one (1) Rotary Drying System for Product Potash Saskatoon, SK (Cory Facility) – one (1) PGR Fluid Bed Dryer – one (1) Column Dryer Rocanville, SK – one (1) PGR Fluid Bed Dryer for Coarse Product Potash – one (1) PGR Ring Dryer for Fine Product Potash – one (1) Fluid Bed Dryer/Cooler (evaporative cooling) – two (2) Direct Contact Column Coolers w/embedded tubes
SQM	Salar de Atacama , Antofagasta – one (1) Rotary Conditioner for Granular Potash – one (1) Fluid Bed Dryer/Cooler for Granular Potash (evaporative cooling)
Vale	Bahia Blanca , Argentina – one (1) Fluid Bed Dryer for Crystallized Potash – one (1) Fluid Bed Reheater for Crystallized Potash – one (1) Rotary Conditioner for Granular Potash – one (1) Fluid Bed Dryer/Cooler for Granular Potash (evaporative cooling)

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2.0 SYSTEM SPECIFICATION

2 2.1. Performance Data

2.1.1. GEA Barr-Rosin Integrated Dryer/Dehydrator/Calciner/Cooler

Each proposed GEA Barr-Rosin fluid bed system would process the Polyhalite at the capacities specified below:

System Characteristics	Units	Design
No. of Lines Required	-	3
Feed Rate (Total Wet Feed)	lb/hr	1,109,878
Feed Rate (per line)	lb/hr	369,959
Feed Moisture Content[1]	%	9.9
Feed Temperature	ºF	80
Calcination Temperature (average)	ºF	932
Calcination Residence Tome	mins.	15
Dryer Inlet Air Temperature	ºF	1500
Calciner Inlet Air Temperature	ºF	1500
Cooler Inlet Air Temperature	ºF	110
Final Product Rate	lb/hr	313,410
Final Product Temperature	ºF	248
Cooling Water Rate (per line)	lb/hr	333,333
Cooling Water Inlet Temperature	ºF	150
Cooling Water Outlet Temperature	ºF	205
Bleed-Off Airflow to baghouse (per line)[2]	ACFM	286,000
Installed Power (per line)	HP	7,122
Electrical Consumption (per line)	BHP	5,130
Net Heat Requirement (per line)	MM BTU/hr	214
NG Consumption Rate[3] (per line) (Winter Ambient Temp.: 32ºF)	lb/hr	**10,930**
Fluid Bed Dryer/Calciner Approximate Dimensions[4]	w x l x h	8'-0" x 143'-0" x 20'-0"
Fluid Bed Cooler Approximate Dimensions[4]	w x l x h	8'-0" x 61'-0" x 18'-0"

Please Note:

1. Feed moisture shown is based on surface moisture only for the dryer zone. Dehydration/calcination considers the removal of chemically-bound water.
2. Bleed-off airflow is based on actual conditions for elevation, temperature, and pressure at site based on estimated site conditions for Carlsbad, NM according to ASHRAE 2005.
3. Gas consumption based on a natural gas lower heat value of 10,888 kcal/kg (19,600 BTU/lb), and on estimated site conditions for Carlsbad, NM according to ASHRAE 2005.
4. Dimensions shown correspond to the fluid bed unit only; additional space would be required for ancillary air handling components and ductwork.

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2 2.2. Electric Motors

	Installed Power	rpm	Voltage (V)	Control
• Dryer/Calciner Feed Screw Conveyor	30 HP	1800	460	VFD
• Dryer Combustion Air Fan	450 HP	1800	460	Direct
• Dryer Radial Fan	30 HP	1800	460	VFD
• Dryer Recirculation Fan	1000 HP	1800	4160	Direct
• Calcination Combustion Air Fan	1000 HP	1800	4160	Direct
• Calcination Radial Air Fan	60 HP	1800	460	VFD
• Calcination Recirculation Fan	2000 HP	1200	4160	Direct
• Cooler Forced Draft Fan	1000 HP	1800	4160	Direct
• Baghouse Discharge Screws	4 x 10 HP	1800	460	Direct
• Baghouse Discharge Rotary Valves	4 x 3 HP	1800	460	Direct
• Bleed-Off Fan	1500 HP	1800	4160	Direct

2.3. Process Flow Diagram

The following diagram illustrates each proposed dryer/calciner/cooler systems, as well as the required ancillary equipment required for the process.

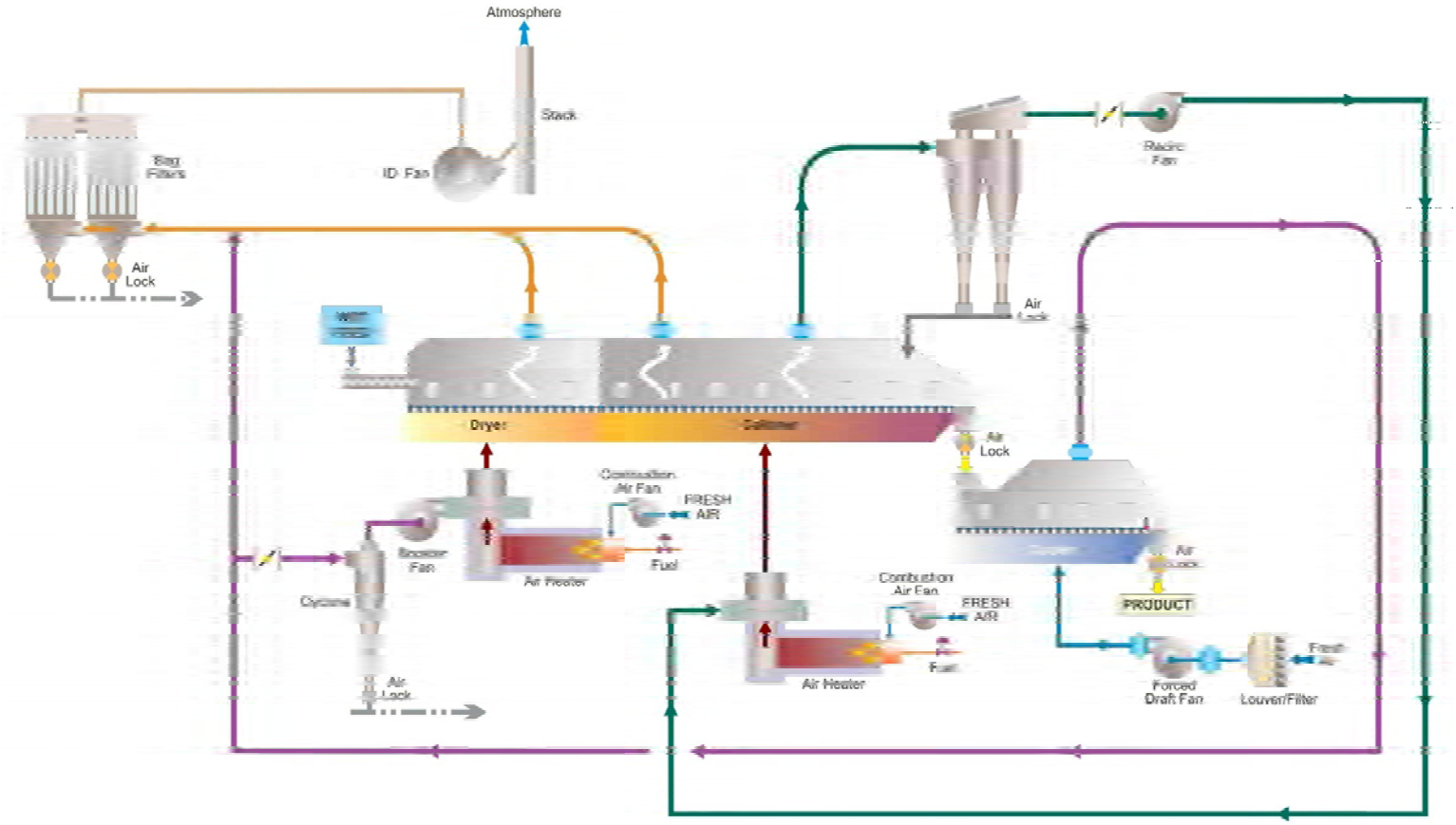

Fig. 1. Preliminary Process Flow Diagram of each proposed integrated drying/calcining/cooling system

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2.4. Scope of Supply

- Complete equipment supply within the battery limits shown below
- Burner system instrumentation and controls, with local control panel
- Overall system controls and instrumentation
- Engineering services, including process evaluation and detail design

2.5. Battery Limits

Feed Inlet	Inlet to fluid bed dryer feed screw conveyor
Product Outlet	Outlet of final product discharge after cooler
	Outlet of cyclone rotary valves
	Outlet of baghouse bag rotary valves
Air Inlet	Inlet to combustion/radial and cooler air louvers
Air Exhaust	At outlet of non-free standing stack
Gas Supply	Inlet of gas valve train. Gas train within proximity of burner
Electrical Power	At inlet of burner control panel
	At individual motor terminal boxes
Compressed / Instrument Air Supply	Inlet connection to actuators on dampers
	Inlet connection to duct collector pulse-jet system

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3.0 ENGINEERING SERVICES

3.1. GEA Barr-Rosin Engineering Package

GEA Barr-Rosin would provide engineering services to ensure that the proposed dryer/calciner/cooler systems would be designed to operate continuously at the rates stipulated in *Section 2.1 – Performance Data*. The GEA Barr-Rosin engineering package would include the following GEA Barr-Rosin standard deliverables; upon discussion of a mutually-agreed Vendor Data Requirements List (VDRL) schedule, a VDRL engineering option could be offered:

3.1.1. Preliminary Documentation:

- Preliminary project schedule
- Preliminary overall general arrangement drawing for approval
- Preliminary process and instrumentation diagram (P&ID) for approval
- Preliminary utilities list
- Preliminary motor list
- Preliminary instrumentation list

Note: GEA Barr-Rosin would submit approval drawings containing dimension details and other customer information for Buyer's comments or approval as appropriate within the agreed review period. The resulting design would be frozen, and thus any subsequent request for design or drawing changes may require a price and/or delivery schedule adjustment.

3.1.2. Documentation before delivery:

- Final overall general arrangement drawing
- Final process and instrumentation diagram (P&ID)
- Delivery and manufacturing schedule
- Detailed fixing and static loading drawings, including anchor bolt location drawings
- Instrumentation list and instrumentation connections drawings
- System control narrative
- Alarm and interlock schedule, including list of signals and interlock diagram
- Detailed motor list
- Detailed utilities schedule
- Erection manual and installation procedure

3.1.3. Documentation at Delivery:

- Final layout drawing showing civil loads and suggested support steel access structure (steelwork design excluded)
- Thermal insulation manual and recommendations
- Start-up/shut-down procedures
- Itemised and priced spares list

3.1.4. Operating and Maintenance Manuals

Three (3) sets of Operating and Maintenance Manuals would be provided in hard copies and one (1) copy in electronic format, and would include the final version of the above mentioned documents.

3.2. GEA Barr-Rosin Engineering Services

The services of a GEA Barr-Rosin Engineer could be made available to assist and advise during start-up, commissioning, and training for the proposed systems. The additional cost for these services would be according to the GEA Barr-Rosin Field Service Rates document included in the proposal package. Any additional services of burner and fan technicians required for start-up would be invoiced at cost +10%. Total period to be agreed.

3.3. GEA Barr-Rosin Site Supervisor

The presence of a GEA Barr-Rosin site supervisor onsite during the installation of the proposed systems are recommended. We estimate that our site supervisor would be required onsite for approximately 4 – 8 weeks. The services of a GEA Barr-Rosin site supervisor could be available during installation at the rates shown in the GEA Barr-Rosin Field Service Rates document included in the proposal package. Total period to be agreed.

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4.0 PRICING AND DELIVERY

2 4.1. Budgetary Pricing

Our price for design, manufacture and delivery of the proposed systems are as follows:

GEA Barr-Rosin Fluid Bed System for Polyhalite		
One (1) lot of Detail Engineering Services (GEA Barr-Rosin Standard Deliverables)	Included	USD
Three (3) GEA Barr-Rosin Fluid Bed Dryers/Calciners/Coolers	Included	USD
TOTAL Price[1,2]	**$ 49,800,000**	**USD**

Please Note:

2 1. The above pricing is based on a higher design feed rate of 500 STPH dry solids. Based on an e-mail clarification on August 23, 2013, the design feed rate was re-confirmed to be 459 STPH dry solids feed rate. This reduction in capacity would result in a price reduction to approximately USD$47,300,000 for the three (3) parallel systems.
2. FCA Point of Manufacture
3. All applicable sales taxes, freight, customs, fees for Letters of Credit, etc. would be extra.
4. The proposal would be valid for 90 days, subject to price adjustments (increase or decrease) until receipt of a Purchase Order according to fluctuations in raw material costs and USD/CAD exchange rate.
5. The current proposal would be subject to mutual Terms & Conditions to be agreed between GEA Barr-Rosin and SNC Lavalin/IC Potash. The GEA Barr-Rosin Standard Terms & Conditions could serve as a basis for the current project.

4.2. Payment Terms

GEA Barr-Rosin would propose the following payment:

30% with receipt of order; net ten (10) days.
30% with 50% fabrication.
35% upon notification of equipment readiness-to-ship, and delivery of final manuals (pro-rata).
5% upon process commissioning, not to exceed 3 months after delivery.

All payments are net thirty (30) days from the date of the invoice, unless otherwise noted.

4.3. Delivery Schedule

Based on a two-week turnaround time for approval of General Arrangement and P&ID drawings, delivery of drying and cooling systems is approximately 50 weeks from receipt of order.

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5.0 EXCLUSIONS

Pricing excludes anything not specifically mentioned above, and specifically excludes the following items:

- Authorities' approval for constructions and operation of the plant (GEA Barr-Rosin would co-operate and supply information as required)
- Permit fees, site arrangement, and other costs associated with gas inspection
- Offloading of equipment at site
- Mechanical erection and installation
- Supply and operation of cranes, hoists, lifts, and other installation equipment
- Civil engineering and design, and civil work.(GEA Barr-Rosin would supply loading and bolting plans)
- Design and supply of foundations or modifications to existing structures or buildings
- Design and supply of supporting steelwork
- Thermal Insulation and cladding
- Plant lighting
- Electrical cabling, instrument wiring and installation
- Supply of utilities including natural gas, compressed air, steam, electricity, and water
- Variable frequency drives (VFDs), motor control centers (MCCs), motor starters, etc.
- Utility pipework and isolation valves, unless clearly included in scope (up to battery limits)
- Supply and installation of acoustic insulation and sound attenuation equipment/enclosures
- Material handling conveyors
- Extended runs of inlet or exhaust ductwork
- All utilities, raw materials and labour for testing, commissioning and operating the plant
- Analysis and laboratory equipment
- Any environmental tests, including measurement of noise and dust levels by third parties
- Site supervisor
- Start-up and commissioning services
- Start-up spares
- Running spares and wear parts
- Capital/strategic spare parts
- Any applicable sales taxes, freight, customs, fees for Letters of Credit, etc.

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Canada

BOI-13-056 & BOI-13-057
COMMERCIAL PROPOSAL
SNC Lavalin Inc. Project # 510315 - P - 53520

ONE (1) OPEN CIRCUIT FLUID BED DRYER SYSTEM & ONE (1) COLUMN COOLER

for

SOP

IC Potash - Ochoa Project
Hobbs, NM

Attention: Mr. Archy Gamvrelis (archy.gamvrelis@snclavalin.com)		
Submitted By: Gregory See Hoye (gregory.see.hoye@gea.com)		
Market Manager: Francis Chartrand (francis.chartrand@gea.com)		
Issue	Date	Update
0	May 8, 2013	First Issue

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1.0 CLARIFICATIONS TO PROPOSAL

1.1. General

1. As part of SNC-Lavalin RFQ No. 510315-P-53520 for the IC Potash – Ochoa Project, GEA Barr-Rosin would propose one (1) fluid bed drying system and one (1) direct-contact column cooler to process Sulphate of Potash (SOP) product. The design solids feed rate would be 106 STPH, and the final product would contain <0.3%MC by weight and have a final temperature of 190°F.
2. The proposed design would be subject to Pilot Plant testing to confirm operating parameters and expected product behavior for the specific ore at the proposed mine site. GEA Barr-Rosin has a fully operational Pilot Plant Testing facility in Montreal, Canada that would be available for evaluation purposes.
3. All electric motors required for the proposed GEA Barr-Rosin equipment would be included. However, all motor control centers (MCC) and variable frequency drives (VFD) would be excluded from the scope of supply to enable local supply by others.
4. Thermal Insulation and cladding to ensure thermal efficiency of the system and for personnel protection would be supplied by others to enable cost-savings associated with a GEA Barr-Rosin markup. GEA Barr-Rosin would provide insulation specifications and installation instructions to facilitate procurement by others.
5. GEA Barr-Rosin would investigate local fabrication upon shop qualification to minimize freight costs.
6. All material handling conveyors, unless specifically mentioned, to feed/discharge/connect the proposed systems are excluded from the scope of supply but could be included in GBRI scope upon request.
7. Steelwork and foundation design, including platforms, walkways, stairs, ladders, and handrails, would be excluded from the GEA Barr-Rosin scope of supply to enable local supply by others.
8. Current pricing is based on May 2013 raw material costs and current CAD/USD exchange rate. Subject to these cost variations, pricing would be valid for 90 days.
9. The current proposal would be subject to mutual Terms & Conditions to be agreed between GEA Barr-Rosin and SNC-Lavalin/IC Potash. The GEA Barr-Rosin Standard Terms & Conditions could serve as a basis for the current project.

1.2. Fluid Bed Dryer (BOI-13-056)

1. One (1) fluid bed drying system operating in high-temperature open-circuit configuration would be sized to dry 106 STPH design dry solids feed rate of SOP Product from 5%MC by weight to <0.3%MC. Please refer to *Section 2.1 – Performance Data* for additional design operating details.
2. The proposed fluid bed would feature the specially-designed GEA Barr-Rosin high-temperature metallic lower plenum without refractory that enables wash-out and avoids water/solids contact with any refractory; please refer to the document *GEA Barr-Rosin HTMFB Fluid Bed Design Description*.
3. The GEA Barr-Rosin rectangular fluid bed dryer design would feature the following key benefits:
   - Two (2) fluidization zones: the front-end zone with intense high-velocity fluidization would create high solids agitation to minimize lump formation, and would elutriate the ultra-fines to prevent potential build-up/maintenance issues. The back-end zone with gentler fluidization would provide uniform product heating to achieve final moisture content.
   - True plug flow design: the fluid bed geometry promotes true plug flow to prevent bulk solids mixing in the second zone, ensuring discharge of only the driest product after achieving a constant residence time.
   - Perforated directional bedplate: the bedplate design would prevent material build-up and product back-sifting to the lower plenum while directing the airflow to promote bulk product flow.
   - Expanded upper canopy: the gradual plenum expansion in the vertical direction would result in the most aggressive fluidizing layer near the bedplate to avoid lump formation and system upsets, while the reduced velocity near the air exhaust would minimize product elutriation.

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4. The fluid bed dryer unit would feature the following design considerations:
   - The fluid bed would be designed to provide intimate gas contact between individual solid and air particles in crossflow for efficient drying and heating.
   - Lower plenum designed to allow high-temperature operation while enabling wash-out with water during maintenance shut-downs. The specially-designed GEA Barr-Rosin metallic/washable lower plenum design would feature a SS309 inner liner for contact with wash water, an intermediate insulation board layer, and a heavy-duty carbon steel outer shell supporting the internal air pressure and the operating system weight. Please refer to the document *GEA Barr-Rosin HTMFB Fluid Bed Design Description*.
   - The fluid bed lower plenum would operate at 1200°F inlet temperature for high-efficiency operation.
   - The fluid bed would operate with a 24" deep static depth of material for robustness against process upset conditions and to absorb variations in feed rate and moisture content.
   - The fluid bed discharge section would feature a product discharge hood complete with underflow gate valve to control bed depth and product residence time, while facilitating lump management.
   - The fluid bed upper plenum and expanded canopy would be fabricated in ¼" thick SS316L construction to provide optimum wear-resistance and corrosion-resistance from contact with wet feed material, and would be designed to elutriate the fine particles with the exhaust airstream to the cyclones.
   - The perforated bedplate would feature SS309 construction (with under-grid supports in 253MA) to resist high-temperature operation and corrosion from wet feed contact. The directional design would propel the oversized agglomerates towards the discharge end, and prevent backflow into the lower plenum.
   - A specially-designed feed screw in SS316L construction would be included to evenly distribute wet feed into the dryer, providing a uniform dispersion of feed over the fluidizing bed of material. All other material handling conveyors required to feed and discharge the fluid bed drying system are excluded from the scope of supply but could be included in the GBR scope upon request.

5. The fluid bed dryer would be supplied with the following ancillary equipment to complete the overall system:
   - Natural Gas Air Heater: a refractory-lined air heater system featuring an in-line duct burner designed to fire Natural Gas would be supplied complete with burner management system, natural gas valve train, flow-measuring devices, instrumentation, skid-mounted ductwork, and interlocks.
   - Supply/Exhaust Fans: a system of heavy-duty forced and induced draft fans operating under a balanced-draft push-pull configuration would be included to supply the required drying airflow, while enabling controlled operation at near-atmospheric pressure in the fluid bed to minimize in-leaks of ambient air. The exhaust fan is currently sized with a 25"w.c. pressure drop allowance for a downstream scrubber.
   - Cyclones: one (1) high-efficiency cyclone would act as the primary dust collector for the elutriated fines, and would be fabricated in carbon steel construction with a replaceable inlet section in Hardox450 construction for optimal wear-resistance. Complete with a discharge rotary valve.
   - Interconnecting Ductwork: predominantly fabricated in carbon steel construction, with high-temperature SS309 where necessary, a set of ductwork would connect the dryer components into a complete system.

6. A wet scrubber (supplied by others) would be required for final gas-cleaning, and would be installed downstream of the exhaust fan. However, a baghouse dust collector may be a suitable alternative with lower pressure drop and capital cost to the cyclone/scrubber combination, and could be offered if preferred. SNC-Lavalin/IC Potash to confirm the suitability of baghouses on this application.

7. A set of field instrumentation would be included in the scope of supply to monitor the system operation and ensure operating performance. Installation of the field instrumentation would be by others.

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8. Although the burner control system, including NEMA-4X local control panel, is included in the proposed scope of supply, the dedicated local control system (e.g. PLC-based or other) for the overall drying system is excluded to allow system control through the plant DCS. However, GEA Barr-Rosin would supply, as part of the basic Engineering Package, the following information to enable local supply and programming of the Controls Logic by client:
   - Start-Up, Shut-Down, and emergency procedures
   - Control Philosophy
   - Process & Instrumentation Diagram
   - Instrumentation List and Locations
   - Safety Interlocks and Alarm Sequences

Fig. 1. Coarse Product Dryer (High-Temperature) for **Potash Corp. of Saskatchewan**

Fig. 2. Fluid bed dryer for granular potash for **The Mosaic Co.**

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1.3. Direct-Contact Column Cooler with Embedded Tubes (BOI-13-057)

1. One (1) GEA Barr-Rosin Direct Contact Column Cooling system with embedded tubes would be sized to cool 106 STPH design dry solids feed rate of SOP Product to 190°F. Please refer to *Section 2.1 – Performance Data* for additional design operating details.

2. The GEA Barr-Rosin Direct Contact Column Cooler has been developed through extensive Pilot Plant testing at our facility in Montreal, Quebec and on-site with specific industry partners using the GEA Barr-Rosin pilot-scale column cooler (see *Fig. 3* and *Fig. 4* below). Please note the following key benefits:
   - Removable coils: the removable heat transfer surfaces in a drawer-style pull-out design facilitates maintenance and repair work, thus eliminating unnecessary servicing downtime. External tube access also allows better and more complete cleanability.
   - Robust construction: the coil design/construction requires a high degree of robustness to prevent warping/damage during external handling.
   - Staggered tubes: the heat transfer surface would be embedded tubes in a staggered configuration that promotes uniform product mixing and cooling, resulting in consistent product quality.
   - No product channeling: the evenly-spaced tubes avoid product channeling, thus improving product flowability without confined product mobility.
   - Flexible cooling fluids: the embedded tubes are suited for operation directly with reclaim brine (or other fluids with suspended or dissolved solids) as the cooling fluid, with minimal fouling and uniform flow.
   - No continuous airflow required: pilot plant tests show that the above benefits may be obtained without continuous airflow during operation, including a minimal product build-up compared to a plate-type design which would be more prone to build-up.

   The pilot-scale system would be available at our Pilot Plant facility in Montreal, Canada to demonstrate the concept of the GEA Barr-Rosin column cooler on product specific to the IC Potash project if necessary**.**

3. The specially-designed GEA Barr-Rosin Direct Contact Cooler with drawer-style heat-transfer units (HTU) and embedded tubes would include the following features and design parameters:
   - Operation with a 12.7% NaCl solution as the cooling fluid.
   - Hot product evenly distributed across the column cross-section at the top of the unit by a custom-designed static feed distributor.
   - Conduction cooling of product over a constant residence time through contact with multi-pass coils of embedded tubes in **Duplex Alloy 2205** construction, with thick-wall tube construction for robustness, high-yield strength, superior corrosion-resistance, and long service life.
   - Removable drawer-style pull-out coil design to facilitate maintenance. Individual coils would be independently accessible/removable (see *fig. 5* below).
   - Self-supporting structure in **carbon steel** construction designed for vertical-load support of the system operating weight, with support lugs for lateral support to the main structure.
   - Outer shell casing in 1/4" carbon steel construction to house the individual/modular HTUs.
   - Residence time would be controlled and adjusted using a specially-designed vibrating bulk discharger.
   - A rotary valve would isolate the system from atmosphere, and would feature carbon steel construction.
   - Continuous sweep airflow would not be required, eliminating the need for dedicated fans and dust collection equipment while simplifying maintenance and operation due to the predominantly static system with minimal moving parts. For temporary upset conditions, a small sweep gas flow introduced at the bottom of the column may be required to ensure product flowability and could be supplied by plant compressed or ambient air (by others), discharged through a local area dust collection system (by others).

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4. As an alternate design for cost comparison, the external cooler shell could be provided in SS316L construction to house the individual HTUs with improved corrosion-resistance.

5. A maintenance platform required to maintain the individual HTUs would be included to allow lateral in/out manipulation of the removable coil bundles to facilitate removal, access, and maintenance. Supplied complete with specially-designed spreader bar with lifting lugs and hydraulic cylinder pulling system. An overhead 3-axis motorized hoist would be supplied by others to lift the HTUs away from the cooler for maintenance.

6. A set of field instrumentation would be included in the scope of supply to monitor the system operation and ensure operating performance; installation of the field instrumentation and accessories would be by others.

7. A dedicated local control system (e.g. PLC-based or other) for the column cooler would be excluded as specified to allow system control through the plant DCS. However, GEA Barr-Rosin would supply, as part of the basic Engineering Package, the following information to enable local supply and programming of the Controls Logic by client:
   - Start-Up, Shut-Down, and emergency procedures
   - Control Philosophy
   - Process & Instrumentation
   - Diagram Instrumentation List and Locations
   - Safety Interlocks and Alarm Sequences

8. The ancillary equipment required to supply the cooling fluid would be provided by others. This equipment may include recirculation pumps, heat exchangers, pipework, valves, filters, traps, etc. GEA Barr-Rosin would provide flow specifications and additional engineering support to enable local supply of this equipment.

Fig. 3: GEA Barr-Rosin Pilot-Scale Direct Column Contact Processor

Fig. 4: Vibrating Bulk Discharger on Pilot-Scale Direct Column Contact Processor

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Fig. 5: Removable Heat Transfer Units for Contact Column Cooler supplied to **Potash Corp. of Saskatchewan.**

Fig. 6: Contact Column Cooler supplied to **Potash Corp. of Saskatchewan**.

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1.4. Partial Reference List – Potash Industry

Provided below is a brief reference list of GEA Barr-Rosin equipment for potash applications. These units process potash similar to this proposed application:

Agrium Inc.	Vanscoy, SK – two (2) Fluid Bed Dryers – three (3) Rotary Conditioners
BHP Billiton	Jansen, SK – two (2) PGR Fluid Bed Dryers for Standard Product Potash – two (2) Direct Contact Column Coolers w/embedded tubes – one (1) Rotary Conditioner – one (1) Fluid Bed Dryer/Cooler (evaporative cooling)
Intrepid Potash	Carlsbad, NM – one (1) Fluid Bed Drying System for Coarse Langbeinite
Mosaic Co.	Carlsbad, NM – one (1) Rotary Conditioner for Granular Potash – one (1) Fluid Bed Dryer for Granular Potash Esterhazy, SK (K1 Facility) – one (1) Rotary Conditioner for Granular Potash – one (1) Fluid Bed Dryer for Granular Potash Esterhazy, SK (K2 Facility) – one (1) Rotary Conditioner for Granular Potash – one (1) Fluid Bed Dryer for Granular Potash – one (1) Fluid Bed Dryer for Standard Potash Colonsay ,SK – one (1) Rotary Conditioner for Granular Potash – one (1) Fluid Bed Dryer for Granular Potash – one (1) Fluid Bed Dryer for Standard Potash
Potash Corp. of Saskatchewan	Allan, SK – one (1) Rotary Drying System for Product Potash Saskatoon, SK (Cory Facility) – one (1) PGR Fluid Bed Dryer – one (1) Column Dryer Rocanville, SK – one (1) PGR Fluid Bed Dryer for Coarse Product Potash – one (1) PGR Ring Dryer for Fine Product Potash – one (1) Fluid Bed Dryer/Cooler (evaporative cooling) – two (2) Direct Contact Column Coolers w/embedded tubes
SQM	Salar de Atacama , Antofagasta – one (1) Rotary Conditioner for Granular Potash – one (1) Fluid Bed Dryer/Cooler for Granular Potash (evaporative cooling)
Vale	Bahia Blanca , Argentina – one (1) Fluid Bed Dryer for Crystallized Potash – one (1) Fluid Bed Reheater for Crystallized Potash – one (1) Rotary Conditioner for Granular Potash – one (1) Fluid Bed Dryer/Cooler for Granular Potash (evaporative cooling)

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2.0 SYSTEM SPECIFICATION

2.1. Performance Data

2.1.1. Fluid Bed Dryer and Column Cooler

The proposed GEA Barr-Rosin fluid bed dryer and column cooler would process the SOP product at the capacities specified below:

System Characteristics	Units	Design	Nominal
No. of Lines Required	-	1	1
Feed Rate (Total Wet Feed)	lb/h	223,158	154,526
Feed Moisture Content	%	5	5
Feed Temperature	°F	194	194
Product Temperature	°F	190	165
Product Rate	lb/h	212,638	147,241
Fluid Bed Dryer			
Configuration	-	Open-Circuit (OC)	Open-Circuit (OC)
Final Moisture Content	%	0.3	0.3
Evaporation Rate	lb/h	10,520	7,285
Hot Air Inlet Temperature	°F	1200	1100
Airflow (for gas cleaning)[1]	ACFM	28,500	21,500
Absorbed Power	BHP	555	352
Installed Power	HP	722	722
Fuel Consumption[2] (Winter Ambient Temp.: 8°F)[3]	lb/h	956	680
Approximate Dimensions[4]	w x l x h (ft.)	3'-6" x 21'-0" x 20'-0"	3'-6" x 21'-0" x 20'-0"
Column Cooler			
Technology	-	Embedded Tubes	Embedded Tubes
No. of HTUs per cooler	-	4	4
Product Temperature	°F	190	165
Product Rate		212,638	147,241
Cooling Fluid	-	12.7% NaCl Solution	12.7% NaCl Solution
Cooling Fluid Availability	lb/hr	656,000	546,000
Cooling Fluid Rate	lb/hr	197,000	93,000
Cooling Fluid Inlet Temperature	ºF	66	66
Cooling Fluid Outlet Temperature	ºF	86	104
Fluid Specific Heat (assumed)	BTU/lb·ºF	0.9	0.9
Absorbed Power	BHP	3.5	3.5
Installed Power	HP	5	5
Approximate Dimensions[5]	w x l x h (ft.)	6'-9" x 7'-6" x 34'-9"	6'-9" x 7'-6" x 34'-9
Total Cooling Tube Surface Area in Unit	ft^2	2985	2985

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Please Note:

1. Bleed-off airflow is based on actual conditions for elevation, temperature, and pressure at site based on SNC-Lavalin Specification No. 510315-00000-41EG-0001.
2. Gas consumption based on a natural gas lower heat value of 10,888 kcal/kg (19,600 BTU/lb).
3. The fuel consumption is based on estimated site conditions based on SNC-Lavalin Specification No. 510315-00000-41EG-0001.
4. Dimensions shown correspond to the fluid bed unit only; additional space would be required for ancillary air handling components and ductwork.
5. Dimensions shown correspond to the overall column cooler unit.
6. Figures shown in the above table would be subject to Pilot Plant testing to confirm the operating parameters and expected product behavior for the specific ore from the proposed mine site.

2.2. Electric Motors

	Installed Power	rpm	Voltage (V)	Control
• Feed Screw	20 HP	1800	460	VFD
• Forced Draft Fan	300 HP	1800	460	Direct
• Cyclone Rotary Valve	2 HP	1800	460	Direct
• Exhaust Fan	400 HP	1800	4160	Direct
• Vibrating Bin Discharger	3 HP	1800	460	VFD
• Cooler Rotary Valve	2 HP	1800	460	Direct

2.3. Scope of Supply

- Complete equipment supply within the battery limits shown below
- Burner system instrumentation and controls, with local control panel
- Engineering services, including process evaluation and detail design

2.4. Battery Limits

Feed Inlet	Inlet to feed screw
Product Outlet	Outlet of final product discharge after column cooler
	Outlet of cyclone rotary valve
Air Inlet	Inlet to air louver to dryer & inlet flange to column cooler
Air Exhaust	Exhaust fan outlet & air exhaust flange on column cooler
Gas Supply	Inlet of gas valve train. Gas train within proximity of burner
Electrical Power	At inlet of burner control panel
	At individual motor terminal boxes
Compressed / Instrument Air Supply	Inlet connection to actuators on dampers

Note: Any interconnecting conveyors between the fluid bed dryer and the column cooler would be currently excluded subject to confirmation of the site layout.

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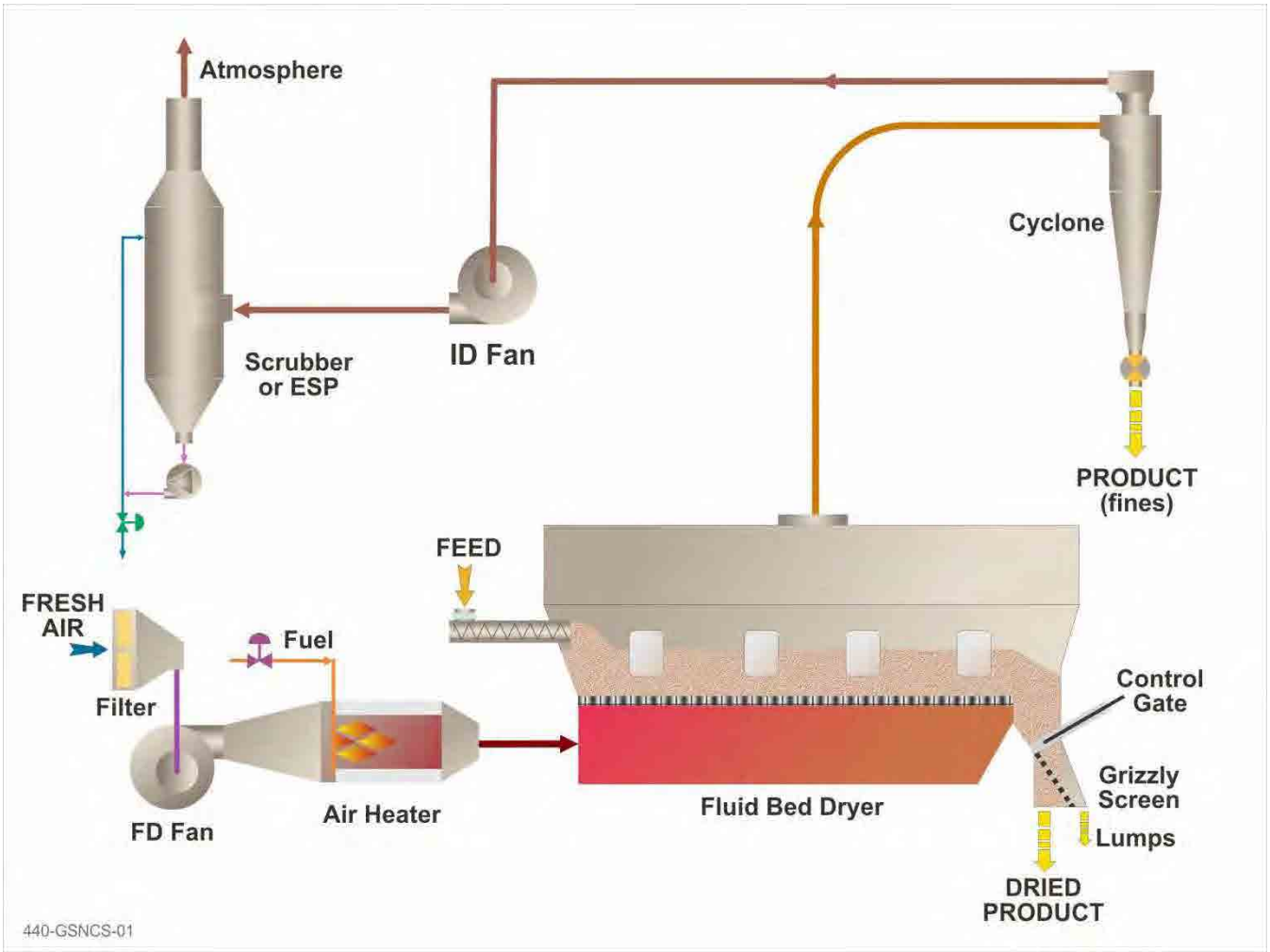
2.5. Process Flow Diagrams

2.5.1. Fluid Bed Dryer

The following diagram illustrates the proposed fluid bed dryer, as well as the required ancillary equipment required for the process.



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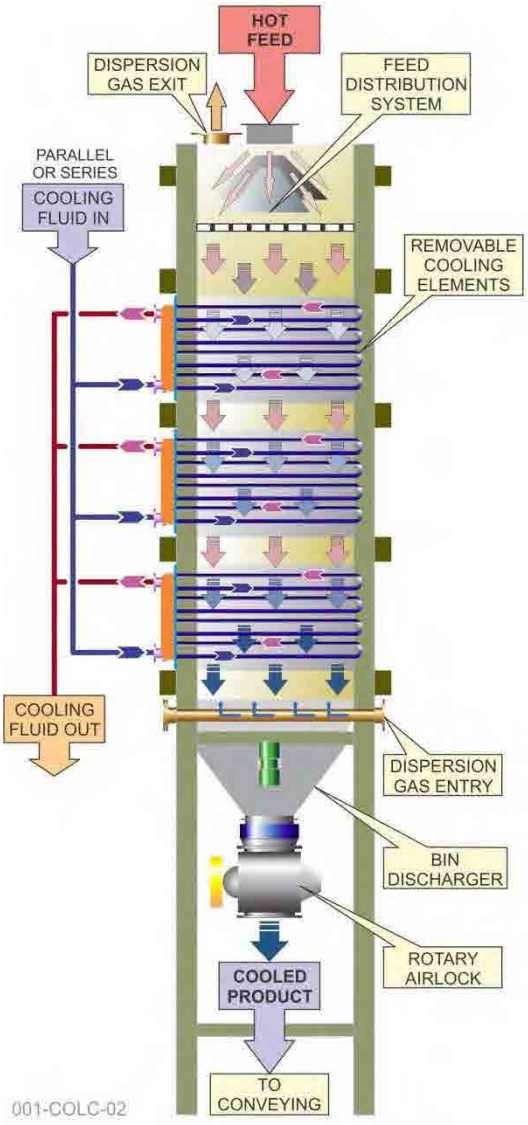
2.5.2. Column Cooler

The following diagram shows a typical column cooler configuration on the left hand side. The right hand side better displays the separate HTU units, which can slide out for easier maintenance.



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3.0 ENGINEERING SERVICES

3.1. GEA Barr-Rosin Engineering Package

GEA Barr-Rosin would provide engineering services to ensure that the proposed fluid bed dryer and column cooler systems would be designed to operate continuously at the rates stipulated in *Section 2.1 – Performance Data*. The GEA Barr-Rosin engineering package would include the following GEA Barr-Rosin standard deliverables; upon discussion of a mutually-agreed Vendor Data Requirements List (VDRL) schedule, a VDRL engineering option could be offered:

3.1.1. Preliminary Documentation:

- Preliminary project schedule
- Preliminary overall general arrangement drawing for approval
- Preliminary process and instrumentation diagram (P&ID) for approval
- Preliminary utilities list
- Preliminary motor list
- Preliminary instrumentation list

Note: GEA Barr-Rosin would submit approval drawings containing dimension details and other customer information for Buyer's comments or approval as appropriate within the agreed review period. The resulting design would be frozen, and thus any subsequent request for design or drawing changes may require a price and/or delivery schedule adjustment.

3.1.2. Documentation before delivery:

- Final overall general arrangement drawing
- Final process and instrumentation diagram (P&ID)
- Delivery and manufacturing schedule
- Detailed fixing and static loading drawings, including anchor bolt location drawings
- Instrumentation list and instrumentation connections drawings
- System control narrative
- Alarm and interlock schedule, including list of signals and interlock diagram
- Detailed motor list
- Detailed utilities schedule
- Erection manual and installation procedure

3.1.3. Documentation at Delivery:

- Final layout drawing showing civil loads and suggested support steel access structure (steelwork design excluded)
- Thermal insulation manual and recommendations
- Start-up/shut-down procedures
- Itemised and priced spares list

3.1.4. Operating and Maintenance Manuals

Three (3) sets of Operating and Maintenance Manuals would be provided in hard copies and one (1) copy in electronic format, and would include the final version of the above mentioned documents.

3.2. GEA Barr-Rosin Engineering Services

The services of a GEA Barr-Rosin Engineer could be made available to assist and advise during start-up, commissioning, and training for the proposed systems. The additional cost for these services would be according to the GEA Barr-Rosin Field Service Rates document included in the proposal package. Any additional services of burner and fan technicians required for start-up would be invoiced at cost +10%. Total period to be agreed.

3.3. GEA Barr-Rosin Site Supervisor

The presence of a GEA Barr-Rosin site supervisor onsite during the installation of the proposed systems are recommended. We estimate that our site supervisor would be required onsite for approximately 4 – 8 weeks. The services of a GEA Barr-Rosin site supervisor could be available during installation at the rates shown in the GEA Barr-Rosin Field Service Rates document included in the proposal package. Total period to be agreed.

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4.0 PRICING AND DELIVERY

4.1. Budgetary Pricing

Our price for design, manufacture and delivery of the proposed systems are as follows:

GEA Barr-Rosin SOP Dryer & Cooler		
One (1) lot of Detail Engineering Services (GEA Barr-Rosin Standard Deliverables)	Included	USD
One (1) GEA Barr-Rosin Fluid Bed Dryer	Included	USD
One (1) GEA Barr-Rosin Direct Contact Column Cooler	Included	USD
TOTAL Price [1]	**$ 2,872,000**	**USD**
OPTION		
Column Cooler External Shell in SS316L Construction	+ $ 75,000	USD

Please Note:

1. FCA Point of Manufacture
2. All applicable sales taxes, freight, customs, fees for Letters of Credit, etc. would be extra.
3. The proposal would be valid for 90 days, subject to price adjustments (increase or decrease) until receipt of a Purchase Order according to fluctuations in raw material costs and USD/CAD exchange rate.
4. The current proposal would be subject to mutual Terms & Conditions to be agreed between GEA Barr-Rosin and SNC Lavalin/IC Potash. The GEA Barr-Rosin Standard Terms & Conditions could serve as a basis for the current project.

4.2. Payment Terms

GEA Barr-Rosin would propose the following payment:

30% with receipt of order; net ten (10) days.
30% with 50% fabrication.
35% upon notification of equipment readiness-to-ship, and delivery of final manuals (pro-rata).
5% upon process commissioning, not to exceed 3 months after delivery.

All payments are net thirty (30) days from the date of the invoice, unless otherwise noted.

4.3. Delivery Schedule

Based on a two-week turnaround time for approval of General Arrangement and P&ID drawings, delivery of drying and cooling systems is approximately 40 weeks from receipt of order.

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5.0 EXCLUSIONS

Pricing excludes anything not specifically mentioned above, and specifically excludes the following items:

- Authorities' approval for constructions and operation of the plant (GEA Barr-Rosin would co-operate and supply information as required)
- Permit fees, site arrangement, and other costs associated with gas inspection
- Offloading of equipment at site
- Mechanical erection and installation
- Supply and operation of cranes, hoists, lifts, and other installation equipment
- Civil engineering and design, and civil work.(GEA Barr-Rosin would supply loading and bolting plans)
- Design and supply of foundations or modifications to existing structures or buildings
- Design and supply of supporting steelwork
- Thermal Insulation and cladding
- Plant lighting
- Electrical cabling, instrument wiring and installation
- Local control system, except burner controls.
- Supply of utilities including natural gas, compressed air, steam, electricity, and water
- Variable frequency drives (VFDs), motor control centers (MCCs), motor starters, etc.
- Utility pipework and isolation valves, unless clearly included in scope (up to battery limits)
- Supply and installation of acoustic insulation and sound attenuation equipment/enclosures
- Material handling conveyors
- Extended runs of inlet or exhaust ductwork
- Final gas-cleaning equipment (e.g. scrubber, baghouse)
- Exhaust stack
- All utilities, raw materials and labour for testing, commissioning and operating the plant
- Analysis and laboratory equipment
- Any environmental tests, including measurement of noise and dust levels by third parties
- Site supervisor
- Start-up and commissioning services
- Start-up spares
- Running spares and wear parts
- Capital/strategic spare parts
- Any applicable sales taxes, freight, customs, fees for Letters of Credit, etc.

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BOI-13-058 & BOI-13-059
COMMERCIAL PROPOSAL
SNC-Lavalin Inc. Project No. 510315-P-53520

TWO (2) PGR FLUID BED DRYER SYSTEM & TWO (2) COLUMN COOLER

for

Granulated SOP

IC Potash - Ochoa Project
Hobbs, NM

Attention: Mr. Mazi Rejaee (mazi@novopro.ca)		
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Issue	Date	Update
0	May 8, 2013	First Issue
1	August 27, 2013	Revised Capacity

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1.0 CLARIFICATIONS TO PROPOSAL

1.1. General

1. As part of SNC-Lavalin RFQ No. 510315-P-53520 for the IC Potash – Ochoa Project, GEA Barr-Rosin would propose two (2) fluid bed drying systems and two (2) direct-contact column coolers to process Granulated SOP. The total design solids feed rate would be 144 STPH, and the final product would contain <0.3%MC by weight and have a final temperature of 180℉.

2. The Rev.1 proposal has been revised to reflect the following proposed system updates:
   - Based on the e-mail clarification on August 23, 2013, the total design feed rate was revised to 144 STPH dry solids basis.
   - Additionally, in order to facilitate compatibility with the upstream granulation equipment and to simplify the operations flowsheet, the previously-proposed system would be split into two (2) parallel lines each at 50% capacity or 72 STPH dry solids basis.

   All other design features remain unchanged from the previous proposal.

3. The proposed design would be subject to Pilot Plant testing to confirm operating parameters and expected product behavior for the specific ore at the proposed mine site. GEA Barr-Rosin has a fully operational Pilot Plant Testing facility in Montreal, Canada that would be available for evaluation purposes.

4. All electric motors required for the proposed GEA Barr-Rosin equipment would be included. However, all motor control centers (MCC) and variable frequency drives (VFD) would be excluded from the scope of supply to enable local supply by others.

5. Thermal Insulation and cladding to ensure thermal efficiency of the system and for personnel protection would be supplied by others to enable cost-savings associated with a GEA Barr-Rosin markup. GEA Barr-Rosin would provide insulation specifications and installation instructions to facilitate procurement by others.

6. GEA Barr-Rosin would investigate local fabrication upon shop qualification to minimize freight costs.

7. All material handling conveyors, unless specifically mentioned, to feed/discharge/connect the proposed systems are excluded from the scope of supply but could be included in GBRI scope upon request.

8. Steelwork and foundation design, including platforms, walkways, stairs, ladders, and handrails, would be excluded from the GEA Barr-Rosin scope of supply to enable local supply by others.

9. Current pricing is based on August 2013 raw material costs and current CAD/USD exchange rate. Subject to these cost variations, pricing would be valid for 90 days.

10. The current proposal would be subject to mutual Terms & Conditions to be agreed between GEA Barr-Rosin and SNC-Lavalin/IC Potash. The GEA Barr-Rosin Standard Terms & Conditions could serve as a basis for the current project.

1.2. Fluid Bed Dryer (BOI-13-058)

1. Two (2) fluid bed drying systems operating in Partial Gas Recycle (PGR) configuration would be sized to dry 144 STPH total design dry solids feed rate of Granulated SOP from 6.4%MC by weight to <0.3%MC. Please refer to *Section 2.1 – Performance Data* for additional design operating details.

2. The fluid bed dryer would operate under Partial Gas Recycle (PGR) configuration for energy conservation and high operating thermal efficiency. PGR configuration enables exhaust gas recycle which offers advantages of high operating thermal efficiency and energy recovery:
   - Reduced energy consumption by up to 15-20%
   - Continuously improving thermal efficiency at various turndown conditions through increase in recycled hot gas for every downward step in capacity
   - Optimized combustion control for maximum thermal efficiency by minimizing the fresh air intake with a PLC-based combustion control system (CCS) for fuel/air ratio control.
   - Smaller bleed-off gas stream (about 75% smaller than an open-circuit dryer at design conditions) consisting only of combustion products, evaporated vapours, and system leaks

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- Minimized size of the downstream gas-cleaning system yielding overall capital cost-savings.

The PGR configuration is a proven technology in operation on an existing potash prills application in Saskatchewan, and another system operating on Standard Product Potash is expected to start-up this year.

3. The fluid bed dryer design is based on an assumed inlet temperature limitation to enable a thermally-sensitive binder for SOP granulation. If the inlet temperature could be increased, then a smaller fluid bed system with corresponding reduction in power consumption and equipment size could be offered.

4. The GEA Barr-Rosin rectangular fluid bed dryer design would feature the following key benefits:
   - Two (2) fluidization zones: the front-end zone with intense high-velocity fluidization would create high solids agitation to minimize lump formation, and would elutriate the ultra-fines to prevent potential build-up/maintenance issues. The back-end zone with gentler fluidization would provide uniform product heating to achieve final moisture content.
   - True plug flow design: the fluid bed geometry promotes true plug flow to prevent bulk solids mixing in the second zone, ensuring discharge of only the driest product after achieving a constant residence time.
   - Perforated directional bedplate: the bedplate design would prevent material build-up and product back-sifting to the lower plenum while directing the airflow to promote bulk product flow.
   - Expanded upper canopy: the gradual plenum expansion in the vertical direction would result in the most aggressive fluidizing layer near the bedplate to avoid lump formation and system upsets, while the reduced velocity near the air exhaust would minimize product elutriation.

5. The fluid bed dryer unit would feature the following design considerations:
   - The fluid bed would be designed to provide intimate gas contact between individual solid and air particles in crossflow for efficient drying and heating.
   - The fluid bed lower plenum would operate at 400℉ inlet temperature to allow the use of a thermally-sensitive granulation binder; the actual temperature limitation would be later confirmed by SNC-Lavalin and IC Potash. For corrosion-resistance, the lower plenum would be constructed in SS316L.
   - The fluid bed discharge section would feature a product discharge hood complete with underflow gate valve to control bed depth and product residence time, while facilitating lump management.
   - The fluid bed upper plenum and expanded canopy would be fabricated in ¼" thick SS316L construction to provide optimum wear-resistance and corrosion-resistance from contact with wet feed material, and would be designed to elutriate the fine particles with the exhaust airstream to the cyclones.
   - The perforated bedplate would feature SS316L construction to resist corrosion from wet feed contact. The directional design would propel the oversized agglomerates towards the discharge end, and prevent backflow into the lower plenum.

6. The fluid bed dryer would be supplied with the following ancillary equipment to complete the overall system:
   - Natural Gas Air Heater for PGR: a specially-designed GEA Barr-Rosin air heater system for PGR application would feature an Ultra Low NOx pre-mix type burner and multi-stage recirculation concept for safe, efficient, and reliable dryer operation under PGR configuration in the Potash industry, particularly due to the recirculating stream laden with potash dust; please refer to the enclosed document *GEA Barr-Rosin Air Heater Design Comparison for PGR Applications* for design and concept details.
   - System of Fans: a set of combustion air, recirculation air, and bleed-off fans operating under a balanced-draft push-pull configuration would be included to supply the required drying airflow, while enabling controlled operation at near-atmospheric pressure in the fluid bed to minimize in-leaks of ambient air. The bleed-off fan is currently sized with a 25"w.c. pressure drop allowance for a downstream scrubber.
   - Bleed-Off Cyclone: one (1) high-efficiency cyclone would act as the primary dust collector in the bleed-off stream for elutriated fines, and would be fabricated in carbon steel construction with a replaceable inlet section in Hardox450 construction for optimal wear-resistance. Complete with a discharge rotary valve.

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- Recirculation Cyclones: a separate set of high-efficiency cyclones in the recirculation loop would minimize dust-loading returned to the air heater. Fabricated in carbon steel construction with a replaceable Hardox450 inlet section for optimal wear-resistance. Complete with discharge rotary valves.
- Interconnecting Ductwork: predominantly fabricated in carbon steel construction, a set of ductwork would connect the dryer components into a complete system.

7. A wet scrubber (supplied by others) would be required for final gas-cleaning, and would be installed downstream of the bleed-off fan. However, a baghouse dust collector may be a suitable alternative with lower pressure drop and capital cost to the cyclone/scrubber combination, and could be offered if preferred. SNC-Lavalin/IC Potash to confirm the suitability of baghouses on this application.
8. A set of field instrumentation would be included in the scope of supply to monitor the system operation and ensure operating performance. Installation of the field instrumentation would be by others.
9. Although the burner control system, including NEMA-4X local control panel, is included in the proposed scope of supply, the dedicated local control system (e.g. PLC-based or other) for the overall drying system is excluded to allow system control through the plant DCS. However, GEA Barr-Rosin would supply, as part of the basic Engineering Package, the following information to enable local supply and programming of the Controls Logic by client:
   - Start-Up, Shut-Down, and emergency procedures
   - Control Philosophy
   - Process & Instrumentation Diagram
   - Instrumentation List and Locations
   - Safety Interlocks and Alarm Sequences

Fig. 1. Coarse Product Dryer (High-Temperature) for **Potash Corp. of Saskatchewan**

Fig. 2. Fluid bed dryer for granular potash for **The Mosaic Co.**

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1.3. Direct-Contact Column Cooler with Embedded Tubes (BOI-13-059)

1. One (1) GEA Barr-Rosin Direct Contact Column Cooling system with embedded tubes would be sized to cool 144 STPH design dry solids feed rate of Granulated SOP to 180℉. Please refer to *Section 2.1 – Performance Data* for additional design operating details.

2. The GEA Barr-Rosin Direct Contact Column Cooler has been developed through extensive Pilot Plant testing at our facility in Montreal, Quebec and on-site with specific industry partners using the GEA Barr-Rosin pilot-scale column cooler (see *Fig. 3* and *Fig. 4* below). Please note the following key benefits:
   - Removable coils: the removable heat transfer surfaces in a drawer-style pull-out design facilitates maintenance and repair work, thus eliminating unnecessary servicing downtime. External tube access also allows better and more complete cleanability.
   - Robust construction: the coil design/construction requires a high degree of robustness to prevent warping/damage during external handling.
   - Staggered tubes: the heat transfer surface would be embedded tubes in a staggered configuration that promotes uniform product mixing and cooling, resulting in consistent product quality.
   - No product channeling: the evenly-spaced tubes avoid product channeling, thus improving product flowability without confined product mobility.
   - Flexible cooling fluids: the embedded tubes are suited for operation directly with reclaim brine (or other fluids with suspended or dissolved solids) as the cooling fluid, with minimal fouling and uniform flow.
   - No continuous airflow required: pilot plant tests show that the above benefits may be obtained without continuous airflow during operation, including a minimal product build-up compared to a plate-type design which would be more prone to build-up.

   The pilot-scale system would be available at our Pilot Plant facility in Montreal, Canada to demonstrate the concept of the GEA Barr-Rosin column cooler on product specific to the IC Potash project if necessary**.**

3. The specially-designed GEA Barr-Rosin Direct Contact Cooler with drawer-style heat-transfer units (HTU) and embedded tubes would include the following features and design parameters:
   - Operation with a Reverse Osmosis (RO) waste water stream with 14.1% NaCl content as the cooling fluid.
   - Hot product evenly distributed across the column cross-section at the top of the unit by a custom-designed static feed distributor.
   - Conduction cooling of product over a constant residence time through contact with multi-pass coils of embedded tubes in **Duplex Alloy 2205** construction, with thick-wall tube construction for robustness, high-yield strength, superior corrosion-resistance, and long service life.
   - Removable drawer-style pull-out coil design to facilitate maintenance. Individual coils would be independently accessible/removable (see *fig. 5* below).
   - Self-supporting structure in **carbon steel** construction designed for vertical-load support of the system operating weight, with support lugs for lateral support to the main structure.
   - Outer shell casing in 1/4” carbon steel construction to house the individual/modular HTUs.
   - Residence time would be controlled and adjusted using a specially-designed vibrating bulk discharger.
   - A rotary valve would isolate the system from atmosphere, and would feature carbon steel construction.
   - Continuous sweep airflow would not be required, eliminating the need for dedicated fans and dust collection equipment while simplifying maintenance and operation due to the predominantly static system with minimal moving parts. For temporary upset conditions, a small sweep gas flow introduced at the bottom of the column may be required to ensure product flowability and could be supplied by plant compressed or ambient air (by others), discharged through a local area dust collection system (by others).

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4. As an alternate design for cost comparison, the external cooler shell could be provided in SS316L construction to house the individual HTUs with improved corrosion-resistance.

5. A maintenance platform required to maintain the individual HTUs would be included to allow lateral in/out manipulation of the removable coil bundles to facilitate removal, access, and maintenance. Supplied complete with specially-designed spreader bar with lifting lugs and hydraulic cylinder pulling system. An overhead 3-axis motorized hoist would be supplied by others to lift the HTUs away from the cooler for maintenance.

6. A set of field instrumentation would be included in the scope of supply to monitor the system operation and ensure operating performance; installation of the field instrumentation and accessories would be by others.

7. A dedicated local control system (e.g. PLC-based or other) for the column cooler would be excluded as specified to allow system control through the plant DCS. However, GEA Barr-Rosin would supply, as part of the basic Engineering Package, the following information to enable local supply and programming of the Controls Logic by client:
   - Start-Up, Shut-Down, and emergency procedures
   - Control Philosophy
   - Process & Instrumentation
   - Diagram Instrumentation List and Locations
   - Safety Interlocks and Alarm Sequences

8. The ancillary equipment required to supply the cooling fluid would be provided by others. This equipment may include recirculation pumps, heat exchangers, pipework, valves, filters, traps, etc. GEA Barr-Rosin would provide flow specifications and additional engineering support to enable local supply of this equipment.

Fig. 3: GEA Barr-Rosin Pilot-Scale Direct Column Contact Processor

Fig. 4: Vibrating Bulk Discharger on Pilot-Scale Direct Column Contact Processor

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Fig. 5: Removable Heat Transfer Units for Contact Column Cooler supplied to **Potash Corp. of Saskatchewan.**

Fig. 6: Contact Column Cooler supplied to **Potash Corp. of Saskatchewan**.

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1.4. Partial Reference List – Potash Industry

Provided below is a brief reference list of GEA Barr-Rosin equipment for potash applications. These units process potash similar to this proposed application:

Agrium Inc.	Vanscoy, SK – two (2) Fluid Bed Dryers – three (3) Rotary Conditioners
BHP Billiton	Jansen, SK – two (2) PGR Fluid Bed Dryers for Standard Product Potash – two (2) Direct Contact Column Coolers w/embedded tubes – one (1) Rotary Conditioner – one (1) Fluid Bed Dryer/Cooler (evaporative cooling)
Intrepid Potash	Carlsbad, NM – one (1) Fluid Bed Drying System for Coarse Langbeinite
Mosaic Co.	Carlsbad, NM – one (1) Rotary Conditioner for Granular Potash – one (1) Fluid Bed Dryer for Granular Potash Esterhazy, SK (K1 Facility) – one (1) Rotary Conditioner for Granular Potash – one (1) Fluid Bed Dryer for Granular Potash Esterhazy, SK (K2 Facility) – one (1) Rotary Conditioner for Granular Potash – one (1) Fluid Bed Dryer for Granular Potash – one (1) Fluid Bed Dryer for Standard Potash Colonsay ,SK – one (1) Rotary Conditioner for Granular Potash – one (1) Fluid Bed Dryer for Granular Potash – one (1) Fluid Bed Dryer for Standard Potash
Potash Corp. of Saskatchewan	Allan, SK – one (1) Rotary Drying System for Product Potash Saskatoon, SK (Cory Facility) – one (1) PGR Fluid Bed Dryer – one (1) Column Dryer Rocanville, SK – one (1) PGR Fluid Bed Dryer for Coarse Product Potash – one (1) PGR Ring Dryer for Fine Product Potash – one (1) Fluid Bed Dryer/Cooler (evaporative cooling) – two (2) Direct Contact Column Coolers w/embedded tubes
SQM	Salar de Atacama , Antofagasta – one (1) Rotary Conditioner for Granular Potash – one (1) Fluid Bed Dryer/Cooler for Granular Potash (evaporative cooling)
Vale	Bahia Blanca , Argentina – one (1) Fluid Bed Dryer for Crystallized Potash – one (1) Fluid Bed Reheater for Crystallized Potash – one (1) Rotary Conditioner for Granular Potash – one (1) Fluid Bed Dryer/Cooler for Granular Potash (evaporative cooling)

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2.0 SYSTEM SPECIFICATION

2.1. Performance Data

2.1.1. Fluid Bed Dryer and Column Cooler

The proposed GEA Barr-Rosin fluid bed dryer and column cooler would process the Granulated SOP at the capacities specified below:

System Characteristics	Units	Design	Nominal
No. of Lines Required	-	2	2
Feed Rate (Total Wet Feed)	lb/h	307,692	200,855
Feed Moisture Content	%	6.4	6.4
Feed Temperature	℉	134	134
Product Temperature	℉	180	156
Product Rate	lb/h	288,866	188,566
Cooling Fluid Availability	lb/hr	682,000	568,000
Fluid Bed Dryer (data per dryer)			
Configuration	-	Partial Gas Recycle (PGR)	Partial Gas Recycle (PGR)
Final Moisture Content	%	0.3	0.3
Evaporation Rate	lb/h	9,413	6,144
Hot Air Inlet Temperature[1]	℉	400	350
Airflow (for gas cleaning)[2]	ACFM	18,500	14,600
Absorbed Power	BHP	1250	1250
Installed Power	HP	1,740	1,735
Fuel Consumption[3] (Winter Ambient Temp.: 8℉) [4]	lb/h	844	572
Approximate Dimensions[5]	w x l x h (ft.)	6'-6" x 30'-0" x 18'-0"	6'-6" x 30'-0" x 18'-0"
Column Cooler (data per cooler)			
Technology	-	Embedded Tubes	Embedded Tubes
No. of HTUs per cooler	-	4	4
Product Temperature	℉	180	156
Product Rate		144,433	94,283
Cooling Fluid	-	14.1% NaCl Waste Water	14.1% NaCl Waste Water
Cooling Fluid Rate (each cooler)	lb/hr	123,000	114,700
Cooling Fluid Inlet Temperature	ºF	68	68
Cooling Fluid Outlet Temperature	ºF	86	86
Fluid Specific Heat (assumed)	BTU/lb·ºF	0.89	0.89
Absorbed Power	BHP	3.5	3.5
Installed Power	HP	5	5
Approximate Dimensions[6]	w x l x h (ft.)	6'-3" x 6'-3" x 44'-5"	6'-3" x 6'-3" x 44'-5"
Total Cooling Tube Surface Area in Unit	ft^2	3,044	3,044

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Please Note:

1. The inlet temperature is based on an assumed temperature limitation for a thermally-sensitive binder. If the inlet temperature could be increased, then a smaller fluid bed system with corresponding reduction in power consumption and equipment size could be offered. Further discussion to follow.
2. Bleed-off airflow is based on actual conditions for elevation, temperature, and pressure at site based on SNC-Lavalin Specification No. 510315-00000-41EG-0001.
3. Gas consumption based on a natural gas lower heat value of 10,888 kcal/kg (19,600 BTU/lb).
4. The fuel consumption is based on estimated site conditions based on SNC-Lavalin Specification No. 510315-00000-41EG-0001.
5. Dimensions shown correspond to the fluid bed unit only; additional space would be required for ancillary air handling components and ductwork.
6. Dimensions shown correspond to the overall column cooler unit, including support legs
7. Figures shown in the above table would be subject to Pilot Plant testing to confirm the operating parameters and expected product behavior for the specific ore from the proposed mine site.

2.2. Electric Motors

	Installed Power	rpm	Voltage (V)	Control
• Combustion Air Fan	75 HP	1800	460	VFD
• Recirculation Fan	1400 HP	1200	4160	Direct
• Cyclone Rotary Valves	5 x 2 HP	1800	460	Direct
• Bleed-Off Fan	250 HP	1800	460	Direct
• Vibrating Bin Discharger	3 HP	1800	460	VFD
• Cooler Rotary Valve	2 HP	1800	460	Direct

2.3. Scope of Supply

- Complete equipment supply within the battery limits shown below
- Burner system instrumentation and controls, with local control panel
- Engineering services, including process evaluation and detail design

2.4. Battery Limits

Feed Inlet	Inlet to fluid bed dryer chute
Product Outlet	Outlet of final product discharge after column cooler
	Outlet of cyclone rotary valves
Air Inlet	Inlet to air louver to dryer & inlet flange to column cooler
Air Exhaust	Exhaust fan outlet & air exhaust flange on column cooler
Gas Supply	Inlet of gas valve train. Gas train within proximity of burner
Electrical Power	At inlet of burner control panel
	At individual motor terminal boxes
Compressed / Instrument Air Supply	Inlet connection to actuators on dampers

Note: Any interconnecting conveyors between the fluid bed dryer and the column cooler would be currently excluded subject to confirmation of the site layout.

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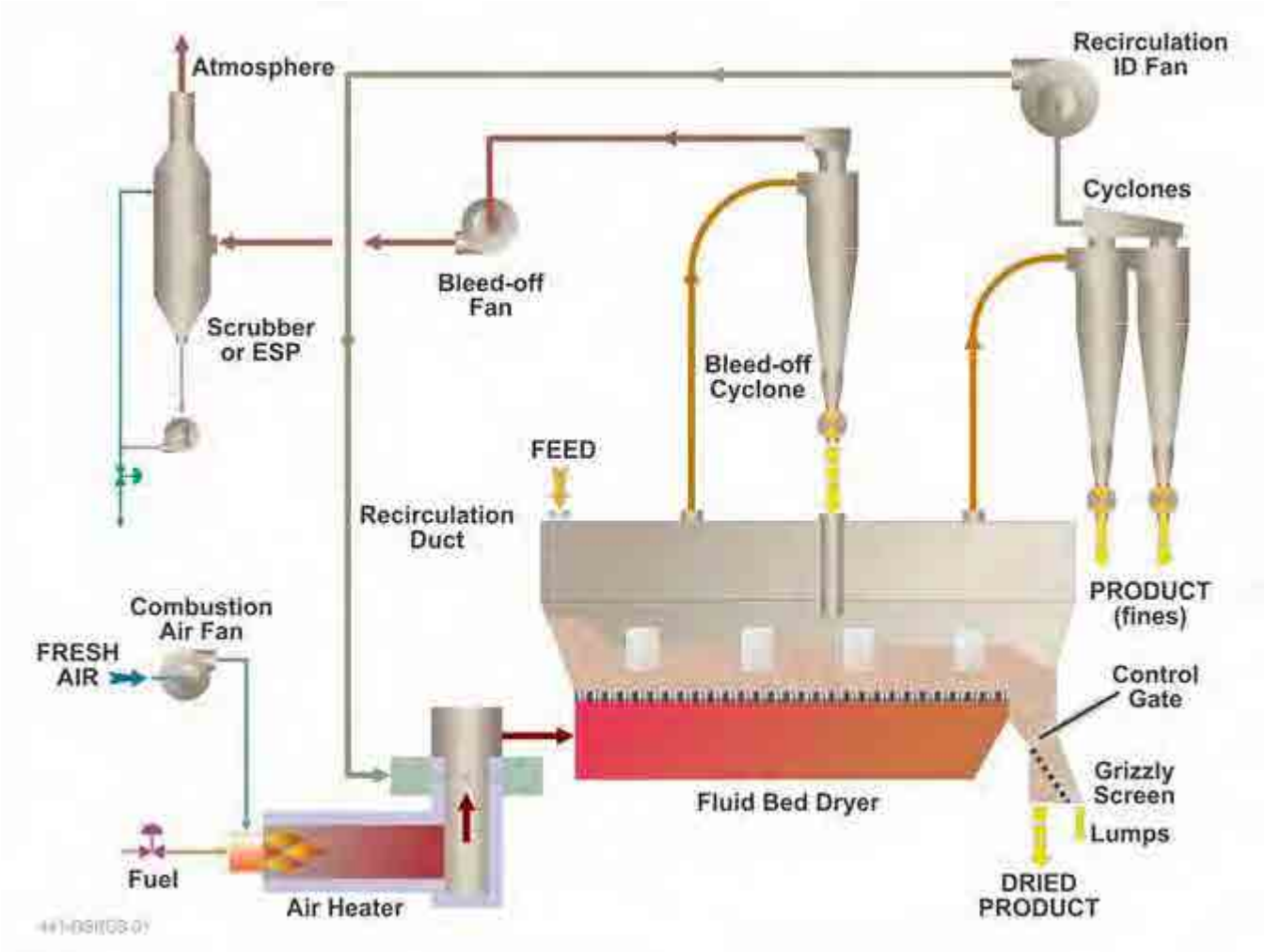
2.5. Process Flow Diagrams

2.5.1. PGR Fluid Bed Dryer

The following diagram illustrates the proposed fluid bed dryer, as well as the required ancillary equipment required for the process.



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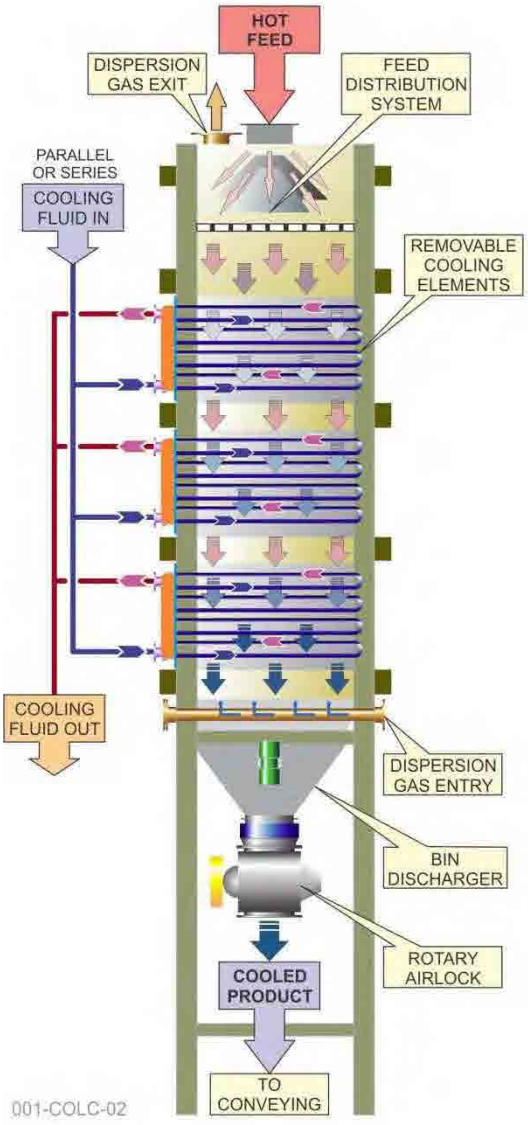
2.5.2. Column Cooler

The following diagram shows a typical column cooler configuration on the left hand side. The right hand side better displays the separate HTU units, which can slide out for easier maintenance.



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3.0 ENGINEERING SERVICES

3.1. GEA Barr-Rosin Engineering Package

GEA Barr-Rosin would provide engineering services to ensure that the proposed fluid bed dryer and column cooler systems would be designed to operate continuously at the rates stipulated in *Section 2.1 – Performance Data*. The GEA Barr-Rosin engineering package would include the following GEA Barr-Rosin standard deliverables; upon discussion of a mutually-agreed Vendor Data Requirements List (VDRL) schedule, a VDRL engineering option could be offered:

3.1.1. Preliminary Documentation:

- Preliminary project schedule
- Preliminary overall general arrangement drawing for approval
- Preliminary process and instrumentation diagram (P&ID) for approval
- Preliminary utilities list
- Preliminary motor list
- Preliminary instrumentation list

Note: GEA Barr-Rosin would submit approval drawings containing dimension details and other customer information for Buyer's comments or approval as appropriate within the agreed review period. The resulting design would be frozen, and thus any subsequent request for design or drawing changes may require a price and/or delivery schedule adjustment.

3.1.2. Documentation before delivery:

- Final overall general arrangement drawing
- Final process and instrumentation diagram (P&ID)
- Delivery and manufacturing schedule
- Detailed fixing and static loading drawings, including anchor bolt location drawings
- Instrumentation list and instrumentation connections drawings
- System control narrative
- Alarm and interlock schedule, including list of signals and interlock diagram
- Detailed motor list
- Detailed utilities schedule
- Erection manual and installation procedure

3.1.3. Documentation at Delivery:

- Final layout drawing showing civil loads and suggested support steel access structure (steelwork design excluded)
- Thermal insulation manual and recommendations
- Start-up/shut-down procedures
- Itemised and priced spares list

3.1.4. Operating and Maintenance Manuals

Three (3) sets of Operating and Maintenance Manuals would be provided in hard copies and one (1) copy in electronic format, and would include the final version of the above mentioned documents.

3.2. GEA Barr-Rosin Engineering Services

The services of a GEA Barr-Rosin Engineer could be made available to assist and advise during start-up, commissioning, and training for the proposed systems. The additional cost for these services would be according to the GEA Barr-Rosin Field Service Rates document included in the proposal package. Any additional services of burner and fan technicians required for start-up would be invoiced at cost +10%. Total period to be agreed.

3.3. GEA Barr-Rosin Site Supervisor

The presence of a GEA Barr-Rosin site supervisor onsite during the installation of the proposed systems are recommended. We estimate that our site supervisor would be required onsite for approximately 4 – 8 weeks. The services of a GEA Barr-Rosin site supervisor could be available during installation at the rates shown in the GEA Barr-Rosin Field Service Rates document included in the proposal package. Total period to be agreed.

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4.0 PRICING AND DELIVERY

4.1. Budgetary Pricing

Our price for design, manufacture and delivery of the proposed systems are as follows:

GEA Barr-Rosin Granulated SOP Dryer & Cooler		
One (1) lot of Detail Engineering Services (GEA Barr-Rosin Standard Deliverables)	Included	USD
Two (2) GEA Barr-Rosin PGR Fluid Bed Dryers	$ 4,300,000	USD
Two (2) GEA Barr-Rosin Direct Contact Column Coolers	$ 2,300,000	USD
TOTAL Price [1]	**$ 6,600,000**	**USD**
OPTION		
Column Cooler External Shell in SS316L Construction	+ $ 150,000	USD

Please Note:

1. FCA Point of Manufacture
2. All applicable sales taxes, freight, customs, fees for Letters of Credit, etc. would be extra.
3. The proposal would be valid for 90 days, subject to price adjustments (increase or decrease) until receipt of a Purchase Order according to fluctuations in raw material costs and USD/CAD exchange rate.
4. The current proposal would be subject to mutual Terms & Conditions to be agreed between GEA Barr-Rosin and SNC Lavalin/IC Potash. The GEA Barr-Rosin Standard Terms & Conditions could serve as a basis for the current project.

4.2. Payment Terms

GEA Barr-Rosin would propose the following payment:

30% with receipt of order; net ten (10) days.
30% with 50% fabrication.
35% upon notification of equipment readiness-to-ship, and delivery of final manuals (pro-rata).
5% upon process commissioning, not to exceed 3 months after delivery.

All payments are net thirty (30) days from the date of the invoice, unless otherwise noted.

4.3. Delivery Schedule

Based on a two-week turnaround time for approval of General Arrangement and P&ID drawings, delivery of drying and cooling systems is approximately 40 weeks from receipt of order.

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5.0 EXCLUSIONS

Pricing excludes anything not specifically mentioned above, and specifically excludes the following items:

- Authorities' approval for constructions and operation of the plant (GEA Barr-Rosin would co-operate and supply information as required)
- Permit fees, site arrangement, and other costs associated with gas inspection
- Offloading of equipment at site
- Mechanical erection and installation
- Supply and operation of cranes, hoists, lifts, and other installation equipment
- Civil engineering and design, and civil work.(GEA Barr-Rosin would supply loading and bolting plans)
- Design and supply of foundations or modifications to existing structures or buildings
- Design and supply of supporting steelwork
- Thermal Insulation and cladding
- Plant lighting
- Electrical cabling, instrument wiring and installation
- Local control system, except burner controls.
- Supply of utilities including natural gas, compressed air, steam, electricity, and water
- Variable frequency drives (VFDs), motor control centers (MCCs), motor starters, etc.
- Utility pipework and isolation valves, unless clearly included in scope (up to battery limits)
- Supply and installation of acoustic insulation and sound attenuation equipment/enclosures
- Material handling conveyors
- Extended runs of inlet or exhaust ductwork
- Final gas-cleaning equipment (e.g. scrubber, baghouse)
- Exhaust stack
- All utilities, raw materials and labour for testing, commissioning and operating the plant
- Analysis and laboratory equipment
- Any environmental tests, including measurement of noise and dust levels by third parties
- Site supervisor
- Start-up and commissioning services
- Start-up spares
- Running spares and wear parts
- Capital/strategic spare parts
- Any applicable sales taxes, freight, customs, fees for Letters of Credit, etc.

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IC Potash Corp
c/o SNC-Lavalin
216 – 1st Ave South
Saskatoon, SK S7K 1K3
Canada

BOI-13-060 – COMMERCIAL PROPOSAL

SNC Lavalin Inc. Project # 510315 - P - 53520

ONE (1) OPEN CIRCUIT FLUID BED DRYER

for

Crystallized Langbeinite

IC Potash - Ochoa Project
Hobbs, NM

Attention: Mr. Archy Gamvrelis (archy.gamvrelis@snclavalin.com)		
Submitted By: Gregory See Hoye (gregory.see.hoye@gea.com)		
Market Manager: Francis Chartrand (francis.chartrand@gea.com)		
Issue	Date	Update
0	May 8, 2013	First Issue

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1.0 CLARIFICATIONS TO PROPOSAL

1.1. GEA Barr-Rosin Langbeinite Product Dryer – Summary

1. As part of SNC-Lavalin RFQ No. 510315-P-53520 for the IC Potash – Ochoa Project, GEA Barr-Rosin would propose one (1) fluid bed drying system operating in high-temperature open-circuit configuration sized to dry 42 STPH design dry solids feed rate of crystallized Langbeinite product from 5%MC by weight to <0.2%MC while heating to the required compaction temperature range 320-350°F. Please refer to *Section 2.1 – Performance Data* for additional design operating details.

2. Due to the very fine Particle Size Distribution (PSD) and the abrasiveness of the specified Langbeinite, a specially-designed multi-zone fluid bed design has been proposed:
   - Zone 1: the front-end zone would receive wet feed into a pre-dried fluidizing bed of material and would feature an intense high-velocity fluidization to create high solids agitation, minimize lump formation, break-up agglomerates, and mitigate upset conditions through bulk solids mixing. A hard separation between Zone 1 and Zone 2 would prevent product cross-over before sufficient drying has been attained, as the product would remain in Zone 1 until fine/dry enough to discharge with the conveying air to the Zone 1 baghouse dust collector.
   - Zone 2: The back-end zone would receive dried feed from the Zone 1 baghouse and would feature low-velocity gentle fluidization to prevent product elutriation while providing uniform product heating to achieve the required compaction temperatures. The geometry of this zone would promote true plug flow to prevent bulk solids mixing, while ensuring discharge of only the hottest product after a constant residence time.
   - Low-Attrition Exhaust Configuration: a custom-designed baghouse inlet manifold would be supplied to enable low-attrition air/solids entry to the Zone 1 and Zone 2 baghouses without abrupt changes in flow direction (e.g. ductwork bends) that could result in immature wear on the ductwork surfaces. This design avoids sacrificial wear-plates or abrasion-liners, and eliminates excessive maintenance requirements.

3. The proposed fluid bed design would offer the following advantages:
   - No external backmixing or feed conditioning.
   - No ceramic-lining or sacrificial wear plates required.
   - Suitable for highly abrasive and fine materials.
   - Accepts varying feed characteristics or upset conditions.
   - Robust design and construction
   - Crossflow heat/mass transfer interaction between solids/solids and solids/air.

4. Although this special fluid bed design has been proposed as the base offer, GEA Barr-Rosin would also be open to investigating the possibility of using ring drying technology for this application due to the fine PSD. Considerations to enable abrasion-resistance and to evaluate external backmixing while preventing wet feed hardening/solidification would be required. Further discussions to follow.

5. The proposed fluid bed design would be subject to Pilot Plant testing to confirm operating parameters and expected product behavior for the specific ore at the proposed mine site. GEA Barr-Rosin has a fully operational Pilot Plant Testing facility in Montreal, Canada that would be available for evaluation purposes.

6. The fluid bed dryer unit would feature the following design considerations:
   - The fluid bed would be designed to provide intimate gas contact between individual solid and air particles in crossflow for efficient drying and heating.
   - The specially-designed GEA Barr-Rosin high-temperature metallic lower plenum without refractory would allow high-temperature operation while enabling wash-out with water during maintenance shut-downs. This washable design would avoid water/solids contact with any refractory, featuring instead a SS309 inner liner for contact with wash water, an intermediate insulation board layer, and a heavy-duty carbon steel outer shell supporting the internal air pressure and the operating system weight. Please refer to the document *GEA Barr-Rosin HTMFB Fluid Bed Design Description*.
   - The fluid bed lower plenum would operate at 1200°F inlet temperature for high-efficiency operation.

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- The fluid bed would operate with a 24" deep static depth of material for robustness against process upset conditions and to absorb variations in feed rate and moisture content.
- The fluid bed would feature a sloped design to propel the larger particles towards the discharge end.
- The fluid bed discharge section would feature a product discharge hood complete with underflow gate valve to control bed depth and product residence time, while facilitating lump management. A second underflow gate valve in Zone 1, normally closed, would allow periodic discharge of oversize material or for complete fluid bed emptying during maintenance.
- The fluid bed upper plenum would be fabricated in ¼" thick SS316L construction to provide adequate wear-resistance and corrosion-resistance from contact with wet feed material.
- The perforated bedplate would feature SS309 construction (with under-grid supports in 253MA) to resist high-temperature operation and corrosion from wet feed contact. The directional design would propel the oversized agglomerates towards the discharge end, and prevent backflow into the lower plenum.

7. The fluid bed dryer would be supplied with the following ancillary equipment to complete the overall system:
   - Natural Gas Air Heater: a refractory-lined air heater system featuring an in-line duct burner designed to fire Natural Gas would be supplied complete with burner management system, natural gas valve train, flow-measuring devices, instrumentation, skid-mounted ductwork, and interlocks.
   - Supply/Exhaust Fans: a system of heavy-duty forced and induced draft fans operating under a balanced-draft push-pull configuration would be included to supply the required drying airflow, while enabling controlled operation at near-atmospheric pressure in the fluid bed to minimize in-leaks of ambient air.
   - Interconnecting Ductwork: predominantly fabricated in carbon steel construction, with high-temperature SS309 where necessary, a set of ductwork would connect the dryer components into a complete system.
8. Two (2) baghouse dust collectors would capture the elutriated fines and provide final gas-cleaning prior to atmospheric discharge of the exhaust airstream. As previously requested, baghouses would be supplied by others to allow cost advantages of simultaneous purchase of all the plant's baghouses.
9. A set of field instrumentation would be included in the scope of supply to monitor the system operation and ensure operating performance. Installation of the field instrumentation would be by others.
10. Although the burner control system, including NEMA-4X local control panel, is included in the proposed scope of supply, the dedicated local control system (e.g. PLC-based or other) for the overall drying system is excluded to allow system control through the plant DCS. However, GEA Barr-Rosin would supply, as part of the basic Engineering Package, the following information to enable local supply and programming of the Controls Logic by client:
    - Start-Up, Shut-Down, and emergency procedures
    - Control Philosophy
    - Process & Instrumentation Diagram
    - Instrumentation List and Locations
    - Safety Interlocks and Alarm Sequences
11. All electric motors required for the proposed GEA Barr-Rosin equipment would be included. However, all motor control centers (MCC) and variable frequency drives (VFD) would be excluded from the scope of supply to enable local supply by others.
12. Thermal Insulation and cladding to ensure thermal efficiency of the system and for personnel protection would be supplied by others to enable cost-savings associated with a GEA Barr-Rosin markup. GEA Barr-Rosin would provide insulation specifications and installation instructions to facilitate procurement by others.
13. All material handling conveyors, unless specifically mentioned, to feed/discharge/connect the proposed systems are excluded from the scope of supply but could be included in GBRI scope upon request.
14. Steelwork and foundation design, including platforms, walkways, stairs, ladders, and handrails, would be excluded from the GEA Barr-Rosin scope of supply to enable local supply by others.

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15. GEA Barr-Rosin would investigate local fabrication upon shop qualification to minimize freight costs.
16. Current pricing is based on May 2013 raw material costs and current CAD/USD exchange rate. Subject to these cost variations, pricing would be valid for 90 days.
17. The current proposal would be subject to mutual Terms & Conditions to be agreed between GEA Barr-Rosin and SNC-Lavalin/IC Potash. The GEA Barr-Rosin Standard Terms & Conditions could serve as a basis for the current project.

Fig. 1. Coarse Product Dryer (High-Temperature) for **Potash Corp. of Saskatchewan**

Fig. 2. Fluid bed dryer for granular potash for **The Mosaic Co.**

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1.2. Partial Reference List – Potash Industry

Provided below is a brief reference list of GEA Barr-Rosin equipment for potash applications. These units process potash similar to this proposed application:

Agrium Inc.	Vanscoy, SK – two (2) Fluid Bed Dryers – three (3) Rotary Conditioners
BHP Billiton	Jansen, SK – two (2) PGR Fluid Bed Dryers for Standard Product Potash – two (2) Direct Contact Column Coolers w/embedded tubes – one (1) Rotary Conditioner – one (1) Fluid Bed Dryer/Cooler (evaporative cooling)
Intrepid Potash	Carlsbad, NM – one (1) Fluid Bed Drying System for Coarse Langbeinite
Mosaic Co.	Carlsbad, NM – one (1) Rotary Conditioner for Granular Potash – one (1) Fluid Bed Dryer for Granular Potash Esterhazy, SK (K1 Facility) – one (1) Rotary Conditioner for Granular Potash – one (1) Fluid Bed Dryer for Granular Potash Esterhazy, SK (K2 Facility) – one (1) Rotary Conditioner for Granular Potash – one (1) Fluid Bed Dryer for Granular Potash – one (1) Fluid Bed Dryer for Standard Potash Colonsay ,SK – one (1) Rotary Conditioner for Granular Potash – one (1) Fluid Bed Dryer for Granular Potash – one (1) Fluid Bed Dryer for Standard Potash
Potash Corp. of Saskatchewan	Allan, SK – one (1) Rotary Drying System for Product Potash Saskatoon, SK (Cory Facility) – one (1) PGR Fluid Bed Dryer – one (1) Column Dryer Rocanville, SK – one (1) PGR Fluid Bed Dryer for Coarse Product Potash – one (1) PGR Ring Dryer for Fine Product Potash – one (1) Fluid Bed Dryer/Cooler (evaporative cooling) – two (2) Direct Contact Column Coolers w/embedded tubes
SQM	Salar de Atacama , Antofagasta – one (1) Rotary Conditioner for Granular Potash – one (1) Fluid Bed Dryer/Cooler for Granular Potash (evaporative cooling)
Vale	Bahia Blanca , Argentina – one (1) Fluid Bed Dryer for Crystallized Potash – one (1) Fluid Bed Reheater for Crystallized Potash – one (1) Rotary Conditioner for Granular Potash – one (1) Fluid Bed Dryer/Cooler for Granular Potash (evaporative cooling)

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2.0 SYSTEM SPECIFICATION

2.1. Performance Data

The proposed GEA Barr-Rosin fluid bed dryer and column cooler would process the SOP product at the capacities specified below:

System Characteristics	Units	Design	Nominal
No. of Lines Required	-	1	1
Technology[1]	-	Fluid Bed	Fluid Bed
Configuration	-	Open-Circuit (OC)	Open-Circuit (OC)
Feed Rate (Total Wet Feed)	lb/h	88,421	73,684
Feed Moisture Content	%	5	5
Feed Temperature	°F	162	162
Product Temperature	°F	320-350	320-350
Product Rate	lb/h	84,168	70,140
Final Moisture Content	%	0.2	0.2
Evaporation Rate	lb/h	4,253	3,544
Hot Air Inlet Temperature	°F	1200	1100
Airflow (for gas cleaning)[2]	ACFM	15,000	12,500
Absorbed Power	BHP	200	170
Installed Power	HP	250	200
Fuel Consumption[3] (Winter Ambient Temp.: 8°F)[4]	lb/h	528	438
Approximate Dimensions[5]	w x l x h (ft.)	3'-6" x 21'-0" x 20'-0"	3'-6" x 21'-0" x 20'-0"

Please Note:

1. Ring drying technology could be considered upon further discussion and investigation.
2. Bleed-off airflow is based on actual conditions for elevation, temperature, and pressure at site based on SNC-Lavalin Specification No. 510315-00000-41EG-0001.
3. Gas consumption based on a natural gas lower heat value of 10,888 kcal/kg (19,600 BTU/lb).
4. The fuel consumption is based on estimated site conditions based on SNC-Lavalin Specification No. 510315-00000-41EG-0001.
5. Dimensions shown correspond to the fluid bed unit only; additional space would be required for ancillary air handling components and ductwork.
6. Figures shown in the above table would be subject to Pilot Plant testing to confirm the operating parameters and expected product behavior for the specific ore from the proposed mine site.

2.2. Electric Motors

	Installed Power	rpm	Voltage (V)	Control
• Forced Draft Fan	150 HP	1800	460	Direct
• Exhaust Fan	100 HP	1800	460	Direct

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2.3. Scope of Supply

- Complete equipment supply within the battery limits shown below
- Burner system instrumentation and controls, with local control panel
- Engineering services, including process evaluation and detail design

2.4. Battery Limits

Feed Inlet	Inlet to fluid bed dryer chute
Product Outlet	Outlet of final product discharge after fluid bed
Air Inlet	Inlet to air louver
Air Exhaust	Exhaust fan outlet
Gas Supply	Inlet of gas valve train. Gas train within proximity of burner
Electrical Power	At inlet of burner control panel
	At individual motor terminal boxes
Compressed / Instrument Air Supply	Inlet connection to actuators on dampers

Note: As previously requested, the baghouse dust collectors would be supplied by others together with the plant's other baghouse requirements.

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3.0 ENGINEERING SERVICES

3.1. GEA Barr-Rosin Engineering Package

GEA Barr-Rosin would provide engineering services to ensure that the proposed fluid bed dryer would be designed to operate continuously at the rates stipulated in *Section 2.1 – Performance Data*. The GEA Barr-Rosin engineering package would include the following GEA Barr-Rosin standard deliverables; upon discussion of a mutually-agreed Vendor Data Requirements List (VDRL) schedule, a VDRL engineering option could be offered:

3.1.1. Preliminary Documentation:

- Preliminary project schedule
- Preliminary overall general arrangement drawing for approval
- Preliminary process and instrumentation diagram (P&ID) for approval
- Preliminary utilities list
- Preliminary motor list
- Preliminary instrumentation list

Note: GEA Barr-Rosin would submit approval drawings containing dimension details and other customer information for Buyer's comments or approval as appropriate within the agreed review period. The resulting design would be frozen, and thus any subsequent request for design or drawing changes may require a price and/or delivery schedule adjustment.

3.1.2. Documentation before delivery:

- Final overall general arrangement drawing
- Final process and instrumentation diagram (P&ID)
- Delivery and manufacturing schedule
- Detailed fixing and static loading drawings, including anchor bolt location drawings
- Instrumentation list and instrumentation connections drawings
- System control narrative
- Alarm and interlock schedule, including list of signals and interlock diagram
- Detailed motor list
- Detailed utilities schedule
- Erection manual and installation procedure

3.1.3. Documentation at Delivery:

- Final layout drawing showing civil loads and suggested support steel access structure (steelwork design excluded)
- Thermal insulation manual and recommendations
- Start-up/shut-down procedures
- Itemised and priced spares list

3.1.4. Operating and Maintenance Manuals

Three (3) sets of Operating and Maintenance Manuals would be provided in hard copies and one (1) copy in electronic format, and would include the final version of the above mentioned documents.

3.2. GEA Barr-Rosin Engineering Services

The services of a GEA Barr-Rosin Engineer could be made available to assist and advise during start-up, commissioning, and training for the proposed systems. The additional cost for these services would be according to the GEA Barr-Rosin Field Service Rates document included in the proposal package. Any additional services of burner and fan technicians required for start-up would be invoiced at cost +10%. Total period to be agreed.

3.3. GEA Barr-Rosin Site Supervisor

The presence of a GEA Barr-Rosin site supervisor onsite during the installation of the proposed systems are recommended. We estimate that our site supervisor would be required onsite for approximately 4 – 8 weeks. The services of a GEA Barr-Rosin site supervisor could be available during installation at the rates shown in the GEA Barr-Rosin Field Service Rates document included in the proposal package. Total period to be agreed.

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4.0 PRICING AND DELIVERY

4.1. Budgetary Pricing

Our price for design, manufacture and delivery of the proposed system is as follows:

GEA Barr-Rosin Langbeinite Product Dryer		
One (1) lot of Detail Engineering Services (GEA Barr-Rosin Standard Deliverables)	Included	USD
One (1) GEA Barr-Rosin Fluid Bed Dryer	Included	USD
TOTAL Price[1]	**$ 1,500,000**	**USD**

Please Note:

1. FCA Point of Manufacture
2. All applicable sales taxes, freight, customs, fees for Letters of Credit, etc. would be extra.
3. The proposal would be valid for 90 days, subject to price adjustments (increase or decrease) until receipt of a Purchase Order according to fluctuations in raw material costs and USD/CAD exchange rate.
4. The current proposal would be subject to mutual Terms & Conditions to be agreed between GEA Barr-Rosin and SNC Lavalin/IC Potash. The GEA Barr-Rosin Standard Terms & Conditions could serve as a basis for the current project.

4.2. Payment Terms

GEA Barr-Rosin would propose the following payment:

30% with receipt of order; net ten (10) days.
30% with 50% fabrication.
35% upon notification of equipment readiness-to-ship, and delivery of final manuals (pro-rata).
5% upon process commissioning, not to exceed 3 months after delivery.

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- Any environmental tests, including measurement of noise and dust levels by third parties
- Site supervisor
- Start-up and commissioning services
- Start-up spares
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BOI-13-061 – COMMERCIAL PROPOSAL

SNC Lavalin Inc. Project # 510315 - P - 53520

ONE (1) CONDITIONING/GLAZING SYSTEM

for

Granular/Compacted Langbeinite

IC Potash - Ochoa Project
Hobbs, NM

Attention: Mr. Archy Gamvrelis (archy.gamvrelis@snclavalin.com)		
Submitted By: Gregory See Hoye (gregory.see.hoye@gea.com)		
Market Manager: Francis Chartrand (francis.chartrand@gea.com)		
Issue	Date	Update
0	May 8, 2013	First Issue

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1.0 CLARIFICATIONS TO PROPOSAL

1.1. GEA Barr-Rosin Glazing System – Summary

1. As part of SNC-Lavalin RFQ No. 510315-P-53520 for the IC Potash – Ochoa Project, GEA Barr-Rosin would propose one (1) conditioning system to glaze, polish, dry, and cool granular langbeinite. The design solids feed rate would be 143 STPH, and the final product would contain 0.3%MC by weight and have a final temperature of 180°F.

2. The system would enable granular langbeinite to be simultaneously sprayed with glazing water and conditioned/polished in a rotary conditioning drum without forced airflow for subsequent drying and cooling in an integral fluid bed by evaporative cooling.

3. The fluid bed operating under evaporative cooling simultaneously dries and cools granular product without any Natural Gas consumption by relying solely on the latent energy remaining in the feed after compaction to evaporate the glazing water added in the upstream glazing/polishing drum. Consequently, the potash product would exit the fluid bed dry and cool, while eliminating fuel consumption and costs.

4. Through extensive Research & Development and Pilot Plant testing using the specially-designed pilot-scale system (*see Fig. 1*), the GEA Barr-Rosin Conditioning System has been demonstrated to result in higher quality product with respect to product degradation, and temperature/moisture uniformity for potash applications. However, the proposed design would be subject to Pilot Plant Testing to confirm the operating parameters and expected product behavior on langbeinite from the proposed mine site.

5. The GEA Barr-Rosin Conditioning System features a coordinated operation of the glazing rotary drum and the integral fluid bed system:
   - Drum operation influences fluid bed duty
   - Fluid bed system influences humidity in drum
   - Fluid bed system design optimized for a range of product characteristics/conditions exiting the drum
   - Optimized layout with close-coupled drum / fluid bed reduces intermediate transfer conveyor, ductwork, and chutes.

   Due to the coordinated operation of both these equipment's with respect to optimized operation/performance, the design of the rotary conditioner and the fluid bed would be simultaneously designed as a single system.

6. The conditioning drum would feature the following design considerations:
   - The glazing conditioning drum would spray glazing water while efficiently polishing and tumbling compacted Granular Langbeinite over a 1½-minute residence time, subsequently discharging the wetted product into the downstream fluid bed dryer/cooler.
   - The internals design featuring angle-type tumbling flights would promote effective water-coating, rapid product tumbling, and vigorous mixing without a cascading/showering effect for improved solids-to-solids contact and more effective polishing throughout the drum over a 1.5-minute residence time. The specially-designed tumbling flights would be welded in place.
   - The base design would feature a robust 3/8" thick Duplex Alloy 2205 outer shell construction for superior corrosion-resistance, The shell would be complete with ¾" thick sections under the tires and ¾" thick section under the drive gear for stiffened load support. The shell would be designed without through-shell bolting for support/drive components and internals, which enables mechanical and operational robustness and eliminates the potential for penetrating corrosion. The internals and end plates would also be constructed in 3/8" thick Duplex Alloy 2205.
   - The feed section of the drum would feature a conical shape without internal lifters to promote feed entry into the tumbling zone. This design eliminates build-up that occurs in helical-lifter channels while preventing back-spilling of feed at the front-end.
   - The drum would be supported on 'floating' tires fabricated of forged high carbon steel, located by retaining blocks and installed on machined pads to ensure true rolling concentricity and superior surface contact between the tires and pads. The machined pads would be welded to the shell.

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- The specially-designed spray bars would feature nozzles with adjustable spraying angles and fine misting for best possible uniform coating. The spray bars would be supported by a chain across the length of the drum to facilitate cleaning and maintenance, and would be easily removable from the discharge end of the drum. The support system would be in SS316L construction.
- A local spray water control system would be included for flow control to the spray bars, comprised of a skid-mounted positive displacement pump, a strainer, valves, instrumentation, a flowmeter, and piping. A VFD (by others) would be used for water flow control.
- A chain drive system would be included, complete with an automatic lubrication system. The drive system would feature a VFD (by others) for speed control.
- The support and thrust rollers would be designed in special heat-stabilized cast nylon (*please refer to Fig. 3 below*) and would be provided to enable a **lubrication-free** operation that would be quiet and smooth. This design results in **lower wear** and **lower maintenance** than the conventional steel design, based on GEA Barr-Rosin's experience with over twenty (20) installations, including a conditioning drum for potash in Saskatchewan, Canada.
- To mitigate and remove potential build-up during operation, the conditioning drum would feature three (3) hammer bands designed for impact and one (1) impact hammer at the feed end of the drum with provision for two (2) additional hammers.
- To facilitate installation of the conditioning drum and its ancillary support and drive components, a common baseframe would be included in the scope of supply.

7. The fluid bed unit that would subsequently dry and cool the conditioned potash would be fabricated with thick-gauge construction for optimum wear-resistance. Please also note the following design considerations:
   - The proposed rectangular fluid bed unit would provide constant residence time, even product temperature, true plug flow, and intimate gas contact with individually fluidized particles in the crossflow for high-efficiency operation.
   - The fluid bed lower and upper plenums would be fabricated of SS316L for corrosion-resistance.
   - The bedplate would feature a design with directional flow to promote material flow towards the discharge end of the fluid bed while preventing back-sifting of product into the lower plenum, and would be supplied in SS316L construction to provide corrosion-resistance against contact with wet product.
   - A small air heater system featuring a duct-mounted burner (Maxon or equivalent) firing Natural Gas would be supplied for use during cold ambient conditions to prevent condensation in the fluid bed and associated operating/maintenance issues; the air heater could potentially be turned off during the warm summer months.
   - An inlet airflow venturi would be included to enable measurement and control of the fluidizing airflow.
   - The bed depth and residence time would be controlled with an adjustable underflow gate valve.
   - The proposed drying system would operate at near-atmospheric pressure in the fluid bed to minimize in-leaks of ambient air, and would be controlled by a balanced-draft system produced by a system of forced and induced draft fans.
   - All interconnecting ductwork is included and would be fabricated in mild steel construction. Stack is currently excluded.
   - A baghouse dust collector would capture the elutriated fines and provide final gas-cleaning prior to atmospheric discharge of the exhaust airstream. As previously requested, the baghouse would be supplied by others to allow cost advantages of simultaneous purchase of all the plant's baghouses.

8. A set of field instrumentation would be included in the scope of supply to monitor the system operation and ensure operating performance. Installation of the field instrumentation would be by others.

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9. Although the burner control system, including NEMA-4X local control panel, is included in the proposed scope of supply, the dedicated local control system (e.g. PLC-based or other) for the overall conditioning system is excluded to allow system control through the plant DCS. However, GEA Barr-Rosin would supply, as part of the basic Engineering Package, the following information to enable local supply and programming of the Controls Logic by client:
   - Start-Up, Shut-Down, and emergency procedures
   - Control Philosophy
   - Process & Instrumentation Diagram
   - Instrumentation List and Locations
   - Safety Interlocks and Alarm Sequences
10. All electric motors required for the proposed GEA Barr-Rosin equipment would be included. However, all motor control centers (MCC) and variable frequency drives (VFD) would be excluded from the scope of supply to enable local supply by others.
11. All material handling conveyors, unless specifically mentioned, to feed and discharge the proposed systems are excluded from the scope of supply but could be included in GBRI scope upon request.
12. Steelwork and foundation design, including platforms, walkways, stairs, ladders, and handrails, would be excluded from the GEA Barr-Rosin scope of supply to enable local supply by others.
13. GEA Barr-Rosin would investigate local fabrication upon shop qualification to minimize freight costs.
14. Current pricing is based on May 2013 raw material costs and current CAD/USD exchange rate. Subject to these cost variations, pricing would be valid for 90 days.
15. The current proposal would be subject to mutual Terms & Conditions to be agreed between GEA Barr-Rosin and SNC-Lavalin/IC Potash. The GEA Barr-Rosin Standard Terms & Conditions could serve as a basis for the current project.

Fig. 1. GEA Barr-Rosin Conditioning Circuit Pilot Plant System for Granular Potash featuring conditioning drum and fluid bed.

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Fig. 2. Rotary Conditioning Drum for **the Mosaic Co.**

Fig. 3. Nylon support (trunnion) roller. Allows lubrication-free operation with minimal noise, smooth running, low wear and low maintenance.

Fig. 1. Coarse Product Dryer (High-Temperature) for **Potash Corp. of Saskatchewan**

Fig. 2. Fluid bed dryer for granular potash for **The Mosaic Co.**

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1.2. Partial Reference List – Potash Industry

Provided below is a brief reference list of GEA Barr-Rosin equipment for potash applications. These units process potash similar to this proposed application:

Agrium Inc.	Vanscoy, SK – two (2) Fluid Bed Dryers – three (3) Rotary Conditioners
BHP Billiton	Jansen, SK – two (2) PGR Fluid Bed Dryers for Standard Product Potash – two (2) Direct Contact Column Coolers w/embedded tubes – one (1) Rotary Conditioner – one (1) Fluid Bed Dryer/Cooler (evaporative cooling)
Intrepid Potash	Carlsbad, NM – one (1) Fluid Bed Drying System for Coarse Langbeinite
Mosaic Co.	Carlsbad, NM – one (1) Rotary Conditioner for Granular Potash – one (1) Fluid Bed Dryer for Granular Potash Esterhazy, SK (K1 Facility) – one (1) Rotary Conditioner for Granular Potash – one (1) Fluid Bed Dryer for Granular Potash Esterhazy, SK (K2 Facility) – one (1) Rotary Conditioner for Granular Potash – one (1) Fluid Bed Dryer for Granular Potash – one (1) Fluid Bed Dryer for Standard Potash Colonsay ,SK – one (1) Rotary Conditioner for Granular Potash – one (1) Fluid Bed Dryer for Granular Potash – one (1) Fluid Bed Dryer for Standard Potash
Potash Corp. of Saskatchewan	Allan, SK – one (1) Rotary Drying System for Product Potash Saskatoon, SK (Cory Facility) – one (1) PGR Fluid Bed Dryer – one (1) Column Dryer Rocanville, SK – one (1) PGR Fluid Bed Dryer for Coarse Product Potash – one (1) PGR Ring Dryer for Fine Product Potash – one (1) Fluid Bed Dryer/Cooler (evaporative cooling) – two (2) Direct Contact Column Coolers w/embedded tubes
SQM	Salar de Atacama , Antofagasta – one (1) Rotary Conditioner for Granular Potash – one (1) Fluid Bed Dryer/Cooler for Granular Potash (evaporative cooling)
Vale	Bahia Blanca , Argentina – one (1) Fluid Bed Dryer for Crystallized Potash – one (1) Fluid Bed Reheater for Crystallized Potash – one (1) Rotary Conditioner for Granular Potash – one (1) Fluid Bed Dryer/Cooler for Granular Potash (evaporative cooling)

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2.0 SYSTEM SPECIFICATION

2.1. Performance Data

System Characteristics	Units	Design	Nominal
No. of Lines Required	-	1	
Technology	-	Rotary Drum and Integral Fluid Bed	
Configuration	-	Evaporative Cooling	
Solids Feed Rate to Drum	lb/h	286,000	238,000
Feed Temperature	°F	320 – 350	320 – 350
Water Added in the Drum	%	3	2.5
Total Dry Product Rate	lb/h	286,860	238,716
Product Temperature	°F	<180	<180
Final Moisture Content	%	0.3	0.3
Airflow (for gas cleaning)[1]	ACFM	20,500	20,500
Drum Rotating Speed Range	RPM	12 – 14	12 – 14
Drum Volume Hold-up	%	15	15
Fluid Bed Inlet Gas Temperature	ºF	105 (max.)	105 (max.)
Absorbed Power	BHP	256	256
Installed Power	HP	435	435
Fuel Consumption[2]	lb/h	negligible	negligible
Approximate Drum Dimensions	w x l x h (ft.)	6'-0" x 22'-6"	
Approximate Fluid Bed Dimensions[3]	dia. x l (ft.)	2'-0" x 16'-0" x 20'-0"	

Please Note:

1. Bleed-off airflow is based on actual conditions for elevation, temperature, and pressure at site based on SNC-Lavalin Specification No. 510315-00000-41EG-0001, and includes flash evaporation from the drum and exhaust cooling air from the fluid bed.
2. The air heater would be required from temperature control for upset conditions and dew point/condensation management. Under normal operating conditions, the air heater could be turned off.
3. Dimensions shown correspond to the fluid bed unit only; additional space would be required for ancillary air handling components and ductwork.
4. Figures shown in the above table would be subject to Pilot Plant testing to confirm the operating parameters and expected product behavior for the specific ore from the proposed mine site.

2.2. Electric Motors

	Installed Power	rpm	Voltage (V)	Control
• Rotary Drum Drive	75 HP	1800	460	VFD
• Water Spray Pump	10 HP	1800	460	VFD
• Forced Draft Fan	250 HP	1800	460	Direct
• Exhaust Fan	100 HP	1800	460	Direct

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2.3. Scope of Supply

- Complete equipment supply within the battery limits shown below
- Burner system instrumentation and controls, with local control panel
- Engineering services, including process evaluation and detail design

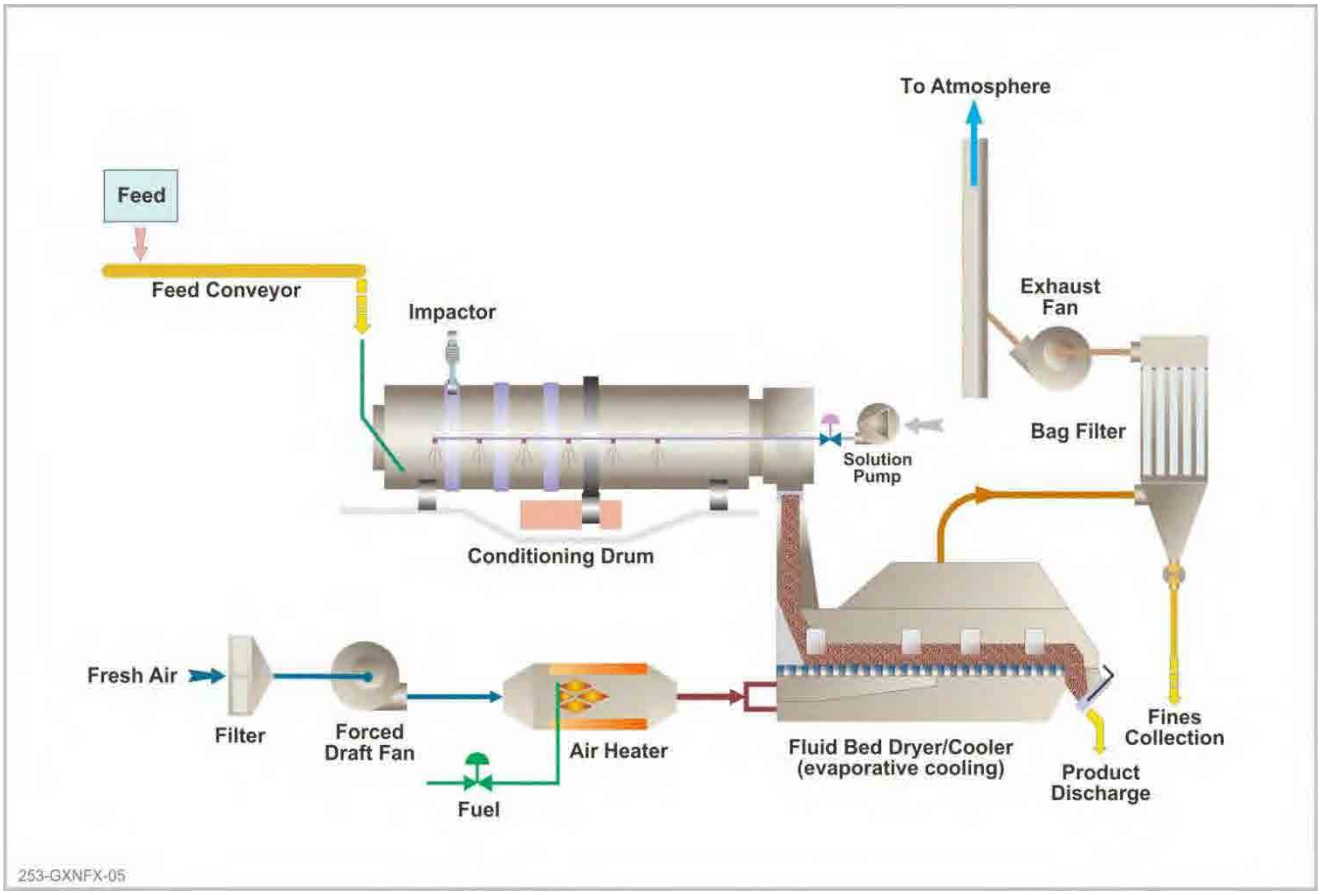
2.4. Battery Limits

Initial Feed	Inlet chute to conditioning drum
Product Outlet	Outlet of final product discharge after fluid bed
Air Inlet	Inlet louver to fluid bed
Air Exhaust	Outlet of exhaust fan
Gas Supply	Inlet of gas valve train. Gas train within 5 ft distance of burner
Electrical Power	At inlet of burner control panel
	At individual motor terminal boxes
Water	Inlet connections to positive displacement pump
Compressed/Instrument Air Supply	Inlet connection to actuators on dampers

Note: As previously requested, the baghouse dust collector would be supplied by others together with the plant's other baghouse requirements.

2.5. Process Flow Diagram

The following diagram illustrates the proposed glazing system, as well as the required ancillary equipment required for the process.



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3.0 ENGINEERING SERVICES

3.1. GEA Barr-Rosin Engineering Package

GEA Barr-Rosin would provide engineering services to ensure that the proposed glazing system would be designed to operate continuously at the rates stipulated in *Section 2.1 – Performance Data*. The GEA Barr-Rosin engineering package would include the following GEA Barr-Rosin standard deliverables; upon discussion of a mutually-agreed Vendor Data Requirements List (VDRL) schedule, a VDRL engineering option could be offered:

3.1.1. Preliminary Documentation:

- Preliminary project schedule
- Preliminary overall general arrangement drawing for approval
- Preliminary process and instrumentation diagram (P&ID) for approval
- Preliminary utilities list
- Preliminary motor list
- Preliminary instrumentation list

Note: GEA Barr-Rosin would submit approval drawings containing dimension details and other customer information for Buyer's comments or approval as appropriate within the agreed review period. The resulting design would be frozen, and thus any subsequent request for design or drawing changes may require a price and/or delivery schedule adjustment.

3.1.2. Documentation before delivery:

- Final overall general arrangement drawing
- Final process and instrumentation diagram (P&ID)
- Delivery and manufacturing schedule
- Detailed fixing and static loading drawings, including anchor bolt location drawings
- Instrumentation list and instrumentation connections drawings
- System control narrative
- Alarm and interlock schedule, including list of signals and interlock diagram
- Detailed motor list
- Detailed utilities schedule
- Erection manual and installation procedure

3.1.3. Documentation at Delivery:

- Final layout drawing showing civil loads and suggested support steel access structure (steelwork design excluded)
- Start-up/shut-down procedures
- Itemised and priced spares list

3.1.4. Operating and Maintenance Manuals

Three (3) sets of Operating and Maintenance Manuals would be provided in hard copies and one (1) copy in electronic format, and would include the final version of the above mentioned documents.

3.2. GEA Barr-Rosin Engineering Services

The services of a GEA Barr-Rosin Engineer could be made available to assist and advise during start-up, commissioning, and training for the proposed systems. The additional cost for these services would be according to the GEA Barr-Rosin Field Service Rates document included in the proposal package. Any additional services of burner and fan technicians required for start-up would be invoiced at cost +15%. Total period to be agreed.

3.3. GEA Barr-Rosin Site Supervisor

The presence of a GEA Barr-Rosin site supervisor onsite during the installation of the GEA Barr-Rosin Conditioning System would be recommended for on-site supervision during the installation of the system for approximately 2 – 4 weeks. However, as a minimum, we would recommend the services of a site supervisor for five (5) days during the critical stages of the initial installation, particularly during the alignment and adjustment of the rollers on the foundation prior to mounting the conditioning drum. These services of a GEA Barr-Rosin site supervisor could be available at the rates shown in the GEA Barr-Rosin Field Service Rates document included in the proposal package. Total period to be agreed.

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4.0 PRICING AND DELIVERY

4.1. Pricing

Our price for design, manufacture and delivery of the proposed systems are as follows:

GEA Barr-Rosin Langbeinite Conditioning System		
One (1) lot of Detail Engineering Services (VDRL Deliverables)	Included	USD
One (1) GEA Barr-Rosin Conditioning System for Langbeinite	Included	USD
TOTAL Price [1]	**$ 1,675,000**	**USD**

Please Note:

1. FCA Point of Manufacture
2. All applicable sales taxes, freight, customs, fees for Letters of Credit, etc. would be extra.
3. The proposal would be valid for 90 days, subject to price adjustments (increase or decrease) until receipt of a Purchase Order according to fluctuations in raw material costs and USD/CAD exchange rate.
4. The current proposal would be subject to mutual Terms & Conditions to be agreed between GEA Barr-Rosin and SNC Lavalin/IC Potash. The GEA Barr-Rosin Standard Terms & Conditions could serve as a basis for the current project.

4.2. Payment Terms

GEA Barr-Rosin would propose the following payment:

30% with receipt of order; net ten (10) days.
30% with 50% fabrication.
35% upon notification of equipment readiness-to-ship, and delivery of final manuals (pro-rata).
5% upon process commissioning, not to exceed 3 months after delivery.

All payments are net thirty (30) days from the date of the invoice, unless otherwise noted.

4.3. Delivery Schedule

Based on a two-week turnaround time for approval of General Arrangement and P&ID drawings, delivery of drying and cooling systems is approximately 40 weeks from receipt of order.

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5.0 EXCLUSIONS

Pricing excludes anything not specifically mentioned above, and specifically excludes the following items:

- Authorities' approval for constructions and operation of the plant (GEA Barr-Rosin would co-operate and supply information as required)
- Permit fees, site arrangement, and other costs associated with gas inspection
- Offloading of equipment at site
- Mechanical erection and installation
- Supply and operation of cranes, hoists, lifts, and other installation equipment
- Civil engineering and design, and civil work.(GEA Barr-Rosin would supply loading and bolting plans)
- Design and supply of foundations or modifications to existing structures or buildings
- Design and supply of supporting steelwork
- Thermal Insulation and cladding
- Plant lighting
- Electrical cabling, instrument wiring and installation
- Local control system, except burner controls.
- Supply of utilities including natural gas, compressed air, steam, electricity, and water
- Variable frequency drives (VFDs), motor control centers (MCCs), motor starters, etc.
- Utility pipework and isolation valves, unless clearly included in scope (up to battery limits)
- Supply and installation of acoustic insulation and sound attenuation equipment/enclosures
- Material handling conveyors
- Extended runs of inlet or exhaust ductwork
- Baghouse dust collector and related product discharge components
- Exhaust stack
- All utilities, raw materials and labour for testing, commissioning and operating the plant
- Analysis and laboratory equipment
- Any environmental tests, including measurement of noise and dust levels by third parties
- Site supervisor
- Start-up and commissioning services
- Start-up spares
- Running spares and wear parts
- Capital/strategic spare parts
- Any applicable sales taxes, freight, customs, fees for Letters of Credit, etc.

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PERFORMANCE DATA[DM8263]

April 26, 2013

Performance Number: DM8263 **Change Level: 03**

SALES MODEL:	3516C	**COMBUSTION:**	DI
ENGINE POWER (BHP):	2,937	**ENGINE SPEED (RPM):**	1,800
GEN POWER WITH FAN (EKW):	2,000.0	**HERTZ:**	60
COMPRESSION RATIO:	14.7	**FAN POWER (HP):**	114.0
APPLICATION:	PACKAGED GENSET	**ASPIRATION:**	TA
RATING LEVEL:	STANDBY	**AFTERCOOLER TYPE:**	ATAAC
SUB APPLICATION:	STANDARD	**AFTERCOOLER CIRCUIT TYPE:**	JW+OC, ATAAC
PUMP QUANTITY:	2	**INLET MANIFOLD AIR TEMP (F):**	122
FUEL TYPE:	DIESEL	**JACKET WATER TEMP (F):**	210.2
MANIFOLD TYPE:	DRY	**TURBO CONFIGURATION:**	PARALLEL
GOVERNOR TYPE:	ADEM3	**TURBO QUANTITY:**	4
ELECTRONICS TYPE:	ADEM3	**TURBOCHARGER MODEL:**	GTA5518BN-56T-1.12
CAMSHAFT TYPE:	STANDARD	**CERTIFICATION YEAR:**	2006
IGNITION TYPE:	CI	**CRANKCASE BLOWBY RATE (FT3/HR):**	2,937.9
INJECTOR TYPE:	EUI	**FUEL RATE (RATED RPM) NO LOAD (GAL/HR):**	13.7
FUEL INJECTOR:	2664387	**PISTON SPD @ RATED ENG SPD (FT/MIN):**	2,244.1
REF EXH STACK DIAMETER (IN):	12		
MAX OPERATING ALTITUDE (FT):	3,117		

General Performance Data

GENSET POWER WITH FAN	PERCENT LOAD	ENGINE POWER	BRAKE MEAN EFF PRES (BMEP)	BRAKE SPEC FUEL CONSUMPTN (BSFC)	VOL FUEL CONSUMPTN (VFC)	INLET MFLD PRES	INLET MFLD TEMP	EXH MFLD TEMP	EXH MFLD PRES	ENGINE OUTLET TEMP
EKW	%	BHP	PSI	LB/BHP-HR	GAL/HR	IN-HG	DEG F	DEG F	IN-HG	DEG F
2,000.0	100	2,937	307	0.329	138.0	78.3	121.2	1,118.5	71.5	752.1
1,800.0	90	2,641	276	0.331	124.9	73.1	119.6	1,067.5	65.7	716.0
1,600.0	80	2,353	246	0.337	113.1	68.0	118.2	1,027.0	60.0	693.3
1,500.0	75	2,212	231	0.340	107.5	65.2	117.5	1,008.1	57.2	684.6
1,400.0	70	2,071	216	0.344	101.8	62.3	116.8	989.4	54.4	676.9
1,200.0	60	1,795	188	0.352	90.1	55.5	115.4	952.0	48.0	662.8
1,000.0	50	1,521	159	0.357	77.5	46.5	113.7	913.4	40.1	654.0
800.0	40	1,250	131	0.357	63.8	34.8	111.8	863.8	30.3	655.0
600.0	30	977	102	0.365	50.9	24.2	110.6	803.8	22.0	650.0
500.0	25	839	88	0.374	44.8	19.7	110.2	767.0	18.7	641.7
400.0	20	699	73	0.388	38.8	15.7	109.8	724.6	15.7	629.0
200.0	10	411	43	0.450	26.4	9.0	109.1	596.9	10.9	552.8

GENSET POWER WITH FAN	PERCENT LOAD	ENGINE POWER	COMPRESSOR OUTLET PRES	COMPRESSOR OUTLET TEMP	WET INLET AIR VOL FLOW RATE	ENGINE OUTLET WET EXH GAS VOL FLOW RATE	WET INLET AIR MASS FLOW RATE	WET EXH GAS MASS FLOW RATE	WET EXH VOL FLOW RATE (32 DEG F AND 29.98 IN HG)	DRY EXH VOL FLOW RATE (32 DEG F AND 29.98 IN HG)
EKW	%	BHP	IN-HG	DEG F	CFM	CFM	LB/HR	LB/HR	FT3/MIN	FT3/MIN
2,000.0	100	2,937	83	454.3	6,548.9	15,292.8	28,512.8	29,478.4	6,205.0	5,738.7
1,800.0	90	2,641	77	428.8	6,318.7	14,243.0	27,390.5	28,264.7	5,956.5	5,533.7
1,600.0	80	2,353	72	404.5	6,073.3	13,331.0	26,220.6	27,012.9	5,685.0	5,301.6
1,500.0	75	2,212	69	392.7	5,932.2	12,897.9	25,568.0	26,319.7	5,542.0	5,176.6
1,400.0	70	2,071	66	380.9	5,777.2	12,448.0	24,862.1	25,573.8	5,384.8	5,037.5
1,200.0	60	1,795	59	353.9	5,397.2	11,422.5	23,141.0	23,771.1	5,003.4	4,694.0
1,000.0	50	1,521	50	318.8	4,857.3	10,138.7	20,731.5	21,274.5	4,476.2	4,208.4
800.0	40	1,250	38	271.1	4,090.0	8,488.8	17,357.1	17,803.6	3,744.5	3,524.2
600.0	30	977	27	225.0	3,394.1	6,989.6	14,328.5	14,684.4	3,097.0	2,920.6
500.0	25	839	22	204.1	3,103.5	6,328.1	13,075.2	13,388.4	2,825.1	2,668.8
400.0	20	699	18	184.1	2,840.4	5,696.0	11,947.2	12,218.4	2,572.5	2,435.7
200.0	10	411	11	148.5	2,409.4	4,478.2	10,105.7	10,290.7	2,174.6	2,076.8

Heat Rejection Data

GENSET POWER WITH FAN	PERCENT LOAD	ENGINE POWER	REJECTION TO JACKET WATER	REJECTION TO ATMOSPHERE	REJECTION TO EXH	EXHUAST RECOVERY TO 350F	FROM OIL COOLER	FROM AFTERCOOLER	WORK ENERGY	LOW HEAT VALUE ENERGY	HIGH HEAT VALUE ENERGY
EKW	%	BHP	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN	BTU/MIN
2,000.0	100	2,937	43,150	7,564	101,696	49,615	15,778	38,240	124,558	296,234	315,563
1,800.0	90	2,641	40,179	7,175	92,069	43,106	14,280	34,105	111,977	268,102	285,596
1,600.0	80	2,353	37,427	6,907	84,225	38,510	12,931	30,201	99,774	242,774	258,615
1,500.0	75	2,212	36,092	6,791	80,632	36,523	12,286	28,303	93,784	230,664	245,715
1,400.0	70	2,071	34,737	6,671	77,064	34,629	11,640	26,432	87,835	218,548	232,809
1,200.0	60	1,795	31,877	6,341	69,432	30,722	10,302	22,179	76,103	193,426	206,048
1,000.0	50	1,521	28,631	6,026	60,835	26,675	8,865	17,129	64,508	166,434	177,294
800.0	40	1,250	24,910	5,810	50,784	22,387	7,288	11,280	53,005	136,837	145,766
600.0	30	977	21,252	5,496	41,420	18,139	5,820	6,677	41,431	109,268	116,397
500.0	25	839	19,405	5,303	37,082	16,055	5,124	4,986	35,574	96,210	102,488
400.0	20	699	17,492	5,098	32,738	13,986	4,431	3,593	29,634	83,193	88,622
200.0	10	411	13,286	4,670	23,481	8,473	3,022	1,516	17,448	56,745	60,447

Emissions Data

RATED SPEED POTENTIAL SITE VARIATION: 1800 RPM

GENSET POWER WITH FAN		EKW	2,000.0	1,500.0	1,000.0	500.0	200.0
PERCENT LOAD		%	100	75	50	25	10
ENGINE POWER		BHP	2,937	2,212	1,521	839	411
TOTAL NOX (AS NO2)		G/HR	19,098	10,213	5,798	4,218	2,932
TOTAL CO		G/HR	1,564	847	905	1,772	1,794
TOTAL HC		G/HR	423	513	512	409	443
PART MATTER		G/HR	103.2	99.5	123.9	256.7	203.1
TOTAL NOX (AS NO2)	(CORR 5% O2)	MG/NM3	3,299.4	2,320.1	1,852.8	2,379.4	2,855.8
TOTAL CO	(CORR 5% O2)	MG/NM3	257.0	181.1	277.5	896.4	1,715.8
TOTAL HC	(CORR 5% O2)	MG/NM3	60.1	93.7	132.1	194.2	379.5
PART MATTER	(CORR 5% O2)	MG/NM3	14.4	18.5	35.1	120.0	161.3
TOTAL NOX (AS NO2)	(CORR 5% O2)	PPM	1,607	1,130	902	1,159	1,391
TOTAL CO	(CORR 5% O2)	PPM	206	145	222	717	1,373
TOTAL HC	(CORR 5% O2)	PPM	112	175	247	363	708
TOTAL NOX (AS NO2)		G/HP-HR	6.54	4.64	3.82	5.04	7.13
TOTAL CO		G/HP-HR	0.54	0.38	0.60	2.12	4.36
TOTAL HC		G/HP-HR	0.15	0.23	0.34	0.49	1.08
PART MATTER		G/HP-HR	0.04	0.05	0.08	0.31	0.49
TOTAL NOX (AS NO2)		LB/HR	42.10	22.52	12.78	9.30	6.46
TOTAL CO		LB/HR	3.45	1.87	2.00	3.91	3.95
TOTAL HC		LB/HR	0.93	1.13	1.13	0.90	0.98
PART MATTER		LB/HR	0.23	0.22	0.27	0.57	0.45

RATED SPEED NOMINAL DATA: 1800 RPM

GENSET POWER WITH FAN		EKW	2,000.0	1,500.0	1,000.0	500.0	200.0
PERCENT LOAD		%	100	75	50	25	10
ENGINE POWER		BHP	2,937	2,212	1,521	839	411
TOTAL NOX (AS NO2)		G/HR	15,915	8,511	4,832	3,515	2,443
TOTAL CO		G/HR	869	471	503	984	997
TOTAL HC		G/HR	318	385	385	308	333
TOTAL CO2		KG/HR	1,383	1,068	762	430	250
PART MATTER		G/HR	73.7	71.1	88.5	183.4	145.1
TOTAL NOX (AS NO2)	(CORR 5% O2)	MG/NM3	2,749.5	1,933.4	1,544.0	1,982.8	2,379.8
TOTAL CO	(CORR 5% O2)	MG/NM3	142.8	100.6	154.2	498.0	953.2
TOTAL HC	(CORR 5% O2)	MG/NM3	45.2	70.4	99.3	146.0	285.3
PART MATTER	(CORR 5% O2)	MG/NM3	10.3	13.2	25.1	85.7	115.2
TOTAL NOX (AS NO2)	(CORR 5% O2)	PPM	1,339	942	752	966	1,159
TOTAL CO	(CORR 5% O2)	PPM	114	80	123	398	763
TOTAL HC	(CORR 5% O2)	PPM	84	131	185	273	533
TOTAL NOX (AS NO2)		G/HP-HR	5.45	3.87	3.19	4.20	5.94
TOTAL CO		G/HP-HR	0.30	0.21	0.33	1.18	2.42
TOTAL HC		G/HP-HR	0.11	0.18	0.25	0.37	0.81
PART MATTER		G/HP-HR	0.03	0.03	0.06	0.22	0.35
TOTAL NOX (AS NO2)		LB/HR	35.09	18.76	10.65	7.75	5.39
TOTAL CO		LB/HR	1.92	1.04	1.11	2.17	2.20
TOTAL HC		LB/HR	0.70	0.85	0.85	0.68	0.73
TOTAL CO2		LB/HR	3,049	2,356	1,681	947	551
PART MATTER		LB/HR	0.16	0.16	0.20	0.40	0.32
OXYGEN IN EXH		%	10.8	12.3	13.3	14.2	15.8
DRY SMOKE OPACITY		%	0.3	0.5	1.2	3.7	3.0
BOSCH SMOKE NUMBER			0.15	0.21	0.43	1.25	1.12

Regulatory Information

EPA TIER 2		2006 - 2010		
GASEOUS EMISSIONS DATA MEASUREMENTS ARE CONSISTENT WITH THOSE DESCRIBED IN EPA 40 CFR PART 89 SUBPART D AND ISO 8178 FOR MEASURING HC, CO, PM, AND NOX. GASEOUS EMISSIONS VALUES ARE WEIGHTED CYCLE AVERAGES AND ARE IN COMPLIANCE WITH THE NON-ROAD REGULATIONS.				
Locality	**Agency**	**Regulation**	**Tier/Stage**	**Max Limits - G/BKW - HR**
U.S. (INCL CALIF)	EPA	NON-ROAD	TIER 2	CO: 3.5 NOx + HC: 6.4 PM: 0.20

EPA EMERGENCY STATIONARY		2011 - ----		
GASEOUS EMISSIONS DATA MEASUREMENTS ARE CONSISTENT WITH THOSE DESCRIBED IN EPA 40 CFR PART 60 SUBPART IIII AND ISO 8178 FOR MEASURING HC, CO, PM, AND NOX. GASEOUS EMISSIONS LIMIT VALUES ARE WEIGHTED CYCLE AVERAGES AND ARE IN COMPLIANCE WITH THE NON-ROAD REGULATIONS.				
Locality	**Agency**	**Regulation**	**Tier/Stage**	**Max Limits - G/BKW - HR**
U.S. (INCL CALIF)	EPA	STATIONARY	EMERGENCY STATIONARY	CO: 3.5 NOx + HC: 6.4 PM: 0.20

Altitude Derate Data

ALTITUDE CORRECTED POWER CAPABILITY (BHP)

AMBIENT OPERATING TEMP (F)	50	60	70	80	90	100	110	120	130	NORMAL
ALTITUDE (FT)										
0	2,937	2,937	2,937	2,937	2,937	2,937	2,937	2,937	2,937	2,937
1,000	2,937	2,937	2,937	2,937	2,937	2,937	2,937	2,937	2,937	2,937
2,000	2,937	2,937	2,937	2,937	2,937	2,937	2,937	2,937	2,937	2,937
3,000	2,937	2,937	2,937	2,937	2,937	2,937	2,937	2,896	2,847	2,937
4,000	2,937	2,937	2,937	2,937	2,937	2,886	2,835	2,786	2,739	2,937
5,000	2,937	2,937	2,933	2,879	2,826	2,776	2,727	2,680	2,634	2,937
6,000	2,930	2,874	2,820	2,767	2,717	2,669	2,622	2,576	2,533	2,890
7,000	2,816	2,762	2,710	2,660	2,611	2,565	2,520	2,476	2,434	2,796
8,000	2,706	2,654	2,604	2,555	2,509	2,464	2,421	2,379	2,339	2,705
9,000	2,598	2,548	2,500	2,454	2,409	2,366	2,325	2,285	2,246	2,616
10,000	2,495	2,447	2,400	2,356	2,313	2,272	2,232	2,193	2,156	2,530
11,000	2,394	2,348	2,303	2,261	2,220	2,180	2,142	2,105	2,069	2,445
12,000	2,296	2,252	2,210	2,169	2,129	2,091	2,054	2,019	1,985	2,362
13,000	2,202	2,159	2,119	2,079	2,042	2,005	1,970	1,936	1,903	2,281
14,000	2,110	2,070	2,031	1,993	1,957	1,922	1,888	1,855	1,824	2,202
15,000	2,022	1,983	1,945	1,909	1,875	1,841	1,809	1,778	1,747	2,125

Cross Reference

Engine Arrangement			
Arrangement Number	Effective Serial Number	Engineering Model	Engineering Model Version
2666137	SBJ00001	GS334	-
3994236	DD600001	GS717	-

Test Specification Data						
Test Spec	Setting	Effective Serial Number	Engine Arrangement	Governor Type	Default Low Idle Speed	Default High Idle Speed
0K6996	GG0395	SBJ00001	2666137	ADEM3		
3457917	LL5712	SBJ00001	2666137	ADEM3		
3704959	GG0602	DD600001	3994236	ADEM3		

General Notes

General Notes DM8263 - 03
SOUND PRESSURE DATA FOR THIS RATING CAN BE FOUND IN PERFORMANCE NUMBER - DM8779

Performance Parameter Reference

Parameters Reference:DM9600-05

PERFORMANCE DEFINITIONS

PERFORMANCE DEFINITIONS DM9600

APPLICATION:
Engine performance tolerance values below are representative of a typical production engine tested in a calibrated dynamometer test cell at SAE J1995 standard reference conditions. Caterpillar maintains ISO9001:2000 certified quality management systems for engine test Facilities to assure accurate calibration of test equipment. Engine test data is corrected in accordance with SAE J1995. Additional reference material SAE J1228, J1349, ISO 8665, 3046-1:2002E, 3046-3:1989, 1585, 2534, 2288, and 9249 may apply in part or are similar to SAE J1995. Special engine rating request(SERR)test data shall be noted.

PERFORMANCE PARAMETER TOLERANCE FACTORS:

Power	+/- 3%
Torque	+/- 3%
Exhaust stack temperature	+/- 8%
Inlet airflow	+/- 5%
Intake manifold pressure-gage	+/- 10%
Exhaust flow	+/- 6%
Specific fuel consumption	+/- 3%
Fuel rate	+/- 5%
Heat rejection	+/- 5%
Heat rejection exhaust only	+/- 10%

Torque is included for truck and industrial applications, do not use for Gen Set or steady state applications.

On C7 - C18 engines, at speeds of 1100 RPM and under these values are provided for reference only, and may not meet the tolerance listed.

These values do not apply to C280/3600. For these models, see the tolerances listed below.

C280/3600 HEAT REJECTION TOLERANCE FACTORS:

Heat rejection	+/- 10%
Heat rejection to Atmosphere	+/- 50%
Heat rejection to Lube Oil	+/- 20%
Heat rejection to Aftercooler	+/- 5%

TEST CELL TRANSDUCER TOLERANCE FACTORS:

Torque	+/- 0.5%
Speed	+/- 0.2%
Fuel flow	+/- 1.0%
Temperature	+/- 2.0 C degrees
Intake manifold pressure	+/- 0.1 kPa

OBSERVED ENGINE PERFORMANCE IS CORRECTED TO SAE J1995 REFERENCE AIR AND FUEL CONDITIONS.

REFERENCE ATMOSPHERIC INLET AIR

FOR 3500 ENGINES AND SMALLER
SAE J1228 reference atmospheric pressure is 100 KPA (29.61 in hg) and standard temperature is 25 (77) at 60% relative humidity.

FOR 3600 ENGINES
Engine rating obtained and presented in accordance with ISO 3046/1 and SAE J1995 JAN90 standard reference conditions of 25, 100 KPA 30% relative humidity and 150M altitude at the stated aftercooler water temperature.

MEASUREMENT LOCATION FOR INLET AIR TEMPERATURE
Location for air temperature measurement air cleaner inlet at stabilized operating conditions.

REFERENCE EXHAUST STACK DIAMETER
The Reference Exhaust Stack Diameter published with this dataset is only used for the calculation of Smoke Opacity values displayed in this dataset. This value does not necessarily represent the actual stack diameter of the engine due to the variety of exhaust stack adapter options available. Consult the price list, engine order or general dimension drawings for the actual stack diameter size ordered or options available.

REFERENCE FUEL

DIESEL
Reference fuel is #2 distillate diesel with a 35API gravity;
A lower heating value is 42,780 KJ/KG (18,390 BTU/LB) when used at 29 (84.2), where the density is 838.9 G/Liter (7.001 Lbs/Gal).

GAS
Reference natural gas fuel has a lower heating value of 33.74 KJ/L (905 BTU/CU Ft). Low BTU ratings are based on 18.64 KJ/L (500 BTU/CU FT) lower heating value gas. Propane ratings are based on 87.56 KJ/L (2350 BTU/CU Ft) lower heating value gas.

ENGINE POWER (NET) IS THE CORRECTED FLYWHEEL POWER (GROSS) LESS EXTERNAL AUXILIARY LOAD
Engine corrected gross output includes the power required to drive standard equipment; lube oil, scavenge lube oil, fuel transfer, common rail fuel, separate circuit aftercooler and jacket water pumps. Engine net power available for the external (flywheel) load is calculated by subtracting the sum of auxiliary load from the corrected gross flywheel out put power. Typical auxiliary loads are radiator cooling fans, hydraulic pumps, air compressors and battery charging alternators.

ALTITUDE CAPABILITY
Altitude capability is the maximum altitude above sea level at standar d temperature and standard pressure at which the engine could develop full rated output power on the current performance data set. Standard temperature values versus altitude could be seen on TM2001.

Engines with ADEM MEUI and HEUI fuel systems operating at conditions above the defined altitude capability derate for atmospheric pressure and temperature conditions outside the values defined, see TM2001. Mechanical governor controlled unit injector engines require a setting change for operation at conditions above the altitude defined on the engine performance sheet. See your Caterpillar technical representative for non standard ratings.

REGULATIONS AND PRODUCT COMPLIANCE
TMI Emissions information is presented at 'nominal' and 'Potential Site Variation' values for standard ratings. No tolerances are applied to the emissions data. These values are subject to change at any time. The controlling federal and local emission requirements need to be verified by your Caterpillar technical representative. Log on to the Technology and Solutions Divisions (T&SD) web page (http://tsd.cat.com/etsd/index.cfm?tech_id=2635ICAL) for information including federal regulation applicability and time lines for implementation. Information for labeling and tagging requirements is also provided.

NOTES:
Regulation watch covers regulations in effect and future regulation changes for world, federal, state and local. This page includes items on the watch list where a regulation change or product change might be pending and may need attention of the engine product group. For additional emissions information log on to the TMI web page.

Additional product information for specific market application is available.
Customer's may have special emission site requirements that need to be verified by the Caterpillar Product Group engineer.

HEAT REJECTION DEFINITIONS:
Diesel Circuit Type and HHV Balance : DM9500

EMISSIONS DEFINITIONS:
Emissions : DM1176

SOUND DEFINITIONS:
Sound Power : DM8702

Sound Pressure : TM7080

RATING DEFINITIONS:
Agriculture : TM6008

Fire Pump : TM6009

Generator Set : TM6035

Generator (Gas) : TM6041

Industrial Diesel : TM6010

Industrial (Gas) : TM6040

Irrigation : TM5749

Locomotive : TM6037

Marine Auxiliary : TM6036

Marine Prop (Except 3600) : TM5747

Marine Prop (3600 only) : TM5748

MSHA : TM6042

Oil Field (Petroleum) : TM6011

Off-Highway Truck : TM6039

On-Highway Truck : TM6038

Date Released : 11/23/11

Rating Specific Emissions Data - John Deere Power Systems

JOHN DEERE

Nameplate Rating Information	
Clarke Model	JU4H-UFADW8
Power Rating (BHP / kW)	144 / 107
Certified Speed (RPM)	1760

Rating Data		
Rating	4045HFC28A	
Certified Power (kW)	117	
Rated Speed	1760	
Vehicle Model Number	Clarke Fire Pump	
Units	g/kW-hr	g/hp-hr
NOx	3.7	2.8
HC	0.1	0.1
NOx + HC	3.8	2.8
Pm	0.12	0.09
CO	1.3	1.0

Certificate Data	
Engine Model Year	2013
EPA Family Name	DJDXL04.5119
EPA JD Name	350HAJ
EPA Certificate Number	DJDXL04.5119-008
CARB Executive Order	Not Required
Parent of Family	4045HFG82A
Units	g/kW-hr
NOx	3.4
HC	0.2
NOx + HC	3.5
Pm	0.17
CO	1.3

* The emission data listed is measured from a laboratory test engine according to the test procedures of 40 CFR 89 or 40 CFR 1039, as applicable. The test engine is intended to represent nominal production hardware, and we do not guarantee that every production engine will have identical test results. The family parent data represents multiple ratings and this data may have been collected at a different engine speed and load. Emission results may vary due to engine manufacturing tolerances, engine operating conditions, fuels used, or other conditions beyond our control.

This information is property of Deere & Company. It is provided solely for the purpose of obtaining certification or permits of Deere powered equipment. Unauthorized distribution of this information is prohibited

Section 8

Map(s)

A map such as a 7.5 minute topographic quadrangle showing the exact location of the source. The map shall also include the following:

The UTM or Longitudinal coordinate system on both axes	An indicator showing which direction is north
A minimum radius around the plant of 0.8km (0.5 miles)	Access and haul roads
Topographic features of the area	Facility property boundaries
The name of the map	The area which will be restricted to public access
A graphical scale	

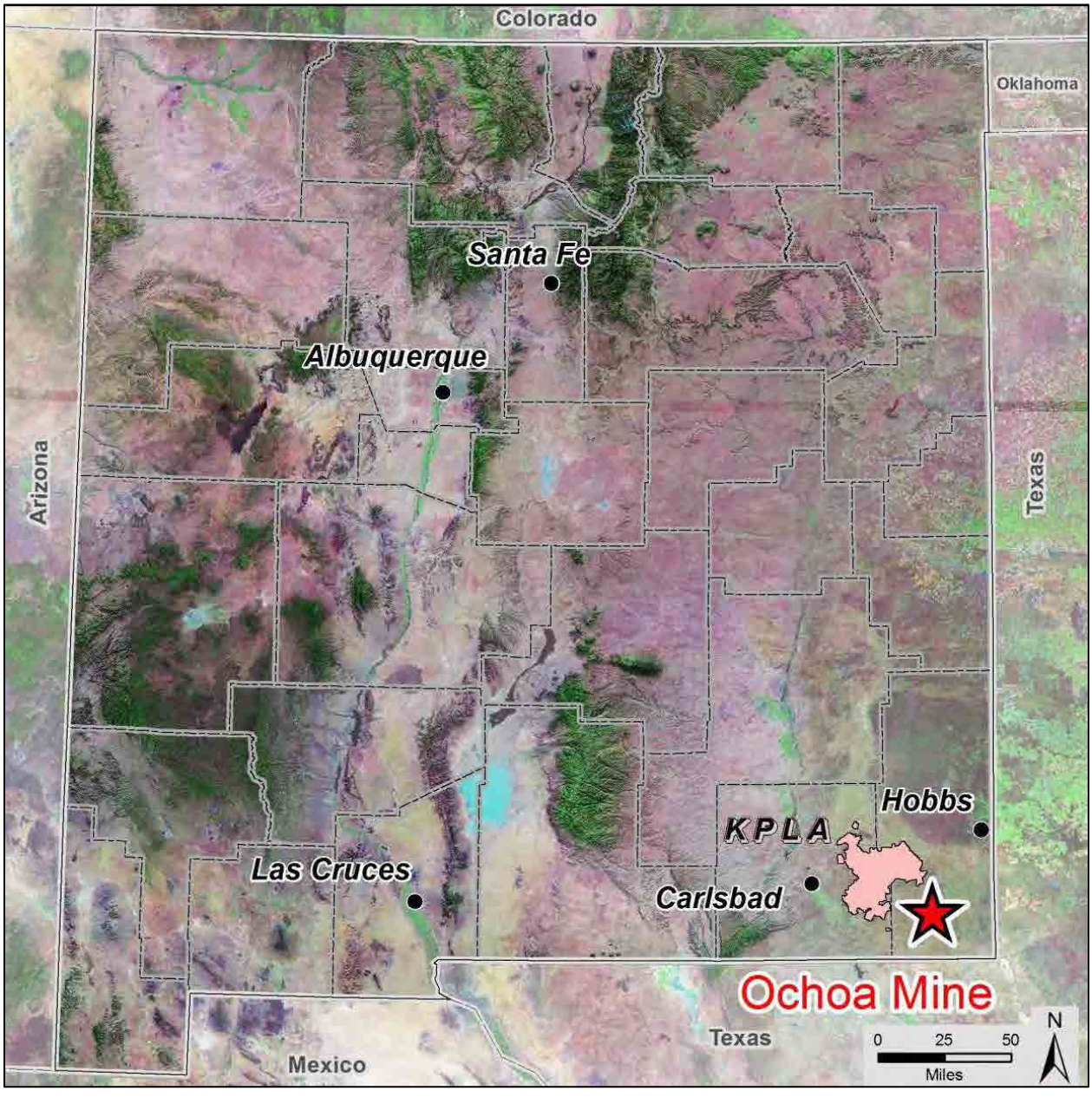

Figure 8-1 Location of ICP Ochoa Mine – Regional Overview

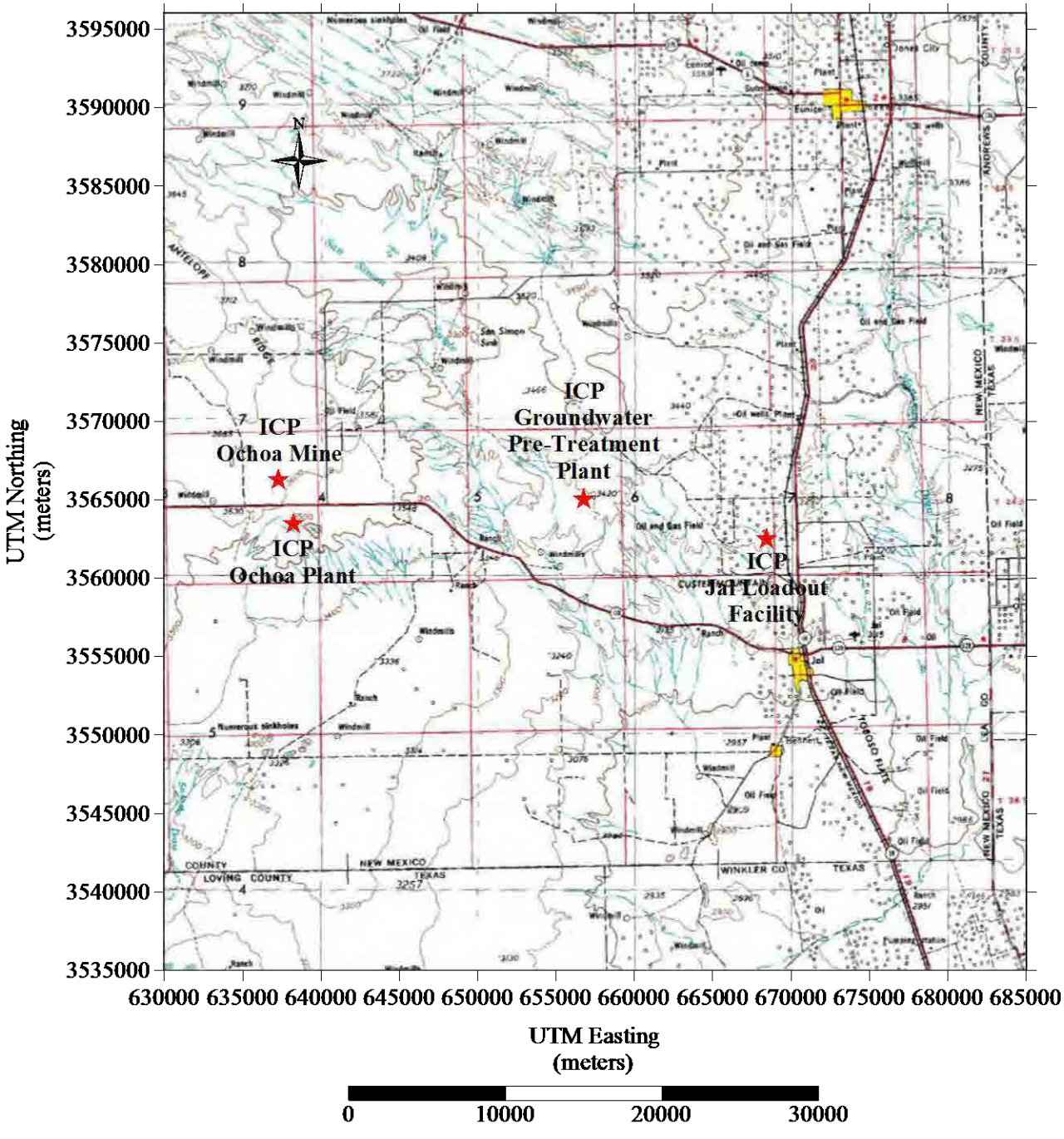

Figure 8-2 Location of ICP Ochoa Project – Regional Overview

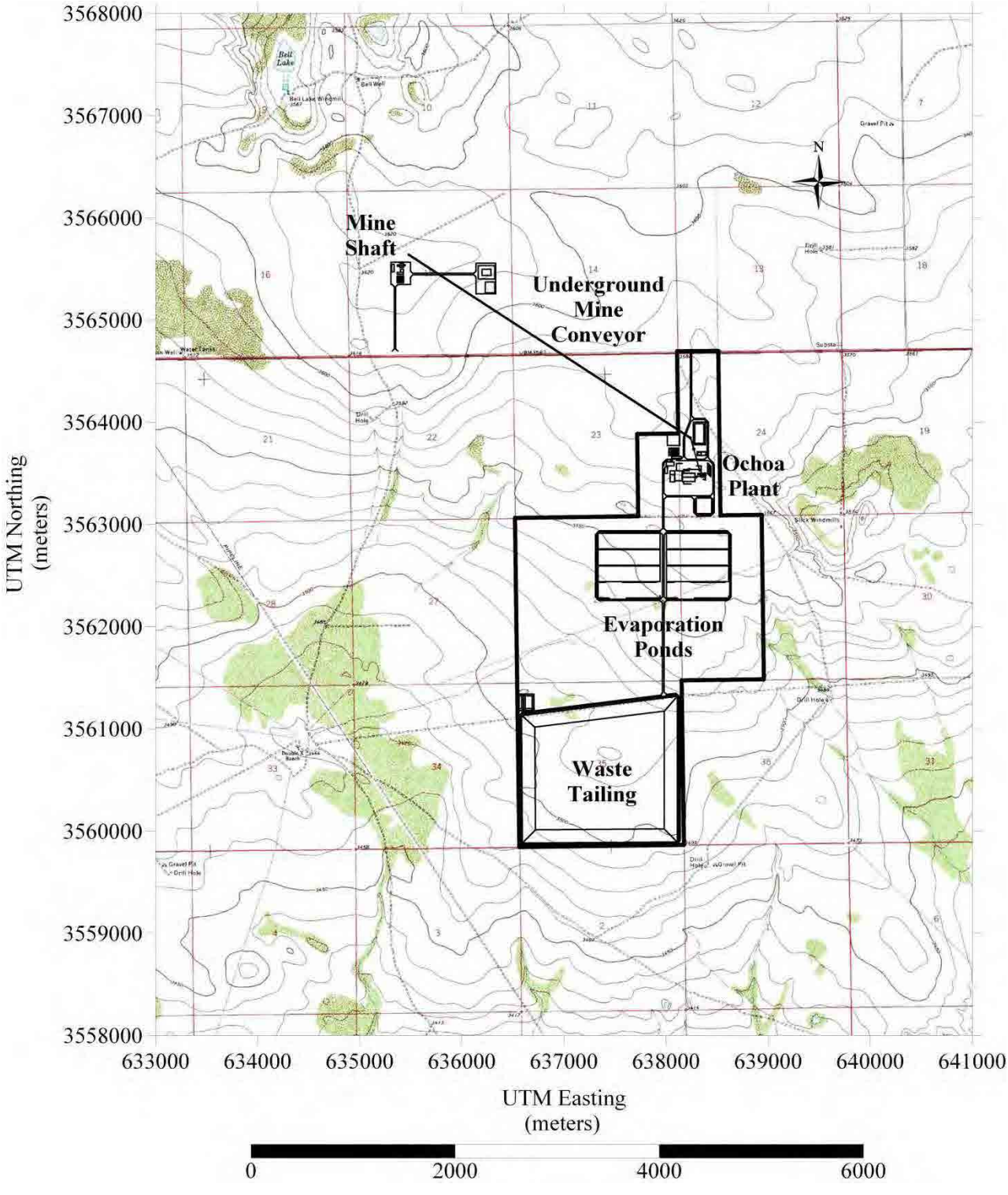

Figure 8-3 ICP Ochoa Polyhalite Processing Plant Location Overview

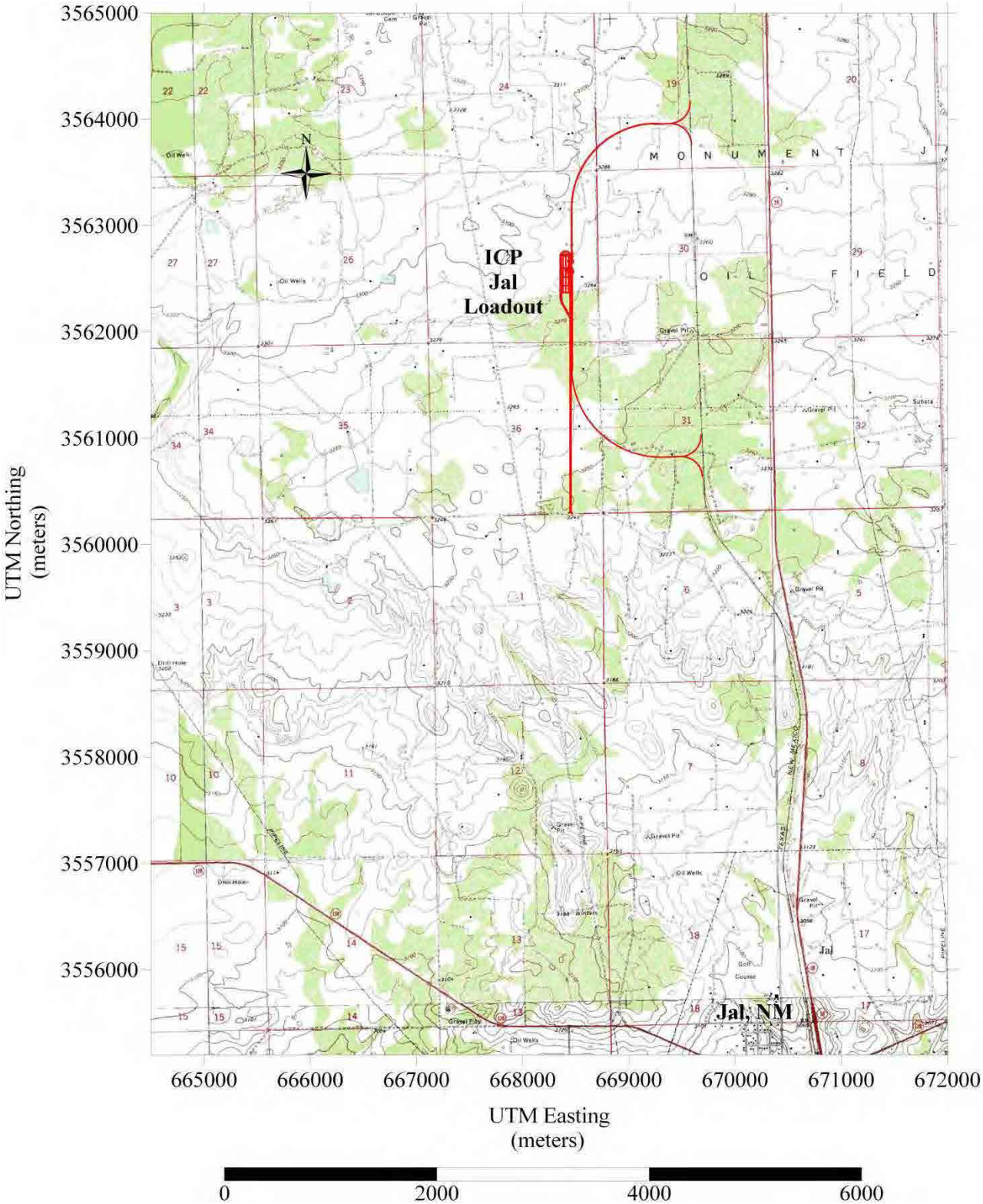

Figure 8-4 ICP Jal Loadout Facility Location Overview

Section 9

Proof of Public Notice

(for NSR applications submitting under 20.2.72 or 20.2.74 NMAC)
(This proof is required by: 20.2.72.203.A.14 NMAC "Documentary Proof of applicant's public notice")

X I have read the AQB "Guidelines for Public Notification for Air Quality Permit Applications"
This document provides detailed instructions about public notice requirements for various permitting actions. It also provides public notice examples and certification forms. Material mistakes in the public notice will require a re-notice before issuance of the permit.

Unless otherwise allowed elsewhere in this document, the following items document proof of the applicant's Public Notification. Please include this page in your proof of public notice submittal with checkmarks indicating which documents are being submitted with the application.

New Permit and **Significant Permit Revision** public notices must include all items in this list.

Technical Revision public notices require only items 1, 5, 9, and 10.

Per the Guidelines for Public Notification document mentioned above, include:

1. X A copy of the certified letter receipts with post marks (20.2.72.203.B NMAC)
2. X A list of the places where the public notice has been posted in at least four publicly accessible and conspicuous places, including the proposed or existing facility entrance. (e.g: post office, library, grocery, etc.)
3. X A copy of the property tax record (20.2.72.203.B NMAC).
4. X A sample of the letters sent to the owners of record.
5. X A sample of the letters sent to counties, municipalities, and Indian tribes.
6. X A sample of the public notice posted and a verification of the local postings.
7. X A table of the noticed citizens, counties, municipalities and tribes and to whom the notices were sent in each group.
8. X A copy of the public service announcement (PSA) sent to a local radio station and documentary proof of submittal.
9. X A copy of the classified or legal ad including the page header (date and newspaper title) or its affidavit of publication stating the ad date, and a copy of the ad. When appropriate, this ad shall be printed in both English and Spanish.
10. X A copy of the display ad including the page header (date and newspaper title) or its affidavit of publication stating the ad date, and a copy of the ad. When appropriate, this ad shall be printed in both English and Spanish.
11. X A map with a graphic scale showing the facility boundary and the surrounding area in which owners of record were notified by mail. This is necessary for verification that the correct facility boundary was used in determining distance for notifying land owners of record.

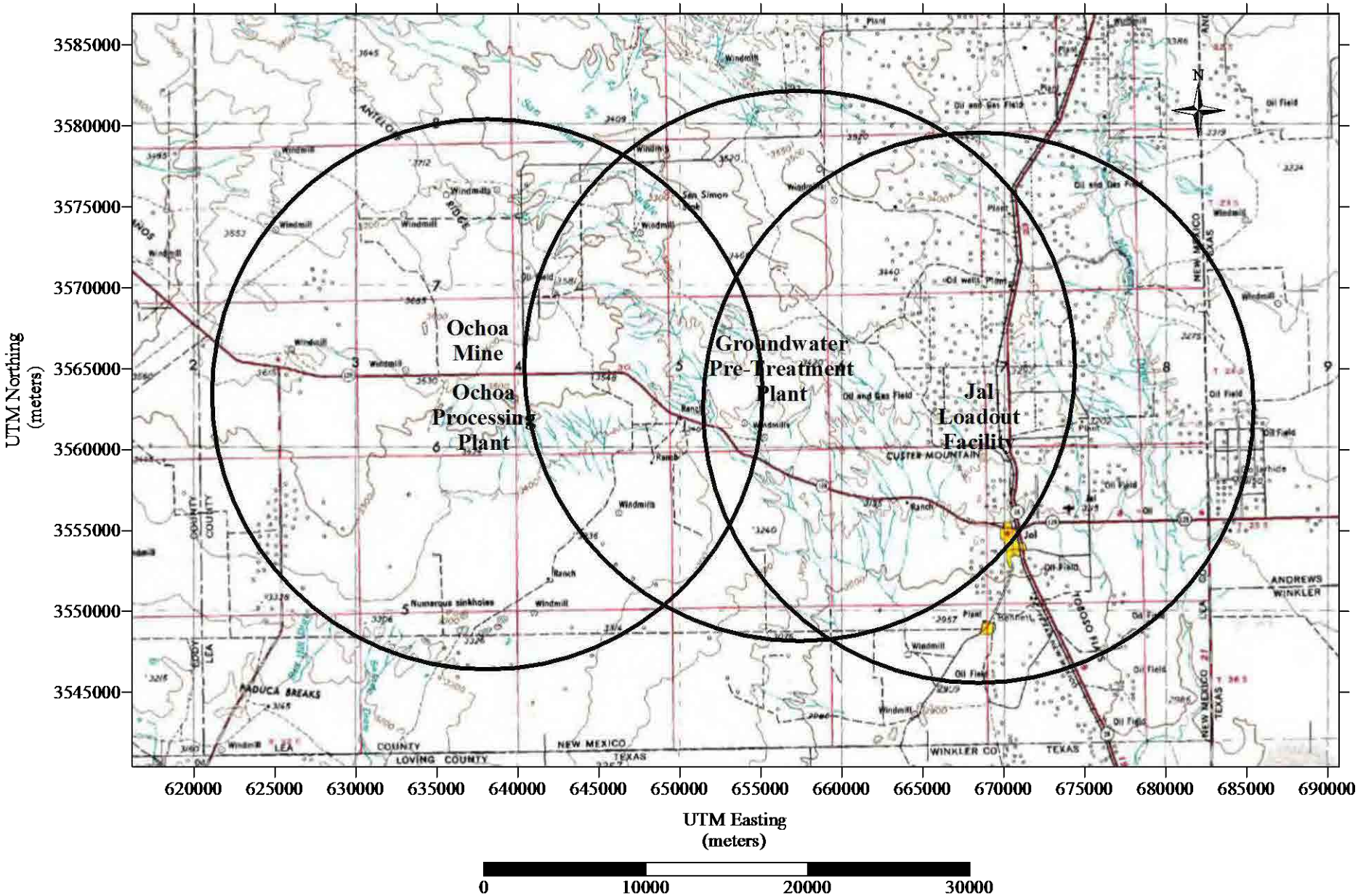

Figure 9-1: 10 mile radius surrounding each of the ICP facility locations

List of Government Entities

Pat Chappelle
Lea County Clerk
100 North Main
Lovington, NM 88260

Cheryl Chance
Mayor, City of Jal
PO Drawer 340
Jal, NM 88252

List of Landowners within half-mile of one of the three ICP facility locations

Landowners Name	In Care Of	Address	City	State	Zip	ZipExt
CRAWFORD, RANDALL JAY		PO BOX 246	JAL	NM	88252	
DEEP WELLS RANCH		ST RT 1 BOX 244	JAL	NM	88252	
HARRISON, HENRY H JR	HARRISON, RONALD M	1120 WILMA	TYLER	TX	75701	
JAL PUBLIC LIBRARY TRUST		BOX 178	JAL	NM	88252	
LEA PARTNERS		PO BOX 4967	HOUSTON	TX	77210	4967
MADERA, RUBERT TRUST	MADERA, BERT	524 ANTELOPE RD	JAL	NM	88252	
MC CLOY, MARK T		254 DIAMOND RD	JAL	NM	88252	9727
MC CLOY, MARK T		BOX 1076	JAL	NM	88252	
PRUETT, CHRISTEEN		4501 NORTH CENTRAL ROAD	BETHANY	OK	73008	
PRUETT, JAMES R ET AL	THOMAS, LOUIS Q	13120 TURTLE CREEK DR	OKLAHOMA CITY	OK	73170	
R R R LAND & CATTLE CO		2001 BARBERRY RD	ROSWELL	NM	88201	
TEXACO EXPLORATION & PRODUCTION CO	TAX DEPT 1941 %	PO BOX 285	HOUSTON	TX	77001	
TEXAS TEN LTD		BOX 305	CEDAR HILL	TX	75104	
WOOLWORTH, C D TRUST	JAL PUBLIC LIBRARY FUND	BOX 178	JAL	NM	88252	

October 31, 2013

CLASS 1
TECHNICAL SERVICES

Cheryl Chance
City of Jal Mayor
P. O. Drawer 340
Jal, NM 88252-0340

CERTIFIED MAIL 7008 1140 0003 2306 7051
RETURN RECEIPT REQUESTED

Dear Cheryl Chance:

According to New Mexico air quality regulations, Intercontinental Potash Corp. (USA) (ICP) must announce its intent to apply to the New Mexico Environment Department for a 20.2.74 NMAC Prevention of Signification Deterioration (PSD) Air Quality Permit for the construction of its Ochoa Mine Project. The expected date of the application submittal is November 6, 2013.

Intercontinental Potash Corp. (USA) (ICP) is proposing to develop a new mine in southeastern Lea County, New Mexico to extract polyhalite ore for the production of sulphate of potash (SOP) and langbeinite for use as fertilizer. The proposed Ochoa Mine Project consists of four operations, the underground Ochoa Mine, the Ochoa Processing Plant, the Jal Loadout Facility, and a Groundwater Well Field.

The exact location of the proposed Ochoa Processing Plant will be at latitude 32 deg, 11 min, 59.1 sec and longitude -103 deg, 31 min, 59.2 sec. The approximate location of this facility will be 20.7 miles West-Northwest (285 degrees) from the intersection of Highways 128 and 18 in Jal, NM. The underground Ochoa Mine is located across from the Ochoa Processing Plant, north of Highway 128.

The exact location for the proposed Jal Loadout Facility will be at latitude 32 deg, 11 min, 14.1 sec and longitude -103 deg, 12 min, 47.2 sec. The approximate location of this facility will be 4.7 miles, North-Northwest (340 degrees) from the intersection of Highways 128 and 18 in Jal, NM.

The exact location for the proposed Groundwater Well Field will be at latitude 32 deg, 12 min, 43.8 sec and longitude -103 deg, 19 min, 47.1 sec. The approximate location of this facility will be 10.4 miles, Northwest (320 degrees) from the intersection of Highways 128 and 18 in Jal, NM.

There are two primary operations for obtaining the ore and manufacturing a finished fertilizer product. The first operation is to mine raw polyhalite approximately 1,500 feet underground in the Rustler Formation. Once mined, the polyhalite is transported by covered conveyor to the Ochoa Processing Plant at the surface where it is crushed, ground, washed, calcined, leached, crystallized, and granulated to produce SOP and langbeinite, the saleable products. The final product would be moved by truck to a

load-out facility (Jal Loadout Facility) near Jal, New Mexico, to be loaded on trains and shipped to distributors. Water developed from the Groundwater Well Field will be pre-treated at the groundwater well field and then piped to the Ochoa Processing Plant. Once delivered to the Processing Plant, the water will be heated in one of two boilers to create steam for ore processing. Waste material, from the ore processing will be stored at the Ochoa Processing Plant in a contained tailing area.

The estimated maximum quantities of any regulated air contaminants after the construction will be:
(Process emissions include: raw ore processing, and product drying and processing)
(Fugitive emissions include: raw ore material handling, product truck loading and unloading, rail car loading, vehicle traffic road dust, bulldozer operations, tailing area material handling, and wind-blown dust)

	Total Facility Emissions		**Process Emissions**		**Fugitive Emissions**	
Pollutant:	**Pounds per hour**	**Tons per year**	**Pounds per hour**	**Tons per year**	**Pounds per hour**	**Tons per year**
Total Suspended Particulates (TSP)	164 pph	342 tpy	29 pph	125 tpy	135 pph	217 tpy
PM_{10}	82 pph	191 tpy	29 pph	125 tpy	54 pph	66 tpy
$PM_{2.5}$	37 pph	134 tpy	29 pph	125 tpy	8.0 pph	9.0 tpy
Sulfur Dioxide (SO_2)	0.65 pph	2.8 tpy	0.65 pph	2.8 tpy		
Nitrogen Oxides (NO_x)	36 pph	157 tpy	36 pph	157 tpy		
Carbon Monoxide (CO)	38 pph	165 tpy	38 pph	165 tpy		
Volatile Organic Compounds (VOC)	5.9 pph	26 tpy	5.9 pph	26 tpy		
Hydrogen Sulfide (H_2S)	1.6 pph	7.1 tpy	1.6 pph	7.1 tpy		
Lead	0.00054 pph	0.0024 tpy	0.00054 pph	0.0024 tpy		
Hazardous Air Pollutants (HAPs)	<0.5 pph	<0.5 tpy	<0.5 pph	<0.5 tpy		
State Toxic Air Pollutants (TAPs)	<0.5 pph	<0.5 tpy	<0.5 pph	<0.5 tpy		
Green House Gas Emissions as Total CO_2e	119187 pph	522040 tpy	119187 pph	522040 tpy		

The proposed hours of operation that will be permitted are 24 hours per day, 7 days per week, and 8760 hours per year.

The owner and/or operator of the Facility is:

Intercontinental Potash Corp. (USA)
Attn: Manager of Environmental Affairs
1030 Johnson Road, Suite 300
Golden, CO 80401

If you have any comments about the construction or operation of the above facility, and you want your comments to be made as part of the permit review process, you must submit your comments in writing to the address below:

Permit Programs Manager
New Mexico Environment Department
Air Quality Bureau
525 Camino de los Marquez, Suite 1
Santa Fe, New Mexico, 87505
(505) 476-4300

Other comments and questions may be submitted verbally.

Please refer to the company name and facility name, as used in this notice or send a copy of this notice along with your comments, since the Department may not have received the permit application at the time of this notice. Please include a legible mailing address with your comments. Once the Department has performed a preliminary review of the application and its air quality impacts, the Department's notice will be published in the legal section of a newspaper circulated near the facility location.

Sincerely,

Paul Wade

Paul D. Wade
Air Quality Consultant
Class One Technical Services, Inc.

7008 1140 0003 2306 6924

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Street, Apt. No.; or PO Box No.: c/o Ronald M. Harrison
City, State, ZIP+4: 1120 Wilma
Tyler, TX 75701-5643

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Street, Apt. No.; or PO Box No.: 254 Diamond Rd.
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524 Antelope Rd.
City, State, ZIP+4: Jal, NM 88252-9719

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Sent To: James R. Pruett, Et Al
Street, Apt. No.; or PO Box No.: c/o Louis Q. Thomas
13120 Turtle Creek Dr.
City, State, ZIP+4: Oklahoma City, OK 73170-6805

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Sent To: Christeen Pruett
Street, Apt. No.; or PO Box No.: 4501 North Central Rd.
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Sent To: Texaco Exploration & Production Co.
Street, Apt. No.; or PO Box No.: c/o Tax Dept. 1941
P. O. Box 285
City, State, ZIP+4: Houston, TX 77001-0285

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Street, Apt. No.; or PO Box No.: 2001 Barbery Rd.
City, State, ZIP+4: Roswell, NM 88201-9723

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Jal, NM 88252-0178

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Sent To: Cheryl Chance
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City, State, ZIP+4: P. O. Drawer 340
Jal, NM 88252-0340

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Sent To: Pat Chappelle
Street, Apt. No.; or PO Box No.: Lea County Clerk
City, State, ZIP+4: 100 North Main
Lovington, NM 88260-4030

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Land ownership in areas of ICP activity
Legend
Land ownership
USA
STATE
Private
Areas of ICP Activities
ICP Activities Half-Mile Buffer
PLSS Townships
PLSS Sections
Highway 128
IC POTASH CORP
0 4,000 8,000 Feet
1 in = 8,000 feet
22S 34E
22S 35E
22S 36E
22S 37E
23S 34E
23S 35E
23S 36E
23S 37E
24S 33E
24S 34E
24S 35E
24S 36E
24S 37E
25S 33E
25S 34E
25S 35E
25S 36E
25S 37E
ICP Well Field
Processing Area
Jal Loadout Area
Highway 128
Highway 18

TRIADIC	UPC_XY	CALC_ACR	TWP	RNG	SECTION	PARCELCO	OwnerNam	InCareOf	Address1	Address2	City	State	Zip	ZipExt
51689	4216144482243	80.00	24	37	31	4970423102640	CRAWFORD, RANDALL JAY			PO BOX 246	JAL	NM	88252	
201607	4216141391261	286.65	24	37	18	4000201607001	DEEP WELLS RANCH			ST RT 1 BOX 244	JAL	NM	88252	
201607	4216141391261	286.65	24	37	18	4000201607001	DEEP WELLS RANCH			ST RT 1 BOX 244	JAL	NM	88252	
51825	4216141131268	312.44	24	37	18	4000518250005	DEEP WELLS RANCH INC			STAR RT, COMBEST RANCH	JAL	NM	88252	
51740	4217142266266	640.00	24	37	20	4000517400001	HARRISON, HENRY H JR	HARRISON, RONALD M &		1120 WILMA	TYLER	TX	75701	
51740	4217143134268	320.00	24	37	29	4000517400002	HARRISON, HENRY H JR	HARRISON, RONALD M &		1120 WILMA	TYLER	TX	75701	
51888	4208140461666	40.00	24	35	11	4000518880005	JAL PUBLIC LIBRARY TRUST			BOX 178	JAL	NM	88252	
51888	4209142463132	80.00	24	35	24	4000518880010	JAL PUBLIC LIBRARY TRUST			BOX 178	JAL	NM	88252	
51888	4210139131135	158.69	24	36	06	4000518880014	JAL PUBLIC LIBRARY TRUST			BOX 178	JAL	NM	88252	
51888	4209139200266	480.15	24	35	01	4000518880001	JAL PUBLIC LIBRARY TRUST			BOX 178	JAL	NM	88252	
51888	4207139267266	641.00	24	35	03	4000518880002	JAL PUBLIC LIBRARY TRUST			BOX 178	JAL	NM	88252	
51888	4208142356120	200.00	24	35	23	4000518880009	JAL PUBLIC LIBRARY TRUST			BOX 178	JAL	NM	88252	
51888	4209140266266	640.00	24	35	12	4000518880006	JAL PUBLIC LIBRARY TRUST			BOX 178	JAL	NM	88252	
51888	4208141278279	600.00	24	35	14	4000518880008	JAL PUBLIC LIBRARY TRUST			BOX 178	JAL	NM	88252	
51888	4209141183184	320.00	24	35	13	4000518880007	JAL PUBLIC LIBRARY TRUST			BOX 178	JAL	NM	88252	
51888	4209142132687	80.00	24	35	24	4000518880010	JAL PUBLIC LIBRARY TRUST			BOX 178	JAL	NM	88252	
51888	4210142294358	401.14	24	36	19	4000518880015	JAL PUBLIC LIBRARY TRUST			BOX 178	JAL	NM	88252	
90406	4215142333298	2.50	24	36	24	4000904060009	LEA PARTNERS		PO BOX 4967		HOUSTON	TX	77210	4967
51789	4197142355237	400.00	24	33	24	4000517890003	MADERA, RUBERT TRUST	MADERA, BERT %	524 ANTELOPE RD		JAL	NM	88252	
51789	4201140645204	433.73	24	34	10	4000517890002	MADERA, RUBERT TRUST	MADERA, BERT %	524 ANTELOPE RD		JAL	NM	88252	
681	4197142223441	80.00	24	33	24	4000006810008	MC CLOY, MARK T			254 DIAMOND RD	JAL	NM	88252	9727
51695	4196142236255	542.21	24	33	23	4000516950002	MC CLOY, MARK T			BOX 1076	JAL	NM	88252	
51695	4197141681260	157.04	24	33	13	4000516950003	MC CLOY, MARK T			BOX 1076	JAL	NM	88252	
51695	4196141265260	627.96	24	33	14	4000516950004	MC CLOY, MARK T			BOX 1076	JAL	NM	88252	
51861	4216143262135	304.05	24	37	30	4000518610002	PRUETT, CHRISTEEN		4501 NORTH CENTRAL ROAD		BETHANY	OK	73008	
51861	4216142392265	295.66	24	37	19	4000518610001	PRUETT, CHRISTEEN		4501 NORTH CENTRAL ROAD		BETHANY	OK	73008	
51860	4215142200399	237.50	24	36	24	4000518600002	PRUETT, JAMES R ET AL	THOMAS, LOUIS Q %	13120 TURTLE CREEK DR		OKLAHOMA CITY	OK	73170	
51687	4216142131268	212.40	24	37	19	4000516870001	R R R LAND & CATTLE CO		2001 BARBERRY RD		ROSWELL	NM	88201	
51683	4215142305186	400.00	24	36	24	4000516830004	R R R LAND & CATTLE CO		2001 BARBERRY RD		ROSWELL	NM	88201	
204464	4216143264398	304.05	24	37	30	4000516890001	R R R LAND & CATTLE CO			2001 BARBERRY RD	ROSWELL	NM	88201	
204464	4216144256132	307.53	24	37	31	4000516890002	R R R LAND & CATTLE CO			2001 BARBERRY RD	ROSWELL	NM	88201	
5069	4210141266265	640.08	24	36	18	4000050690002	TEXACO EXPLORATION & PRODUCTION CO	TAX DEPT 1941 %		PO BOX 285	HOUSTON	TX	77001	
51889	4207142267265	640.00	24	35	22	4000518890001	TEXAS TEN LTD			BOX 305	CEDAR HILL	TX	75104	
51882	4210140265265	638.16	24	36	07	4000518820010	WOOLWORTH, C D TRUST	JAL PUBLIC LIBRARY FUND &		BOX 178	JAL	NM	88252	
51882	4208142233299	320.00	24	35	23	4000518820006	WOOLWORTH, C D TRUST	JAL PUBLIC LIBRARY FUND &		BOX 178	JAL	NM	88252	
51882	4210142221112	240.70	24	36	19	4000518820012	WOOLWORTH, C D TRUST	JAL PUBLIC LIBRARY FUND &		BOX 178	JAL	NM	88252	
51882	4209141349347	320.00	24	35	13	4000518820003	WOOLWORTH, C D TRUST	JAL PUBLIC LIBRARY FUND &		BOX 178	JAL	NM	88252	
51882	4208141664702	40.00	24	35	14	4000518820004	WOOLWORTH, C D TRUST	JAL PUBLIC LIBRARY FUND &		BOX 178	JAL	NM	88252	
51882	4209139464264	160.10	24	35	01	4000518820001	WOOLWORTH, C D TRUST	JAL PUBLIC LIBRARY FUND &		BOX 178	JAL	NM	88252	
51882	4208140252279	600.00	24	35	11	4000518820002	WOOLWORTH, C D TRUST	JAL PUBLIC LIBRARY FUND &		BOX 178	JAL	NM	88252	
51882	4209142250249	320.00	24	35	24	4000518820007	WOOLWORTH, C D TRUST	JAL PUBLIC LIBRARY FUND &		BOX 178	JAL	NM	88252	
51882	4210139134399	158.50	24	36	06	4000518820009	WOOLWORTH, C D TRUST	JAL PUBLIC LIBRARY FUND &		BOX 178	JAL	NM	88252	
51882	4215143266266	640.00	24	36	25	4000518820016	WOOLWORTH, C D TRUST	JAL PUBLIC LIBRARY FUND &		BOX 178	JAL	NM	88252	
STATE - Henry H Harrison Jr	4217144263266	626.54	24	37	32									
STATE - Henry Harrison	4215144266266	640.00	24	36	36									
STATE - Jal Library	4208139267266	640.12	24	35	02									
STATE - Jal Library	4207141267266	640.00	24	35	15									
STATE - Jal Library	4207140267265	640.00	24	35	10									
STATE - Jal Public Library Fund	4208138266266	640.00	23	35	35									
STATE - Jal Public Library Fund	4209138266266	640.00	23	35	36									
STATE - Jal Public Library Fund	4207138266266	640.00	23	35	34									
STATE - Mark T McCloy	4196145265265	640.00	25	33	02									
STATE - Mark T McCloy	4197143398264	320.00	24	33	25									
STATE - Mark T McCloy	4197144266265	640.00	24	33	36									
STATE - Mark T McCloy	4195144266265	640.00	24	33	34									
STATE - Mark T McCloy	4195142265273	622.76	24	33	22									
STATE - Mark T McCloy	4195143266265	640.00	24	33	27									
USA	4208143647127	880.18	24	35	26									
USA - Deep Wells Inc	4210139395265	320.50	24	36	06									
USA - Mark T McCloy	4197145266265	641.58	25	33	01									
USA - Mark T McCloy	4195145265265	641.07	25	33	03									
USA - Mark T McCloy	4196143266265	640.00	24	33	26									
USA - Mark T McCloy	4196144266265	640.00	24	33	35									
USA - Mark T McCloy	4197143134266	320.00	24	33	25									
USA - Mark T McCloy	4197142682273	155.75	24	33	24									
USA - Mark T McCloy	4196142465396	80.00	24	33	23									

NOTICE

Intercontinental Potash Corp. (USA) (ICP) announces its intent to apply to the New Mexico Environment Department for a 20.2.74 NMAC Prevention of Signification Deterioration (PSD) Air Quality Permit for the construction of its Ochoa Mine Project. The expected date of application submittal to the Air Quality Bureau is November 6, 2013. This notice is a requirement according to New Mexico air quality regulations.

Intercontinental Potash Corp. (USA) (ICP) is proposing to develop a new mine in southeastern Lea County, New Mexico to extract polyhalite ore for the production of sulphate of potash (SOP) and langbeinite for use as fertilizer. The proposed Ochoa Mine Project consists of four operations, the underground Ochoa Mine, the Ochoa Processing Plant, the Jal Loadout Facility, and a Groundwater Well Field.

The exact location of the proposed Ochoa Processing Plant will be at latitude 32 deg, 11 min, 59.1 sec and longitude -103 deg, 31 min, 59.2 sec. The approximate location of this facility will be 20.7 miles West-Northwest (285 degrees) from the intersection of Highways 128 and 18 in Jal, NM. The underground Ochoa Mine is located across from the Ochoa Processing Plant, north of Highway 128.

The exact location for the proposed Jal Loadout Facility will be at latitude 32 deg, 11 min, 14.1 sec and longitude -103 deg, 12 min, 47.2 sec. The approximate location of this facility will be 4.7 miles, North-Northwest (340 degrees) from the intersection of Highways 128 and 18 in Jal, NM.

The exact location for the proposed Groundwater Well Field will be at latitude 32 deg, 12 min, 43.8 sec and longitude -103 deg, 19 min, 47.1 sec. The approximate location of this facility will be 10.4 miles, Northwest (320 degrees) from the intersection of Highways 128 and 18 in Jal, NM.

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Pollutant:	**Pounds per hour**	**Tons per year**	**Pounds per hour**	**Tons per year**	**Pounds per hour**	**Tons per year**
Total Suspended Particulates (TSP)	164 pph	342 tpy	29 pph	125 tpy	135 pph	217 tpy
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Hazardous Air Pollutants (HAPs)	<0.5 pph	<0.5 tpy	<0.5 pph	<0.5 tpy		
State Toxic Air Pollutants (TAPs)	<0.5 pph	<0.5 tpy	<0.5 pph	<0.5 tpy		
Green House Gas Emissions as Total CO_2e	119187 pph	522040 tpy	119187 pph	522040 tpy		

The proposed hours of operation that will be permitted are 24 hours per day, 7 days per week, and 8760 hours per year.

The owner and/or operator of the Facility is:

Intercontinental Potash Corp. (USA)
Attn: Manager of Environmental Affairs
1030 Johnson Road, Suite 300
Golden, CO 80401

If you have any comments about the construction or operation of the above facility, and you want your comments to be made as part of the permit review process, you must submit your comments in writing to the address below:

Permit Programs Manager
New Mexico Environment Department
Air Quality Bureau
525 Camino de los Marquez, Suite 1
Santa Fe, New Mexico 87505-1816
(505) 476-4300

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General Posting of Notices – Certification

I, *Robert Goins*, the undersigned, certify that on November 4, 2013, posted a true and correct copy of the attached Public Notice in the following publicly accessible and conspicuous places in the Cities of Jal and Hobbs of Lea County, State of New Mexico on the following dates:

1. Main entrance to the Ochoa Processing Plant on 11/04/2013
2. Main entrance to the Jal Loadout Facility on 11/04/2013
3. Main entrance to the Groundwater Well Field on 11/04/2013
4. Jal Library, 100 E Utah Ave, Jal, NM 88252, on 11/04/2013
5. Jal Post Office, 111 S 4th St, Jal, NM 88252, on 11/04/2013
6. Hobbs Library, 509 N Shipp St, Hobbs, NM 88240, on 11/04/2013

Signed this 5th day of November, 2013

Signature

November 5, 2013
Date

Robert Goins
Printed Name

Landman, Intercontinental Potash Corp.
Title {APPLICANT OR RELATIONSHIP TO APPLICANT}

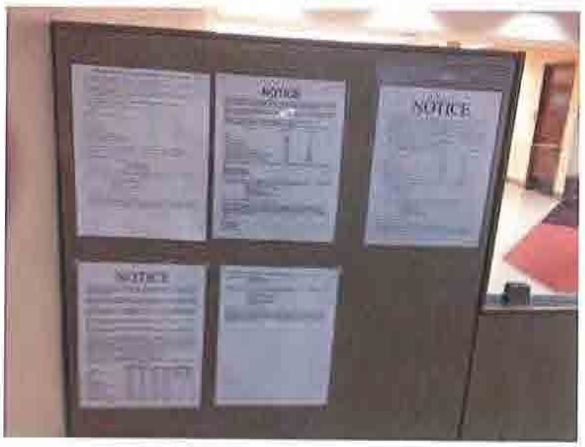
Ochoa Processing Plant Site

Jal Library

Jal Loadout Site

Jal Post Office

Groundwater Oil Field Site



Hobbs Post Office

NOTICE OF AIR QUALITY PERMIT APPLICATION

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	Total Facility Emissions		Process Emissions		Fugitive Emissions	
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Golden, CO 80401

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New Mexico Environment Department
Air Quality Bureau
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Affidavit of Publication

State of New Mexico,
County of Lea.

I, DANIEL RUSSELL
PUBLISHER
of the Hobbs News-Sun, a newspaper published at Hobbs, New Mexico, do solemnly swear that the clipping attached hereto was published in the regular and entire issue of said newspaper, and not a supplement thereof for a period

of 1 issue(s).
Beginning with the issue dated
November 01, 2013
and ending with the issue dated
November 01, 2013

PUBLISHER
Sworn and subscribed to before me
this 1st day of
November, 2013

Notary Public

My commission expires
January 29, 2015
(Seal)

OFFICIAL SEAL
GUSSIE BLACK
Notary Public
State of New Mexico
My Commission Expires 1-29-15

This newspaper is duly qualified to publish legal notices or advertisments within the meaning of Section 3, Chapter 167, Laws of 1937 and payment of fees for said publication has been made.

LEGAL LEGAL LEGAL

LEGAL NOTICE
November 1, 2013

NOTICE OF AIR QUALITY PERMIT APPLICATION

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g attack is something Gleghorn must establish.

get the running game going," d. "It got a little bit better last week o be able to run it when we have to. don't want to chew up the clock, to get positive yards and not fall ains."

face a Carlsbad team allowing 18 ame, including shutting out La time out.

er (5-10, 175) leads the team with 53 along with two fumble recoveries eption.

:o Carlsbad 57-7 last year but the 2 so far against teams they lost to :e.

en have won the last three meet- two via the 50-point mercy rule) as aven't beat Carlsbad since 2009 P.J. Smith ran for a school-record six touchdowns in Carlsbad.

37-1 against Carlsbad since 1953.

---

ff 11 times.

; the receivers with 35 receptions and four touchdowns while Norton ions for 353 yards and four touch-

) has lost its last three, including a ing 42-27 loss at Ruidoso last starting the season 5-1. The Rams' sses in the streak were at Hope 32) and against Class 4A Roswell

) the Ruidoso Free Press, Portales Bronte Staugaard paced the Rams s for 146 yards and scored his lone ith 8:07 remaining in the game to ors' lead to 35-27.

x Daniel Sanchez went 9-for-24 0 yards and one touchdown (a 52- John Young in the third quarter) arries for 57 yards and another

id Portales runs a spread offense the Wildcats to defend the entire

:ian finished with 357 yards of assing, 122 rushing) in last week's vington and Meyer-Hagen had sses of 27, 28 and 48 yards.

quit giving up the big pass plays," id. "Portales, they're going to all around Friday night. We have ur pass defense, we have to put he quarterback, and we have to 've been not too aggressive this nd of been on our heels all year to be more aggressive."

; have won the last 18 regular sea- with the Rams, but lost to Portales te championship game.

ads the series 47-21-1 since 1940.

Mike Nugent kicked a 54-yard field goal with 1:24 remaining in regulation to put the Bengals ahead, but Miami answered with a 50-yard drive, and Caleb Sturgis made a 44-yard field goal with 11 seconds left to force overtime.

start overtime. After Cincinnati's Terence Newman was called for a 38-yard pass interference penalty, the Bengals dug in and forced another punt that pinned them deep, setting up the safety.

Cincinnati's Marvin Jones was kept out of the end zone

On third-and-4, Grimes snatched Dalton's pass away from Jones, sprinted up the sideline and somersaulted after crossing the goal line. It was the first touchdown for the eighth-year pro, and the Dolphins' longest interception return since 2002.

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PUBLIC SERVICE ANNOUNCEMENT

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Public notices have been posted in the following locations for review by the public:

1. At the Entrance to the Ochoa Processing Plant;
2. At the Entrance to the Jal Loadout Facility;
3. At the Entrance to the Groundwater Well Field
4. At the Jal Library, 100 E Utah Ave., Jal NM;
5. At the Jal Post Office, 111 S 4th St., Jal, NM; and
6. At the Hobbs Library, 509 N Shipp St., Hobbs NM.

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November 5, 2013

KZOR Radio
619 N. Turner St.
Hobbs, NM 88240

Dear Sirs:

Subject: Intercontinental Potash Corp. (USA) (ICP) – 20.2.74 NMAC Air Quality Permit – Proposed Ochoa Project – Public Service Announcement

Please read the attached on the air as a "Public Service Announcement".

Please let me know if you have questions. I can be reached at (505) 830-9680 ext 102. Thank you in advance.

Sincerely,

Paul Wade

Paul Wade
Project Engineer
Class One Technical Services, Inc.

Submittal of Public Service Announcement – Certification

I, Paul Wade, the undersigned, certify that on November 5, 2013, submitted a public service announcement to KZOR Radio that serves the Cities of Jal and Hobbs, Lea County, New Mexico, in which the source will be located and that KZOR Radio did not respond that it would not air the announcement.

Signed this 5th day of November, 2013,

Paul Wade
Signature

11/5/13
Date

Paul Wade
Printed Name

Air Permitting Consultant, Class One Technical Services, Inc.
Title {APPLICANT OR RELATIONSHIP TO APPLICANT}

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PS Form 3800, August 2006 See Reverse for Instructions

Section 10

Written Description of the Routine Operations of the Facility

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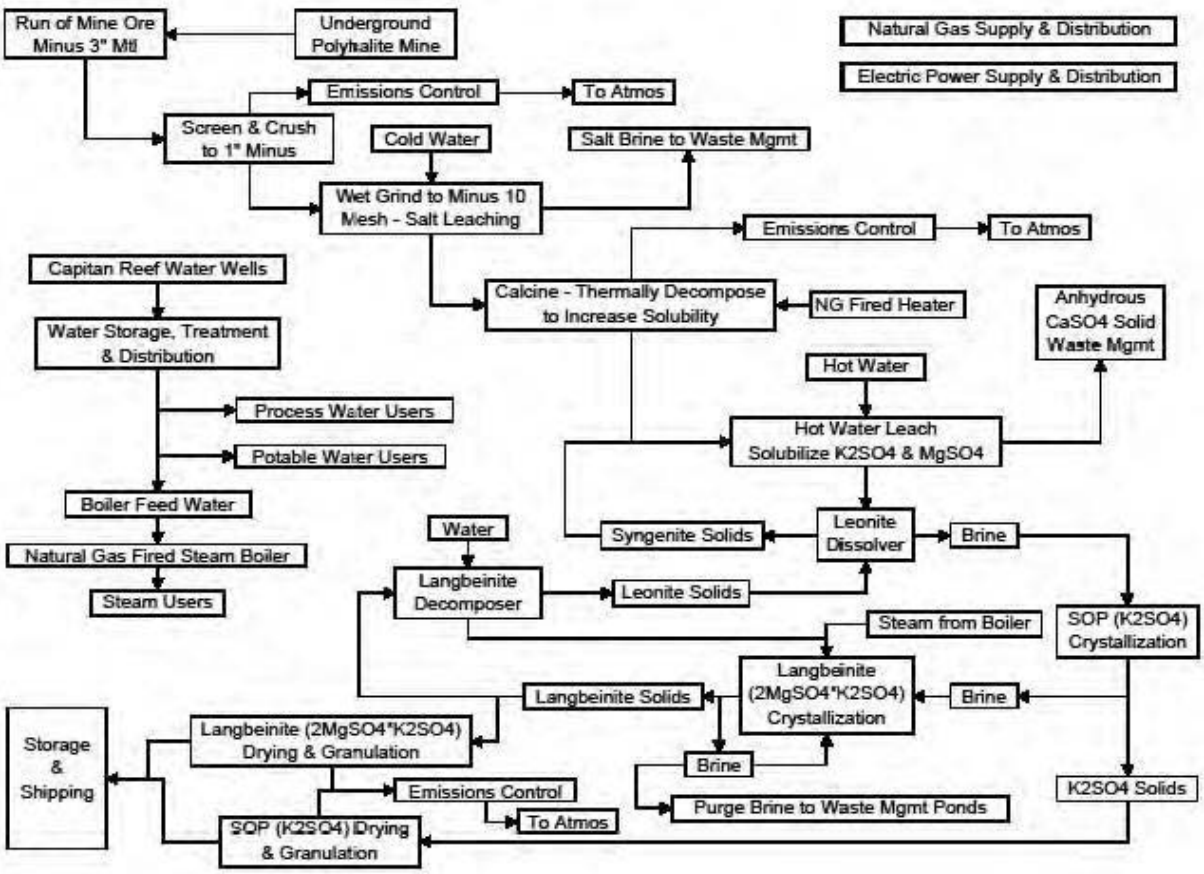
A written description of the routine operations of the facility. Include a description of how each piece of equipment will be operated, how controls will be used, and the fate of both the products and waste generated. For modifications and/or revisions, explain how the changes will affect the existing process. In a separate paragraph describe the major process bottlenecks that limit production. The purpose of this description is to provide sufficient information about plant operations for the permit writer to determine appropriate emission sources.

The figure below presents a simplified process flow of the Ochoa Project.



Ochoa Plant

Raw ore comes by overland conveyor from the mine to the "run of mine" (ROM) storage bins (Units S1 – S8). The ROM storage bins reclaimed by conveyors below bin and conveyed to a surge bin. Average hourly material throughput to and from the ROM storage bins is 550.4 tons per hour (tph). Enclosures control the transfer of material for the overland conveyors. A dust collector controls fugitive dust for the ROM stock bin and conveyors.

From the surge bin, material is sent by apron feeder to a raw ore roll crusher (Units S9 – S13). Crusher material is sent to a wet sizing screen feed pump box where the raw ore is put in solution. The ore is than wet screened and the oversized re-crushed. Dust generated in the crushing circuit is controlled with a dust collector.

The raw ore solution is washed to remove sodium chloride and dewatered. No air emissions are expected for this process.

The dewater material (Units S14 – S17) is sent to three polyhalite dryer/calciner/coolers (Unit S18A,B,C – S30A,B,C). Average hourly material throughput to polyhalite dryer/calciner/coolers is 555.1 tph. A dust collector controls particulate emissions from the dryer/calciner/cooler exhaust.

From the dryer/calciner/coolers, the K_2SO_4 and $MgSO_4$ materials are put into solution in a counter current leach tank system. Liquor produced in the leach system is fed to a multi-stage evaporator crystallizer system.

After the crystallization process, the SOP and langbeinite crystals are dried and granulated in similar but separate circuits. Each circuit will consist of a product dryer with fugitive dust control system, product granulator and dryer with fugitive dust control system, and fugitive dust collection for the product processing, and recycled material from the Jal Loadout feeder bin and conveyor (Units S32 – S135).

The particulate concentration in the final baghouse exhaust for dust control systems will be at or below 0.005 grains per dry standard cubic feet. The particulate concentration in the final baghouse exhaust for dryer systems will be at or below 0.0052 grains per dry standard cubic feet.

Jal Loadout Facility (Units S136 – S174)

From the product loadout, all finished material will be shipped by product haul trucks and stored in storage bins at the train load-out facility near Jal, New Mexico. The storage bins will have capacity to store up to 3 months worth of all finished products. Trucks will dump their finished product into one of two separate circuits, which prevents different products from co-mingling with each other. Once product is ready to be shipped, it will be screened to customer's specification and loaded into 100-ton rail cars. The process flow at the Jal train load-out consists of a truck hopper, truck hopper conveyor/elevators to storage bins, storage bin feeder and loadout conveyors/elevators, loadout conveyors to fines screening, fines screen to product return hopper for fines or product to train loading bin, truck loading of fines to be returned back to the Ochoa Plant, and train loading bin to train.

<u>SOP Product (Units S136 – S156)</u>

SOP product trucks unloading into the hopper where vibratory feeder loads the product onto the storage belt conveyor and storage bucket elevator. Truck unloading and loading of the storage belt conveyor/bucket elevator are controlled by enclosures and De-Dust oil application in prior processes. The supply conveyor loads the storage domes, where the SOP is stored until sold. Dust produced during the loading of the storage bins are controlled by enclosures and De-Dust oil application in prior processes. Once the SOP is ready to ship, it is loaded by front-end loader into feed hoppers and sent by conveyor and bucket elevator to fines screening. Dust produced during the loading of the feed hopper and conveyor/elevator is controlled by enclosures and De-Dust oil application in prior processes.

A bucket elevator sends the SOP to the SOP drag conveyor where, depending on the product, the material is sent to one of three screens to be screened to a final product and stored in a SOP Reclaim Loading Bin. From the SOP Reclaim Loading Bin, product is sent by elevator to a SOP Loading Bulk Weigher. Dust produced during these processes is controlled with a fabric filter dust control system.

The fines and oversizes from the screens are sent to the SOP Reclaim Loading Bin where they are loaded onto trucks returning to the Ochoa Plant for reprocessing. The De-Dusting oil controls excess fugitive dust emissions during truck loading.

The final SOP product from the screen is recoated with a De-Dusting Oil and sent by train loading bin to the train loading bin where the material is loaded into train cars. The De-Dusting oil controls excess fugitive dust emissions during train loading.

Langbeinite Product (Units S157 – S174)

Langbeinite product trucks unloading into the hopper where vibratory feeder loads the product onto the storage belt conveyor and storage bucket elevator. Truck unloading and loading of the storage belt conveyor/bucket elevator are controlled by enclosures and De-Dust oil application in prior processes. The supply conveyor loads the storage domes, where the langbeinite is stored until sold. Dust produced during the loading of the storage bins are controlled by enclosures and De-Dust oil application in prior processes. Once the langbeinite is ready to ship, it is loaded by front-end loader into feed hoppers and sent by conveyor and bucket elevator to fines screening. Dust produced during the loading of the feed hopper and conveyor/elevator is controlled by enclosures and De-Dust oil application in prior processes.

A bucket elevator sends the langbeinite to the Langbeinite Reclaim Multi-Deck Screen. The material is screened to a final product and stored in a Langbeinite Reclaim Loading Bin. From the Langbeinite Reclaim Loading Bin, product is sent by elevator to a Langbeinite Loading Bulk Weigher. Dust produced during these processes is controlled with a fabric filter dust control system.

The fines and oversizes from the screen are sent to the Langbeinite Reclaim Loading Bin where they are loaded onto trucks returning to the Ochoa Plant for reprocessing. The De-Dusting oil controls excess fugitive dust emissions during truck loading.

The final langbeinite product from the screen is recoated with a De-Dusting Oil and sent by train loading bin to the train loading bin where the material is loaded into train cars. The De-Dusting oil controls excess fugitive dust emissions during train loading.

The particulate concentration in the final baghouse exhaust for dust control system will be at or below 0.005 grains per dry standard cubic feet.

Waste Handling (Units S175 – S180)

An above ground, lined tailings storage facility (TSF) would receive the waste solids coming from the ore processing using a dry stacking deposition method of placement with haul trucks. The TSF would cover approximately 448 acres in T24S, R33E, Sections 26 and 35, with dimension of 3,770 by 5,178 feet and a maximum height of 200 feet at the end of 50 years. The TSF will be constructed in 20-foot high lifts with 10-foot-wide benches with final side slopes of 3 feet (horizontal) to 1 foot (vertical). Earthen berms and drainage swales would divert surface water runoff away from the stockpile. Water falling on the tailings pile would be contained by two ponds at the southwest corner of the TSF.

Tailings will consist of calcium sulfate, which would form gypsum through the interaction with water from precipitation and water spayed onto the pile for dust suppression. Once wet, the pile would harden to a concrete-like substance so that it would not be prone to wind erosion.

Groundwater Pre-Treatment Plant

The Groundwater Pre-Treatment Plant (S200A,B) will remove hydrogen sulfide (H_2S) and balance the pH levels for the Ochoa Plant supply water. During the process, the hydrogen sulfide (H2S) concentration and the water temperature will be monitored. The pH of the water will be reduced to 5.0 to convert the bisulfide ion (HS-) to H_2S. Reducing the pH to 5.0 will allow about 98% removal of H_2S through packed bed air strippers. The flow will be monitored then directed to one or both of the forced air H_2S strippers depending upon water and air temperatures. Each H_2S stripper will be sized to remove 98% of H_2S at 2,755 GPM with a water temperature of 80º F and air temperature of 68º F. The second H_2S stripper will allow continuous efficient operation (98% removal of H_2S) when the capacity of the H_2S strippers is reduced during cold periods. The stripped H_2S will be collected and treated by a bio-trickling filter with a control efficiency of 99%. The treated water will then be stored and piped to the Ochoa Plant.

Other potential sources of emissions at the Ochoa Plant are two steam boilers (Units S196 and S197) which provide steam/hot water for the process.

Section 11

Source Determination

Source submitting under 20.2.70, 20.2.72, 20.2.73, and 20.2.74 NMAC

Sources applying for a construction permit, PSD permit, or operating permit shall evaluate surrounding and/or associated sources (including those sources directly connected to this source for business reasons) and complete this section. Responses to the following questions shall be consistent with the Air Quality Bureau's permitting guidance, Single Source Determination Guidance, which may be found on the Applications Page in the Permitting Section of the Air Quality Bureau website.

Typically, buildings, structures, installations, or facilities that have the same SIC code, that are under common ownership or control, and that are contiguous or adjacent constitute a single stationary source for 20.2.70, 20.2.72, 20.2.73, and 20.2.74 NMAC applicability purposes. Submission of your analysis of these factors in support of the responses below is optional, unless requested by NMED.

A. Identify the emission sources evaluated in this section (list and describe)**:** The source consists of a underground mine overland conveyor system transporting raw material (polyhalite) to a plant that will process the polyhalite into two products, sulfate of potash (SOP) and langbeinite. The plants final products will be transported by truck to a loadout terminal, located approximately 19 miles west of the Ochoa Plant, where the product will be stored and loaded into railcars for transport to customers. A Groundwater Pre-Treatment Plant will be located approximately 12 miles west of the Ochoa Plant and pre-treated water will be conveyed via buried pipe to the Ochoa Plant.

B. Apply the 3 criteria for determining a single source:

SIC Code: Surrounding or associated sources belong to the same 2-digit industrial grouping (2-digit SIC code) as this facility, OR surrounding or associated sources that belong to different 2-digit SIC codes are support facilities for this source.

X Yes ☐ **No**

Common Ownership or Control: Surrounding or associated sources are under common ownership or control as this source.

X Yes ☐ **No**

Contiguous or Adjacent: Surrounding or associated sources are contiguous or adjacent with this source.

X Yes ☐ **No**

C. Make a determination:

X The source, as described in this application, constitutes the entire source for 20.2.70, 20.2.72, 20.2.73, or 20.2.74 NMAC applicability purposes. If in "A" above you evaluated only the source that is the subject of this application, all "**YES**" boxes should be checked. If in "A" above you evaluated other sources as well, you must check **AT LEAST ONE** of the boxes "**NO**" to conclude that the source, as described in the application, is the entire source for 20.2.70, 20.2.72, 20.2.73, and 20.2.74 NMAC applicability purposes.

☐ The source, as described in this application, **does not** constitute the entire source for 20.2.70, 20.2.72, 20.2.73, or 20.2.74 NMAC applicability purposes (A permit may be issued for a portion of a source). The entire source consists of the following facilities or emissions sources (list and describe):

Section 12

Section 12.A
PSD Applicability Determination for All Sources

(Submitting under 20.2.72, 20.2.74 NMAC)

A PSD applicability determination for all sources. For sources applying for a significant permit revision, apply the applicable requirements of 20.2.74.AG and 20.2.74.200 NMAC and to determine whether this facility is a major or minor PSD source, and whether this modification is a major or a minor PSD modification. It may be helpful to refer to the procedures for Determining the Net Emissions Change at a Source as specified by Table A-5 (Page A.45) of the EPA New Source Review Workshop Manual to determine if the revision is subject to PSD review.

A. This facility is:

- ☐ **a minor PSD source before and after this modification (if so, delete C and D below).**
- ☐ **a major PSD source before this modification. This modification will make this a PSD minor source.**
- ☐ **an existing PSD Major Source that has never had a major modification requiring a BACT analysis.**
- ☐ **an existing PSD Major Source that has had a major modification requiring a BACT analysis**
- **X a new PSD Major Source.**

B. **This facility is not one of the listed 20.2.74.501 Table I – PSD Source Categories. The project emissions for this project are as follows [see Table 2 in 20.2.74.502 NMAC for a complete list of significance levels]:**

a. **NOx: 157 TPY**
b. **CO: 165 TPY**
c. **VOC: 26 TPY**
d. **SOx: 2.8 TPY**
e. **TSP (PM): 342 TPY**
f. **PM10: 191 TPY**
g. **PM2.5: 134 TPY**
h. **Fluorides: 0.0 TPY**
i. **Lead: 0.0024 TPY**
j. **Sulfur compounds (listed in Table 2): 7.1 TPY**
k. **GHG: 522040 TPY**

C. Netting is not required since this is a new source**.**

D. BACT is required for this new major PSD facility. The pollutants subject to BACT review are GHG, NO_x, and PM/ PM_{10}/ $PM_{2.5}$. A full top down BACT determination is provided below**.**

E. A determination regarding whether a PSD modification is triggered is not required since this is a new project.

Section 12.B
Special Requirements for a PSD Application

(Submitting under 20.2.74 NMAC)

Prior *to Submitting a PSD application*, the permittee shall:

- **X** Submit the BACT analysis for review prior to submittal of the application. No application will be ruled complete until the final determination regarding BACT is made, as this determination can ultimately affect information to be provided in the application. A pre-application meeting is recommended to discuss the requirements of the BACT analysis.
- **X** Submit a modeling protocol prior to submitting the permit application. **[Except for GHG]**
- **X** Submit the monitoring exemption analysis protocol prior to submitting the application. **[Except for GHG]**

For PSD applications, the permittee shall also include the following:

- **X** Documentation containing an analysis on the impact on visibility. **[Except for GHG]**
- **X** Documentation containing an analysis on the impact on soil. **[Except for GHG]**
- **X** Documentation containing an analysis on the impact on vegetation, including state and federal threatened and endangered species. **[Except for GHG]**
- **X** Documentation containing an analysis on the impact on water consumption and quality. **[Except for GHG]**
- **X** Documentation that the federal land manager of a Class I area within 100 km of the site has been notified and provided a copy of the application, including the BACT and modeling results. The name of any Class I Federal area located within one hundred (100) kilometers of the facility.

PSD Applicability Determination

OCHOA MINE PROJECT

PREVENTION OF SIGNIFICANT DETERIORATION PERMIT APPLICATION BEST AVAILABLE CONTROL TECHNOLOGY ANALYSES

Prepared for:

INTERCONTINENTAL POTASH CORP. (USA)

Prepared by:

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304-A West Millbrook Rd.

Raleigh, NC 27609

OCTOBER 2013

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Acronyms

acfm ..... actual cubic feet per minute
ASTM ..... American Society for Testing and Materials
BACT ..... Best Available Control Technology
Bhp ..... brake horsepower
CCS ..... carbon capture and sequestration
CFR ..... Code of Federal Regulation
CI ..... spark ignition
CO ..... carbon monoxides
CO_2 ..... carbon dioxides
CO_2e ..... greenhouse gas equivalents
DDC ..... Dryer/Calciner/Coolers
EGR ..... Enhanced Gas Recovery
EOR ..... Enhanced Oil Recovery
EPA ..... United States Environmental Protection Agency
ESP ..... Electrostatic Precipitator
FA ..... fuel reburn
FFB ..... fabric filter baghouse
FGR ..... fuel gas recirculation
FPM ..... fine particulate matter
FPM_{10} ..... fine particulate matter 10 microns and less in diameter
GCP ..... good combustion practices
GWP ..... global warming potential
gr/acfm ..... grains per actual cubic foot per minute
gr/dscf ..... grains per dry standard cubic foot
hp ..... horsepower
H_2S ..... hydrogen sulfide
lb/hr ..... pounds per hour
IC ..... internal combustion
ICP ..... Intercontinental Potash Corp.
kW-hr/yr ..... kilowatts-hr per year
Lb/MMBtu ..... pounds per million British thermal unit
LNB ..... low NOx burner
MACT ..... Maximum Achievable Control Technology
MEA ..... Monoethanolamine
MMBtu ..... million British thermal units
MMBtu/hr ..... million British thermal units per hour
NG ..... natural gas
NOx ..... nitrogen oxides
NO_2 ..... nitrogen dioxides
NSPS ..... New Source Performance Standard
NSR ..... New Source Review
OAQPS ..... Office of Air Quality Planning and Standards
OFA ..... overfire air
PM ..... particulate matter

PM_{10} ..... particulate matter 10 microns and less in diameter
$PM_{2.5}$ ..... particulate matter 2.5 microns and less in diameter
PSD ..... Prevention of Significant Deterioration
RBLC ..... RACT/BACT/LAER Clearinghouse
RICE ..... reciprocating internal combustion engine
ROM ..... Run-Of-Mine
RCSPs ..... Regional Carbon Sequestration Partnerships
scfm ..... standard cubic feet per minute
SCR ..... selective catalytic reduction
SNCR ..... selective non-catalytic reduction
SO_2 ..... sulfur dioxide
SOP ..... sulphate of potash
SOPM ..... sulphate of potash magnesia
TPY ..... tons per year
TSP ..... total suspended particulate
ULNB ..... ultra-low NOx burner
USEPA ..... United States Environmental Protection Agency
VOC ..... volatile organic compounds

1.0 INTRODUCTION

This document presents the Best Available Control Technology (BACT) review of the proposed Intercontinental Potash Corp. (USA) ("ICP") Ochoa Mine Project located about 60 miles east-southeast of Carlsbad, New Mexico, and less than 20 miles west of the Texas-New Mexico state line. The Ochoa Mine Project will include the construction of a Processing Plant (the Plant) to develop sulphate of potash (SOP) and Langbeinite (sulphate of potash magnesia - SOPM) from polyhalite ore extracted from an underground mine. The Plant will restrict public access to approximately 1,850 acres. Product produced at the Plant will be trucked to the Jal, New Mexico load-out facility, where it is loaded into train cars and shipped to customers.

The proposed load-out facility at Jal is approximately 19 miles from the Plant. The load-out facility is partially located on private land and partially located on State lands. Trucks will travel from the processing plant for 18 miles along highway 128, and for 3.5 miles on a planned road to be developed through rural, largely undeveloped areas. In order to move the product, trucks will transport material on a continuous basis operating around the clock, seven days per week.

ICP Ochoa Mine Project will be a major stationary source under the Prevention of Significant Deterioration (PSD) regulations. Per regulation 20.2.74.7.AZ NMAC, the facilities must undergo BACT review for any pollutants that exceed the PSD major threshold values. For this facility the estimated greenhouse gases (GHG), including carbon dioxide (CO_2), will be over the PSD major threshold value of 100,000 tons per year, per regulation 20.2.74.7.AZ.(5)(a) NMAC.

The potential maximum emission rates for nitrogen dioxide (NO_2), carbon monoxide (CO), volatile organic compounds (VOC), greenhouse gases (GHG) including carbon dioxide (CO_2), sulfur dioxide (SO_2), total suspended particulate matter (TSP), particulate matter with aerodynamic diameter less than 10 micrometers (PM_{10}), particulate matter with aerodynamic diameter less than 2.5 micrometers ($PM_{2.5}$), and significant hazardous

air pollutants due to the combustion of natural gas (lead and formaldehyde) and fugitive dust emissions due to vehicle traffic and material processing/handling, were estimated based on the Ochoa Project feasibility design and presented in Table 1-1. These projected emission rates are the basis for all BACT analysis in this report. Calculated emission rates were determined from preliminary design specification for processing polyhalite, $K_2Ca_2Mg(SO_4)_4 \bullet 2(H_2O)$, mined at the Ochoa Mine located north of the plant into sellable product; granular, standard, and soluble SOP (K_2SO_4); and Langbeinite ($2Mg(SO_4) \bullet K_2SO_4$) granular.

For the proposed facilities, emissions of CO, NOx, $PM/PM_{10}/PM_{2.5}$, and GHGs exceed the PSD major threshold ton per year values of 100, 40, 25/15/10, and 100,000, respectively (see Table 1-1), per regulation 20.2.74.502.Table 2 "Significant Emission Rates". As a result, any emission unit which emits any of these pollutants must undergo BACT review for each pollutant emitted.

Table 1-1. Ochoa Project Emission Source Annual Emissions

Pollutant	Emissions TPY	PSD Significant Emission Rate TPY	PSD Review Required?
Nitrogen Oxides	157	40	Yes
Carbon Monoxide	165	100	Yes
Sulfur Dioxide	2.8	40	No
Volatile Organic Compounds	26	40	No
Particulate (PM30)	386	25	Yes
PM_{10}	202	15	Yes
Direct $PM_{2.5}$	135	10	Yes
Lead	0.0024	0.6	No
Hydrogen Sulfide	7.1	10	No
Greenhouse Gases	522,469	100,000	Yes
Formaldehyde	0.35	-----	------

1.1 OVERVIEW OF PROJECT

Once the polyhalite is delivered from the mine, it is first crushed and washed to remove salt associated with the ore; this produces essentially salt-free material sized for optimum calcining and leaching. The calcined product is cooled to recover energy and then leached in a counter current circuit using water at 95°C as the solvent. The potassium and magnesium sulfates are taken into solution, leaving anhydrous calcium sulfate residue, which is removed and sent to the solid waste management area. The resulting potassium and magnesium sulfate rich brine is crystallized to create SOP and then Langbeinite crystals. The final steps of the process are product drying and then granulation, which involves drying the SOP and the Langbeinite and then granulating the material – in separate but identical equipment – to produce a product that meets market standards for particle sizing.

1.2 BACT ANALYSES OVERVIEW

The contents of this document are organized as follows:

Section 2.0 includes a description of Ochoa plant and Jal Loadout emission sources.

Section 3.0 includes a description of the BACT methodology.

Section 4.0 includes the combustion source BACT analyses.

Section 5.0 includes the emergency diesel engine BACT analyses.

Section 6.0 includes the fugitive PM BACT analyses.

Appendix A includes supporting BACT impacts calculations.

2.0 DESCRIPTION OF EMISSION SOURCES

ICP is proposing to develop a new mine in Lea and Eddy Counties, New Mexico to extract polyhalite ore for the production of SOP and Langbeinite for use as fertilizer. There are three primary operations to get the ore to a finished fertilizer product.

1) The first operation is to mine raw polyhalite approximately 1,500 feet underground in the Rustler Formation.
2) Once mined, the polyhalite is conveyed to the surface and transported to the Ochoa processing facility where it is crushed, ground, leached, calcined, crystallized, and granulated to produce SOP and Langbeinite, the saleable products.
3) The final products would be moved by truck to a loadout facility near Jal, New Mexico, to be loaded on trains and shipped to distributors selling to farmers.

This BACT document addresses point source and fugitive emissions from the Ochoa and Jal Loadout facilities for the following pollutants: particulate matter, oxides of nitrogen, carbon monoxide, and greenhouse gases. Run of Mine (ROM) material is sent to the Ochoa Polyhalite Processing Plant by way of covered overland conveyor.

2.1 SOP AND LANGBEINITE FACILITIES

The following process description addresses the three main areas of emissions:

- Ochoa Polyhalite Processing Plant,
- Ochoa Plant Waste Handling and Disposal Facilities, and
- The Jal Loadout Facility.

2.2 OCHOA POLYHALITE PROCESSING PLANT

Raw ore processing involves seven major unit operation steps; primary crushing, wet grinding and salt removal, calcination, leaching, evaporative crystallization of SOP (K2SO4), evaporative crystallization of Langbeinite [2Mg(SO4)•K2SO4], and drying/granulation of both products.

Polyhalite, $K_2Ca_2Mg(SO_4)_4 \cdot 2(H_2O)$, is first crushed and washed to remove salt associated with the ore; this produces essentially salt-free material sized for optimum leaching conditions that can be quickly and easily calcined. The calcined product is cooled to recover energy and then leached in a counter current circuit using water at 95°C as the solvent. The potassium and magnesium sulfates are taken into solution, leaving anhydrous calcium sulfate residue, which is removed and sent to the solid waste management area. The resulting potassium and magnesium sulfate rich brine is crystallized to create SOP and then Langbeinite crystals. The final step of the process, granulation, involves drying the potassium sulfate and the Langbeinite and then granulating the material – in separate but identical equipment – to produce a product that meets market standards for particle sizing.

2.2.1 Waste Handling and Disposal

There are three waste streams generated at the Ochoa plant: sodium chloride bleed stream from the salt wash process, calcium sulfate from the leaching process, and magnesium sulfate from the crystallization process. The waste handling and disposal facilities are located just south of the Ochoa processing facilities.

The sodium chloride bleed stream and magnesium sulfate stream are pumped to a series of evaporation ponds to dewater the salts, which would then be disposed of in onsite injection wells. The evaporation ponds will have a total area of 177,077 square feet (approximately 4.1 acres). There is also a storm pond which will have an area of 231,523 square feet (approximately 5.3 acres).

The calcium sulfate waste is transported by truck to the dry stack tailings facility. The dry stack tailings facility will be bermed to prevent run-on/off. Grading at the base of the tailings pile will direct runoff in to the retention area. The pile will not be covered; however, sprayed water will be used to control dust. Eventually, the interaction of the water will hydrate the anhydrite to gypsum which will harden into a concrete-like substance that is not prone to wind or water erosion.

2.2.2 Jal Loadout Facility

The proposed loadout facility at Jal is located approximately 19 miles from the Ochoa Polyhalite Processing Plant. Trucks will travel from the processing plant for 15 miles along highway 128, and for 3.5 miles on a planned road to be developed through rural, largely undeveloped areas. In order to move 792,000 tons of potassium sulfate and 512,500 tons of Langbeinite per annum, 25-ton load trucks will transport material on a continuous basis operating around the clock seven days per week.

All finished material will be stored in storage domes at the train loadout facility in Jal. The storage domes will have capacity to store up to 3 months of all finished products. Trucks will dump their finished product into one of three separate circuits, which prevents different products from co-mingling with each other. Once product is ready to be shipped, it will be screened to customer's specification and loaded into 100-ton rail cars. The load-out facility in Jal is approximately 175 acres in size. This area includes all storage and load-out facilities, a rail car wash area, and all rail sidings that will be constructed for the loadout.

2.3 COMBUSTION EMISSION SOURCES

The Ochoa Polyhalite Processing Plant will have a number of combustions sources as follows.

- Polyhalite Dryer/Dehydrator/Calciners (DCC) - natural gas-fired (3)
- SOP Product Dryer - natural gas-fired
- SOP Granulation Dryers (2) - natural gas-fired
- Langbeinite Product Dryer - natural gas-fired
- Langbeinite Conditioning/Glazing Dryer - natural gas-fired
- Boiler 1 & 2 - natural gas-fired
- Diesel Emergency Use Engines (2)

Except for the diesel fired emergency engines, natural gas will be the primary or only fuel combusted. Natural gas will be the primary fuel for the boilers. Table 2-1 summarizes the projected CO, NO_X, TSP/PM_{10}/$PM_{2.5}$, and GHGs emissions from each combustion source.

Table 2-1. Combustion Source Annual Emissions

Pollutant▶ Source▼	Heat Input MMBtu/hr	CO TPY	NO_X TPY	TSP TPY	PM_{10} TPY	$PM_{2.5}$ TPY	GHGs TPY
DCC 1	214.23	34.7	39.4	27.1	27.1	27.1	109,878
DCC 2	214.23	34.7	39.4	27.1	27.1	27.1	109,878
DCC 3	214.23	34.7	39.4	27.1	27.1	27.1	109,878
SOP Product Dryer	18.7	3.0	3.5	2.8	2.8	2.8	9,612
SOP Granulator Dryer #1	16.54	2.7	3.0	2.3	2.3	2.3	8,483
SOP Granulator Dryer #2	16.54	2.7	3.0	2.3	2.3	2.3	8,483
Lang. Product Dryer	10.4	1.7	1.9	1.8	1.8	1.8	5,308
Lang. Glazing/Conditioning	2.0	0.3	0.4	2.7	2.7	2.7	1,026
Boiler 1	155.9	25.3	13.7	3.6	3.6	3.6	79,961
Boiler 2	155.9	25.3	13.7	3.6	3.6	3.6	79,961
Diesel Engine 1	2937 HP	0.8	1.4	0.04	0.04	0.04	1125
Diesel Engine 2	144 HP	0.06	0.05	0.004	0.004	0.004	82
Totals		165	157	100	100	100	523,676

2.4 PARTICULATE SOURCE EMISSIONS UNITS

The TSP/PM10/PM2.5 particulate sources located at the Ochoa Polyhalite Processing Plant and the Jal Loadout facility not emitted from a calciner/dryer/boiler as follows.

- Raw Ore Storage/Screening/Crushing dust collector vents
  - Raw ore storage bins
  - Crusher area
- SOP dust collector vents
  - SOP Area
- Langbeinite baghouse/dust collector vents
  - Langbeinite Area
  - Langbeinite Compaction
- Product Loading Circuit fugitives
- Additive fugitives
- SOP Jal Loadout Circuit fugitives
- Langbeinite Jal Loadout Circuit fugitives
- Ochoa Plant Waste Handling Circuit fugitives

- Wind Erosion Emissions Storage Piles

A number of combustion source vents are included because the vents have baghouses for control of particulates not generated by the combustion process. Table 2-2 summarizes the $TSP/PM_{10}/PM_{2.5}$ emissions from each area.

Table 2-2. Particulate Matter Point Source Annual Emissions

Source▼ Pollutant▶	TSP TPY	PM10 TPY	PM2.5 TPY
Raw Ore Handling and Crushing Circuits	4.9	4.2	3.7
SOP Product Circuit	8.0	8.0	8.0
Langbeinite Product Circuit	6.4	6.4	6.4
Product Loading Circuit	4.9	2.3	0.4
Additives	0.15	0.069	0.010
SOP Jal Loading Circuit	31.5	13.6	2.1
Langbeinite Jal Loadout Circuit	17.4	11.4	7.5
Ochoa Waste Handling Circuit	18.8	6.8	1.7
Wind Erosion – Storage Piles	0.5	0.3	0.04
Totals	**74**	**46.4**	**28**

2.5 TRAFFIC FUGITIVE PARTICULATE EMISSION SOURCES

The TSP/PM10/PM2.5 fugitive particulates due to truck traffic at the Ochoa Polyhalite Processing Plant, and the Jal Loadout facility follow.

- **Ochoa Plant and Roads**
  - SOP/Langbeinite product trucks traffic from Ochoa Plant to Jal Loadout
  - SOP/Langbeinite fines recycle trucks from Jal Loadout to Ochoa Plant
  - Additive delivery truck traffic
  - Equipment delivery truck traffic
  - De-duster delivery truck traffic
  - Waste (Gypsum) haul trucks
- **Jal Train-Loading Facility**
  - SOP/Langbeinite product trucks from Ochoa Plant
  - SOP/Langbeinite fines recycle trucks return to Ochoa Plant
  - Additive delivery truck traffic
  - De-duster delivery truck traffic

Table 2-3summarizes the TSP/PM_{10}/$PM_{2.5}$ emissions due to truck traffic.

Table 2-3. Fugitive Particulate Matter Annual Emissions

Source▼ Pollutant►	TSP TPY	PM10 TPY	PM2.5 TPY
Product Truck Traffic Ochoa Plant to Jal Loadout	10	1.9	0.48
Return Truck Traffic Ochoa Plant from Jal Loadout	0.29	0.058	0.014
Additive Delivery Truck Traffic to Ochoa Plant	0.13	0.027	0.007
Equipment Delivery Truck Traffic to Ochoa Plant	1.2	0.32	0.032
De-Duster Delivery Truck Traffic to Ochoa Plant	1.2	0.32	0.032
Waste (Gypsum) Haul Trucks	134	34	3.4
Product Truck Traffic from Ochoa Plant to Jal Loadout	47	12	1.2
Return Truck Traffic at Jal Loadout to Ochoa Plant	10	1.9	0.48
Additive Truck Traffic at Jal Loadout	0.29	0.058	0.014
De-Duster Truck Traffic at Jal Loadout	0.13	0.027	0.007
Totals	**195**	**49**	**5**

3.0 BACT METHODOLOGY

The New Mexico Air Quality Regulations TITLE 20 - ENVIRONMENTAL PROTECTION CHAPTER 2 AIR QUALITY at 20.2.74.7 (K) define "best available control technology" (BACT) as:

> *"means an emissions limitation (including a visible emission standard) based on the maximum degree of reduction for each regulated pollutant which would be emitted from any proposed major stationary source or major modification, which the secretary determines is achievable on a case-by-case basis. This determination will take into account energy, environmental, and economic impacts and other costs. The determination must be achievable for such source or modification through application of production processes or available methods, systems, and techniques, including fuel cleaning, clean fuels, or treatment or innovative fuel combustion techniques for control of such pollutants. In no event shall application of best available control technology result in emissions of any pollutant which would exceed the emissions allowed by any applicable standard under 40 CFR Parts 60 and 61. If the department determines that technological or economic limitations on the application of measurement methodology to a particular emissions unit would make the imposition of an emissions standard infeasible, a design, equipment, work practice, operational standard, or combination thereof, may be prescribed instead to satisfy the requirement for the application of best available control technology. Such standard shall, to the degree possible, set forth the emissions reduction achievable by implementation of such design, equipment, work practice, or operation, and shall provide for compliance by means which achieve equivalent results."*

The PSD regulations do not prescribe a procedure for conducting BACT analyses. Instead, the U.S. EPA has consistently interpreted the BACT requirement as containing two core criteria: First, the BACT analysis must include consideration of the most stringent available technologies, (i.e., those that provide the "maximum degree of emissions reduction"). Second, any decision to require as BACT a control alternative that is less effective than the most stringent available must be justified by an analysis of objective indicators showing that energy, environmental, and economic impacts render the most stringent alternative unreasonable or otherwise not achievable.

The U.S. EPA has developed what it terms the "top-down" approach for conducting BACT analyses and has indicated that this approach will generally yield a BACT determination satisfying the two core criteria. Under the "top-down" approach, progressively less stringent control technologies are analyzed until a level of control considered BACT is reached based on the environmental, energy, and economic impacts. The EPA's recommended five-step top-down approach is utilized in this BACT analysis.

Step 1: Identify all available control technologies with practical potential for application to the emission unit and regulated pollutant under evaluation;

Step 2: Eliminate all technically infeasible control technologies;

Step 3: Rank remaining control technologies by effectiveness and tabulate a control hierarchy;

Step 4: Evaluate most effective controls and document results; and

Step 5: Select BACT, which will be the most effective practical option not rejected, based on economic, environmental, and/or energy impacts.

For purposes of the BACT analysis included with this application, the following approach has been taken with regards to quantifying the environmental, energy, and economic impacts. The net environmental impact associated with a control alternative may be considered if dispersion modeling analyses are performed. The energy impact analysis estimates the direct energy impacts of the control alternatives in units of energy consumption. If possible, the energy requirements for each control option are assessed in terms of total annual energy consumption. The economic impact of a control option is assessed in terms of cost effectiveness and ultimately, whether the option is economically reasonable. As directed by U.S. EPA's October 1990 Draft New Source Review Workshop Manual (1990 Draft Workshop Manual), the economic impacts are reviewed on a cost per ton controlled basis. Cost estimates are developed using the U.S. EPA's Office of Air Quality Planning and Standards (OAQPS) Cost Control Manual, Fifth and Sixth Editions.

3.1 CONTEXT FOR BACT ANALYSIS

As proposed the ICP Ochoa Polyhalite Plant and Jal Loadout Facility would be a major stationary source under the PSD regulations. As such, the facilities must undergo BACT review for any pollutants that exceed the PSD major threshold values. For the proposed facilities, emissions of CO, NOx, $PM/PM_{10}/PM_{2.5}$, and GHGs exceed the PSD major threshold ton per year values of 100, 40, 25/15/10, and 100,000, respectively (see Table 1-1). As a result, any emission unit which emits any of these pollutants must undergo BACT review for each pollutant emitted. For example, if a combustion source emits CO, NOx, $PM/PM_{10}/PM_{2.5}$, and GHGs, the combustion source must have separate BACT determinations (proposed emission limits) for each pollutant emitted by the proposed project in excess of the PSD threshold value.

As part of the BACT review, the use of alternative raw materials, production processes, or products that would be inconsistent with the fundamental objectives or basic design would impermissibly redefine the source and are not a part of the BACT analysis. Since 1988, EPA has recognized that BACT options that fundamentally redefine the proposed source may be excluded at Step 1 of the analysis.[1] Recent EPA decisions emphasize the need for a strong record showing that the excluded option would disrupt the applicant's basic business purpose for the proposed facility. The business object of the proposed facilities is the manufacture of SOP and Langbeinite from polyhalite mined nearby.

[1] Defining and Redefining the "Source" for the PSD BACT Analysis; Brian Doster, Air and Radiation Law Office, EPA Office of General Counsel, February 3, 2010.

3.2 TECHNICAL FEASIBILITY

Step 2 of the BACT analysis involves the evaluation of all of the identified available control technologies from Step 1 to determine their technical feasibility. A control technology is technically feasible if it has been previously installed and operated successfully at a similar emission source, or there is technical agreement that the technology can be applied to the emission source. Technical infeasibility is demonstrated through clear physical, chemical, or other engineering principles that demonstrate that technical difficulties preclude the successful use of the control option.

The technology must be commercially available for it to be considered as a candidate for BACT. The 1990 Draft Workshop Manual, states, "Technologies which have not yet been applied to (or permitted for) full scale operations need not be considered available; an applicant should be able to purchase or construct a process or control device that has already been demonstrated in practice."[2]

In general, if a control technology has been "demonstrated" successfully for the type of emission source under review, then it would normally be considered technically feasible. For an undemonstrated technology, "availability" and "applicability" determine technical feasibility. Page B.17 of the 1990 Draft Workshop Manual states:

> *Two key concepts are important in determining whether an undemonstrated technology is feasible: "availability" and "applicability." As explained in more detail below, a technology is considered "available" if it can be obtained by the applicant through commercial channels or is otherwise available within the common sense meaning of the term. An available technology is "applicable" if it can reasonably be installed and operated on the source type under consideration. A technology that is available and applicable is technically feasible.*
>
> *Availability in this context is further explained using the following process commonly used for bringing a control technology concept to reality as a commercial product:*

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[2] New Source Review Workshop Manual, Draft 1990, page B-12.

- *concept stage;*
- *research and patenting;*
- *bench scale or laboratory testing;*
- *pilot scale testing;*
- *licensing and commercial demonstration; and*
- *commercial sales.*

Note that some vendors will provide guarantees and commercial sale of technology that has not been sufficiently demonstrated commercially. Doing so can lead to significant compliance issues.

Applicability involves not only commercial availability (as evidenced by past or expected near-term deployment on the same or similar type of emission source), but also involves consideration of the physical and chemical characteristics of the gas stream to be controlled. A control method applicable to one emission source may not be applicable to a similar source depending on differences in physical and chemical gas stream characteristics. Note that vendor guarantees alone do not constitute technical availability. The 1990 Draft Workshop Manual states the following:[3]

> *Vendor guarantees may provide an indication of commercial availability and the technical feasibility of a control technique and could contribute to a determination of technical feasibility or technical infeasibility, depending on circumstances. However, EPA does not consider a vendor guarantee alone to be sufficient justification that a control option will work.*

This caveat is noteworthy because there are many instances where vendor guarantees for emission control equipment have not been met. .

3.3 ECONOMIC FEASIBILITY

Economic feasibility is normally evaluated according to the average and incremental cost effectiveness of the control option. From the 1990 Draft Workshop Manual, average cost effectiveness is the annualized dollars per ton of pollutant reduced. The incremental cost

[3] New Source Review Workshop Manual, Draft 1990, page B.20.

effectiveness is the cost per ton reduced from the technology being evaluated as compared to the next lower emitting control technology. The 1990 Draft Workshop Manual states the following:[4]

"Cost effectiveness is the economic criterion used to assess the potential for achieving an objective at the least cost. Effectiveness is measured in terms of tons of pollutant emissions removed. Cost is measured in terms of annualized control costs. The Cost effectiveness calculations can be conducted on an average, or incremental basis. In addition to the average cost effectiveness of a control option, incremental cost effectiveness between control options should also be calculated. The incremental cost effectiveness should be examined in combination with the total cost effectiveness in order to justify elimination of a control option."

3.3.1 Average Cost Effectiveness

In the 1990 Draft Workshop Manual, average cost effectiveness is calculated as:

$$\text{Average Cost Effectiveness (\$ per ton removed)} = \frac{\text{Control option annualized cost}}{\text{Baseline emission rate} - \text{Control option emissions rate}}$$

The average cost effectiveness is based on the overall reduction in the air pollutant from the baseline emission rate in tons per year. In the 1990 Draft Workshop Manual, the EPA states that the baseline emission rate represents uncontrolled emissions for the source. However, the manual also states that when calculating the cost effectiveness of adding controls to inherently lower emitting processes, baseline emissions may be assumed to be the emissions from the lower emitting process itself. For example, any new pulverized coal boiler will be supplied with low NOx burners. This is because the burner vendors do not supply burners that are not low NOx. As such, the boiler/vendor NOx emission guarantee can be used as the baseline NOx emissions for a new pulverized coal fired boiler.

[4] New Source Review Workshop Manual, Draft 1990, page B-36 and 41.

3.3.2 Incremental Cost Effectiveness

In addition to determining the average cost effectiveness of a control option, the 1990 Draft Workshop Manual states that the incremental cost effectiveness between dominant control options should also be calculated. The incremental cost effectiveness compares the costs and emissions performance level of a control option to those of the next most stringent (i.e., higher emitting) control option:

$$\text{Incremental Cost (\$ per incremental ton removed)} = \frac{\text{Control option annualized cost} - \text{Next control option annualized cost}}{\text{Next control option emission rate} - \text{Control option emissions rate}}$$

Numerous permitting authorities have made decisions regarding the economic feasibility of air pollution controls. While cost effectiveness is determined on a case-by-case basis, incremental cost effectiveness is most often used for determining the economic impact of various control scenarios. This is because in many cases the average cost effectiveness is generally small and the difference in the average cost effectiveness for one control option versus another is small (e.g., $150 per ton versus $160 per ton). Typical incremental cost effectiveness values that are considered as cost infeasible for BACT range from $5,000 to $10,000 incremental cost per ton of incremental pollutant removed. These values vary by agency, state and region, and pollutant, and must be considered in context with the energy and environmental impacts.

4.0 COMBUSTION SOURCE BACT ANALYSES

As discussed in Section 2.3, the Ochoa Polyhalite Processing Plant will have a number of combustions sources as follows.

- Polyhalite Dryer/ Calciner/Cooler (3 total) (natural gas-fired)
- SOP Product Dryer (natural gas-fired)
- SOP Granulator Dryer (natural gas-fired)
- Langbeinite Product Dryer (natural gas-fired)
- Langbeinite Glazing/Conditioning (natural gas-fired)
- Boiler 1 & 2 (natural gas-fired)
- Emergency Use Engines (diesel)

The following subsections present the BACT analyses for CO, NOx, PM, and GHGs for all combustion sources except the emergency diesel engines. The BACT analyses for the emergency diesel engines are found in Section 5.

4.1 COMBUSTION SOURCE CARBON MONOXIDE BACT ANALYSES

CO is formed from the incomplete combustion of the natural gas used to dry/dehydrate/calcine the polyhalite, dry and granulate the SOP and Langbeinite products, and to generate hot water and steam in the process boilers. Incomplete combustion can also result in reduced calciner/dryer/boiler efficiency and emissions of particulate matter, volatile organic compounds, and organic hazardous air pollutants. The formation of CO is typically limited by ensuring complete and efficient combustion of the fuel in the calciner/dryers/boilers. High combustion temperatures, adequate excess air, and good air/fuel mixing during combustion minimize CO emissions. Measures taken to minimize the formation of NOx during combustion may inhibit complete combustion, which can increase CO emissions. Lowering combustion temperatures through staged-combustion to reduce NOx emissions can be counterproductive with regard to CO emissions. However, the improved air/fuel mixing that is inherent in newer low NOx burner (LNB) designs and combustion control systems help overcome the impact of fuel and/or air

staging on CO emissions. This section presents the CO BACT analysis for the proposed calciner/dryers/boilers.

4.1.1 Step 1 and 2. Identification of Available & Feasible CO Controls

The RACT/BACT/LAER Clearinghouse (RBLC)[5] database was reviewed for CO controls for kilns, calciners, dryers, furnaces and boilers. Table 4-1 summarizes the results of this review for natural-gas fired kilns/calciners/dryers, and Table 4-2 summarizes the results for boilers. Based on a review of the information provided in the RBLC database, and knowledge related to the control of CO emissions from combustion sources, the following controls were identified:

Oxidation catalyst, and
Good combustion practices.[6]

Oxidation catalysts have previously been applied to natural gas fired boilers located in CO and/or VOC nonattainment areas. RTP is unaware of the application of oxidation catalysts to kilns, calciners, and dryers.

The oxidation catalyst is typically a precious metal catalyst (e.g., platinum) that has been applied over a metal or ceramic substrate. Depending on the flue temperature and catalyst type, the catalyst is located in the flue gas temperature range of 400 to 1100 ^{o}F. The catalyst lowers the activation energy for the oxidation of CO so that it is oxidized at lower temperatures (400 to 1100°F) than seen at the burner (i.e., combustion zone).

Oxidation catalyst technology has been applied to 357 MMBtu/hr boilers (RBLC ID PA-0253), and as such is considered a demonstrated technology. The CO removal efficiency in natural gas fired systems is typically greater than 90 percent. The CO emission limits for two boiler permits requiring oxidation catalyst identified through the RBLC database are 0.015 and 0.019 lb/MMBtu.

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[5] RACT/BACT/LAER Clearinghouse; http://cfpub.epa.gov/RBLC/index.cfm?action=Home.Home&lang=en
[6] Also referred to as good combustion control, good equipment design and proper combustion.

Table 4-1. Summary of CO BACT Precedents for Natural Gas Fired Kilns/Calciners/Dryers/Furnaces

RBLC ID NO.	FACILITY NAME	PERMIT DATE	PROCESS DESCRIPTION	CAPACITY	CONTROL	EMISSION LIMIT Lb/MMBtu
MN-0061	ERIE NUGGET	06/26/2005	ROTARY HEARTH FURNACE	600000 metric tons per year	Thermal oxidation	0.057 (3-hr average)
OK-0111	MUSKOGEE PORCELAIN FLOOR TILE PLT	10/14/2005	KILNS	30.36 MMBtu/hr	GCP	0.065 (calculated)
OK-0110	MUSKOGEE PORCELAIN FLOOR TILE PLT	10/21/2005	KILNS	30.36 MMBtu/hr	GCP	0.065 (calculated)
IN-0119	AUBURN NUGGET	05/31/2005	PRODUCT SEPARATOR/DRYER	33 Tons/hr	Not identified	0.071 (calculated) (3-hr average)
IN-0119	AUBURN NUGGET	05/31/2005	ORE DRYER	125 Tons/hr	Not identified	0.080 (calculated) (3-hr average)
IN-0119	AUBURN NUGGET	05/31/2005	COAL DRYER	33 Tons/hr	Not identified	0.083 (calculated) (3-hr average)
OH-0231	TOLEDO EDISON CO. - BAYSHORE PLANT	07/31/2003	LIMESTONE DRYER	276,000 Tons/year	Not identified	0.083 (calculated)
OK-0110	MUSKOGEE PORCELAIN FLOOR TILE PLT	10/14/2005	VERTICLE DRYERS	6.42 MMBtu/hr	GCP	0.165 (calculated)
OK-0111	MUSKOGEE PORCELAIN FLOOR TILE PLT	10/21/2005	VERTICLE DRYERS	6.42 MMBtu/hr	GCP	0.198 (calculated)
IN-0119	AUBURN NUGGET	05/31/2005	GREEN BALL DRYER	153.25 Tons/hr	Not identified	0.278 (calculated)

RBLC ID NO.	FACILITY NAME	PERMIT DATE	PROCESS DESCRIPTION	CAPACITY	CONTROL	EMISSION LIMIT Lb/MMBtu
						(3-hr average)
OR-0042	EAGLE-PICHER VALE, OREGON PLANT	05/23/2003	DRYER 2/CALCINER 2	Dryer 20 MMBtu/hr/Calciner 45 MMBtu/hr	GOOD COMBUSTION PRACTICES	0.329 (calculated)
OR-0042	EAGLE-PICHER VALE, OREGON PLANT	05/23/2003	DRYER 1/CALCINER 1	Dryer 20 MMBtu/hr/Calciner 40 MMBtu/hr	GOOD COMBUSTION CONTROL	0.329 (calculated)

Table 4-2. Summary of CO BACT Precedents for Natural Gas Fired Boilers

RBLC ID NO.	FACILITY NAME	PERMIT DATE	PROCESS DESCRIPTION	CAPACITY (MMBtu/hr)	CONTROL	EMISSION LIMIT Lb/MMBtu
FL-0330	PORT DOLPHIN ENERGY LLC	12/01/2011 [a]	BOILERS (4)	278	Oxidation catalyst [a]	0.015 (3-hour rolling average)
AZ-0046	ARIZONA CLEAN FUELS YUMA	04/14/2005	STEAM BOILERS NOS. 1 AND 2	419	Not specified	0.016 (3-hour average)
PA-0253	CONOCOPHILLIPS TRAINER REFINERY	02/06/2007	BOILER 9 & 20	357 (calculated)	CO catalyst	0.019 (calculated) (12 consecutive months)
LA-0248	DIRECT REDUCTION IRON PLANT	01/27/2011	DRI-109 & 209 – PACKAGE BOILERS	201 (calculated)	GCP	0.039
MN-0062	HEARTLAND CORN PRODUCTS	12/22/2005	BOILER	198	Not specified	0.04
WA-0301	BP CHERRY POINT REFINERY	04/20/2005	BOILER, NATURAL GAS	363	GCP	0.05 (24-hour average)
SC-0091	COLUMBIA ENERGY CENTER	07/03/2003	BOILER	550	GCP	0.06
TX-0373	ODESSA PETROCHEMICAL PLANT	10/24/2002	F BOILER STACK, EYFBLRST	370	GCP	0.065
TX-0479	DOW TEXAS OPERATIONS FREEPORT	12/02/2004	FOUR GAS-FIRED STEAM BOILERS	410	GCP	0.068 (calculated)
TX-0511	BASF ETHYLENE/PROPYLENE CRACKER	02/03/2006	BOILER (2)	425.4	Not specified	0.07 (calculated)
LA-0174	PORT HUDSON OPERATIONS	01/25/2002	POWER BOILER NO. 5	987	GCP	0.07
IA-0088	ADM CORN PROCESSING - CEDAR RAPIDS	06/29/2007	NATURAL GAS BOILER	292.5	GCP	0.072 (30-day rolling average)
ID-0017	POWER COUNTY ADVANCED ENERGY CENTER	02/10/2009	250 MMBTU/H PACKAGE BOILER, SRC24	250	GCP	0.074
OH-0241	MILLER BREWING COMPANY - TRENTON	05/27/2004	BOILER (2), NATURAL GAS	238	Not specified	0.084
TX-0373	ODESSA PETROCHEMICAL PLANT	10/24/2002	C BOILER STACK, EY003ST	320	GCP	0.084
ND-0025	CASSELTON PLANT	12/20/2007	BOILER	480	Not specified	0.09 (calculated) (3-hour average)

RBLC ID NO.	FACILITY NAME	PERMIT DATE	PROCESS DESCRIPTION	CAPACITY (MMBtu/hr)	CONTROL	EMISSION LIMIT Lb/MMBtu
LA-0184	TITANIUM DIOXIDE FACILITY	05/13/2003	UTILITY BOILERS D841-1X & D841-2X	135	GCP	0.091
VA-0278	VCU EAST PLANT	03/31/2003	BOILER, NATURAL GAS, (3)	150.6	GCP	0.1
VA-0270	VCU EAST PLANT	03/31/2003	BOILER NATUAL GAS	150	GCP	0.1
AL-0199	WEYERHAEUSER COMPANY	11/15/2002	BOILER	300	Not specified	0.1
LA-0233	LAKE CHARLES COMPLEX	01/30/2009	3(K-6)8 POWERHOUSE BOILER B-5A	337.6	GCP	0.12 (calculated)
WI-0244	APPLETON COATED COMBINED LOCKS MILL	06/19/2007	BOILER B05 (#11) NATURAL GAS / DISTILLATE OIL FIRED BOILER	285	GCP	0.12
NE-0024	CARGILL - BLAIR PLANT	06/22/2004	BOILER D (NO. 21)	276.67	GCP	0.14 (3-hour)
LA-0229	SHINTECH PLAQUEMINE PLANT 2	07/10/2008	EQT112, EQT113 - TWO UTIL. BOILERS (2U-1, 2U-2)	250	GCP	0.362

GCP- good combustion practices. Also referred to as good combustion control, and good equipment design and proper combustion.
a- From Permit to Construct, Permit Number DPA-EPA-R4001, Dec. 01, 2011.

Good combustion practices, as the name implies, are based upon maintaining good fuel/air mixing, a proper fuel/air ratio, and adequate time at the required combustion temperature. The CO emission limits for GCP, identified in the RBLC database, range from 0.016 to 0.14 lb/MMBtu. The project permitted with the 0.016 lb CO/MMBtu emission limit was never built. The next lowest permit limit based on GCP is 0.039 lb/MMBtu. The analysis of this control will be carried through Step 4 to demonstrate that the application is economically infeasible as CO BACT for small boilers.

The application of oxidation catalyst on the calciner and dryers is considered technically infeasible for a number of reasons. First, the technology has not been demonstrated previously. Second, the application of oxidation catalyst is physically not feasible. Previous applications of oxidation catalyst are on clean natural gas flue gas streams. The flue gas streams from the calciner and dryers contain significant particulate matter which would plug up the oxidation catalyst rendering it ineffective. Application of the oxidation catalyst after the calciner and dryer baghouses would place the catalyst at or below the minimum operating temperature. Reheating the flue gases would significantly increase the cost of oxidation catalyst and increase the emissions of greenhouse gases from the project. For the above reasons, the application of oxidation catalyst to the proposed calciners and dryers is considered infeasible. However, the analysis of this control will be carried through Step 4 to demonstrate that the application is economically infeasible as BACT for CO.

4.1.2 Step 3: Ranking of Technically Feasible CO Controls

Good combustion practices (GCP) is considered the baseline control technology for the emissions of CO for the proposed calciners, dryers, and boilers.

For the calciners and dryers, the addition of oxidation catalyst to reduce outlet emissions of CO to less than 0.015 lb/MMBtu is evaluated in Step 4. To achieve this level of CO emissions requires a control efficiency of approximately 90 percent when applied to the high end of the CO precedents. The BACT evaluation that follows considers the energy,

environmental, and economic impacts of oxidation catalyst relative to good combustion control.

For the boilers, the addition of an oxidation catalyst to reduce outlet emissions of CO to less than 0.015 lb/MMBtu is evaluated in Step 4. To achieve this level of CO emissions requires a control efficiency of approximately 90 percent when applied to the high end of the CO precedents. The BACT evaluation that follows considers the energy, environmental, and economic impacts of oxidation catalyst relative to good combustion control.

4.1.3 Step 4: Evaluation of the Most Effective CO Controls

The following BACT impacts analyses are divided into the dryer/dehydrator/calciners (DCC), SOP product dryer, and boiler oxidation catalyst evaluations. All oxidation catalyst costs were estimated using USEPA's CO$T-AIR spreadsheet for catalytic incinerators.[7] Capital costs were escalated to 2012 dollars using the Chemical Engineering Plant Cost Index.[8] The capital recovery factor is based on 7 percent cost of money and a 15 year equipment life.[9] A catalyst life of five years was assumed.

4.4.1.1 DCC Oxidation Catalyst BACT Impact Evaluation

This subsection documents the energy, environmental, and economic impacts associated with applying oxidation catalyst to the proposed calciners. A summary of the oxidation catalyst BACT impacts analyses is presented in Table 4-3.

Energy Impacts: The major energy impact of apply oxidation catalyst to the calciners is the energy cost required by the exhaust fan to overcome the increased pressure drop of the oxidation catalyst system calculated as ~7 inches of water. The power costs represent 27 percent of the annual cost of applying oxidation catalyst to the DCCs. Because it was

[7] CO$T-AIR Control Cost Spreadsheets, Second Edition, USEPA, July 1999, sheet TCI-CI3.
[8] Economic Indicators, page 60 Chemical Engineering; June 2013.
[9] Standard USEPA capital recovery factor of 0.11

assumed the calciner exhaust gas temperature of 475 ^{o}F was high enough to oxidize CO across the catalyst, the cost of exhaust gas preheat was avoided.

Environmental Impacts: The spent catalyst is composed of precious metals that are not considered toxic. This allows the catalyst to be handled and disposed of following normal waste procedures. Because of its precious metal content, the catalyst is often recycled by the manufacturer to recover the metals. The increased fan electric power due to the pressure drop across the catalyst increases the emission rate of other criteria pollutants, such as NOx, CO, and GHGs, wherever the power is generated.

Economic Impacts: The capital cost associated with the installation of an oxidation catalyst is estimated to be approximately $1.6 million per calciner. The capital cost of the oxidation catalyst system includes the catalyst, catalyst reactor, draft fans, and balance of plant equipment. The annual operating cost associated with the oxidation catalyst system is approximately $ 0.446 million per year. The annual operating costs include capital recovery, energy impacts, and operating and maintenance costs. A catalyst life of five years is assumed.

The GCP baseline used in Table 4-3 is based on a relatively high RBLC GCP emission rate of 0.15 lb/MMBtu. If the GCP emission rate for the proposed calciner is less than the 0.15 lb/MMBtu, then the cost effectiveness values would increase proportionally. Table 4-4 summarizes the impact of reducing the GCP emission rates over the range of permit precedents presented in Table 4-1. For example, the ratio of 0.15 lb/MMBtu to 0.037 lb/MMBtu is approximately four (0.15/0.037 = 4.05), and the resulting cost effectiveness value for 0.037 lb/MMBtu ($14,274) is approximately four times that of 0.15 lb/MMBtu ($3,521).

Table 4-3. Summary of DCC CO BACT Impacts Results

Parameter	Good Combustion Practices (GCP)	GCP + Oxidation Catalyst
Process Parameters:	**Dryer/Calciner/Cooler**	
Heat Input, MMBtu/hr	214	-
Exhaust Gas Flow, ACFM	286,000	-
Operating Hours/Year	8760	-
Environmental Impacts:		
CO Emitted, lb/MMBtu	0.15	0.015
CO Emitted, TPY	140.7	14.1
CO Control, %	Baseline	90%
CO Reduced, TPY	Baseline	126.7
Energy Impacts:		
Power, kW-hr/yr	Baseline	1,983,000
Reheat Fuel, MMBtu/yr	Baseline	0 [a]
Economic Impacts:		
Total Capital Cost	Baseline	$1,568,000
Total Annualized Cost	Baseline	$446,000
CO Incremental Cost Effectiveness	Baseline	$3,521
a- Assumes that calciner exhaust gas temperature is high enough at 475 ^{o}F to oxidize CO over the oxidation catalyst; no exhaust gas preheat required.		

Table 4-4. Summary of Cost Impacts Related to GCP Based Permit Precedents.

GCP Case Description	GCP Emission Rate		GCP + OC Emission Rate		Cost Effectiveness
	lb/MMBtu	Tons/yr	lb/MMBtu	Tons/yr	$/ton
RBLC High Value	0.150	141	0.015	14.1	$3,521
RBLC Middle Value	0.074	69.4	0.007	6.9	$7,137
RBLC Lowest Value	0.037	35	0.004	3.5	$14,274

4.4.1.2 Dryer Oxidation Catalyst BACT Impacts Evaluation

This subsection documents the energy, environmental, and economic impacts associated with applying oxidation catalyst to the largest of the proposed dryers (SOP product dryer).

An evaluation of the smaller dryers was not performed since the application of oxidation catalyst to these smaller exhaust streams would be even less cost effective (higher cost effectiveness values) than for the largest dryer. A summary of the oxidation catalyst impacts analyses is presented in Table 4-5.

Energy Impacts: The major energy impact of applying oxidation catalyst to the SOP dryer is the cost of reheating the dryer exhaust gas after it has passed through the baghouse. It was assumed that the dryer exhaust gas would have to be reheated from 250 ^{o}F to 400 ^{o}F. This amount of natural gas, even with a 70% recovery of the heat, represents 30 percent of the annual cost of applying oxidation catalyst to the SOP product dryer. The power costs required by the exhaust fan to overcome the increased pressure drop of the oxidation catalyst system represents 7 percent of the annual cost of applying oxidation catalyst to the SOP granulation dryer.

Environmental Impacts: The spent catalyst is composed of precious metals that are not considered toxic. This allows the catalyst to be handled and disposed of following normal waste procedures. Because of its precious metal content, the catalyst is often recycled by the manufacturer to recover the metals. The use of natural gas to reheat the dryer flue gas increases the emissions of the project slightly. The increased fan electric power due to the pressure drop across the catalyst increases the emission rate of criteria pollutants, such as NOx, CO, and GHGs, wherever the power is generated.

Economic Impacts: The capital cost associated with the installation of an oxidation catalyst is estimated to be approximately $0.2 million. The capital cost of the oxidation catalyst system includes the catalyst, catalyst reactor, flue gas reheat burner; draft fans; and balance of plant equipment.

Table 4-5. Summary of SOP Dryer CO BACT Impacts Results

Parameter	Good Combustion Practices (GCP)	GCP + Oxidation Catalyst
Process Parameters:		
Dryer Heat Input, MMBtu/hr	18.7	-
Exhaust Gas Flow, ACFM	33,474	-
Operating Hours/Year	8760	-
Environmental Impacts:		
CO Emitted, lb/MMBtu	0.15	0.015
CO Emitted, TPY	12.3	1.2
CO Control, %	Baseline	90%
CO Reduced, TPY	Baseline	11.1
Energy Impacts:		
Power, kW-hr/yr	Baseline	101,000
Reheat Fuel, MMBtu/yr	Baseline	6,000 [a]
Economic Impacts:		
Total Capital Cost	Baseline	$212,000
Total Annualized Cost	Baseline	$92,000
CO Incremental Cost Effectiveness	Baseline	$8,303
a- Preheating the dryer exhaust gases from 250 ^{o}F to 400 ^{o}F would be required.		

The annual operating cost associated with the oxidation catalyst system is approximately $92,000 per year. The annual operating costs include capital recovery, energy impacts, and operating and maintenance costs.

The GCP baseline used in Table 4-5 is based on a relatively high RBLC GCP emission rate of 0.15 lb/MMBtu. If the GCP emission rate for the proposed calciner is less than the 0.15 lb/MMBtu, then the cost effectiveness values would increase proportionally. Table 4-6 summarizes the impact of reducing the GCP emission rates over the range of permit precedents presented in Table 4-1. For example, the ratio of 0.15 lb/MMBtu to 0.037 lb/MMBtu is approximately four (0.15/0.037 = 4.05), and the resulting cost effectiveness value for 0.037 lb/MMBtu ($33,659) is approximately four times that of 0.15 lb/MMBtu ($8,303).

Table 4-6. Summary of Cost Impacts Related to GCP Based Permit Precedents.

GCP Case Description	GCP Emission Rate		GCP + OC Emission Rate		Cost Effectiveness
	lb/MMBtu	Tons/yr	lb/MMBtu	Tons/yr	$/ton
RBLC High Value	0.150	12.3	0.015	1.2	$8,303
RBLC Next Lowest Value	0.074	6.1	0.007	0.6	$16,829
RBLC Lowest Value	0.037	3.0	0.004	0.3	$33,659

4.1.3.1 Boiler Oxidation Catalyst Evaluation

This subsection documents the energy, environmental, and economic impacts associated with applying oxidation catalyst to the proposed boilers. A summary of the impacts analysis is presented in Table 4-7.

Table 4-7. Summary of Boiler CO BACT Impact Results

Parameter	Good Combustion Practices (GCP)	GCP + Oxidation Catalyst
Process Parameters:		
Boiler Heat Input, MMBtu/hr	155.9	-
Exhaust Gas Flow, ACFM	232,259	-
Operating Hours/Year	8760	-
Environmental Impacts:		
CO Emitted, lb/MMBtu	0.15	0.015
CO Emitted, TPY	102.4	10.2
CO Control, %	Baseline	90%
CO Reduced, TPY	Baseline	92.2
Energy Impacts:		
Power, kW-hr/yr	Baseline	412,000
Economic Impacts:		
Total Capital Cost	Baseline	$663,000
Total Annualized Cost	Baseline	$173,000
CO Incremental Cost Effectiveness	Baseline	$1,877

Environmental Impacts: The spent catalyst is composed of precious metals that are not considered toxic. This allows the catalyst to be handled and disposed of following normal waste procedures. Because of its precious metal content, the catalyst is often recycled by the manufacturer to recover the metals. The increased fan electric power due to the pressure drop across the catalyst increases the emission rate of other criteria pollutants, such as NOx, CO, and GHGs wherever the power is generated.

Energy Impacts: The major energy impact of apply oxidation catalyst to the boilers is the energy cost required by the exhaust fan to overcome the increased pressure drop of the oxidation catalyst system calculated as ~7 inches of water. The power costs represent 13 percent of the annual cost of applying oxidation catalyst to the boilers. It was assumed that the oxidation catalyst can be place in a high temperature zone of the boiler flue gas (before the boiler economizer) where the exhaust gas temperature of 400 ^{o}F or greater is high enough to oxidize CO across the catalyst, and as such, the cost of exhaust gas preheat was avoided.

Economic Impacts: The capital cost associated with the installation of an oxidation catalyst is estimated to be $0.7 million per boiler. The capital cost of the oxidation catalyst system includes the catalyst; catalyst housing, economizer modifications; and balance of plant equipment. The annual operating cost associated with the oxidation catalyst system is approximately $173,000 per year per boiler. The annual operating costs include capital recovery, catalyst replacement, energy impacts, operating personnel, and maintenance.

The resultant cost effectiveness associated with the use of oxidation catalyst is $1,877 per ton of CO removed. However, the GCP baseline used in Table 4-5 is based on the least stringent RBLC GCP emission rate of 0.15 lb/MMBtu. If the GCP emission rate for the proposed boilers is less than the 0.15 lb/MMBtu, then the cost effectiveness values would increase proportionally. Table 4-8 summarizes the impact of reducing the GCP emission rates over the range of permit precedents presented in Table 4-2. For example, the ratio of 0.15 lb/MMBtu to 0.037 lb/MMBtu is approximately four (0.15/0.037 = 4.05), and the

resulting cost effectiveness value for 0.037 lb/MMBtu ($7,608) is approximately four times that of 0.15 lb/MMBtu ($1,877).

Table 4-8. Summary of Cost Impacts Related to GCP Based Permit Precedents.

GCP Case Description	GCP Emission Rate		GCP + OC Emission Rate		Cost Effectiveness
	lb/MMBtu	Tons/yr	lb/MMBtu	Tons/yr	$/ton
RBLC Highest Value	0.150	102	0.015	10.2	$1,877
RBLC Next Lowest Value	0.050	34	0.005	3.4	$5,630
RBLC Lowest Value [a]	0.037	25	0.004	2.5	$7,608
a- excludes AZ-0046, Arizona Clean Fuels, limit of 0.016 lb/MMBtu because the project was never built, and the limit was not demonstrated as being technically feasible using GCP.					

4.1.4 Step 5: CO BACT Selection

4.1.4.1 CO BACT for DCCs

Installation of the oxidation catalyst will have negative energy, environmental, and economic impacts. In summary, the catalyst would increase the pressure drop through the DCC exhaust gas systems, resulting in increased electrical demand on the draft fans. The increased electrical demand will result in an increase in fuel consumption to provide electricity resulting in increased pollutant emissions (negative energy and environmental impacts). The negative economic impacts include the increased capital cost for the installation of the oxidation catalyst system, and increased operating cost due to periodic replacement of the catalyst.

ICP proposed a CO emission rate of 0.037 based on the lowest BACT limit found in RBLC based on GCP. Based on the energy, environmental, and economic (over $14,000 dollars per ton) impacts, the installation of oxidation catalyst is eliminated from consideration as BACT for CO emissions for the proposed calciners. ICP proposes to demonstrate compliance with the proposed limit using USEPA test method 10.

4.1.4.2 CO BACT for Dryers

Installation of the oxidation catalyst will have negative energy, environmental, and economic impacts. In summary, the catalyst would increase the pressure drop through the dryers exhaust gas systems, resulting in increased electrical demand on the draft fans. The increased electrical demand will result in an increase in fuel consumption to provide electricity resulting in increased pollutant emissions (negative energy and environmental impacts). The negative economic impacts include the increased capital cost for the installation of the oxidation catalyst system, and increased operating cost due to periodic replacement of the catalyst.

ICP proposed a CO emission rate of 0.037 based on the lowest BACT limit found in RBLC based on GCP. Based on the energy, environmental, and economic (over $33,000 dollars per ton) impacts, the installation of oxidation catalyst is eliminated from consideration as BACT for CO emissions for the proposed dryers. ICP proposes to demonstrate compliance with the proposed limit using USEPA test method 10.

4.1.4.3 CO BACT for Boilers

Installation of the oxidation catalyst will have negative energy, environmental, and economic impacts. In summary, the catalyst would increase the pressure drop through the boiler flue gas systems, resulting in increased electrical demand on the draft fans. The increased electrical demand will result in an increase in fuel consumption to provide electricity resulting in increased pollutant emissions (negative energy and environmental impacts). The negative economic impacts include the increased capital cost for the installation of the oxidation catalyst system, and increased operating cost due to periodic replacement of the catalyst.

ICP proposed a CO emission rate of 0.037 based on the lowest BACT limit found in RBLC based on GCP. Based on the energy, environmental, and economic (over $7,600 dollars per ton) impacts, the installation of oxidation catalyst is eliminated from consideration as BACT for CO emissions for the proposed boilers. ICP proposes to demonstrate compliance with the proposed limit using USEPA test method 10.

4.2 COMBUSTION SOURCE NITROGEN OXIDE BACT ANALYSES

Nitrogen oxides are formed as part of the combustion process and are generally classified in accordance with their formation mechanism as either thermal NOx or fuel NOx. Thermal NOx is formed by the thermal dissociation and subsequent reaction of the nitrogen and oxygen in the combustion air at high temperature. The amount of thermal NOx formation is a function of the boiler, calciner, and dryer burner design, flame temperature, residence time at flame temperature, and fuel/air ratios in the primary combustion zone. The rate of thermal NOx formation is an exponential function of the flame temperature.

Fuel NOx is formed by the gas-phase oxidation of the nitrogen that is chemically bound (i.e., CN compounds) in the fuel (i.e., char nitrogen). Fuel NOx formation is largely independent of combustion temperature and the nature of the organic nitrogen compound. Its formation is dependent on fuel nitrogen content and the amount of excess combustion air (i.e., the excess oxygen beyond the fuel's stoichiometric requirement). Natural gas contains negligible amounts of fuel bound nitrogen. As such, the predominant type of NOx that will be formed is thermal NOx.

The control of air/fuel stoichiometry is critical in achieving reductions in thermal NOx. Thermal NOx formation also decreases rapidly as the combustion temperature drops below the adiabatic flame temperature for a given stoichiometry. Maximum reduction of thermal NOx is achieved by simultaneous control of both combustion temperature and air/fuel stoichiometry.

4.2.1 Step 1: Identification of Available NOx Controls

Summary results from the NOx BACT precedent review for natural gas fired kilns/calciners/dryers and boilers are presented in Tables 4-9 and 4-10, respectively. As Table 4-9 shows, the use of good combustion control/practices (GCP) and low NOx burners (LNB) have been demonstrated as BACT for kilns, calciners, and dryers.

Table 4-9. Summary of NOx BACT Precedents for Natural Gas Fired Kilns/Calciners/Dryers

RBLC ID NO.	FACILITY NAME	PERMIT DATE	PROCESS DESCRIPTION	CAPACITY	CONTROL	EMISSION LIMIT Lb/MMBtu
IN-0119	AUBURN NUGGET	05/31/2005	PRODUCT SEPARATOR/DRYER	33 Tons/hr	LOW NOX BURNERS	0.042 (calculated) (3-hr average)
IN-0119	AUBURN NUGGET	05/31/2005	COAL DRYER	33 Tons/hr	LOW NOX BURNERS	0.049 (calculated) (3-hr average)
IN-0119	AUBURN NUGGET	05/31/2005	ORE DRYER	125 Tons/hr	LOW NOX BURNER	0.050 (calculated) (3-hr average)
OR-0042	EAGLE-PICHER VALE, OREGON PLANT	05/23/2003	DRYER 1/CALCINER 1	Dryer 20 MMBtu/hr/Calciner 45 MMBtu/hr	GOOD COMBUSTION CONTROL	0.102 (calculated)
OR-0042	EAGLE-PICHER VALE, OREGON PLANT	05/23/2003	DRYER 2/CALCINER 2	Dryer 20 MMBtu/hr/Calciner 40 MMBtu/hr	GOOD COMBUSTION PRACTICES	0.118 (calculated)
MN-0061	ERIE NUGGET	06/26/2005	ROTARY HEARTH FURNACE	600,000 metric tons per year	GOOD DESIGN AND LOW NOX BURNERS	0.119 (3-hr average) (calculated)
TN-0157	HOEGANAES CORP.	12/31/2003	ROTARY KILN	16 MMBtu/hr	PROPER COMBUSTION CONTROL	0.143 (calculated)
IN-0119	AUBURN NUGGET	05/31/2005	GREEN BALL DRYER	153.25 Tons/hr	LOW NOX BURNERS	0.162 (calculated) (3-hr average)
MN-0061	ERIE NUGGET	06/26/2005	GREEN BALL DRYER	200 metric tons/hr	LOW NOX BURNERS.	0.25

Table 4-10. Summary of NOx BACT Precedent for Natural Gas Fired Boilers

RBLC ID NO.	FACILITY NAME	PERMIT DATE	PROCESS DESCRIPTION	CAPACITY (MMBtu/hr)	CONTROL	EMISSION LIMIT Lb/MMBtu
LA-0248	DIRECT REDUCTION IRON PLANT	01/27/2011	DRI-109 & 209 – PACKAGE BOILERS	201 (calculated)	LNB & SCR	0.0032
PA-0253	CONOCOPHILLIPS TRAINER REFINERY	02/06/2007	BOILER 9 & 20	357 (calculated)	LNB, & FGR & SCR	0.008 (calculated) (12 consecutive months)
FL-0330	PORT DOLPHIN ENERGY LLC	12/01/2011	BOILERS (4)	278	SCR	0.012 (3-hour rolling average)
AZ-0046	ARIZONA CLEAN FUELS YUMA	04/14/2005	STEAM BOILERS NOS. 1 AND 2	419	LNB & FGR	0.0125 (3-hour average)
TX-0511	BASF ETHYLENE/PROPYLENE CRACKER	02/03/2006	BOILER (2) (Permitted to burn NG, high pressure fuel gas, C4-Acetylene and C4 vent stream fuels)	425.4	SCR [a]	0.01 [a]
TX-0479	DOW TEXAS OPERATIONS FREEPORT	12/02/2004	FOUR GAS-FIRED STEAM BOILERS (permitted to burn NG, offgas, syngas, and hydrogen)	410	LNB & SCR	0.02
ID-0017	POWER COUNTY ADVANCED ENERGY CENTER	02/10/2009	250 MMBTU/H PACKAGE BOILER, SRC24	250	LNB & FGR	0.02
IA-0088	ADM CORN PROCESSING - CEDAR RAPIDS	06/29/2007	NATURAL GAS BOILER	292.5	LNB & FGR & GCP	0.02 (30-day rolling average)
ID-0017	POWER COUNTY ADVANCED ENERGY CENTER	02/10/2009	PACKAGE BOILER, SRC24	250	BACT for the package boiler is selected to be low NOx burners combined with selective catalytic reduction	0.02
TX-0461	WR COWLEY SUGAR HOUSE	10/10/2003	BOILER 5	223 (calculated)	GCP	0.027 (calculated)

RBLC ID NO.	FACILITY NAME	PERMIT DATE	PROCESS DESCRIPTION	CAPACITY (MMBtu/hr)	CONTROL	EMISSION LIMIT Lb/MMBtu
WA-0301	BP CHERRY POINT REFINERY	04/20/2005	BOILER	363	ULNB + FGR	0.028
ND-0025	CASSELTON PLANT	12/20/2007	BOILER	480	LNB & FGR	0.033 (calculated) (30-day rolling average)
LA-0177	SEA ROBIN GAS PROCESSING PLANT	09/08/2005	NATURAL GAS-FIRED BOILER	363	LNB & FGR	0.04 (hourly)
SC-0091	COLUMBIA ENERGY CENTER	07/03/2003	BOILER	550	LNB & FGR	0.04
WI-0244	APPLETON COATED COMBINED LOCKS MILL	06/19/2007	BOILER B05 (#11) NATURAL GAS / DISTILLATE OIL FIRED BOILER	285	GASEOUS FUELS & LNB & FGR	0.05
NE-0024	CARGILL - BLAIR PLANT	06/22/2004	BOILER D (NO. 21)	277	LNB & FGR	0.05 (30-day rolling average)
AL-0199	WEYERHAEUSER COMPANY	11/15/2002	BOILER	300	LNB	0.05
TX-0373	ODESSA PETROCHEMICAL PLANT	10/24/2002	F BOILER STACK	370	GASEOUS FUELS & LNB & FGR	0.05
NE-0024	CARGILL - BLAIR PLANT	06/22/2004	BOILERS A, B & C	198	LNB & FGR	0.07
LA-0174	PORT HUDSON OPERATIONS	01/25/2002	POWER BOILER NO. 5	987	LNB	0.1
TX-0373	ODESSA PETROCHEMICAL PLANT	10/24/2002	C BOILER STACK	320	NONE INDICATED	0.12

[a] Special Conditions Texas Permits 36644, PSD-TX-903M2, and N-007M1, January 19, 2007.
LNB- low NOx burners, SCR- selective catalytic reduction, FGR- internal or external flue gas recirculation, GCP- good combustion practices

As Table 4-10 shows, there are four fundamental categories of NOx emission controls that are demonstrated for natural gas fired boilers: GCP, LNB, Flue Gas Recirculation (FGR), and post-combustion catalytic control to selectively reduce NOx emissions (referred to as selective catalytic reduction or SCR). Other NOx control technologies applied to large gas, oil, and coal-fired utility boilers include over-fire-air (OFA), fuel reburn (FR), and selective non-catalytic reduction (SNCR).

4.2.2 Step 2: Technical Feasibility of Available NOx Controls

The following NOx controls are considered to be demonstrated on natural gas fired calciners and dryers like those proposed by ICP: GCPs, and LNBs. However, the technical feasibility of SCR on the proposed DCCs and dryer emissions is unknown. ICP is not aware of any applications of SCR on calciners and dryers similar to those being proposed herein. A major concern is with the particulate matter that passes through the baghouses. This particulate matter is very alkaline and contains very high levels of alkali metals (potassium, magnesium, and calcium), which are known to poison SCR catalyst.[10] [11] [12] However, for the purposes of this BACT analyses, SCR will be further addressed in Steps 3 through 5 to demonstrate that the cost effectiveness of SCR on these applications is not BACT.

The following NOx controls are considered to be demonstrated on natural gas fired boilers: GCPs, LNBs, FGR, and SCR. As a result, these controls are further addressed in Steps 3 through 5. The technical feasibility of OFA, FR, and SNCR are evaluated further under Step 2 using the previously discussed criteria: applicability, availability, and demonstrated in practice. For each of these controls a general description of each control technology and technical feasibility conclusions are presented.

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[10] SCR DeNOx catalyst considerations when using biomass in power generation. Hans Jensen-Holm, Francesco Castellino and T. Nathan White Haldor Topsøe A/S, 55 Nymøllevej, 2800 Lyngby, Denmark and Haldor Topsøe, Inc., 17629 El Camino Real, Houston, TX 77058, USA.

[11] Deactivation of Vanadia Catalyst in the Selective Catalytic Reduction Process, J.P. Chen, et. al. October 1990; Journal of Air and Waste Management, Association.

[12] Thermochemical Equilibrium Modeling of Selective Catalytic Reduction (SRC) Catalyst Poisons http://www.epri.com/abstracts/Pages/ProductAbstract.aspx?ProductId=000000000001023932

Over-Fire-Air: OFA is a staged combustion NOx control technology where combustion air is diverted from being entirely introduced through and around the burners. The air that is not introduced in and around the burners is injected further down the boiler furnace flow path to provide the necessary air for complete combustion. This technology results in low excess air or fuel rich combustion in and around the burners, which suppresses the formation of NOx, and delays complete combustion until the remainder of the combustion air is added downstream of the main combustion zone. The OFA technology has its primary application in very large utility boilers, not in smaller natural gas fired industrial boilers like the proposed boilers

Although there has been some testing of OFA on natural gas fired package or similarly designed boilers, it is generally not considered practical from an installation and operation standpoint in a typical natural gas fired package boiler.[13] NOx control technologies such as LNB and FGR have been shown to be more effective at reducing NOx in package boiler applications. Because LNB and FGR are widely applied and preferred over the use of OFA, OFA is eliminated from the analysis based on its applicability.

Fuel Reburning Technology: Natural gas reburning is a NO_x control technique used primarily for reducing NO_x emissions from existing, coal-fired, electric utility boilers. Reburning redistributes a portion of both the fuel and air into the upper regions of the boiler furnace to create a second flame zone. This results in chemically reducing conditions that reduce the formation of NO_x in the primary combustion zone. In most pulverized coal-fired boilers, fuel reburning is conducted between the upper burner row and the furnace exit. Most reburn systems divert 10 to 20% of the total boiler heat input to the upper furnace. OFA ports located above the fuel injection ports provide the additional combustion air required to complete the combustion. Reburn systems are designed to maintain acceptable furnace and boiler performance while diverting heat

[13] Page 5-59 from Alternative Control Techniques Document – NOx Emissions from Industrial/Commercial /Institutional Boilers, March 1994; EPA-453/R-94-022.

release and absorption from the lower regions of the furnace. If reburn conditions are not controlled properly, high temperature corrosion problems can occur that can damage the boiler. RTP is not aware of any natural gas reburn projects on natural gas fired package boilers. Because LNB and FGR are widely applied and preferred over the use of natural gas reburning, natural gas reburning is eliminated from the analysis based on its applicability.

Selective Non-Catalytic Reduction (SNCR): SNCR systems use ammonia to reduce NOx emissions by injecting ammonia (NH_3) or urea into the flue gas stream upstream of the boiler convective heat transfer tubes. The chemical reactions involved in the ammonia SNCR process are:

$$4\ NO + 4\ NH_3 + O_2 \rightarrow 4\ N_2 + 6\ H_2O$$
$$6\ NO_2 + 8\ NH_3 \rightarrow 7\ N_2 + 12\ H_2O$$

In a SNCR control system, urea or ammonia is injected into the boiler where the flue gas temperature is approximately 1600 °F to 2100 °F. At these temperatures, the reagent, urea [$CO(NH_2)_2$] or ammonia [NH_3], reacts with the NO_x, forming elemental nitrogen [N_2] and water without the need for a catalyst. Multiple injection points are required to thoroughly mix the reagent into the boiler furnace. The limiting factor in an SNCR system is the ability to contact the NO_x with the reagent (NH_3) at a location where the reaction time, temperature, and optimal NH_3/NOx ratio can be maintained. If the reactant is injected in a region where the temperature is too high, it will oxidize to NOx. If the reactant is injected in a region where the temperature is too low, excess ammonia slip (emissions) will result.

SNCR has been widely used in circulating fluidized bed (CFB) boilers where the gas path temperature is favorable and where the high alkaline ash loading of the CFB boilers makes 'high dust' loading SCR systems technically infeasible.[14] The temperature range for optimum performance of SNCR technology is not as compatible with the design and

[14] Examples include the AES Puerto Rico facility, the Reliant Energy Seward Plant, the JEA Northside Units 1 and 2, the Kentucky Mountain Power project, and the East Kentucky Spurlock plant.

operation of natural gas fired package boilers. This is because the correct temperature range is typically located within the boiler convective pass sections, which makes it difficult to inject and distribute the reagent effectively. In addition, the rapid cooling that occurs in the convective section limits the reaction time. As a result, other NOx control options, such as FGR and SCR, are much more effective at reducing NOx from natural gas fired package boilers. Based on the technical limitations of SNCR when compared to SCR and FGR, SNCR is removed from further consideration.

4.2.3 Step 3: Ranking of Technically Feasible NO_X Controls

As noted above, the following control technologies are considered to be technically feasible for the proposed calciners and dryers:

1. GCP, and
2. LNB

Based on the precedents presented in Table 4-9, the hierarchy of technically feasible control technologies presented in Table 4-11 was developed. As shown, LNB & GCP with and without SCR and the various emission limits and averaging times are defined by the previous permit precedents.

Table 4-11. DCC/Dryer Hierarchy of Technically Feasible NOx Controls

Boiler NOx Control [a]	Emission Rate (lb/MMBtu)	Averaging Period
LNB+SCR	0.006 [b]	3-hour
LNB	0.042 - 0.162	3-hour
GCP	0.102 - 0.118	Not specified

[a] Use of gaseous fuels and GCP assumed for all cases.
[b] 85% reduction from 0.042 lb/MMBtu

For boilers, the following control technologies are considered to be technically feasible for the proposed boiler:

3. GCP, LNB, and FGR, and
4. GCP, LNB, and FGR followed by SCR technology.

Based on the precedents presented in 4-10, the hierarchy of technically feasible control technologies presented in Table 4-12 was developed. As shown, LNB & FGR with and without SCR and the various emission limits and averaging times are defined by the previous permit precedents.

Table 4-12. Boiler Hierarchy of Technically Feasible NOx Controls

Boiler NOx Control [a]	Emission Rate (lb/MMBtu)	Averaging Period
LNB+ FGR+ SCR	0.02 to 0.0032 [b]	3-hour to rolling 12-months
LNB+FGR	0.02 to 0.07	Not specified, hourly, 30-day rolling

[a] Use of gaseous fuels and GCP assumed for all cases.
[b] excludes AZ-0046, Arizona Clean Fuels, limit of 0.0125 lb/MMBtu because the project was never built, and the limit was not demonstrated as being technically feasible using GCP.

4.2.4 Step 4: Evaluation of Most Effective NOx Controls

The following NOx BACT impacts analyses are presented by DCC, SOP dryer, and boiler SCR evaluations. All SCR costs were estimated using USEPA's NOx Alternative Control Technology document SCR 1999 cost update.[15] Capital costs were escalated to 2012 dollars using the Chemical Engineering Plant Cost Index. The capital recovery factor is based on 7 percent cost of money and a 15 year equipment life.[16] A catalyst life of five years was assumed.

4.4.1.3 DCC SCR Impacts Evaluation

This subsection documents the energy, environmental, and economic impacts associated with applying SCR to the proposed DCCs. A summary of the SCR BACT impact analyses is presented in Table 4-13.

Energy Impacts: The major energy impact of apply SCR to the calciners is the energy cost required by the exhaust fan to overcome the increased pressure drop of the oxidation

[15] Appendix A.2.3 available at http: //www.epa.gov/ttn/nsr/gen/appendix.pdf.
[16] Standard USEPA capital recovery factor of 0.11

catalyst system calculated as ~7 inches of water. Because the calciner exhaust gas temperature of 475 ^{o}F is not high enough to reduce NOx across the SCR catalyst, flue gas preheat is necessary.

Table 4-13. Summary of DCC NOx BACT Impacts Results

Parameter	GCP + LNB + FGR	GCP + LNB + FGR + SCR
Process Parameters:	**Dryer/Dehydrator/Calciner**	
Heat Input, MMBtu/hr	214.2	-
Exhaust Gas Flow, ACFM	286,000	-
Operating Hours/Year	8760	-
Environmental Impacts:		
NOx Emitted, lb/MMBtu	0.042	0.006
NOx Emitted, TPY	39.4	5.9
NOx Control, %	Baseline	85%
NOx Reduced, TPY	Baseline	33.5
Energy Impacts:		
Power, kW-hr/yr	Baseline	5,919,000
Reheat Fuel, MMBtu/yr	Baseline	382,000
Economic Impacts:		
Total Capital Cost	Baseline	$1,258,000 [a]
Total Annualized Cost	Baseline	$2,535,000
NOx Incremental Cost Effectiveness	Baseline	$75,700

a- Although preheating the dryer exhaust gases from 475 ^{o}F to 650 ^{o}F would be required, no capital costs are included in this cost estimate for the exhaust gas reheat burner and the heat recovery exchanger.

Environmental Impacts: The spent catalyst is composed of metals that are not considered highly toxic. This allows the catalyst to be handled and disposed of following normal waste procedures. The increased fan electric power due to the pressure drop across the catalyst increases the emission rate of other criteria pollutants, such as NOx, CO, and GHGs, wherever the power is generated.

Economic Impacts: The capital cost associated with the installation of an SCR system is estimated to be approximately $1.3 million. The capital cost of the SCR system includes the catalyst, catalyst reactor, ammonia storage tank and injection system; draft fans; and

balance of plant equipment. The annual operating cost associated with the SCR system is approximately $2.5 million per year. The annual operating costs include capital recovery, energy impacts, and operating and maintenance costs.

4.4.1.4 Dryer BACT Impacts Evaluation

This subsection documents the energy, environmental, and economic impacts associated with applying SCR to the largest of the proposed dryers (SOP product dryer). An evaluation of the smaller dryers was not performed since the application of SCR to these smaller exhaust streams would be even less cost effective (higher cost effectiveness values) than for the largest dryer. A summary of the SCR impacts analyses is presented in Table 4-14.

Energy Impacts: The major energy impact of applying SCR to the SOP dryer is the cost of reheating the dryer exhaust gas after it has passed through the baghouse. It was assumed that the dryer exhaust gas would have to be reheated from 250 ^{o}F to 650 ^{o}F. This amount of natural gas, even with a 70% recovery of the heat, represents 28 percent of the annual cost of applying oxidation catalyst to the SOP dryer. Additionally, there is the energy impact of the exhaust fan to overcome the increased pressure drop of the oxidation catalyst system calculated as ~7 inches of water.

Environmental Impacts: The spent catalyst is composed of metals that are not considered toxic. This allows the catalyst to be handled and disposed of following normal waste procedures. The use of natural gas to reheat the dryer flue gas increases the emissions of the project slightly. The increased fan electric power due to the pressure drop across the catalyst increases the emission rate of criteria pollutants, such as NOx, CO, and GHGs, wherever the power is generated.

Economic Impacts: The capital cost associated with the installation of an SCR is estimated to be approximately $0.65 million. The capital cost of the SCR system includes the catalyst, catalyst reactor, draft fans; and balance of plant equipment. The annual operating cost associated with the SCR system is approximately $0.27 million per

year. The annual operating costs include capital recovery, energy impacts, and operating and maintenance costs.

Table 4-14. Summary of SOP Dryer NOx BACT Impact Results

Parameter	GCP+ULNB+FGR	GCP+ULNB+FGR+ SCR
Process Parameters:		
Dryer Heat Input, MMBtu/hr	18.7	-
Exhaust Gas Flow, ACFM	33,474	-
Operating Hours/Year	8760	-
Environmental Impacts:		
NOx Emitted, lb/MMBtu	0.042	0.006
NOx Emitted, TPY	3.4	0.5
NOx Control, %	Baseline	85%
NOx Reduced, TPY	Baseline	2.9
Energy Impacts:		
Power, kW-hr/yr	Baseline	101,000
Reheat Fuel, MMBtu/yr	Baseline	6,000
Economic Impacts:		
Total Capital Cost	Baseline	$652,000 [a]
Total Annualized Cost	Baseline	$270,000
NOx Incremental Cost Effectiveness	Baseline	$92,100

a- Although preheating the dryer exhaust gases from 250 ^{o}F to 650 ^{o}F would be required, no capital costs are included in this cost estimate for the exhaust gas reheat burner and the heat recovery exchanger.

4.2.4.1 Boiler SCR Evaluation

This subsection documents the energy, environmental, and economic impacts associated with applying SCR to the proposed boilers. A summary of the impacts analysis is presented in Table 4-15.

Environmental Impacts: The spent catalyst is composed of metals that are not considered toxic. This allows the catalyst to be handled and disposed of following normal waste procedures. The increased fan electric power due to the pressure drop across the catalyst increases the emission rate of other criteria pollutants, such as NOx, CO, and GHGs wherever the power is generated.

Energy Impacts: The major energy impact of apply SCR to the boilers is the energy cost required by the exhaust fan to overcome the increased pressure drop of the catalyst system calculated as ~7 inches of water. The power costs represent 11 percent of the annual cost of applying oxidation catalyst to the calciners. Because it was assumed the SCR can be placed where the gas temperature of 650 ^{o}F; the cost of exhaust gas preheat was avoided.

Economic Impacts: The capital cost associated with the installation of an oxidation catalyst is estimated to be $0.7 million per boiler. The capital cost of the oxidation catalyst system includes the catalyst; catalyst housing, economizer modifications; and balance of plant equipment. The annual operating cost associated with the oxidation catalyst system is over $0.23 million per year per boiler. The annual operating costs include capital recovery, catalyst replacement, energy impacts, operating personnel, and maintenance.

Table 4-15. Summary of Boiler NOx BACT Impact Results

Parameter	GCP+ULNB+FGR	GCP+ULNB+FGR+ SCR
Process Parameters:		
Boiler Heat Input, MMBtu/hr	155.9	-
Exhaust Gas Flow, ACFM	65,615	-
Operating Hours/Year	8760	-
Environmental Impacts:		
NOx Emitted, lb/MMBtu	0.02	0.003
NOx Emitted, TPY	13.7	2.0
NOx Control, %	Baseline	85%
NOx Reduced, TPY	Baseline	11.6
Energy Impacts:		
Power, kW-hr/yr	Baseline	412,000
Economic Impacts:		
Total Capital Cost	Baseline	$731,300
Total Annualized Cost	Baseline	$228,000
NOx Incremental Cost Effectiveness	Baseline	$19,600

4.2.5 Step 5: NOx BACT Selection

4.2.5.1 NOx BACT for DCCs

Installation of SCR will have negative energy, environmental, and economic impacts. In summary, the SCR would increase the pressure drop through the DCC exhaust gas systems, resulting in increased electrical demand on the draft fans. The increased electrical demand will result in an increase in fuel consumption to provide electricity resulting in increased pollutant emissions (negative energy and environmental impacts). The negative economic impacts include the increased capital cost for the installation of the SCR system, and increased operating cost due to periodic replacement of the catalyst.

ICP proposes Ultra Low NOx pre-mix type burner with multi-stage recirculation, and a NOx emission rate of 0.042 based on the lowest BACT limit found in RBLC based on GCP. Based on the energy, environmental, and economic (over $75,000 dollars per ton) impacts, the installation of SCR is eliminated from consideration as BACT for NOx

emissions for the proposed calciners. ICP proposes to demonstrate compliance with the proposed limit using USEPA test method 7E.

4.2.5.2 NOx BACT for Dryers

Installation of the SCR will have negative energy, environmental, and economic impacts. In summary, the SCR would increase the pressure drop through the dryer exhaust gas systems, resulting in increased electrical demand on the draft fans. The increased electrical demand will result in an increase in fuel consumption to provide electricity resulting in increased pollutant emissions (negative energy and environmental impacts). The negative economic impacts include the increased capital cost for the installation of the SCR system, and increased operating cost due to periodic replacement of the catalyst.

ICP proposed a NOx emission rate of 0.042 based on the lowest BACT limit found in RBLC based on GCP. Based on the energy, environmental, and economic (over $92,000 dollars per ton) impacts, the installation of SCR is eliminated from consideration as BACT for NOx emissions for the proposed dryers. ICP proposes to demonstrate compliance with the proposed limit using USEPA test method 7E.

4.2.5.3 NOx BACT for Boilers

Installation of SCR will have negative energy, environmental, and economic impacts. In summary, the SCR system would increase the pressure drop through the boiler flue gas systems, resulting in increased electrical demand on the draft fans. The increased electrical demand will result in an increase in fuel consumption to provide electricity resulting in increased pollutant emissions (negative energy and environmental impacts). The negative economic impacts include the increased capital cost for the installation of the SCR system, and increased operating cost due to periodic replacement of the catalyst.

ICP proposed a NOx emission rate of 0.02 based on the lowest BACT limit found in RBLC based for GCP+ULNB+FGR. Based on the energy, environmental, and economic (over $19,000 dollars per ton) impacts, the installation of SCR is eliminated from

consideration as BACT for NOx emissions for the proposed boilers. ICP proposes to demonstrate compliance with the proposed limit using USEPA test method 7E.

4.3 COMBUSTION SOURCE PM BACT ANALYSES

This BACT section addresses PM, PM_{10}, and $PM_{2.5}$. PM, PM_{10}, and $PM_{2.5}$ will be generally referred to as "PM" throughout of this section. Particulate matter from the combustion of natural gas is formed as condensed VOC from the incomplete combustion of the natural gas used to dry/dehydrate/calcine the polyhalite, dry and granulate the SOP and Langbeinite products, and to generate hot water and steam in the process boilers. Incomplete combustion can also result in reduced calciner/dryer/boiler efficiency and emissions of particulate matter, volatile organic compounds, and organic hazardous air pollutants. The formation of particulate is typically limited by ensuring complete and efficient combustion of the fuel in the calciner/dryers/boilers. High combustion temperatures, adequate excess air, and good air/fuel mixing during combustion minimize PM emissions. Measures taken to minimize the formation of NOx during combustion may inhibit complete combustion, which can increase PM emissions. Lowering combustion temperatures through staged-combustion to reduce NOx emissions can be counterproductive with regard to PM emissions. However, the improved air/fuel mixing that is inherent in newer low NOx burner (LNB) designs and combustion control systems help overcome the impact of fuel and/or air staging on PM emissions. Particulate matter from the combustion of natural gas is 2.5 microns and smaller ($PM_{2.5}$).

In addition to the $PM_{2.5}$ emissions from combusting natural gas, the DCCs and dryers have particulate matter entrained in the exhaust gases as a result of the calcining and drying processes which directly contact the solid materials being calcined and dried. These exhaust streams pass through fabric filter baghouses where greater than 99 percent of the entrained particulate matter is removed from the exhaust gases. Particulate matter from the exhaust streams that have passed through a baghouse is 10 microns and smaller (PM_{10}).

4.3.1 Step 1: Identification of Available PM Control Technologies

Summary results from the PM BACT precedent review for natural gas fired kilns/calciners/dryers and boilers are presented in Tables 4-16 and 4-17, respectively. As Table 4-16 shows, for kilns, calciners and dryers fabric filter baghouses are the predominate PM control method. Wet scrubbers (e.g. reverse jet scrubber) are only used when the flue gas is at or below the water saturation temperature or the particulate matter is sticky or the flue gas temperature is too hot for baghouse filter material.

As Table 4-17 shows, for natural gas fired boilers there are two fundamental categories of PM emission controls: good combustion practices (GCP) and the use of clean burning fuels (e.g., natural gas). Add-on controls, such as ESP's, baghouses, and scrubbers, have never been applied in the broader context on natural gas fired boilers.

Based on the BACT precedent information presented in Tables 4-16 and 4-17, and taking into account technology transfer from other combustion sources, the following PM emissions control technologies were identified as "available:"

1. Add-on control technologies including: electrostatic precipitators, baghouses or fabric collectors, and venturi or packed bed scrubbers;
2. Use of clean (i.e., low ash) and low sulfur fuels such as natural gas; and
3. Combustion controls and practices designed to minimize the production of soot.

4.3.2 Step 2: Technical Feasibility of PM Control Technologies

4.3.2.1 DCCs and Dryers

As noted above, data from the U.S. EPA's RBLC indicate that the technologies selected as BACT include primarily fabric filter baghouses and wet scrubbers. Other controls include mechanical collectors, such as multi-cyclones, and electrostatic precipitators.

Table 4-16. Summary of PM BACT Precedents for Natural Gas Fired Kilns/Calciners/Dryers

RBLC ID NO.	FACILITY NAME	PERMIT DATE	PROCESS DESCRIPTION	CAPACITY	CONTROL	EMISSION LIMIT gr/dscf
IN-0119	AUBURN NUGGET	05/31/2005	PRODUCT SEPARATOR/DRYER	33 Tons/hr 29 MMBtu/hr	BAGHOUSE	0.0052 FPM 0.015 FPM10 (3-hr average)
MS-0091	DUPONT DELISLE FACILITY	03/21/2011	LINE 2 ORE DRYER	30 MMBtu/hr	REVERSE JET SCRUBBER	0.0085 PM2.5 0.011 TPM10 (3-hr average)
IN-0119	AUBURN NUGGET	05/31/2005	COAL DRYER	33 Tons/hr 36 MMBtu/hr	BAGHOUSE	0.01 FPM 0.015 FPM10 (3-hr average)
IN-0119	AUBURN NUGGET	05/31/2005	ORE DRYER	125 Tons/hr 25 MMBtu/hr	BAGHOUSE	0.01 FPM 0.015 FPM10 (3-hr average)
MN-0061	ERIE NUGGET	06/26/2005	GREEN BALL DRYER	200 metric tons/hr	CYCLONE WITH BAGHOUSE	0.01 PM 0.015 FPM10 (3-hr average)
IN-0119	AUBURN NUGGET	05/31/2005	GREEN BALL DRYER	153 metric tons/hr 209 MMBtu/hr	BAGHOUSE	0.013 FPM 0.015 FPM10 (3-hr average)
OR-0042	EAGLE-PICHER VALE, OREGON PLANT	05/23/2003	DRYER 1/CALCINER 1	Dryer 20 MMBtu/hr/Calciner 45 MMBtu/hr	PULSE-JET BAGHOUSE	0.04 FPM 0.1 PM
OR-0042	EAGLE-PICHER VALE, OREGON PLANT	05/23/2003	DRYER 2/CALCINER 2	Dryer 20 MMBtu/hr/Calciner 40 MMBtu/hr	PULSE-JET BAGHOUSE	0.04 FPM 0.1 PM

Table 4-17. Summary of PM BACT Precedent for Natural Gas Fired Boilers

RBLC ID NO.	FACILITY NAME	PERMIT DATE	PROCESS DESCRIPTION	CAPACITY (MMBtu/hr)	CONTROL	EMISSION LIMIT lb/MMBtu
LA-0229	SHINTECH PLAQUEMINE PLANT 2	07/10/2008	TWO UTIL. BOILERS (2U-1, 2U-2)	250	GCP & CLEAN BURNING FUELS	0.005 TPM10
ID-0017	POWER COUNTY ADVANCED ENERGY CENTER	02/10/2009	PACKAGE BOILER SRC24	250	GCP	0.0052 PM & FPM10
OH-0310	AMERICAN MUNICIPAL POWER GENERATING STATION	10/08/2009	AUXILIARY BOILER	150	Not identified	0.0076 FPM10
GCP- good combustion practices						

Fabric Filter Baghouses

Fabric filter baghouse (FFB) were mentioned in the PM/PM_{10} control technology review. Fabric filter baghouses are very effective at reducing PM emissions, especially in the fine particle size ranges. As noted in the PM/PM_{10} analysis, the primary filtering media in a fabric filter baghouse is actually the filter cake rather than the fabric itself. The filter cake acts much like a fixed-bed reactor, contributing to greater absorption of pollutants, including fine particulate matter, sulfur dioxide (SO_2), sulfuric acid mist, mercury and hazardous air pollutants including hydrogen chloride (HCl) and hydrogen fluoride (HF). Since pollutants such as sulfuric acid mist, HCl, and HF directly contribute to condensable PM, fabric filter baghouses are also very effective at reducing the condensable portion of $PM_{2.5}$ emissions by controlling these $PM_{2.5}$ precursors in the baghouse. However, it is not expected that any of these $PM_{2.5}$ precursors will be in the DCC/dryer exhaust gases due to the relatively low process operating temperatures. The low process operating temperatures would not drive off and of the $PM_{2.5}$ precursor species even if sulfur (S), chlorine (Cl), and fluorine (F) is present in the polyhalite.

There is a wide variety of fabric filter material available for fabric filter baghouses. For reverse air baghouses, the most common fabric is a simple woven fabric such as woven fiberglass. For pulse jet baghouses, the most common fabric is a woven fabric backing called a “scrim” with a felted layer needle punched into the scrim. Other fabric materials include Nomex®, Ryton®, Gortex®, and Hyglass®.

FFs have several advantages when used for PM control including:

- High particulate matter control efficiencies.
- Relatively constant outlet grain loading over the entire dryer load range.
- Simple operation and maintenance.

The primary disadvantage of fabric filter baghouses is the relatively high pressure drop across the baghouse as compared to a dry ESP and the resulting increased fan power requirements.

Electrostatic precipitators

Electrostatic precipitators (ESP) are a common PM control system for heavy oil and solid fuel fired boilers. An ESP uses a large enclosure to slow the exhaust gas stream, which allows more time to electrostatically charge particulates and collect them in the ESP. An ESP is arranged in a series of fields which consist of negatively charged discharge electrodes and positively charged collection plates. The discharge electrodes impart a negative charge to particles in the gas stream. The negatively charged particles then migrate to the larger positively charged plates. PM collected on the plates is periodically removed by rapping the plate. Most of the PM knocked off the plates fall into collection hoppers for removal. A portion of the collected PM is re-entrained in the gas stream during rapping. This re-entrained PM is normally collected in subsequent sections of the ESP. ESP's may be located either upstream of the air heater (hot-side ESP) or downstream of the air heater (cold-side ESP). The location is selected to achieve the best PM resistivity conditions. Gas composition and temperature and particle composition all influence resistivity, which is a measure of the ability of a particle to retain an electrostatic charge. The ability to collect particles using electrostatic attraction is directly related to particle resistivity. If the particle resistivity is outside the design range, particle collection efficiency is reduced.

Factors affecting the PM collection efficiency of an ESP include flue gas flow rate through the ESP, total plate area, PM resistivity, voltage, and the sectionalization of the ESP. The smaller the collection area of the ESP, the narrower the acceptable resistivity range becomes. For boilers firing low sulfur fuels, a sulfur trioxide (SO_3) injection system can be used to condition the ash and reduce particulate resistivity. In addition, modern ESP controls allow the ESP operation to be optimized to maximize particulate control through overall ESP performance management, power optimization, and programmed cleaning cycles. Finally, good sectionalization and flue gas distribution is important to maximize ESP performance and reliability.

ESPs offer an important advantage over FFBs in that ESPs have lower pressure drop across the system. The lower pressure drop saves electric energy by reducing fan horsepower requirements, making the electric generating unit more efficient due to lower parasitic power consumption. However, with regard to the proposed calciner and dryer exhaust gas PM, very large ESPs would

be required due to the high PM resistivity. As such, FFBs are favored for control of the proposed calciner and dryer exhaust vents due to the lower cost and due to the higher control efficiencies that can be achieved using FFBs versus ESPs. The use of ESPs will not be evaluated further.

Wet Scrubbers

Wet scrubbers are used in many industrial processes to control PM emissions. Wet scrubbers reduce PM emissions through several mechanisms, including condensation, inertial impaction of PM with water droplets, and reactions of PM and PM precursors with the scrubber reagent.

There are many types of wet scrubbers, namely, spray towers, packed tower and venturi scrubbers. All of these scrubbers have one principal in common and that is to contact the particles in the flue gas with a liquid droplet. Once wetted or trapped inside a liquid droplet, the particle can be separated from the flue gas and washed away with the liquid stream.

Spray tower type scrubbers counter currently contact the flue gas with a liquid spray. The liquid spray is generated either using spray nozzles or high speed rotating disks. Spray tower type scrubbers typically have high removal efficiencies for large particles and are less effective as the particle size decreases. The spray tower type scrubbers have low energy costs associated with liquid pumping and flue gas compression (fan energy).

Packed tower type scrubbers counter currently contact the flue gas with a liquid cascading down through packing. The packing is wetted with the liquid and the particles in the flue gas are impacted on the wet packing as the flue gas flows up through the packing. Packed tower type scrubbers typically have higher removal efficiencies for small particles than do spray towers. However, packed towers are easily plugged if the particle loading is high and the particles are sticky in nature. The packed tower type scrubbers have low energy costs associated with liquid pumping and moderate energy costs for flue gas compression (fan energy). Packed tower type scrubbers can have high costs associated with lost production due to downtime for cleaning of the packing and with labor.

Venturi type scrubbers contact the flue gas with a liquid by forcing the liquid and gas through a small diameter pipe called a venturi throat. The compressed flue gas and liquid rapidly mix in the throat causing fine liquid droplets. After passing through the venturi throat, the flue gas and liquid droplets are well mixed as they are rapidly expanded in the expansion section of the venturi. Venturi type scrubbers have a range of removal efficiencies depending on the particle size and the amount of energy used to compress the liquid and flue gas through the venturi throat. To effectively remove fine small particles and to achieve low particulate outlet concentrations, a high energy venturi is required. The high energy venturi scrubbers have high energy costs associated with liquid pumping and with flue gas compression.

Wet scrubbers (e.g. reverse jet scrubber) are typically only used when the exhaust gas is at the water saturation temperature or the particulate matter is sticky or the flue gas temperature is too hot for FFB filter material. These situations do not exist with respect to the proposed calciner and dryer exhaust gases. As such, FFBs are favored for control of the proposed calciner and dryer exhaust vents due to the lower energy cost and due to the higher control efficiencies that can be achieved using FFBs versus wet scrubbers. The use of wet scrubbers will not be evaluated further.

Mechanical Collectors

Mechanical collectors (cyclones) are not as effective as FFBs for particulate matter control. Therefore, while mechanical collectors are a technically feasible BACT alternative, the performance of mechanical collectors is inferior to FFBs. Mechanical collectors are typically used before more effective control devices such as FFBs and ESPs. As such, FFBs are favored for control of the proposed calciner and dryer exhaust vents due to the higher control efficiencies that can be achieved using FFBs versus mechanical collectors. The use of mechanical collectors will not be evaluated further.

4.3.2.2 Boilers

As noted above, there are no known applications of add-on controls for PM emissions from boilers firing gaseous fuel. PM emissions from the subject sources are inherently low because 1)

gaseous fuels have no ash content that would contribute to the formation of PM and 2) the potential for soot formation is very low if GCPs are followed.

Add-on control technologies such as ESP's, baghouses, and scrubbers are considered technically infeasible for controlling PM emissions from the proposed natural gas fired boilers. This is because these technologies have design outlet PM emissions that are typically higher than what natural gas fired boilers emit, and because the technologies would be ineffective in removing any additional PM because any filterable PM from gaseous fuel combustion is very fine and cannot be effectively captured. The remaining control methods identified, including fuel specifications and good combustion design/practice are considered to be technically feasible.

4.3.3 Step 3: Ranking of Technically Feasible PM Control Technologies

For the proposed DCCs and dryers, FFBs have been selected as the most effective PM control technology. As such, there is no control hierarchy to propose and evaluate in Step 4.

For the boilers, GCP and use of natural gas have been selected as the most effective PM control technology. As such, there is no control hierarchy to propose and evaluate in Step 4.

4.3.4 Step 4: Evaluation of Most Effective PM Control Technologies

Since the most effective PM controls have been proposed for the DCCs, dryers, and boilers, this analysis moves to Step 5 for the selection/proposal of BACT limits.

4.3.5 Step 5: PM BACT Selection

4.3.5.1 PM BACT for DCCs and Dryers

The following table summarizes the range of PM limit determinations shown in Table 4-16 for FFBs:

Type of Particulate Matter[17]	Limit Range – gr/dscf
PM/FPM	0.0052 – 0.1
FPM10	0.015

ICP proposes a baghouse emission limit of 0.0052 gr/dscf, which is the low range of the permit limits for DCCs and dryers. ICP proposes to demonstrate compliance with the proposed limit using USEPA test method 201. A condensable PM limit is not proposed because condensables (organics, HF, SO2, HCl, etc.) are not expected to exist from the natural gas fired calciners and dryers. Additionally, all PM emitted from the FFBs will be smaller than PM2.5, as FFBs are very effective at removing PM greater in size than PM2.5.

4.3.5.2 PM BACT for Boilers

The following table summarizes the range of PM limit determinations shown in Table 4-17 for GCPs:

Type of Particulate Matter	Limit Range – lb/MMBtu
PM	0.0052
FPM10	0.0052-0.0076
TPM10	0.005

ICP proposes a boiler limit of 0.0052 lb/MMBtu which is the low range of the permit limits for boilers. ICP proposes to demonstrate compliance with the proposed limit using USEPA test method 201. A condensable PM limit is not proposed because condensables (organics, HF, SO2, HCl, etc.) are not expected to be significant from the natural gas fired boilers.

4.4 COMBUSTION SOURCE GREENHOUSE GAS EMISSIONS

The GHG pollutants emitted from the Ochoa plant combustion sources are carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). The proposed combustion sources combust natural gas, and will emit CH_4, CO_2, and N_2O as products of combustion. All fossil fuels, including

[17] In the RBLC database PM, FPM, and FPM10 refer to filterable PM as would be measured using reference methods 5 or 201. TPM and PM2.5 would include filterable and condensable PM.

natural gas, contain carbon, and much of the heat released comes from the oxidation of the carbon in the fuel to form CO_2. Methane from the combustion of fossil fuels is a product of incomplete combustion, and is emitted in much smaller quantities than CO_2. Trace quantities of N_2O are generated by oxidation of fuel nitrogen content and of nitrogen in the air used for combustion.

The GHG emissions are combined on a CO_2 equivalent (CO_2e) basis using the global warming potential (GWP), which is a relative measure of how much heat a GHG traps in the atmosphere as compared the amount of heat trapped by CO_2. The GWP for methane is 21 (21 times that of CO_2), and nitrous oxide is 310 (310 times that of CO_2). The major sources of CO_2e are from the boilers and calciners. Because the amount of N_2O and CH_4 emitted is very small (less than 1 percent) relative to the amount of CO_2 emitted on a CO_2e basis, the GHG BACT analyses will only address control of CO_2.

4.4.1 Step 1 - Identify Available GHG Controls.

There are three broad strategies for reducing the amount of GHG emissions from the Ochoa plant combustion sources: energy efficiency, use of low carbon fuels, and carbon capture and sequestration. The "top" control strategy is the use of carbon capture and sequestration (CCS), followed by the use of low carbon fuels and energy efficiency.

4.4.1.1 Carbon Capture and Sequestration (CCS)

CCS is an approach to mitigating global warming by capturing CO_2 from large industrial facilities, such as large power plants, and subsequently (and permanently) storing it instead of releasing it into the atmosphere. The process involves three main steps:

- Capturing CO_2, at its source, by separating it from other gases produced;
- Transporting the captured CO_2 to a suitable storage location (typically in compressed, liquid form which requires dehydration and compression of the CO_2); and
- Storing the CO_2 away from the atmosphere for a long period of time in underground geological formations, in the deep ocean, or within certain mineral formations.

The use of recovered CO_2 for reuse to carbonate soft drinks or to produce dry ice is not considered because these reuse options do not permanently sequester CO_2.

The CO_2 produced by the combustion of natural gas can be concentrated through post-combustion methods or through pre-combustion methods. Post-combustion methods are applied to conventional combustion systems using air and carbon-containing fuels in order to isolate/concentrate the CO_2 from the combustion exhaust gases.

The processes for capturing CO_2 from air combusted exhaust gas are technically feasible, but require additional energy. The increased energy needs result in increases in emissions of CO_2 and other regulated air pollutants. Therefore, when evaluating CO_2 capture methods, the avoided CO_2 is equal to the CO_2 captured minus the CO_2 created in capturing the CO_2. Technologies for post-combustion capture include:

- Chemical absorption (generally using amines) - currently, the most common method for CO_2 capture. Monoethanolamine (MEA) solvent has the advantage of fast reaction with CO_2 at low partial pressure which is found in most combustion flue gases. However, the main concerns with MEA and other amine solvents are: corrosion due to the presence of O_2 and other impurities in the flue gas, high solvent degradation rates because of solvent irreversible reactions with SO_2 and NOx, and the large amount of energy required for solvent regeneration.
- Physical absorption (e.g., Selexol®) – absorption process at high pressure and low temperature, commonly used for CO_2 rejection from natural gas. Use of physical absorption for CO_2 capture from combustion exhaust gas would entail a significant amount of gas compression capacity and a significant energy penalty.
- Calcium cycle separation - quicklime-based capture that yields limestone, which is then heated, thereby releasing CO_2 and producing quicklime again for recycling. Research and development work is still required to obtain adequate sorbent stability after regeneration.
- Cryogenic separation - based on solidifying CO_2 by frosting it to separate it out; the low concentration of CO_2 in the exhaust gas from conventional air-based combustion processes renders this technology impractical.
- Membrane separation - Commonly used for CO_2 removal from natural gas at high pressure and high CO_2 concentration. Low CO_2 concentration in combustion exhaust gas makes membrane separation uneconomical due to high energy penalties. Research and

development work is still required to develop the membranes themselves, on their optimization for large-scale CO_2 recovery, and on minimizing the energy required for separation.

- Adsorption – Exhaust gas is fed through a bed of solid material with high surface areas, such as zeolites or activated carbon. These materials can preferentially adsorb CO_2 while allowing other gases (e.g., nitrogen) to pass through. Fully saturated bed is regenerated by either pressure swing (low pressure), temperature swing (high temperature), or electric swing (low voltage) desorption. Adsorption would require either a high degree of compression or multiple separation steps to produce high CO_2 concentration from exhaust gas. The associated capital and operating costs are high.

There are additional potential CO_2 reduction measures that are still in laboratory or conceptual stages of development, but will not be discussed here because they have not approached commercial demonstration status.

There are two pre-combustion CO_2 capture techniques being considered: direct use of oxygen and indirect use of oxygen. Both direct and indirect uses of oxygen are accompanied by additional cost and significant energy penalty for installation and operation of the required air separation plant. In the direct use of oxygen approach, oxygen instead of air is used to combust the fuel resulting in a concentrated CO_2 exhaust gas. This approach significantly reduces the capital and energy cost of removing CO_2 from conventional combustion processes using air as an oxygen source, but it incurs significant capital and energy costs associated with separating oxygen from the air.

The indirect approach involves partial combustion of a carbon-containing fuel (e.g., refinery gas, residual oil, or coke) with oxygen and steam to produce a synthesis gas ("syngas") composed of carbon monoxide (CO) and hydrogen (H_2). The CO is reacted with steam in a catalytic reactor, called a shift converter, to yield CO_2 and more H_2. The CO_2 is then separated, usually by a physical or chemical absorption process, resulting in a hydrogen-rich fuel which can be combusted in boilers, furnaces/heaters, gas turbines, engines and fuel cells or used to provide hydrogen for ammonia manufacturing. However, this approach is costly and significantly

increases the cost of fuel for combustion purposes only. For example, this approach is only used to produce hydrogen for use in the manufacture of high valued chemicals (ammonia) and liquid fuels. Use of this process to manufacture ammonia is not cost competitive at the current price of natural gas and use of this approach would be considered as "redefining the source".[18]

4.4.1.2 Minimize the Production of CO_2

There are two strategies that can be used to minimize the production of CO_2. The first is the used of highly efficient design and operation to minimize the fuel required to operate the process, which directly impacts the amount of CO_2 produced. Establishing an aggressive basis for energy recovery and facility efficiency will reduce CO_2 production and the costs to recover it.

The second is through the use of low-carbon fuels. The use of gaseous fuels, such as natural gas, reduces the production of CO_2 during the combustion process relative to burning solid fuels (e.g., coal or coke) and liquid fuels (e.g., distillate or residual oils).

Energy Efficiency

For boilers, calciners and dryers, energy efficiency can be achieved by incorporating a number of features, as follows:[19]

1. Periodic burner tune-up to maintain optimal thermal efficiency,

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[18] Alternative raw materials, production processes, or products that would be inconsistent with the fundamental objectives or basic design would impermissibly redefine the source and are not a part of the BACT analysis. While Step 1 is intended to capture a broad array of potential options for pollution control, this step of the process is not without limits. EPA has recognized that a Step 1 list of options need not necessarily include inherently lower polluting processes that would fundamentally redefine the nature of the source proposed by the permit applicant. BACT should generally not be applied to regulate the applicant's purpose or objective for the proposed facility. From: PSD And Title V Permitting Guidance For Greenhouse Gases, United States Environmental Protection Agency, March 2011.

[19] Except for air preheat, all of the energy efficient design options are consistent with those evaluated/discussed in the Statement of Basis Draft Greenhouse Gas Prevention of Significant Deterioration Preconstruction Permit for the BASF FINA Petrochemicals LP (BFLP), NAFTA Region Olefins Complex Permit; Number: PSD-TX-903-GHG April 2012.

2. Process designs that maximize energy recovery and use,
3. Conventional boiler economizers for steam feed water preheating and steam generation by recovering heat from the combustion flue gases,
4. Boiler oxygen trim control by monitoring oxygen concentration in the flue gas to minimize excess air levels in the flue gas,
5. Boiler condensing economizer for additional preheat of makeup water for steam generation or production of hot water for process uses,
6. Boiler air preheater for recovering heat from the combustion flue gases,
7. Boiler blow down heat recovery by using a blowdown flash tank and blowdown heat exchanger to recover heat from the steam drum continuous blowdown, and
8. Boiler condensate recovery by returning hot condensate for use as steam generation feed water.

The first four of the above efficiency options will be utilized by the Ochoa plant in the design and operation of the proposed boilers, calciners, and dryers. The options that will not be used are discussed below documenting that the use of condensing economizers and air preheat are not BACT.

Condensing Economizer

A natural gas-fired boiler with a traditional economizer cools flue gas to about 250 to 300° F, well above the dew point of the water in the gas vapor and slightly above the dew point of low sulfur fuels (natural gas). This type of system generally yields fuel efficiencies of 80-85 percent, and allows water vapor to escape the system by going out with the flue gas. Additional cooling of the flue gas recovers addition heat from the flue gas and heat of condensation for the water in the flue gas if the flue gas is cooled below the water condensation temperature (~ 120° F). Reclaiming this lost energy requires the installation of a secondary recovery unit that capitalizes on the heat of condensation of the water. A condensing economizer can net an additional 150° F of heat recovery as flue gas cools to temperatures below the water dew point.

The physical facilities needed for a condensing economizer are room for the addition of the condensing economizer, ducting, support steel, transitions, expansion joints, by-pass ducting and stainless steel stack. Additionally, extra fan capacity will be required to compensate for the pressure drop across the condenser and ductwork, and the lower density of flue gas at reduced temperatures. Before entering the condensing economizer, flue gases must pass through a

primary economizer, which recovers sensible heat and reduces the gas temperature to around 250 to 300° F.

This technology has only been applied to small, non-industrial boilers primarily to heat process waters up to temperatures in the 100 to 200 ^{o}F range. Condensing economizers have not been applied to large industrial process boilers that supply critical process steam where economizer uptime or reliability issues can create process hazards due to loss of steam or result in major lost production financial impacts. The increased maintenance and reliability problems associated with the use of a condensing economizer results from the condensation of moisture and acids (sulfuric acid from SO_2 and carbonic acid from CO_2) that negatively impact the operation of the boilers.

The EPA Boiler MACT Emissions Database includes SO_2 emission data for natural gas combustion. That data indicates an average of four ppm SO_2 in the flue gas with the highest test showing six ppm. While these appear to be low emission rates, they are significant relative to acid condensation in flue gas. Estimates of flue gas acid dew point indicate the four ppm average SO_2 case would result in an acid dew point of 279 ^{o}F. Thus, sulfuric acid would begin to condense on cool surfaces at any temperature below about 280° F.

The baseline design case for the proposed boilers is based on use of a traditional design economizer, which would cool flue gas to 300° F at design conditions. Therefore, the baseline economizer design is already very close to the minimum temperature considered applicable for carbon steel construction. Therefore, any further decrease in flue gas temperature would require use of 316 stainless steel or similar materials.

In addition, further flue gas temperature reduction will result in moisture formation in the stack and exiting from the stack under certain conditions, thus causing a visible plume and potential acidic moisture fallout, thus raising a potential need for flue gas reheat. Also, colder flue gas temperatures exiting a secondary/condensing economizer would negatively impact flue gas buoyancy and dispersion relative to ambient concentrations of pollutants. As a result, the use of a condensing economizer is not considered demonstrated in practice for purposes of this

application. Despite this conclusion, for purposes of completeness, the economic impact associated with the use of a condensing economizer is summarized in Table 4-18. Based on the CO_2e cost effectiveness of $94 per ton the use of a condensing economizer is considered to be economically infeasible.[20]

As Table 4-18 shows, the cost of additional economizer heat transfer include additional tube surface area and the use of stainless steel. The additional cost for the stack is for the use of stainless steel construction rather than carbon steel used for the conventional economizer base case. The heat recovery cost savings is based on improving the heater efficiency by two percent[21] for a natural gas price of $5 per million Btu.

Combustion Air Preheat

A combustion air preheater could be used instead of a standard economizer to achieve flue gas cooling to 280°F at design conditions by preheating combustion air. This approach provides an equivalent efficiency improvement to the standard economizer but would result in increased NOx formation due to higher flame/furnace temperatures. As a result, of the higher NOx emissions, combustion air preheat will not be part of the heater design and operation

Lower-Emitting Fuel

Typical GHG emissions from combustion of various fossil fuels, including the natural gas that will be burned by the proposed boilers, calciners, and dryers are shown in Table 4-19. As shown, the combustion of natural gas inherently emits less GHGs than other fossil fuels. This is true because natural gas has a low carbon-to-hydrogen ratio.

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[20] As discussed later, carbon credits cost less than $20 dollars per ton.
[21] CLIMATE LEADERS GREENHOUSE GAS INVENTORY PROTOCOL OFFSET PROJECT METHODOLOGY for Project Type: Industrial Boiler Efficiency (Industrial Process Applications), August 2008 Version 1.3, page 11.

Table 4-18. Boiler Cost Impacts Associated with a Condensing Economizer

Cost Parameter		Condensing Economizer	
		Economizer	Stack
Capital Cost	Equip. Cost ($)	$298,387	$217,009
	TIC Factor	1.98	1.98
	TIC ($)	$589,410	$428,662
Annualized Cost	Capital Recovery	$64,835	$47,153
	O&M ($)	$53,047	$38,580
	Electricity ($)	$22,224	
	TIA ($)	$23,576	$17,146
	Heat Recovery	-$136,568	
	Total ($)	$129,993	
CO_2e Cost Effectiveness	Efficiency (%)	2%	
	CO_2e (TPY controlled)	1,599	
	$/ton ($)	$81	

TIC- total installed cost, O & M – operating and maintenance costs, TIA – taxes, insurance, and administrative costs. Capital recovery is 11% of TIC. Electricity cost based on $0.0477/kWh. Heat recovery based on natural gas price of $5 per million Btu.

Table 4-19. GHG Emission Factors for Fossil Fuels [22]

Fuel	Emission Factor (lb/MMBtu)		
	CH_4	CO_2	N_2O
Petroleum Coke	0.024	225.8	0.0035
Subbituminous Coal	0.024	213.9	0.0035
Residual Oil (No. 6)	0.007	165.6	0.0013
Crude Oil	0.007	164.2	0.0013
Distillate Oil (No. 2)	0.007	163.1	0.0013
Natural Gas	0.002	116.9	0.0002

[22] From Tables C-1 and C-2 to subpart C of 40 CFR part 98.

4.4.2 Step 2 - Identify Technically Feasible GHG Controls.

Step 2 of the BACT analysis involves the evaluation of the control technologies identified from Step 1 to determine their technical feasibility for use at the Ochoa plant. A control technology is technically feasible if it has been previously installed and operated successfully at a similar emission source of comparable size, or there is technical agreement that the technology can be applied to the emission source. Technical infeasibility is demonstrated through clear physical, chemical, or other engineering principles that demonstrate that technical difficulties preclude the successful use of the control option. In addition, the technology must be commercially available for it to be considered technically feasible. A source is not required to experience extended time delays or resource penalties to allow research to be conducted on a new technique or control technology. Neither is it expected that an applicant would be required to experience extended trials to learn how to apply a technology on a totally new and dissimilar source type.

4.4.2.1 Low-Carbon Fuels-Feedstocks

As previously discussed, natural gas has the lowest CO_2 emission rate when combusting a fossil fuel. The use of natural as a fuel is technically feasible for the proposed boilers, calciners, and dryers.

4.4.2.2 Energy Efficiency

For an integrated plant, such as the Ochoa plant, there are a number of ways to improve energy efficiency. All of these discussed below are technically feasible. These include:

- Process Integration and Heat Recovery – Process heat recovery opportunities include advanced heat exchange equipment design, and maximizing feed-to-product heat exchange. The economics of SOP production require careful energy management to optimized heat recovery. As such, process integration and heat recovery will be integral to the design and operation of the Ochoa plant. For example, prior to discharge to the tailings pond, the NaCl bleed stream is used to cool the SOP product leaving the dryer rather than using cooling water to cool both streams.

- Stack temperature reduction – Stack temperature reduction from boilers, calciners, and dryers means that less heat is lost to the atmosphere from combustion exhaust gases. Methods

include recovering heat from the combustion exhaust gas by heating up process fluids/feedstocks. For example, the fluid bed dryer lower plenum flue gases are 1200 ^{o}F prior to contact with the wet SOP, and are finally discharge to the atmosphere at 300 ^{o}F after drying the SOP. A lower discharge temperature is not desirable as the flue gases pass through a fabric filter baghouse and flue gas temperature must be maintained well above the flue gas moisture condensation temperature in order not to plug the fabric filter bags. The amount of CO_2 reduction is typically 1 percent per 40 ^{o}F flue gas temperature decrease.[23] As such, stack temperature reduction is integral to the design and operation of the dryers and calciners.

- Utilize condensate recovery – The Ochoa plant will not utilize a condensate recovery system, because the steam generated by the boilers is injected directly into the process, maximizing the efficient transfer if energy to the process. The primary use of the steam is to heat the water used to leach NaCl from the polyhalite prior to further processing to recover SOP and Langbeinite.

- Continuous excess air monitoring and control – Except for the boilers, continuous excess air monitoring will not be used to control excess air at the calciners and dryers. However, the burners will have burner management systems that will be controlled through the plant digital control system. Also, the calciners and dryers are equipped with forced draft and induced draft fans; so the systems can be operated in a balance draft mode. This allows operation of the calciners and dryers at near atmospheric conditions minimizing any air in-leakage to these systems. This minimizes the heat/fuel requirements of the operation. Excessive amounts of combustion and drying air used in boilers, calciners, and dryers results in heat inefficiencies because more fuel combustion is required in order to heat the unnecessary air up to operating temperatures.

4.4.2.3 CO_2 Capture and Sequestration.

The CCS process involves three main steps:

- Capturing CO_2 at its source,
- Transporting the captured CO_2 to a suitable storage location (typically in compressed form in a pipeline), and
- Storing the CO_2 away from the atmosphere for a long period of time.

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[23] Table 1. ICI Boilers – Summary of Greenhouse Gas Emission Reduction Measures; Available and Emerging Technologies for Reducing Greenhouse Gas Emissions From Industrial, Commercial, and Institutional Boilers; October 2010. http://www.epa.gov/nsr/ghgdocs/iciboilers.pdf

4.4.2.3.1 CO_2 Capture Technologies

CO_2 contained in the boiler, calciner, and dryer off gases can be captured through post-combustion methods or through pre-combustion methods. In the post-combustion approach, air is used as the oxygen source for combustion, resulting in a combustion exhaust gas containing 5 to 15 percent CO_2 depending on the flue gas oxygen content. As a result of the low CO_2 concentration, the CO_2 must be separated from the other exhaust gas constituents (primarily nitrogen) before compression/dehydration, transport and storage. In the pre-combustion approaches, oxygen is used instead of air resulting in a combustion exhaust gas rich in CO_2 because there is no dilution with nitrogen.

Post Combustion Capture Technologies

Most of the CO_2 post-combustion capture technologies listed previously in Step 1 have been demonstrated commercially but not on combustion exhaust gas and exhaust gas flows consistent with the proposed boilers, calciners, and dryers. For example, the amine-based chemical absorption technologies and physical absorption processes (e.g., Selexol®) have significant commercial applications for removing CO_2 from natural gas, syngas, and hydrogen plant vents. There are commercial applications using amine based absorption technology for removing CO_2 from a flue gas slip stream from coal fired boilers. A Kerr-McGee coal fired boiler in Searles Valley, CA successfully used MEA to recovery CO_2 used to carbonate mineral rich brines to precipitate sodium bicarbonate.[24] This was possible because the boiler is equipped with sodium wet scrubber for SO_2 removal. Sulfur dioxide (SO_2) reacts with the MEA solvent making it unsuitable for use for exhaust gas streams with significant amounts of SO_2. The AES Warrior Run 180 MW coal fired utility boiler recovers CO_2 from a flue gas slip stream for making food

[24] Carbon Capture Overview, WorleyParsons; http://www.worleyparsons.com/csg/hydrocarbons/specialtycapabilities/documents/carbon%20capture%20overview.pdf

grade carbon dioxide.[25] The flue gas slip stream equals to 5 percent of the flue gas flow, which is equivalent to 100 MMBtu/hr heat input from coal. This boiler is a fluid bed boiler which uses in-furnace limestone injection for the control of SO_2.

Currently, the least cost system for removing CO_2 from combustion exhaust gases is MEA absorption.[26] Other existing and developing systems have not been demonstrated to achieve lower costs. The total energy consumption for post-combustion capture can be 15 to 45 percent of the fuel requirement, depending on the process configuration and energy integration.[27] The energy impacts include steam and electric demands for: the CO_2 capture system, CO_2 cleaning and dehydration systems, and CO_2 compression to 2000 pounds per square inch absolute.

Pre-Combustion Capture

There are two primary types of pre-combustion CO_2 capture methods: indirect use of oxygen (gasification) and direct replacement of air with oxygen for combustion systems. Gasification technology is technically feasible and there are a number of gasification plants making hydrogen-rich syngas by gasifying fossil fuels (coal, coke, residual oils, etc.), making a CO_2 rich off-gas suitable for sequestration. However, as discussed in Step 1, the use of coal gasification to make hydrogen and a CO_2 rich vent stream would be considered as "redefining the source". As such, the use of gasification to produce hydrogen and a CO_2 rich vent steam will not be considered further.

The basic concept of oxygen firing is to replace air with oxygen for combustion in boilers, calciners, and dryers. Flue gas from the boiler/heater, which is primarily CO_2 and oxygen, is re-circulated to the combustion zone gas to maintain thermal balance between the lower furnace

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[25] The New Clean Coal Technologies, "Advanced Domestic Resources in an Era of Carbon Challenges:, National Energy Technology Laboratory, presented December 4, 2007. http://wvcommerce.org/App_Media/assets/pdf/energy/summits/8Strakey.pdf

[26] Carbon Capture Overview, WorleyParsons; http://www.worleyparsons.com/csg/hydrocarbons/specialtycapabilities/documents/carbon%20capture%20overview.pdf

[27] Ibid.

region and the convective heat transfer surfaces. This arrangement produces a high CO_2 content exhaust gas, which after leaving the boiler/heater, is further processed to provide high-pressure CO_2 liquid product. The electric power needs of the required oxygen plant are significant. Oxygen firing has not been demonstrated to be technically feasible at commercial scale for most gas fired systems, as most research has been focused on coal-fired boilers.

The design of the calciners and dryers is very precise. ICP is unaware of any vendors that have commercial designs for oxygen fired boilers, calciners and dryers, or have commercially demonstrated these designs. As such, the use of oxygen firing for the Ochoa boilers, calciners and dryer is technically infeasible and will not be address further.

4.4.2.3.2 Transportation

After capturing the CO_2, regardless of the capture technique employed, it must be transported to a suitable storage site in order to achieve any environmental benefit. Pipelines are the most common method for transporting large quantities of CO_2 over long distances.

The oldest long-distance CO_2 pipeline in the United States is the 140 mile Canyon Reef Carriers Pipeline (in Texas), which began service in 1972 for Enhanced Oil Recovery (EOR) in regional oil fields.[28] Other large CO_2 pipelines have been constructed since then, mostly in the mid-continent, Western United States, to transport CO_2 for EOR. These pipelines carry CO_2 from naturally-occurring underground reservoirs, natural gas processing facilities, ammonia manufacturing plants, and a large coal gasification project to oil fields. Altogether, approximately 3,600 miles of CO_2 pipeline operate today in the United States.[29]

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[28] Congressional Research Service Report to Congress, Carbon Dioxide Pipelines for Carbon Sequestration: Emerging Policy Issues; Order Code RL33971, updated January 2008. http://www.marstonlaw.com/index_files/Emerging%20Policy%20issues%20for%20CO2%20pipelines%202008%20CORRECTED%20(2008-01-17%20(No%20RL33971).pdf

[29] Ibid.

Pipeline transportation requires very high pressures (and high compressor energy requirements) as the CO_2 is typically transported in its "supercritical" state. It is very important that water be eliminated from CO_2 pipeline systems, as the presence of water results in formation of carbonic acid, which is extremely corrosive to the carbon steel pipe. The primary compressor stations are located at the CO_2 source and where the CO_2 is injected, and booster compressors or pumps located as needed along the pipeline. In overall construction, CO_2 pipelines are similar to natural gas pipelines, requiring the same attention to design, monitoring for leaks, and protection against overpressure, especially in populated areas. All of these technical issues can be addressed through modern pipeline construction and maintenance practices, and CO_2 transportation by pipeline is considered technically feasible for the Ochoa plant CO_2 streams for the purposes of this BACT analysis.

4.4.2.3.3 Sequestration

There are several options being explored and employed for permanent storage of CO_2. These options include storage in various deep geological formations (including saline formations, exhausted oil and gas fields, and unmineable coal seams), liquid storage in the ocean, and solid storage by reaction of CO_2 with metal oxides to produce stable carbonates. Another sequestration option is terrestrial sequestration which does not require CO_2 capture prior to sequestration. The technical feasibility of these options is discussed below.

Geologic Formations[30]

The geologic formations considered appropriate for CO_2 storage are layers of porous rock deep underground that are "capped" by a layer or multiple layers of non-porous rock above them. In this application a well is drilled down into the porous rock and pressurized CO_2 is injected into it. Under high pressure, CO_2 is a liquid and can move through a formation as a fluid. Once injected, the liquid CO_2 tends to be buoyant and will flow upward until it encounters a barrier of non-porous rock, which can trap the CO_2 and prevent further upward migration.

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[30]Page 15. 2008 Carbon Sequestration Atlas of the United States and Canada, U.S. Department of Energy, National Energy Technology Laboratory.

There are other mechanisms for CO_2 trapping as well: CO_2 molecules can dissolve in brine, react with minerals to form solid carbonates, or adsorb in the pores of porous rock. The degree to which a specific underground formation is amenable to CO_2 storage can be difficult to determine. Research is being done today which is aimed at developing the ability to characterize a formation before CO_2 injection in order to predict its CO_2 storage capacity. Another area of research is the development of CO_2 injection techniques that: achieve broad dispersion of CO_2 throughout the formation, overcome low diffusion rates, and avoid fracturing the cap rock.

Several of the major unresolved issues with respect to CO_2 sequestration pertain to the legal framework for closing and remediating geologic sites, including liability for accidental releases from these sites. In December 2010, EPA published the Federal requirements under the Underground Injection Control (UIC) Program for Carbon Dioxide (CO_2) Geologic Sequestration (GS) Wells Final Rule. Under this program EPA will directly implement the Class VI program nationally as of September 7, 2011. As of this date, states and owners or operators must submit all permit applications to the appropriate EPA Region in order for a Class VI permit to be issued per the Federal requirements under the Underground Injection Control (UIC) Program for Carbon Dioxide (CO_2) Geologic Sequestration (GS) Wells final rule of December 10, 2010. Direct implementation of the final Class VI requirements is in effect until such time as a State-submitted primary enforcement responsibility (primacy) application is approved by EPA.[31]

Five storage types for geological carbon storage are currently under investigation in North America, each with unique challenges and opportunities: (1) oil and gas reservoirs, (2) unmineable coal seams, (3) saline formations, (4) organic-rich shales or basalt formations, and (5) terrestrial ecosystems:[32]

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[31] Page 56982. Federal Register / Vol. 76, No. 179 / Thursday, September 15, 2011.
[32] Page 5. The North American Carbon Storage Atlas 2012, U.S. Department of Energy, National Energy Technology Laboratory, et al.

1. Depleted oil and gas reservoirs. These are formations that held crude oil and natural gas at some time. In general, they are characterized by a layer of porous rock with a layer of non-porous rock which forms a dome. This dome offers great potential to trap CO_2 and makes these formations excellent sequestration opportunities. As a value-added benefit, CO_2 injected into a depleting oil reservoir can enable recovery of additional oil and gas. When injected into a depleted oil bearing formation, the CO_2 dissolves in the trapped oil and reduces its viscosity. This "frees" more of the oil by improving its ability to move through the pores in the rock and flow with a pressure differential toward a recovery well. A CO_2 flood typically enables recovery of an additional 10–15% of the original oil in place. CO_2 EOR and enhanced gas recovery (EGR) are commercial processes. It is estimated that 50 to 90 billion metric tons of sequestration potential exists in mature oil and gas reservoirs identified by the Regional Carbon Sequestration Partnerships (RCSPs). Formed by the U.S. Department of Energy in 2003, the seven Partnerships span 40 states, three Indian nations, and four Canadian provinces. The RCSPs[33] has identified that oil and gas reservoirs providing CO_2 sequestration opportunities are in the vicinity of the proposed Ochoa plant.

2. Unmineable coal seams. Unmineable coal seams are those that are too deep or too thin to be mined economically. All coals have varying amounts of methane adsorbed onto pore surfaces, and wells can be drilled into unmineable coal beds to recover this coal bed methane (CBM). Initial CBM recovery methods, dewatering, and depressurization, leave a fair amount of CBM in the reservoir. Additional CBM recovery can be achieved by sweeping the coal bed with nitrogen or CO_2. CO_2 preferentially adsorbs onto the surface of the coal, releasing the methane. Two or three molecules of CO_2 are adsorbed for each molecule of methane released, thereby providing an excellent storage sink for CO_2. Like depleting oil reservoirs, unmineable coal beds are a good early opportunity for CO_2 storage. One potential barrier to injecting CO_2 into unmineable coal seams is swelling. When coal adsorbs CO_2, it swells in volume. In an underground formation swelling can cause a sharp drop in permeability, which not only restricts the flow of CO_2 into the formation but also impedes the recovery of displaced CBM. Two possible solutions to this challenge include angled drilling techniques and fracturing.

   It is estimated that 150 to 200 billion metric tons of CO_2 sequestration potential exists in unmineable coal seams identified by the RCSPs. However, the RCSPs has identified that no unmineable coal seams are available for CO_2 sequestration opportunities within the

[33] Ibid. Page 35.

vicinity of the proposed Ochoa Plant.[34] Accordingly, this CO_2 sequestration technique will not be considered further in this analysis.

3. Saline formations. Saline formations are layers of porous rock that are saturated with brine. They are much more commonplace than coal seams or oil and gas bearing rock, and represent an enormous potential for CO_2 storage capacity. The RCSPs estimates a range of 900 to 3,700 billion metric tons of sequestration potential in saline formations. However, much less is known about saline formations than is known about crude oil reservoirs and coal seams, and there is a greater amount of uncertainty associated with their ability to store CO_2. Saline formations contain minerals that could react with injected CO_2 to form solid carbonates. The carbonate reactions have the potential to be both a positive and a negative. They can increase permanence but they also may plug up the formation in the immediate vicinity of an injection well. Additional research is required to better understand these potential obstacles and how best to overcome them. The RCSPs has identified that there is potential for CO_2 sequestration using saline formations within the vicinity of the proposed Ochoa plant.[35] However, this CO_2 sequestration technique is considered technically infeasible for the Ochoa plant due to the extensive time frame required to research and develop an acceptable saline disposal site.

4. Basalt and Organic Rich Shale formations.[36] Basalts are geologic formations of solidified lava. Basalt formations have a unique chemical makeup that could potentially convert all of the injected CO_2 to a solid mineral form, thus permanently isolating it from the atmosphere. Current research is focused on enhancing and utilizing the mineralization reactions and increasing CO_2 flow within a basalt formation. Although oil and gas-rich organic shale and basalt research is in its infancy, these formations may, in the future, prove to be optimal storage sites for sequestering CO_2 emissions. Since these CO_2 sequestration techniques are in the early research and development phases, they are considered technically infeasible for the Ochoa plant at this time, and will not be considered further in this analysis.

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[34] Ibid. Page 36.
[35] Ibid. Page 37.
[36] Ibid. Page 19.

Deep Ocean Sequestration[37]

It is widely believed that the oceans will eventually absorb 80-90 percent of the CO_2 in the atmosphere and transfer it to the deep ocean. Although the ocean has huge potential as a carbon storage sink, the scientific understanding to enable ocean sequestration to be considered as a real option is not yet available. A small level of funding is provided to leading researchers in this area to develop the necessary scientific understanding of the feasibility of ocean sequestration. Work is focused on understanding the mechanisms of CO_2 uptake in the ocean and assessing the environmental impacts of CO_2 storage. Laboratory studies of the behavior of CO_2 droplets and CO_2/water hydrate structures in simulated ocean environments are being conducted. As such, the lack of commercial demonstration of CO_2 makes this option technically infeasible and it will not be considered further in this analysis.

Terrestrial Ecosystems[38]

Terrestrial sequestration is the enhancement of CO_2 uptake by plants that grow on land and in freshwater and, importantly, the enhancement of carbon storage in soils where it may remain more permanently stored. Terrestrial sequestration provides an opportunity for low-cost CO_2 emissions offsets. Early efforts include tree-plantings, no-till farming, and forest preservation. To date, there are no applications that would be large enough to handle a million tons per year of CO_2. However, due to the undemonstrated cost and effectiveness of terrestrial ecosystem sequestration options over the life of the Ochoa plant, this sequestration option is considered technically infeasible and will not be further evaluated as BACT.

4.4.3 Step 3 - Rank the Technically Feasible GHG Controls.

In order to address the concerns from CO_2 emissions and the potential impact on global warming, there are three possible strategies for the proposed Ochoa plant.

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[37] Department of Energy Ocean Sequestration Research; http://www.fossil.energy.gov/programs/sequestration/ocean/index.html [2/8/2013 4:27:07 PM]

[38] Page 22. 2008 Carbon Sequestration Atlas of the United States and Canada, U.S. Department of Energy, National Energy Technology Laboratory.

1. The first strategy is to maximize the energy efficiency of the proposed facility, which will minimize the production of CO_2. A highly efficient operation requires less fuel to operate which directly impacts the amount of CO_2 emitted. ICP will establish an aggressive basis for energy recovery and facility efficiency that will minimize CO_2 emissions.

2. The second strategy is the use of low carbon fuels and feedstock. The use of low carbon fuels, such as natural gas for combustion, reduces emissions of CO_2 since there is less carbon in the fuel. The use of low carbon fuel at the proposed Ochoa plant will be combined with the first strategy and is planned for implementation at the Ochoa Plant boilers, calciners, and dryers.

3. The third strategy to mitigate the impacts of CO_2 to the environment is CCS. With respect to the Ochoa plant location in southeastern New Mexico, CO_2 injection for enhance oil (EOR) and gas recovery is commercially ongoing. However, the extent to which EOR permanently sequesters CO_2 is being researched. As of April 2011, nine **pilot** CCS projects were in operation in China, Europe, and the United States. These projects are delivering important insights regarding the prospects for large-scale commercial application of carbon capture. **No** large-scale CCS is in operation yet, although large scale use of CO_2 for EOR is commercially well developed. As a result, the use of EOR will be evaluated further.

Table 4-20 presents the proposed GHG BACT hierarchy. This table presents one BACT option, the top option, for further evaluation. The top option is post-combustion capture of CO_2 from the boilers, calciners, and dryers, and compression/dehydration, pipeline transport and sequestration in a nearby oil field or transferred to a nearby CO_2 pipeline. This option represents an additional 90 percent control, over the options proposed as BACT by ICP. The following section will discuss the environmental, energy, and economic impacts of CCS.

4.4.4 Step 4 - Evaluate the Most Effective GHG Controls.

The use of low-carbon fuels/feedstocks (natural gas) and various energy efficiency measures are planned for the proposed facility. Not currently planned is the application of CCS. As such, the energy, environmental, and cost impacts of this option will be addressed below.

Table 4-20. CO_2 BACT Hierarchy for the Ochoa Plant

Control Scenario	Control Description	Control Percent	Tons Per Year Emitted	Tons Per Year Reduced
Baseline	Dryers	0	24,400	0
	Calciners	0	329,100	0
	Boilers	0	159,630	0
Baseline Total		0	513,100	0
CCS	MEA scrubbing/ dehydration/ compression/ transport/ sequestration	90	51,310	461,790

4.4.4.1 CCS Impacts Analyses

Post-combustion control would utilize MEA as the absorption solvent. The cost of the CCS system would include ducting the combustion flue gases to MEA absorption towers, quenching the flue gases prior to entering the absorption towers, regeneration of the MEA for reuse, compression and dehydration of the CO_2, and transported by pipeline to a nearby oil field or CO_2 pipeline.

4.4.4.1.1 Economic Impacts of CCS

There have been numerous studies estimating the energy requirements and costs of CCS systems. Most of these studies have been focused on large coal- and natural gas-fired electric power plants. Because the natural gas-fired boilers, calciners, and dryers will have a flue gas composition very similar or the same as natural gas fired electric power plants, a 2010 report by the National Energy Technology Laboratory of the U.S. Department of Energy (the "NETL report") was used as the primary basis for estimating CCS system energy requirements and costs. The natural gas combined cycle (NGCC) plant evaluated in the NETL report has a nominal electric output of 570 megawatts with a heat input of 3,765 MMBtu/hr. The energy requirements and costs for the CCS systems are based on the ratio of heat input (i.e., natural gas consumption)

rates for the NETL NGCC plant and the proposed boilers, calciners, and dryers. The NGCC plant would emit 3.8 times more CO_2 than the proposed DCCs, dryers, and boilers.[39] The BACT cost impacts are summarized in Table 4-21. As this table shows, the capital and operating costs for CCS are quite high at $157 million and 61 million a year, respectively. The resulting CO_2 CCS cost effectiveness is high at $158 per ton (avoided cost basis).[40]

4.4.4.1.2 Energy Impacts

The energy impacts of CCS are large, and are estimated as 1,292,000 million Btus per year. This is equivalent to ~147 million Btus per hour for generating steam and electricity for the CO_2 capture and compression systems.

4.4.4.1.3 Environmental Impacts

The environmental benefit of the CCS system as applied to the boilers, DCCs, and dryers is the reduction of ~0.46 million tons per year of CO_2 emissions. However, there are a number of disbenefits. The disbenefits include large water consumption for quenching the combustion flue gases before entering the MEA absorbers, and collateral pollutants emitted from an NGCC unit to meet the steam and electric requirements. The following table summarizes the increase in NSR pollutants generated by a NGCC unit for supplying the 147 MMBtu/hr of steam and power requirements: [41]

NSR Pollutants	lb/MMBtu	tons/year
NOx	0.0990	64.0
CO	0.0150	9.7
VOC	0.0021	1.4
$PM_{2.5}$	0.0066	4.3
SO_2	0.0034	2.2

[39] Prior to CO2 capture, the 550 MWe NGCC emits ~223 tons per hour of CO_2 and the proposed combustion sources will emit 58.6 tons per hour of CO_2. 3.8 ratio = 223 tons per year/58.6 tons per year.

[40] Avoided cost effectiveness takes into account that the processes for capturing CO2 require additional energy. The increased energy needs result in increases in emissions of CO2. Therefore, when evaluating CO2 capture methods, the avoided CO2 is equal to the CO2 captured minus the CO2 created in capturing the CO2.

[41] Assumed an average NGCC heat rate of 8,152 Btus/kW. Emission factors based on AP-42.

Table 4-21. Summary of Ochoa Plant BACT Impacts for CCS

Process Data	Units	Boilers/Calciners/Dryers
Heat Input	million Btus/yr	1,002
CO_2 Flow Rate	tons/hr	58.6
Capacity Factor	percent	100%
CO_2 before CCS	tons/yr	490,700
Environmental Impacts		
Percent CO_2 Reduction	percent	90%
CO_2 Captured	tons/yr	461,800
CO_2 Emitted After Capture	tons/yr	51,300
CO_2 Emitted by CCS	tons/yr	75,500
Total CO_2 Emitted with CCS	tons/yr	126,800
CO_2 Reduction due to CCS (avoided)	tons/yr	386,300
Water Consumption	million gallons/yr	81
Energy Impacts		
Steam & Power	million Btus/yr	1,292,000
Economic Impacts		
Escalated Capital Costs	US dollars	$156,700,000
Capital Cost Annualized (11% CRF)	US dollars/yr	$17,300,000
O&M Costs	US dollars/yr	$43,900,000
Total Annual Cost	US dollars/yr	$61,200,000
Avoided Cost Effectiveness	US dollars/ton	$158
Cost and Performance Baseline for Fossil Energy Plants Volume 1: Bituminous Coal and Natural Gas to Electricity Rev2; DOE/NETL-2010/1397; November 2010. Cost escalated to 2012 dollars. CRF- capital recovery factor based on a 7 percent cost of money and 15 year equipment life.		

4.4.5 Step 5 - GHG BACT Selection.

ICP has concluded that carbon capture and storage (CCS) is not feasible for economic and energy reasons. With respect to economic feasibility, CCS cost at $158 per ton is not supported by current carbon credit markets:

- Recent estimated prices for CO_2 credits in Europe in early 2013 are 8 to 10 euros ($10 to $13 US) for carbon allowances.[42]
- "The Green Exchange" lists average annual prices for California Carbon Allowances Futures of $14.45, $14.55, and $14.40 for June 2013, December 2013, and December 2014, respectively. [43]

The above finding of cost unreasonableness for CCS is consistent with recent GHG BACT determinations by U.S. EPA, as follows.

Permit No. PSD-TX-1244-GHG, issued by EPA Region 6 on 11/10/2011 to the Lower Colorado River Authority, covers two natural gas-fired, combined-cycle combustion turbines, two diesel-fired internal combustion engines, natural gas piping, and various circuit breakers. The BACT analysis determined that the cost of CCS technology would increase the project costs by 42 percent and reduce the project efficiency by 15%. This was considered by USEPA Region 6 as cost unreasonable.[44]

Permit No. 052-042-MA15, issued by EPA Region 1 on 5/15/2012 for the Pioneer Valley Energy Center, covers a combined cycle turbine, an auxiliary boiler, an emergency diesel engine/generator, and a diesel engine/fire pump. The BACT analysis determined that the cost of CCS and the pipeline are cost unreasonable.[45]

Permit No. PSD-TX-903-GHG, issued by EPA Region 6 on 8/24/2012 to BASF FINA Petrochemicals LP, covers a new ethylene cracking furnace and modifications to two combined cycle steam generating units. The BACT analysis concluded that CCS would represent a 3 to 17 fold increase in the total cost of the project, which exceeds the threshold that would make the project economically viable.[46]

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[42] EU to Sell 197 Million of CO2 in Early 2013, New Energy Says; http://www.bloomberg.com/news/2012-10-19/eu-to-sell-197-million-of-co2-in-early-2013-new-energy-says-1-.html [2/7/2013 1:52:58 PM]

[43] Average Bid Price Monday, June 10, 2013 - BGC Carbon Market Daily, California Carbon Allowance Futures.

[44] Statement of Basis Greenhouse Gas PSD Preconstruction Permit for the Lower Colorado River Authority, Thomas C. Ferguson Plant, Permit Number PSD-TX-1244-GHG, September 2011.

[45] Fact Sheet Pioneer Valley Energy Center, USEPA Region 3, Permit No. 052-042-MA15. Permit Issued April 2012.

[46] Statement of Basis Draft Greenhouse Gas Prevention of Significant Deterioration Preconstruction Permit for the BASF FINA Petrochemicals LP (BFLP), NAFTA Region Olefins Complex, April 2012.

ICP has concluded that incorporating highly energy efficient, natural gas fired boilers, calciners, and dryers at the facility is BACT for GHGs (CO_2, N_2O and CH_4). ICP proposes the following limits:

- The use of natural gas at the boilers, DCCs, and dryers;
- Hourly limitation of fuel oil usage as backup fuel for the emergency generators, and
- Emissions of CO_2e (CO_2, CH_4, and N_2O) shall not exceed 514,000 tons of CO_2e on a 12 month rolling average basis with compliance determined at the end of each month. Emissions of CO_2e shall be calculated using a natural gas emission factor of 117.1 lb/MMBtu, and distillate oil emission factor of 163.5 lb/MMBtu.

These emission limit form is consistent with recent permit determinations as follows:

Permit No. 147-30464-00060 issued by Indiana Department of Environmental Management on June 27, 2012 to Indiana Gasification LLC for a coal to synthetic natural gas plant.[47]

- Acid gas removal vents (2) GHG limits are: CO_2 emissions from the Acid Gas Recovery (AGR) Vents shall not exceed 1,290,000 tons CO_2 per twelve (12) consecutive month period with compliance determined at the end of each month.
- GHG limits for auxiliary boilers are:
  (a) Use of natural gas or SNG; and
  (b) Energy efficient boiler design (utilizing an economizer, condensate recovery, inlet air controls and blowdown heat recovery.)
  (c) Boiler designed for 81% thermal efficiency (HHV).
  (d) The total CO2 emissions from the auxiliary boilers shall not exceed 88,167 tons per twelve (12) consecutive month period, with compliance determined at the end of each month.

Permit No. 11-SDD-099 issued by Wisconsin Department of Natural Resources to Wisconsin DOA / UW Madison--Charter St.[48]

- Maintain a 70% conversion of heat input to useful steam energy in any month averaged over any 12-month period
- 167 pounds carbon dioxide per 1,000 pounds steam produced when combusting natural gas in any month averaged over any 12-month period
- 233 pounds carbon dioxide per 1,000 pounds steam produced when combusting distillate fuel in any month averaged over any 12-month period

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[47] Permit No. 147-30464-00060 issued by Indiana Department of Environmental Management on June 27, 2012 to Indiana Gasification LLC for a coal to synthetic natural gas plant; page 70 of 152.

[48] Permit No. 11-SDD-099 issued by Wisconsin Department of Natural Resources to Wisconsin DOA / UW Madison--Charter St.; pages 10 & 11 or 27.

5.0 EMERGENCY DIESEL ENGINES

The Ochoa plant will include one diesel powered emergency generator with a rated output of 2,000 ekW with a rated output of 2937 brake horsepower ("bhp"), and one diesel powered fire pump with a rated bhp of 144. This emergency equipment will be powered by a compression-ignition, internal combustion engines (CI RICE). These engines are generally similar to engines that are regulated as non-road mobile sources under 40 CFR parts 89 and 1039. However, the engines are not regulated under the mobile source rules because they will remain at the same site for more than 12 months, and are therefore considered stationary sources

5.1 NITROGEN OXIDES AND VOLATILE ORGANIC COMPOUNDS EMISSIONS

The emergency diesel engines will be affected facilities subject to the standards for emergency engines under subpart IIII of 40 CFR part 60. The minimum standards that would meet BACT requirements for NO_X and VOC emissions from these engines are as follows:

- The emergency generator engine, pursuant to 40 CFR §§ 60.4205(b) and 60.4202(a)(2), will be required to meet the combined NO_X and non-methane hydrocarbons emission standard established for nonroad engines of the same model year pursuant to § 89.112. This emission standard is a specification of 6.4 grams per kilowatt hour ("g/kWh"), as determined by the engine manufacturer using the nonroad engine testing procedures set forth at 40 CFR §§ 89.401 to 89.424.
- The fire water pump engine, pursuant to 40 CFR §§ 60.4205(c), will be required to meet the combined NO_X and non-methane hydrocarbons emission standard established for nonroad engines of the same model year pursuant to Table 4 of subpart IIII. The emission standard is a specification of 3.0 g/bhp-hr, as determined by the engine manufacturer using the nonroad engine testing procedures set forth at 40 CFR §§ 89.401 to 89.424 and at Table 4 of subpart IIII.

5.1.1 Step 1 – Identify NOx and VOC Controls for Diesel Engines

Identified control technologies and techniques for NOx and VOC emissions from compression-ignition engines include the following:

- Injection timing retard, also called ignition timing retard, which involves delaying the fuel injection point in each engine cycle such that the heat release from fuel combustion occurs

during the cylinder expansion. Lower NOx emissions are achieved by reducing the peak combustion temperature;

- Exhaust gas recirculation, which involves retaining or re-introducing a fraction of the exhaust gases. Lower NOx emissions are achieved by reducing the peak combustion temperature and by reducing the amount of available molecular oxygen;
- NOx adsorber technology, which typically utilizes alkali or alkaline earth metal catalysts to adsorb NOx on the catalyst surface under the fuel-lean and oxygen-rich conditions typical of diesel engine exhaust. Periodically, the catalyst bed is subjected to fuel-rich exhaust in order to desorb the NOx and regenerate the catalyst. The desorbed NOx is catalytically reduced over a second catalyst, typically platinum and rhodium;
- SCR for NOx reduction;
- Oxidation catalyst for VOC control, as described in Section 4.1.1; and
- Catalyzed diesel particulate filters, which control emissions by capturing particulate matter in a filter media, typically a ceramic wall flow substrate, and then by oxidizing it in the oxygen-rich atmosphere of diesel exhaust. The particulate matter emitted by diesel engines includes semi-volatile organic compounds that are regulated as VOC.

5.1.2 Step 2 – Eliminate Technically Infeasible Controls for Diesel Engines

All of the identified control options are assumed to be technically feasible.

5.1.3 Step 3 – Control Hierarchy of Controls for Diesel Engines

The third-ranked control option for NOx and VOC emissions comprises the use of internal combustion engines certified by the engine manufacturer to meet the emission standards for non-road, compression-ignition engines listed in Section 5.1.1. Engines meeting these standards may use multiple in-engine control technologies including injection timing retard and exhaust gas recirculation. This control option would result in combined total NOx and VOC emissions less than 2 tpy.

The second-ranked control option for NOx and VOC emissions involves the use of SCR and oxidation catalyst in conjunction with the third-ranked control option. For the purposes of this BACT analysis, it is assumed that 80 percent reduction in NOx and VOC emissions, down to a total annual emission level of 0.4 tpy, is achievable with this control option. This likely overstates the achievable emission reduction by a significant amount, as the engine will have

very little time operating under the steady-state conditions favorable for SCR and oxidation catalyst system performance.

The highest-ranked control option for NOx and VOC emissions involves the use of catalyzed diesel particulate filters and NOx adsorber technology in conjunction with the third-ranked control option. For the purposes of this BACT analysis, it is assumed that 90 percent emission reduction is achievable.

5.1.4 Step 4 – Evaluate More Effective Controls for Diesel Engines

The third-ranked control option will not cause any adverse energy, environmental, or economic impacts. The higher-ranked control options will cause adverse impacts that warrant their exclusion as BACT. The adverse impacts include energy impacts, due to reduced energy efficiency attributable to increased pressure drop, and environmental impacts associated with catalyst disposal. These adverse energy and environmental impacts are minimal.

The adverse economic impacts that would result from requiring catalytic add-on controls for the emergency use, internal combustion engines would be significant. Economic analyses prepared by U.S. EPA in its rulemaking for NSPS subpart IIII showed that, for emergency use engines, the cost effectiveness of SCR is more than $100,000 per ton of NOx reduction, and the cost of catalyzed diesel particulate filter and NOx adsorber are more than $20,000 per ton of total NOx and VOC emission reduction. Considering the minimal environmental benefit that would result, and the adverse energy and environmental impacts described above, these controls are rejected as BACT.

5.1.5 Step 5 – Establish NOx BACT for Diesel Engines

The emergency use, internal combustion engine at the Ochoa plant will be certified by the equipment manufacturers to meet the applicable emission standards for nonroad, compression-ignition engines, as codified in subpart IIII and at 40 CFR § 89.112. Due to the very low emissions from these sources, the fact that they will operate only intermittently, and the availability of engines that are certified to achieve this emission level, and considering the nature

of the certification test procedure for the nonroad engine emission standards, ICP proposes that an equipment design standard rather than an emission rate limit is an appropriate form of expression for the NOx and VOC BACT requirements for these engines.

5.2 CARBON MONOXIDE EMISSIONS FROM DIESEL ENGINES

The emergency use diesel engine will be an affected facility subject to the standards for emergency engines under subpart IIII of 40 CFR part 60. The minimum standards that would meet BACT requirements for CO emissions from these engines are as follows:

- The emergency generator engine, pursuant to 40 CFR §§ 60.4205(b) and 60.4202(a)(2), will be required to meet the CO emission standard established for nonroad engines of the same model year pursuant to § 89.112. This emission standard is a specification of 3.5 g/kWh, as determined by the engine manufacturer using the nonroad engine testing procedures set forth at 40 CFR §§ 89.401 to 89.424.
- The fire water pump engine, pursuant to 40 CFR §§ 60.4205(c), will be required to meet the CO emission standard established for nonroad engines of the same model year pursuant to Table 4 of subpart IIII. The emission standard is a specification of 2.6 g/bhp hr, as determined by the engine manufacturer using the nonroad engine testing procedures set forth at 40 CFR §§ 89.401 to 89.424 and at Table 4 of subpart IIII.

5.2.1 Steps 1-4 CO Controls for Diesel Engines

Identified control technologies and techniques for CO emissions include the combustion controls identified for VOC in Section 5.1.1. These technologies are assumed to be technically feasible. The second-ranked control option, using internal combustion engines certified by the engine manufacturer to meet the emission standards for non-road, compression-ignition engines will result in combined total CO emissions of 0.1 tpy. Oxidation catalyst may be able to achieve a CO emission rate less than 0.01 tpy, but is rejected as BACT due to its adverse energy, environmental, and economic impacts and its minimal environmental benefit, as discussed in the VOC BACT analysis.

5.2.2 Step 5 – Establish CO BACT for Diesel Engines

The emergency use, internal combustion engine at the Ochoa plant will be certified by the equipment manufacturers to meet the applicable emission standards for nonroad, compression-

ignition engines, as codified in subpart IIII and at 40 CFR § 89.112. Due to the very low emissions from this source, the fact that they will operate only intermittently, and the availability of engines that are certified to achieve this emission level, and considering the nature of the certification test procedure for the nonroad engine emission standards, ICP proposes that an equipment design standard rather than an emission rate limit is an appropriate form of expression for the CO BACT requirements for these engines.

5.3 PARTICULATE MATTER EMISSIONS FROM DIESEL ENGINES

Emergency use diesel engines will be affected facilities subject to the standards for emergency engines under subpart IIII of 40 CFR part 60. The minimum standards that would meet BACT requirements for particulate matter emissions from these engines are as follows:

- The emergency generator engine, pursuant to 40 CFR §§ 60.4205(b) and 60.4202(a)(2), will be required to meet the PM emission standard established for nonroad engines of the same model year pursuant to § 89.112. This emission standard is a specification of 0.2 g/kWh, as determined by the engine manufacturer using the nonroad engine testing procedures set forth at 40 CFR §§ 89.401 to 89.424.
- The fire water pump engine, pursuant to 40 CFR §§ 60.4205(c), will be required to meet the PM emission standard established for nonroad engines of the same model year pursuant to Table 4 of subpart IIII. The emission standard is a specification of 0.15 g/bhp hr, as determined by the engine manufacturer using the nonroad engine testing procedures set forth at 40 CFR §§ 89.401 to 89.424 and at Table 4 of subpart IIII.

5.3.1 Steps 1-4 PM Controls for Diesel Engines

Identified control technologies and techniques for particulate matter emissions are the same technologies identified for CO emissions in Section 5.1.1. Each of these technologies is assumed to be technically feasible. The second-ranked control option, using internal combustion engines certified by the engine manufacturer to meet the emission standards for non-road, compression-ignition engines listed in Section 5.1.1 will result in combined total particulate matter emissions less than 0.01 tpy from both engines. The use of catalyst diesel particulate filters could achieve some level of particulate matter emission reduction, but is rejected as BACT due to its adverse energy, environmental, and economic impacts and its minimal environmental benefit, as discussed in the CO BACT analysis.

5.3.2 Step 5 – PM BACT Selection for Diesel Engines

The emergency use, internal combustion engine at the Ochoa plant will be certified by the equipment manufacturers to meet the applicable emission standards for nonroad, compression-ignition engines, as codified in subpart IIII and at 40 CFR § 89.112. Due to the very low emissions from these sources, the fact that they will operate only intermittently, and the availability of engines that are certified to achieve this emission level, and considering the nature of the certification test procedure for the nonroad engine emission standards, ICP proposes that an equipment design standard rather than an emission rate limit is an appropriate form of expression for the particulate matter BACT requirements for these engines.

5.4 GREENHOUSE GAS EMISSIONS FROM DIESEL ENGINES

There are no applicable NSPS or NESHAP rules that would establish a baseline emission rate for GHG emissions from either of the emergency diesel engines at the Ochoa plant. The baseline emission level, representing proper equipment design and operation and the use of diesel fuel, is a GHG emission factor of 163.1 lb per gallon of fuel burned. On a mass basis, emissions of CH_4 and N_2O comprise 0.005 percent of total GHG emissions, with the remainder as CO_2.

5.4.1 Steps 1-4 GHG Controls for Diesel Engines

The only identified control technologies for GHG emissions from the emergency diesel engines are oxidation catalyst (for control of CH_4 emissions) and CCS (for control of CO_2 emissions). Each of these technologies is assumed to be technically feasible. The use of oxidation catalyst could achieve some level of CH_4 emission reduction, but is rejected as BACT due to its adverse energy, environmental, and economic impacts and its minimal environmental benefit, as discussed in the CO BACT analysis above. Similarly, CCS is rejected as BACT because it would not be cost effective, as discussed further in Section 4.4.5.

5.4.2 Step 5 – GHG BACT Selection for Diesel Engines

No control option more effective than the inherent design has been identified as BACT for GHG emissions from the emergency use, diesel engine at the Ochoa plant. ICP proposes that an

equipment design standard rather than an emission rate limit is an appropriate form of expression for the GHG BACT requirements for these engines.

6.0 FUGITIVE PM EMISSIONS BACT ANALYSES

This BACT section addresses PM, PM_{10}, and $PM_{2.5}$ from solids handling systems, such as conveyors, truck and rail loading, bins, and storage buildings. Emissions from these types of sources are referred to as fugitive, although some of the control options would capture these fugitive emissions in a control device making the emissions a point source. PM, PM_{10}, and $PM_{2.5}$ will be generally referred to as "PM" throughout this section.

Dust (PM) emissions from material storage piles result from several distinct source activities within the storage cycle:

1. Loading of material onto storage piles (batch or continuous drop operations).
2. Equipment traffic in storage area.
3. Wind erosion of pile surfaces and ground areas around piles.
4. Loadout of material to the process stream (batch or continuous drop operations).

Either adding 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 stacker is an example of a continuous drop operation.

The quantity of dust emissions from material storage operations varies with the volume of material passing through the storage cycle. Uncontrolled PM emissions also depend on three parameters of the condition of a particular storage pile: age of the pile, moisture content, and proportion of material fines. When freshly processed material is loaded onto a storage pile, the potential for dust emissions is at a maximum. Fines are easily disaggregated and entrained to the atmosphere upon exposure to air currents, either from material transfer itself or from high winds. As the material pile weathers, however, potential for dust emissions is greatly reduced. Moisture causes aggregation and cementation of fines to the surfaces of larger particles. Any significant rainfall soaks the interior of the pile, and then the drying process is very slow. Silt (particles equal to or less than 75 micrometers [μm] in diameter) content is determined by measuring the

portion of dry material that passes through a 200-mesh screen, using ASTM-C-136 method.

6.1 STEP 1: IDENTIFICATION OF AVAILABLE FUGITIVE PM CONTROLS

Summary results from the PM BACT precedent review for materials handling, storage, processing, loading and hauling are presented in Table 6-1. Particulate matter emissions generated from materials handling and storage operations are typically controlled by one or more strategies. Typical strategies include but are not limited to the following:

- Handling and storing bulk materials in a semi-wet condition by controlling the “moisture content”. These materials are considered conditioned materials and will typically have moisture contents greater than 3.5 percent.
- Direct application of water and/or chemicals to bulk materials for purposes of increasing surface moisture content and/or stabilizing small particles is considered as "Wet Suppression" or “Chemical Suppression” techniques.
- Indirect application of water to materials for purposes of knocking down fugitive dust once it is released from the operation is considered the use of "Water Sprays" and “Dry Fogging”.
- Total or partial enclosure such as the use of buildings, conveyor covers, and silos. Also, the use of pneumatic conveying of materials through pipes and ductwork, and use of closed vent systems.
- Wind breaks/guards to reduce or eliminate particulate emissions from wind erosion.
- Dust collection systems which collect and control particulate emissions from partial or totally enclosed operations with the use of FFBs referred to as baghouses, bin vent filters, and fabric filters.

The most stringent control technology is the total enclosure of the emissions unit or activity which is generating the particulate matter. However, in many cases this approach is not practical based on either economic or safety reasons, requiring the use of other available control strategies.

Table 6-1. Emission Limits and Controls Identified in Recent BACT Determinations for Material Handling Systems.

Emission Source	Control Methods	Emission Limits	RBLC ID
Stacker Conveyor Transfer to Active Pile	Chemical Suppressant	95% control	Coal: IA-0067
	Water Spray or Partial Enclosure	90% control Not provided 75% control	Aggregate: NV-0045 Limestone: KY-0100 Biomass: OH-0317
	Lowering Tubes Minimize Drop Height	Not provided 75% control	Coal Ash: LA-0202 Coke: OH-0231
	Moisture Content	95.3% control	Aggregate: NV-0045 Biomass: OH-0317
Active Pile Reclaim	Chemical Suppressant	95% control 95% control	Coal: IA-0067 Coal: IA-0086
	Wet Suppression	Not provided	Coal: LA-0221
Reclaim Silo	Baghouse	0.005 gr/dscf	Coal: IA-0089
Screening	Moisture Content	95.3% control	Aggregate: NV-0045
	Baghouse	75% capture efficiency and 99.5% control efficiency	Aggregate: NV-0045
Material Crusher	Moisture Content	95.3% control	Aggregate: NV-0045
	Water Spray and Partial Enclosure	90% control	Aggregate: LA-0209
	Enclosure & Baghouse	0.01 gr/dscf 99% control	Clinker: LA-0209 Rock: VA-0299
Conveyors and Transfer Points	Enclosure & Baghouse	99% control-0.0022 gr/dscf 99% control-0.008 gr/dscf 0.005 gr/dscf 0.005 gr/dscf	Iron: OH-0315 Cement: AZ-0051 Coal: IA-0067 Ash: IA-0086
	Wind Screens and Dry Fogging	Not provided	Limestone: LA-0223
	Moisture Content	96.6% control	Aggregate: NV-0045
	Wind Screens & Wet Suppression	Not provided	Coke/Coal: LA-0221
Bins & Silos	Bin Vent Filter & Baghouse	0.005 gr/dscf 0.005 gr/dscf 0.01 gr/dscf 0.005 gr/dscf	Salt: IA-0095 Coal/Lime: KY-0100 Rock: SD-0003 Ash: IA-0067
Material Drop to Product Trucks & Rail Cars	Dust Suppression	95% control	Ash: IA-0086
	Dust Collector & Baghouse	0.005 gr/dscf	Ash: IA-0089
	Closed Vent System vented back to Silo	99.5% control Not specified	Ash: LA-0221 LA-0223
Paved Roads	Water Wetting Sweeping	80% combined control Not specified	IA-0067 & IA-0095 KY-0100
	Water Wetting or Sweeping & Speed Reduction	15 & 20 MPH 15 MPH & 90% reduction	AZ-0051 WV-0024
Unpaved Roads	Chemical Suppressant	95% control 98% control	IA-0067 NV-0045
	Watering & Speed Reduction	95.5% control	LA-0209
	Water Wetting	90% control 50% Control	NV-0045 LA-0202
	Paving	Not specified	KY-0100 & LA-0221

When a vehicle travels a paved or unpaved road the force of the wheels on the road surface causes pulverization of surface material. Particles are lifted and dropped from the rolling wheels, and the road surface is exposed to strong air currents from the turbulent wake behind the vehicle and surface winds. Additionally, particulate emissions from roads are in part due to direct emissions from vehicles in the form of vehicle exhaust, brake wear and tire wear emissions. As Table 6-1 shows, PM control strategies traveling vehicle include:

- paving unpaved roads and parking lots,
- water wetting of roads with or without chemical suppressants,
- sweeping of dry roads, and
- reducing vehicle speeds.

6.2 STEP 2: TECHNICAL FEASIBILITY OF FUGITIVE PM CONTROLS

The following sections discuss the applicability of the PM control techniques listed in Table 6-1 to the materials handling and storage operations and the vehicle traffic operations.

6.2.1 Materials Handling and Storage Operations

Section 2.4 lists the material handling fugitive sources for the Ochoa Plant and Jal Loadout facility. These operations include material drop and reclaim points, conveyors, storage bins and silos, and storage piles.

6.2.1.1 Enclosure

Enclosures will dramatically reduce particulate emissions by entirely containing the material preventing any release of particulates or by reducing the wind that can entrain small exposed particles. Enclosures are typically used to capture emissions from operations such as storage piles, drop points, and conveyors. Due to health and safety reasons, most enclosed operations require ventilation to remove the particulates generated by the open operation from the air. Also, pneumatic transfer operations result in ventilation of the pneumatic transfer gas/air. Depending on the amount of fugitive dust generated by the operation, enclosures are frequently vented to a FFB before being

vented to the atmosphere. The reduction in emissions from the decrease in wind velocity is expected to be up to 100 percent when compared to processes in the open.

The effectiveness of the enclosure is directly impacted by the degree to which the operation is enclosed. Totally enclosed buildings, such as the processing buildings, crusher buildings, and conveyor transfer buildings, offer the highest degree of control. Partial enclosures, such as used for rail car and truck unloading, are less effective due to the openings required for the rail car and truck passage. The effectiveness of these types of enclosures can be increased through the use of doors or flexible curtains.

Other types of enclosures typically used for handling dry solids are silos, hoppers, bins, and conveyor covers. As is the case for building enclosures, the degree of control is proportional to which the operation is enclosed. However, in well controlled situations these types of devices are typically totally enclosed.

Solids transfer operations include gravity and pneumatic flow, conveying on belts and buckets, and by using bulldozers, front end loaders, or clamshell loaders. Pneumatic flow is always enclosed in pipes. All the other types of transfer operations can be conducted with or without enclosure.

The use of full and partial enclosure is technically feasible for most of the Ochoa plant and Jal Loadout facility materials handling and storage operations. The degree of PM control is a function of the collection efficiency and control efficiency. FFBs can achieve greater than 99 percent control of PM.

6.2.1.2 Wet and Chemical Suppression

Solid materials with higher moisture content generate less PM. Some materials have high inherent moisture content while others can be controlled through the addition of water.

Controlled emission factors are between 42 and 98 percent less than the uncontrolled factors.[49]

The addition of moisture can be accomplished in two different ways. One way is to mix the water with the solid material increasing the moisture content of the entire material. The other way is to add water only to the exposed surface of the material being handled through the use of sprays. In either case, as the material dries, the effectiveness of the wet suppression decreases.

Chemicals can also be used to bind small particles in solid materials. Some of these chemicals are additives, such as surfactants, to water sprays which allow for a lower water application rate or develop a crust on the material surface. Other chemicals, such as oils, are added in place of water. Chemicals suppressants are particularly effective at reducing emissions from inactive storage piles because undisturbed the chemical can remain effective for much longer periods of time than just the one time use of water.

The use of moisture and surface wetting is technically feasible for some of the Ochoa plant operations. In fact, much of the plant processing includes wet processing for various reasons. However, surface wetting and the use of chemical suppression is not technically feasible due to the raw material and final product specifications. For example, the surface wetting of the feed ore would result in the leaching of sodium chloride on to the ground, and the use of wetting on the final product would render the final product unsalable.

6.2.1.3 Wind Breaks and Guards

Another type of fugitive dust control is the use of wind breaks or guards. These controls reduce average wind speeds across storage piles and other exposed material surfaces; thereby reducing the amount of particulates becoming wind born and migrating offsite. Wind breaks can potentially reduce emissions by 50 to 80 percent.[50] The use of wind

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[49] Pages 4-29 through 4-33 of CONTROL OF OPEN FUGITIVE DUST SOURCES, EPA-450/3-88-008.
[50] Ibid, Page 4-26.

breaks and guards are technically feasible for the Ochoa plant and Jal Loadout facility, although more effective controls are planned by ICP.

6.2.2 Vehicle Traffic

The use of following vehicular traffic controls are considered technically feasible at the Ochoa and Jal Loadout facility roads and parking lots.

- paving unpaved roads and parking lots,
- sweeping of dry roads, and
- reducing vehicle speeds.

The use of water wetting is not considered technically feasible due to the large amount of water that would be required. The product transportation road from Ochoa Plant to the Jal Loadout facility is approximately 1.0 miles of paved road at the Ochoa Plant, 18 miles of paved road along state highway 128, then north for approximately 3.5 miles along an unpaved road to be developed by ICP. The use of a large amount of water for road wetting in a desert area is environmentally undesirable. ICP will make use of the other types of controls (e.g., chemical suppressants) to minimize vehicular traffic PM emissions.

6.3 STEP 3: RANKING OF TECHNICALLY FEASIBLE FUGITIVE PM CONTROLS

Tables 6-2 and 6-3 presents the ICP proposed fugitive PM controls for the Ochoa plant and Jal Loadout facility, and any more stringent control that must be considered in Step 4 of the fugitive PM BACT analysis.

6.4 STEP 4: EVALUATION OF MOST EFFECTIVE FUGITIVE PM CONTROLS

As Tables 6-2 and 6-3 show, many of the fugitive PM sources are proposed to be controlled with the top control options: enclosures and FFB. However, a number of the truck loading and unloading points, and rail loading points are only partially enclosed and do not have dust pickup points for control using FFBs. Also, the Ochoa Plant waste

(gypsum) hauling and Jal Loadout plant roads are proposed to be unpaved with dust emissions being controlled by chemical suppression.

Table 6-2. Jal Loadout Facility Fugitive PM Control Hierarchy

Process Area	Emission Points	Proposed Controls	Top Controls?
Unloading from Product Trucks & Storage	Drop to hopper, feeder, conveyor	½ enclosed and de-dusting agent	Enclosure & FFB
	Drop to bucket elevator, conveyor, bin,	¾ enclosed and de-dusting agent	Enclosure & FFB
	Drop to reclaim feeder, conveyor, bucket elevator	¾ enclosed and de-dusting agent	Enclosure & FFB
Fines Screening	Drops to reclaim conveyors, screens	Enclosed & FFB	Top control
	Drops to conveyors, off-size bin	Enclosed & FFB	Top control
Off-size Reclaim Bin to Truck	Drops to trucks	Retractable loading spouts and partial enclosure	FFB
Reclaim Bin to Train	Drops to reclaim bin, conveyors, weighers, bucket elevator	Enclosed & FFB	Top control
	Drop from weigher to train	de-dust oil	FFB
Vehicular Traffic	Roads and parking	Unpaved	wet/chemical suppression or paved & maintain*
*Maintain means the paved surfaces will be swept & washed.			

Table 6-3. Ochoa Plant and Haul Roads to Jal Loadout Fugitive PM Control Hierarchy

Process Area	Emission Points	Proposed Controls	Top Controls?
Raw Ore Storage Pile & Handling	U/G 1 & 2 conveyor drops	Enclosed	Top control
	Ore storage	Enclosed & FFB	Top control
	Ore Reclaim	Enclosed & FFB	Top control
	Drops to/from bins	Enclosed & FFB	Top control
	Conveyors to crusher	Enclosed & FFB	Top control
Raw Ore Crushing & Screening	Conveyor and bin drops	Building & FFB	Top control
	Crushing	Building & FFB	Top control
	Crushing an sizing	Building & and wet	Top control
Polyhalite Calcining	Sodium chloride wash, bins, conveyors, transfer points	Building, wet & FFB	Top control
	Dryer/calciner/cooler vents, conveyors, transfer points	Building & FFB	Top control
SOP Area	Drying/granulator vents, sizing, grinding, crushing, conveyors, elevators, transfer points	Building & FFB	Top control
	Fines return dump hopper	1/2 enclosure & oil additive	FFB
	Dump hopper to fines return belt	Below grade-enclosed & oil additive	FFB
Langbeinite Area	Drying/conditioning vents, compactor, sizing, conveyors, elevators, transfer points	Building & FFB	Top control
	Fines return dump hopper	1/2 enclosure & oil additive	FFB
	Dump hopper to fines return belt	Below grade-enclosed & oil additive	FFB
SOP Binder & Flocculants	Bags, metering, eductor, wet mixing	Building enclosure	Top Control
Product Loading	Product drops from	Building & FFB	Top control

Process Area	Emission Points	Proposed Controls	Top Controls?
into Trucks	conveyors, bins, weighers		
	Drop to truck from weighers	1/2 enclosure & oil additive	FFB
Gypsum Truck Loading, Unloading & Stacking	Gypsum drops from conveyors, bins	Building enclosure & 20 % moisture	Top control
	Truck loading	20 % moisture	Top control
	Truck unloading	20 % moisture	Top control
	Wind erosion	Wetting	Top control
Vehicular Traffic – Ochoa Product Trucks and Chemical/Additive Deliveries	Roads and parking	Paved and maintained *	Top control
Vehicular Traffic – Ochoa Waste Haul Trucks and Jal Loadout Haul Trucks	Roads and parking	Use of chemical suppression - 90% control	Paved and maintained*
*Maintained means the paved surfaces will be swept or washed.			

As such, a BACT impacts analyses are presented to address the environmental, energy, and economic impacts of full enclosure and control using FFBs, and road paving and maintenance. Table 6-4 presents the BACT impact for a FFB system controlling fugitive emissions from:

- Ochoa Plant
  - Truck loading of SOP & Langbeinite
  - Truck unloading of fines from Jal Loadout
  - Truck loading of gypsum
- Jal Loadout
  - Truck unloading of SOP & Langbeinite
  - Truck loading of off-size reclaimed material
  - Rail car loading of product

Table 6-3 BACT Impact for a FFB System Controlling Fugitive Emissions

PARAMETER	Per Truck Loading/Unloading		Per Rail Loading/Unloading	
	Baseline	Enclosure +FFB	Baseline	Enclosure +FFB
Process Parameters:				
Exhaust Gas Flow, ACFM	5,000	5,000	10,000	10,000
Operating Hours/Year	8760	8760	8760	8760
Environmental Impacts:				
PM Emitted, gr/acfm	0.030 *	0.005	0.030 *	0.005
Uncontrolled PM Emitted, TPY	5.8 *	0.9	1.2 *	0.4
PM Reduced, TPY	Baseline	5.0	Baseline	0.9
Energy Impacts:				
Power, kW-hr/yr	Baseline	76,479	Baseline	152,952
Economic Impacts:				
Total Capital Cost	Baseline	$91,648	Baseline	$174,272
Total Annual Cost	Baseline	$82,579	Baseline	$101,918
PM Cost Effectiveness	Baseline	$16,645	Baseline	$115,554
* Partial enclosure and treated with oil to reduce dust emissions by 80 percent.				

With the exception of rail car loading, the FFB is for 5000 actual cubic feet a minute (acfm). The rail car unloading FFB is sized for 10,000 acfm. The SOP and Langbeinite product loaded into the rail cars is sprayed with oil to reduce dust emissions by 80

percent. The PM BACT impacts are calculated using the CO$T-AIR program[51] for the FFBs, and a vendor quote[52] was obtained for the cost of truck and rail car loading/unloading enclosures. Particulate loadings to the FFBs are based on annual maximum throughput of for the Jal Loadout truck loading/unloading and rail loadout because these emission points had higher throughputs than for the reclaimed material, and gypsum loading/unloading.

Table 6-5 presents the cost impacts of paving the roads at the plant for gypsum waste hauling, and product trucks at Jal Loadout. Total paved road capital costs was estimated to be approximately $41,000 per 100 feet, and the unpaved road capital costs was estimated to be approximately $16,000 per 100 feet.

Table 6-4. Cost Impacts of Road Paving for PM Control

POLLUTANT ►	PM10	PM10	PM10
PARAMETER ▼	Waste	Jal	Waste + Jal
100 ft long, 50 ft wide, unpaved site access	4,161	6,200	10,361
Unpaved Road Capital Cost	$648,022	$965,570	$3,720,091
Paved Road Capital Cost	$1,699,722	$2,532,631	$4,232,353
Unpaved Road Annualized Capital Cost *	$158,117	$235,599	$393,716
Paved Road Annualized Capital Cost *	$414,732	$617,962	$1,032,694
Vehicle Miles Traveled per Year, VMT	481,186	312,583	793,769
Unpaved Road PM Emissions, tpy **	42	22	65
Paved Road PM Emissions, tpy	6.6	1.8	8
Cost Effectiveness, $/ton	$7,174	$18,632	$11,351

* Assumes 5 year life; 0.244 capital recovery factor.
** 90 percent control due to application of surfactants.

[51] USEPA CO$T-AIR Control Cost Spreadsheets, Second Edition, July 1999.
[52] Ironbuilt® Steel Building System between 800-1200 Square Feet will cost between $8.00 & $9.00 Per Square Foot Delivered to your jobsite. The labor to erect the building should come in between $3.25 and $4.00 PSF. June 13, 2013. Jobsite Jal, NM.

6.4.1 Economic Impacts of Fugitive PM Controls

For the truck loading and unloading stations, the estimated capital cost for each system is ~$92,000 with and annual cost of ~$83,000. The annual cost includes the annualized capital costs (11 percent of the capital costs), replacement bags based on a two year life, power costs for the FFB fan, and maintenance labor and material costs, compressed air costs, and taxes, insurance, and administration. By far the largest annual cost component (75 percent) is for maintenance labor and materials. Because the amount of particulate matter captured is small (5 tons per year), the resulting PM cost effectiveness is ~$16,000 per ton of PM removed.

For the rail car loading stations, the estimated capital cost for each system is ~$174,000 with and annual cost of ~$102,000. The annual cost includes the annualized capital costs (11 percent of the capital costs), replacement bags based on a two year life, power costs for the FFB fan, and maintenance labor and material costs, compressed air costs, and taxes, insurance, and administration. By far the largest annual cost component (60 percent) is for maintenance labor and materials. Because the amount of particulate matter captured is small (0.9 tons per year), the resulting PM cost effectiveness is ~$116,000 per ton of PM removed.

The total estimated capital cost for paving the waste haul roads at the Ochoa Plant and Jal Loadout road is ~$4.2 million as compared to ~$1.6 million for gravel roads. The cost effectiveness of paving the Jal Loadout road is ~$18,600 for the waste haul roads ~$7,200 for the Ochoa plant roads. Overall, paving the plant waste haul and Jal Loadout roads would reduce PM_{10} emissions by 56.3 tons with average cost effectiveness of ~$11,400 per ton.

6.4.2 Energy Impacts of Fugitive PM Controls

The energy impacts of the truck loading/unloading FFB result from the electric power required for the draft fan used to pull/push the air and fugitive PM from the truck

loading/unloading enclosure to the FFB. The electric power requirements are minimal at ~76,000 kW-hr per year.

The energy impacts of the rail car loading FFB result from the electric power required for the draft fan used to pull/push the air and fugitive PM from the loading enclosure to the FFB. The electric power requirements are minimal at ~153,000 kW-hr per year.

The energy impact of paving the plant and Jal Loadout roads was not determined.

6.4.3 Environmental Impacts of Fugitive PM Controls

The environmental benefit of the FFB and enclosure system for truck loading/unloading is the reduction of 5 tons per year of PM. Since the captured material would be product, no waste disposal impacts were estimated as it was assumed the capture material can be recycled back and sold as product (not the case for the gypsum which will go to disposal).

The environmental benefit of the FFB and enclosure system rail loading is the reduction of 0.9 tons per year of PM. Since the captured material would be product, no waste disposal impacts were estimated as it was assumed the capture material can be recycled back to the Jal Loadout plant and reprocessed as product.

The environmental benefit of paving the waste haul roads at the Ochoa Plant and Jal Loadout roads is a reduction of 56.3 tons per year of PM_{10}. The environmental benefit for $PM_{2.5}$ would be about one tenth of that for PM_{10}.

6.5 STEP 5: FUGITIVE PM BACT SELECTION

6.5.1 PM BACT for Truck Loading/Unloading

Based on the economic impacts of controlling fugitive PM emissions from truck loading/unloading, ICP proposes no additional control over the use of a covered loading/unloading area and the use of retractable loading chutes. This is based on the

high cost effectiveness value of ~$16,000 per ton of PM captured (the amount of PM_{10} and $PM_{2.5}$ would even be less resulting in higher cost effectiveness values). Typical cost effectiveness values for FFBs applications are in the range of $42 to $266 per ton.[53]

Based on Table 6-1 and the BACT impacts analyses summarized in Table 6-5, a FFB emission rate of 0.005 grains per cubic feet of exhaust gas is the proposed BACT limit for $PM/PM_{10}/PM_{2.5}$.

6.5.2 PM BACT for Rail Car Loading

Based on the economic impacts of controlling fugitive PM emissions from rail car loading, ICP proposes no additional control over the use of de-dusting oil and use of retractable loading chutes. This is based on the high cost effectiveness value of ~$115,000 per ton of PM captured (the amount of PM_{10} and $PM_{2.5}$ would even be less resulting in higher cost effectiveness values). Typical cost effectiveness values for FFBs applications are in the range of $42 to $266 per ton.

6.5.3 PM BACT for Roads

Based on the economic impacts of controlling fugitive PM emissions from waste haul truck traffic and equipment/de-duster delivery truck traffic at the Ochoa plant, and truck traffic at Jal Loadout roads, ICP proposes no additional control over the use chemical suppressants on unpaved roads. This is based on the high cost effectiveness value of ~$11,400 per ton of PM_{10} captured (the cost effectiveness value for $PM_{2.5}$ would be ten times higher) for road paving.

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[53] USEPA Air Pollution Control Fact Sheet, Fabric Filter Baghouse; EPA-452?f-03-025.

APPENDIX A

BACT Impact Calculations

DDC BACT IMPACTS CALCULATIONS FOR OXIDATION CATALYST

TOTAL ANNUAL COST SPREADSHEET PROGRAM--CATALYTIC INCINERATORS (FIXED)

	1998 CEP	2012 CEP
COST REFERENCE DATE: April 1988 [1]	389.5	582.2
VAPCCI from 1998	155.9	

INPUT PARAMETERS

-- Heat Input (MMBtu/hr):	214
-- Gas flowrate (scfm):	164,259
-- Reference temperature (oF):	77
-- Inlet gas temperature (oF):	475
-- Inlet gas density (lb/scf):	0.0739
-- Primary heat recovery (fraction):	0.00
-- Waste gas heat content (BTU/scf):	0.00
-- Waste gas heat content (BTU/lb):	0.00
-- Gas heat capacity (BTU/lb-oF):	0.248
-- Combustion temperature (oF):	475
-- Preheat temperature (oF):	0
-- Fuel heat of combustion (BTU/lb):	21502
-- Fuel density (lb/ft3):	0.0408

DESIGN PARAMETERS

-- Auxiliary Fuel Reqrmnt (lb/min):	0.0
(scfm):	0.0
-- Total Gas Flowrate (scfm):	164259
-- Catalyst Volume (ft3):	318.1

CAPITAL COSTS

Equipment Costs ($):		
-- Incinerator:		
@ 0 % heat recovery:	788,457	
@ 35 % heat recovery:	0	
@ 50 % heat recovery:	0	
@ 70 % heat recovery:	0	
-- Other (auxiliary equipment, etc.):		
Total Equipment Cost--base:	788,457	
' ' ' --escalated:	1,328,752	
Purchased Equipment Cost ($):	1,567,927	
Total Capital Investment ($):	1,567,927	1.00

ANNUAL COST INPUTS

Operating factor (hr/yr):	8760
Operating labor rate ($/hr):	12.96
Maintenance labor rate ($/hr):	14.26
Operating labor factor (hr/sh):	0.5
Maintenance labor factor (hr/sh):	0.5
Electricity price ($/kwh):	0.060
Catalyst price ($/ft3):	650
Natural gas price ($/mscf):	5.00
Annual interest rate (fraction):	0.07
Control system life (years):	15
Catalyst life (years):	5
Capital recovery factor (system):	0.1098
Capital recovery factor (catalyst):	0.2439
Taxes, insurance, admin. factor:	0.04
Pressure drop (in. w.c.):	7.1

ANNUAL COSTS

Item		Cost ($/yr)	Wt. Factor
Operating labor		7,096	0.016
Supervisory labor		1,064	0.002
Maintenance labor		7,805	0.017
Maintenance materials		7,805	0.017
Natural gas		0	0.000
Electricity		118,971	0.267
Catalyst replacement		54,465	0.122
Overhead		14,262	0.032
Taxes, insurance, administrative		62,717	0.141
Capital recovery		172,150	0.386
Total Annual Cost	$/year	446,336	1.000

[1] Original equipment costs reflect this date.
[2] VAPCCI = Vatavuk Air Pollution Control Cost Index (for catalytic incinerators) corresponding to year and quarter shown. Original equipment cost, purchased equipment cost, and total capital investment have been escalated to this date via the VAPCCI and control equipment vendor data.

SOP DRYER BACT IMPACTS CALCULATIONS FOR OXIDATION CATALYST

TOTAL ANNUAL COST SPREADSHEET PROGRAM--CATALYTIC INCINERATORS (FIXED)

	1998 CEP	2012 CEP
COST REFERENCE DATE: April 1988 [1]	389.5	582.2
VAPCCI from 1998	155.9	

INPUT PARAMETERS

-- Heat Input (MMBtu/hr):	18.7
-- Gas flowrate (scfm):	2798
-- Reference temperature (oF):	77
-- Inlet gas temperature (oF):	250
-- Inlet gas density (lb/scf):	0.0739
-- Primary heat recovery (fraction):	0.70
-- Waste gas heat content (BTU/scf):	0.00
-- Waste gas heat content (BTU/lb):	0.00
-- Gas heat capacity (BTU/lb-oF):	0.248
-- Combustion temperature (oF):	400
-- Preheat temperature (oF):	150
-- Fuel heat of combustion (BTU/lb):	21502
-- Fuel density (lb/ft3):	0.0408

DESIGN PARAMETERS

-- Auxiliary Fuel Reqrmnt (lb/min):	0.4
(scfm):	10.6
-- Total Gas Flowrate (scfm):	2809
-- Catalyst Volume (ft3):	5.4

CAPITAL COSTS

Equipment Costs ($):		
-- Incinerator:		
@ 0 % heat recovery:	0	
@ 35 % heat recovery:	0	
@ 50 % heat recovery:	0	
@ 70 % heat recovery:	116,221	
-- Other (auxiliary equipment, etc.):		
Total Equipment Cost--base:	116,221	
' ' ' --escalated:	195,863	
Purchased Equipment Cost ($):	211,532	
Total Capital Investment ($):	211,532	1.00

ANNUAL COST INPUTS

Operating factor (hr/yr):	8760
Operating labor rate ($/hr):	12.96
Maintenance labor rate ($/hr):	14.26
Operating labor factor (hr/sh):	0.0
Maintenance labor factor (hr/sh):	0.5
Electricity price ($/kwh):	0.060
Catalyst price ($/ft3):	650
Natural gas price ($/mscf):	5.00
Annual interest rate (fraction):	0.07
Control system life (years):	15
Catalyst life (years):	5
Capital recovery factor (system):	0.1098
Capital recovery factor (catalyst):	0.2439
Taxes, insurance, admin. factor:	0.04
Pressure drop (in. w.c.):	21.0

ANNUAL COSTS

Item		Cost ($/yr)	Wt. Factor
Operating labor		0	0.000
Supervisory labor		0	0.000
Maintenance labor		7,805	0.085
Maintenance materials		7,805	0.085
Natural gas		27,878	0.305
Electricity		6,046	0.066
Catalyst replacement		931	0.010
Overhead		9,366	0.102
Taxes, insurance, administrative		8,461	0.092
Capital recovery		23,225	0.254
Total Annual Cost	$/year	91,519	1.000

[1] Original equipment costs reflect this date.
[2] VAPCCI = Vatavuk Air Pollution Control Cost Index (for catalytic incinerators) corresponding to year and quarter shown. Original equipment cost, purchased equipment cost, and total capital investment have been escalated to this date via the VAPCCI and control equipment vendor data.

BOILER BACT IMPACTS CALCULATIONS FOR OXIDATION CATALYST

TOTAL ANNUAL COST SPREADSHEET PROGRAM--CATALYTIC INCINERATORS (FIXED)

	1998 CEP	2012 CEP
COST REFERENCE DATE: April 1988 [1]		
	389.5	582.2
VAPCCI from 1998	155.9	

INPUT PARAMETERS

-- Heat Input (MMBtu/hr):	156
-- Gas flowrate (scfm):	34093
-- Reference temperature (oF):	77
-- Inlet gas temperature (oF):	600
-- Inlet gas density (lb/scf):	0.0739
-- Primary heat recovery (fraction):	0.00
-- Waste gas heat content (BTU/scf):	0.00
-- Waste gas heat content (BTU/lb):	0.00
-- Gas heat capacity (BTU/lb-oF):	0.248
-- Combustion temperature (oF):	600
-- Preheat temperature (oF):	0
-- Fuel heat of combustion (BTU/lb):	21502
-- Fuel density (lb/ft3):	0.0408

DESIGN PARAMETERS

-- Auxiliary Fuel Reqrmnt (lb/min):	0.0
(scfm):	0.0
-- Total Gas Flowrate (scfm):	34093
-- Catalyst Volume (ft3):	66.0

CAPITAL COSTS

Equipment Costs ($):		
-- Incinerator:		
@ 0 % heat recovery:	333,569	
@ 35 % heat recovery:	0	
@ 50 % heat recovery:	0	
@ 70 % heat recovery:	0	
-- Other (auxiliary equipment, etc.):		
Total Equipment Cost--base:	333,569	
' ' ' --escalated:	562,149	
Purchased Equipment Cost ($):	663,336	
Total Capital Investment ($):	663,336	1.00

ANNUAL COST INPUTS

Operating factor (hr/yr):	8760
Operating labor rate ($/hr):	12.96
Maintenance labor rate ($/hr):	14.26
Operating labor factor (hr/sh):	0.5
Maintenance labor factor (hr/sh):	0.5
Electricity price ($/kwh):	0.060
Catalyst price ($/ft3):	650
Natural gas price ($/mscf):	5.00
Annual interest rate (fraction):	0.07
Control system life (years):	15
Catalyst life (years):	5
Capital recovery factor (system):	0.1098
Capital recovery factor (catalyst):	0.2439
Taxes, insurance, admin. factor:	0.04
Pressure drop (in. w.c.):	7.1

ANNUAL COSTS

Item		Cost ($/yr)	Wt. Factor
Operating labor		7,096	0.041
Supervisory labor		1,064	0.006
Maintenance labor		7,805	0.045
Maintenance materials		7,805	0.045
Natural gas		0	0.000
Electricity		24,693	0.142
Catalyst replacement		11,305	0.065
Overhead		14,262	0.082
Taxes, insurance, administrative		26,533	0.153
Capital recovery		72,831	0.420
Total Annual Cost	$/year	173,395	1.000

[1] Original equipment costs reflect this date.
[2] VAPCCI = Vatavuk Air Pollution Control Cost Index (for catalytic incinerators) corresponding to year and quarter shown. Original equipment cost, purchased equipment cost, and total capital investment have been escalated to this date via the VAPCCI and control equipment vendor data.

NATURAL GAS FIRED DRYER/CALCINER/COOLER SCR

ACT-NOx Emissions from ICI Boilers SCR Cost Update

PARAMETER		FACTOR	DOLLARS
Direct Capital Costs (DCC)			
	Primary and auxiliary equipment		
	CEM System		
	Instrumentation		
	Sales Tax		
	Freight		
	Total Purchased Equipment Cost (PEC)		included
	Direct Installation Cost (DIC)		included
	Site Prep		included
	Buildings		included
Total Direct Capital Costs (DCC)			$944,217
Indirect Capital Costs			
	Engineering at * PEC	0.20	$188,843
	Construction & Field Expenses at * PEC	0.20	$188,843
	Construction Fee at * PEC	0.20	$188,843
	Startup at * PEC	0.04	$37,769
	Performance test at * PEC	0.02	$18,884
	Total Indirect Capital Costs (ICC)		$623,183
Contingency	at * (DCC + ICC)	0.20	$313,480
Total Capital Investment			$1,257,697
Direct Annual Cost			
	Operating labor at hours per shift	0.5	$10,950
	Maintenance labor at hours per shift	0.5	$10,950
	Maintenance materials fraction of DCC	0.02	$18,884
	Catalyst replacement		$53,668
	Electricity		$355,127
	Steam		$0
	Fuel		$1,909,087
	Waste disposal		$18,632
	Chemicals		$6,495
Total Direct Annual Costs			$2,383,792
Indirect Operating Costs			
	Overhead	0.6	$13,140
	Administration	0.02	included
	Property taxes	0.01	included
	Insurance	0.01	included
Total Indirect Annual Costs			$13,140
Total Annual Operating and Maintenance Cost			$2,396,932
Annualized Capital Costs			
	Cost of money	7%	
	Years of operation	15	
	CRF	0.10979	$138,088
Total Annualized Costs			$2,535,020
Cost Effectiveness			
	Uncontrolled/Controlled emission rate, lb/MMBtu	0.042	0.006
	Uncontrolled/Controlled emissions, tpy	39.41	5.91
	Percent control	85%	
	Heat Input per calciner, MMBtu/hr	214	
	Controlled NOx, tpy		33.50
Average Cost Effectiveness			$75,676

NATURAL GAS FIRED SOP DRYER SCR

ACT-NOx Emissions from ICI Boilers SCR Cost Update

PARAMETER		FACTOR	DOLLARS
Direct Capital Costs (DCC)			
	Primary and auxiliary equipment		
	CEM System		
	Instrumentation		
	Sales Tax		
	Freight		
	Total Purchased Equipment Cost (PEC)		included
	Direct Installation Cost (DIC)		included
	Site Prep		included
	Buildings		included
Total Direct Capital Costs (DCC)			$489,567
Indirect Capital Costs			
	Engineering at * PEC	0.20	$97,913
	Construction & Field Expenses at * PEC	0.20	$97,913
	Construction Fee at * PEC	0.20	$97,913
	Startup at * PEC	0.04	$19,583
	Performance test at * PEC	0.02	$9,791
	Total Indirect Capital Costs (ICC)		$323,114
Contingency	at * (DCC + ICC)	0.20	$162,536
Total Capital Investment			$652,104
Direct Annual Cost			
	Operating labor at hours per shift	0.5	$10,950
	Maintenance labor at hours per shift	0.5	$10,950
	Maintenance materials fraction of DCC	0.02	$9,791
	Catalyst replacement		$53,668
	Electricity		$6,084
	Steam		$0
	Fuel		$74,342
	Waste disposal		$18,708
	Chemicals		$568
Total Direct Annual Costs			$185,063
Indirect Operating Costs			
	Overhead	0.6	$13,140
	Administration	0.02	included
	Property taxes	0.01	included
	Insurance	0.01	included
Total Indirect Annual Costs			$13,140
Total Annual Operating and Maintenance Cost			$198,203
Annualized Capital Costs			
	Cost of money	7%	
	Years of operation	15	
	CRF	0.10979	$71,597
Total Annualized Costs			$269,800
Cost Effectiveness			
	Uncontrolled/Controlled emission rate, lb/MMBtu	0.042	0.006
	Uncontrolled/Controlled emissions, tpy	3.45	0.52
	Percent control	85%	
	Heat Input, MMBtu/hr	18.7	
	Controlled NOx, tpy		2.93
Average Cost Effectiveness			$92,073

NATURAL GAS FIRED PACKAGE WATER TUBE BOILER SCR

ACT-NOx Emissions from ICI Boilers SCR Cost Update

PARAMETER		FACTOR	DOLLARS
Direct Capital Costs (DCC)			
	Primary and auxiliary equipment		
	CEM System		
	Instrumentation		
	Sales Tax		
	Freight		
	Total Purchased Equipment Cost (PEC)		included
	Direct Installation Cost (DIC)		included
	Site Prep		included
	Buildings		included
Total Direct Capital Costs (DCC)			$549,035
Indirect Capital Costs			
	Engineering at * PEC	0.20	$109,807
	Construction & Field Expenses at * PEC	0.20	$109,807
	Construction Fee at * PEC	0.20	$109,807
	Startup at * PEC	0.04	$21,961
	Performance test at * PEC	0.02	$10,981
	Total Indirect Capital Costs (ICC)		$362,363
Contingency	at * (DCC + ICC)	0.20	$182,280
Total Capital Investment			$731,314
Direct Annual Cost			
	Operating labor at hours per shift	0.5	$10,950
	Maintenance labor at hours per shift	0.5	$10,950
	Maintenance materials fraction of DCC	0.02	$10,981
	Catalyst replacement		$53,668
	Electricity		$24,693
	Steam		$0
	Fuel		$0
	Waste disposal		$18,632
	Chemicals		$4,726
Total Direct Annual Costs			$134,600
Indirect Operating Costs			
	Overhead	0.6	$13,140
	Administration	0.02	included
	Property taxes	0.01	included
	Insurance	0.01	included
Total Indirect Annual Costs			$13,140
Total Annual Operating and Maintenance Cost			$147,740
Annualized Capital Costs			
	Cost of money	7%	
	Years of operation	15	
	CRF	0.10979	$80,294
Total Annualized Costs			$228,034
Cost Effectiveness			
	Uncontrolled/Controlled emission rate, lb/MMBtu	0.02	0.003
	Uncontrolled/Controlled emissions, tpy	13.66	2.05
	Percent control	85%	
	Boiler Heat Input, MMBtu/hr	156	
	Controlled NOx, tpy		11.61
Average Cost Effectiveness			$19,644

OCHOA PLANT CARBON CAPTURE & SEQUESTRATION BACT IMPACTS

Process Data	Units	NETL NGCC	Boilers/Calciners/Dryers	NOTES
Heat Input	million Btus/hr	3,765	1,002	NG only peak firing rate
CO_2 Flow Rate	tons/hr	223.0	58.6	
Capacity Factor	percent	100%	100%	
CO_2 before CCS	tons/yr	1,953,663	513,107	
GHG before CCS (CO2e)	tons/yr	1,927,803	514,029	
Environmental Impacts				
Percent CO_2 Reduction	percent	90%	90%	
CO_2 Captured	tons/yr	1,759,534	461,797	
CO_2 Emitted after CCS	tons/yr		51,311	
CO_2 Emitted by CCS	tons/yr	283,722	75,517	
Total CO_2 Emitted with CCS	tons/yr	451,991	126,828	
CO_2 Reduction due to CCS (avoided)	tons/yr	1,475,811	386,279	
Water Consumption	millon gallons/yr	836	81	ratioed on heat input
Collateral NO_X Increase	tons/yr		64.0	
Collateral CO Increase	tons/yr		9.7	
Collateral VOC Increase	tons/yr		1.4	
Collateral PM10/PM2.5 Increase	tons/yr		4.3	
Collateral SO_2 Increase	tons/yr		2.2	
Energy Impacts				
Steam & Power	million Btus/yr	4,854,000	1,292,000	ratioed on heat input
Steam	1000 pounds/hr	615	164	ratioed on steam & power
Power	megawatt electric	28	8	ratioed on steam & power
Economic Impacts				
Escalated Capital Costs	US dollars	$346,500,000	$156,700,000	scaled by 0.6 power applied to ratio of heat input
Capital Cost Annualized (11% CRF)	US dollars/yr	$38,200,000	$17,300,000	
O&M Costs	US dollars/yr	$96,920,255	$43,900,000	ratioed on capital costs
Total Annual Cost	US dollars/yr	$135,120,255	$61,200,000	
Cost Effectiveness	US dollars/ton	$77	$133	
Avoided Cost Effectiveness	US dollars/ton	$92	$158	

Cost and Performance Baseline for Fossil Energy Plants Volume 1: Bituminous Coal and Natural Gas to Electricity Rev2; DOE/NETL-2010/1397; November 2010. Cost escalated to 2012 dollars.CRF- capital recovery factor based on a 7 percent cost of money and 15 year equipment life.

Collateral NSR Pollutants	lb/MMBtu	AP-42 EF Bases	$ Escalation	
NOx	0.0990	lean-premix		
CO	0.0150	lean-premix	CEPCI 2012	
VOC	0.0021	uncontrolled	585.7	
PM2.5	0.0066	uncontrolled	CEPCI 2007	
SO2	0.0034	default	525.4	

TOTAL ANNUAL COST SPREADSHEET PROGRAM--FABRIC FILTERS [1]

Truck Loading/Unloading Total Enclosure & FFB

COST BASE DATE: Second Quarter 1998 [2]

		1998 CEP	2012 CEP
VAPCCI (Fourth Quarter 1998--FINAL): [3]	165.8	389.5	582.2

INPUT PARAMETERS:

-- Inlet stream flowrate (acfm):	5000	
-- Inlet stream temperature (oF):	75	
-- Inlet stream temperature, adjusted--pulse jet on	75	
-- Dust type:	SOP dust	
-- Inlet dust loading (gr/ft3):	0.030	after 80% control
-- Dust mass median diameter (microns):	7	
-- Filtration time (min):	10	
-- Dust specific resistance (in.H2O/fpm/lb/ft2):	15	
-- G/C ratio factors (shaker & reverse-air):		
A:	2.0	
B:	0.9	
C:	1.0	
-- G/C ratio factors (pulse-jet):		
Material:	9.0	
Application:	0.8	
-- G/C ratio factors (cartridge filter A:	2.1	
B:	0.8	
C:	0.75	
D:	0.9	
E:	1.075	
-- Cleaning pressure, psig (pulse-jet only):	100	
-- Fraction of bags cleaned (shaker & rev-air):	0.1	
-- Insulation required? ('yes'=1;'no'=0):	0	
-- Stainless steel required? ('yes'=1;'no'=0):	0	
-- Bag material:	Polyethylene	
-- Fabric effective residual drag (in. H2O/fpm):	1.1	

-- Bag prices ($/ft2): (from table below, for bag material selected above only) [4]

Cleaning Mech.	Bag Diam. (in.)	Price ($/ft2)
Pulse jet--BBR	4.5 to 5.125	1.69
	6 to 8	1.55
Pulse jet--cart.	4.875	2.95
	6.125	0.00
Shaker--strap	5	0.00
Shaker--loop	5	0.00
Reverse air w/o rings	8	0.95
	11.5	0.75

-- Cost of auxiliary equipment (ductwork, fan, stack, etc.), ($):

DESIGN PARAMETERS

-- Gas-to-cloth ratio (acfm/ft2 cloth area):		
Shaker:	1.80	
Reverse-air:	1.80	
Pulse-jet:	8.54	
Cartridge:	1.22	
-- Net cloth area required (ft2):		
Shaker:	2778	
Reverse-air:	2778	
Pulse-jet:	586	
Cartridge:	4102	
-- Gross cloth area required (ft2):		
Shaker:	5556	
Reverse-air:	5556	
Pulse-jet:	586	
Cartridge:	4102	
-- Area per bag--reverse-air (ft2) (8-in. x 24-ft)	50.3	
-- Number of bags--reverse air:	111	
-- Area per bag--shaker (ft2) (5-in x 8-ft):	10.5	
-- Number of bags--shaker	531	
-- Area per bag--pulse je Small (4.5-in. x 8-ft)	9.42	
Large (5.125-in. x 10-ft)	13.42	
-- Number of bags/cages (pulse-jet onlSmall bags	63	
Large bags	44	
-- Area per bag--cartridge (ft2):	153	
-- Number of bags--cartridge:	27	
-- Bag pressure drop (in. w.c.):		
Shaker:	1.98	
Reverse-air:	1.98	
Pulse-jet:	2.65	
Cartridge:	1.34	
-- Baghouse shell pressure drop (in. w.c.):	3.00	
-- Ductwork pressure drop (in. w.c.):	4.00	

CAPITAL COSTS

Equipment Costs ($):

Item:	Cost ($): Rev-air	P-J (mod)	P-J (com)
Baghouse	63,413	18,745	6,503
Bags--small	4,167	990	990
" --large		908	908
Insulation	0	0	0
Stainless	0	0	0
Cages-small [5]	0	377	377
" -large	0	486	486
Auxiliaries	15,600	15,600	15,600
Total--small[5a]	83,180	35,712	23,470
" --large:		35,738	23,497
PEC($)-base:	98,152	42,140	27,695
' ' -esc.:	149,681	64,263	42,234
TCI ($):	324,809	139,451	91,648
($/acfm):	65	28	18

ANNUAL COST INPUTS:

Operating factor (hr/yr):	8760
Operating labor rate ($/hr):	17.26
Maintenance labor rate ($/hr):	17.74
Operating labor factor (hr/sh):	0
Maintenance labor factor (hr/sh):	1
Electricity price ($/kWhr):	0.06
Compressed air ($/1000 scf):	0.25
Dust disposal ($/ton):	0
Annual interest rate (fraction):	0.07
Control system life (years):	15
Capital recovery factor:	0.1098
Bag life (years):	2
Capital recovery factor (bags):	0.5531
Taxes, insurance, admin. factor:	0.04

ANNUAL COSTS ($/yr):

Item	Reverse-air	P-J (modul	P-J (comm	P-J (cartridge)	
Oper. labor	0	0	0		
Supv. labor	0	0	0		
Maint. labor	19,425	19,425	19,425		75%
Maint. matl.	19,425	19,425	19,425		
Electricity	19,732	4,589	4,589		
Compr. air	0	1,314	1,314		
Bag repl.	2,925	981	981		
Dust dispos.	0	0	0		
Overhead	23,310	23,310	23,310		
Tax,ins.,adm	12,992	5,578	3,666		
Cap. recov.	35,082	15,116	9,868		
Total Annual	132,891	89,739	82,579		

TOTAL ANNUAL COST SPREADSHEET PROGRAM--FABRIC FILTERS [1]

Rail Loading/Unloading Total Enclosure & FFB

COST BASE DATE: Second Quarter 1998 [2]

		1998 CEP	2012 CEP
VAPCCI (Fourth Quarter 1998--FINAL): [3]	165.8	389.5	582.2

INPUT PARAMETERS:

-- Inlet stream flowrate (acfm):	10000	
-- Inlet stream temperature (oF):	75	
-- Inlet stream temperature, adjusted--pulse jet on	75	
-- Dust type:	SOP dust	
-- Inlet dust loading (gr/ft3):	0.030	after 80% control
-- Dust mass median diameter (microns):	7	
-- Filtration time (min):	10	
-- Dust specific resistance (in.H2O/fpm/lb/ft2):	15	
-- G/C ratio factors (shaker & reverse-air):		
A:	2.0	
B:	0.9	
C:	1.0	
-- G/C ratio factors (pulse-jet):		
Material:	9.0	
Application:	0.8	
-- G/C ratio factors (cartridge filter A:	2.1	
B:	0.8	
C:	0.75	
D:	0.9	
E:	1.075	
-- Cleaning pressure, psig (pulse-jet only):	100	
-- Fraction of bags cleaned (shaker & rev-air):	0.1	
-- Insulation required? ('yes'=1;'no'=0):	0	
-- Stainless steel required? ('yes'=1;'no'=0):	0	
-- Bag material:	Polyethylene	
-- Fabric effective residual drag (in. H2O/fpm):	1.1	

-- Bag prices ($/ft2): (from table below, for bag material selected above only) [4]

Cleaning Mech.	Bag Diam. (in.)	Price ($/ft2)
Pulse jet--BBR	4.5 to 5.125	1.69
	6 to 8	1.55
Pulse jet--cart.	4.875	2.95
	6.125	0.00
Shaker--strap	5	0.00
Shaker--loop	5	0.00
Reverse air w/o rings	8	0.95
	11.5	0.75

-- Cost of auxiliary equipment (ductwork, fan, stack, etc.), ($):

DESIGN PARAMETERS

-- Gas-to-cloth ratio (acfm/ft2 cloth area):		
	Shaker:	1.80
	Reverse-air:	1.80
	Pulse-jet:	8.53
	Cartridge:	1.22
-- Net cloth area required (ft2):		
	Shaker:	5556
	Reverse-air:	5556
	Pulse-jet:	1172
	Cartridge:	8203
-- Gross cloth area required (ft2):		
	Shaker:	8333
	Reverse-air:	8333
	Pulse-jet:	1172
	Cartridge:	8203
-- Area per bag--reverse-air (ft2) (8-in. x 24-ft)		50.3
-- Number of bags--reverse air:		166
-- Area per bag--shaker (ft2) (5-in x 8-ft):		10.5
-- Number of bags--shaker		796
-- Area per bag--pulse je	Small (4.5-in. x 8-ft)	9.42
	Large (5.125-in. x 10-ft)	13.42
-- Number of bags/cages (pulse-jet onl	Small bags	125
	Large bags	88
-- Area per bag--cartridge (ft2):		153
-- Number of bags--cartridge:		54
-- Bag pressure drop (in. w.c.):		
	Shaker:	1.98
	Reverse-air:	1.98
	Pulse-jet:	2.65
	Cartridge:	1.34
-- Baghouse shell pressure drop (in. w.c.):		3.00
-- Ductwork pressure drop (in. w.c.):		4.00

CAPITAL COSTS

Equipment Costs ($):

Item:	Cost ($): Rev-air	P-J (mod)	P-J (com)
Baghouse	76,255	23,952	10,701
Bags--small	6,250	1,980	1,980
" --large		1,816	1,816
Insulation	0	0	0
Stainless	0	0	0
Cages-small [5]	0	748	748
" -large	0	971	971
Auxiliaries	31,200	31,200	31,200
Total--small[5a]	113,705	57,880	44,629
" --large:		57,939	44,688
PEC($)-base:	134,172	68,299	52,663
' ' -esc.:	204,611	104,155	80,310
TCI ($):	444,005	226,016	174,272
($/acfm):	44	23	17

ANNUAL COST INPUTS:

Operating factor (hr/yr):	8760
Operating labor rate ($/hr):	17.26
Maintenance labor rate ($/hr):	17.74
Operating labor factor (hr/sh):	0
Maintenance labor factor (hr/sh):	1
Electricity price ($/kWhr):	0.0600
Compressed air ($/1000 scf):	0.25
Dust disposal ($/ton):	25
Annual interest rate (fraction):	0.07
Control system life (years):	15
Capital recovery factor:	0.1098
Bag life (years):	2
Capital recovery factor (bags):	0.5531
Taxes, insurance, admin. factor:	0.04

ANNUAL COSTS ($/yr):

Item	Reverse-air	P-J (modul	P-J (common)	
Oper. labor	0	0	0	
Supv. labor	0	0	0	
Maint. labor	19,425	19,425	19,425	61%
Maint. matl.	19,425	19,425	19,425	
Electricity	31,734	9,177	9,177	
Compr. air	0	2,628	2,628	
Bag repl.	4,385	1,957	1,957	
Dust dispos.	278	278	278	
Overhead	23,310	23,310	23,310	
Tax,ins.,adm	17,760	9,041	6,971	
Cap. recov.	47,879	24,427	18,746	
Total Annual	164,197	109,668	101,918	

Section 13

Discussion Demonstrating Compliance With Each Applicable State & Federal Regulation

Provide a discussion demonstrating compliance with applicable state & federal regulation. If there is a state or federal regulation (other than those listed here) for your facility's source category that does not apply to your facility, but seems on the surface that it should apply, add the regulation to the appropriate table below and provide the analysis. Examples of regulatory requirements that may or may not apply to your facility include 40 CFR 60 Subpart OOO (crushers), 40 CFR 63 Subpart HHH (HAPs), or 20.2.74 NMAC (PSD major sources). We don't want a discussion of every non-applicable regulation, but if there is questionable applicability, explain why it does not apply. All input cells should be filled in, even if the response is 'No' or 'N/A'.

In the "Justification" column, identify the criteria that are critical to the applicability determination, numbering each. For each unit listed in the "Applies to Unit No(s)" column, after each listed unit, include the number(s) of the criteria that made the regulation applicable. For example, TK-1 & TK-2 would be listed as: TK-1 (1, 3, 4), TK-2 (1, 2, 4). Doing so will provide the applicability criteria for each unit, while also minimizing the length of these tables.

As this table will become part of the SOB, please do not change the any formatting in the table, especially the width of the table.

If this application includes any proposed exemptions from otherwise applicable requirements, provide a narrative explanation of these proposed exemptions. These exemptions are from specific applicable requirements, which are spelled out in the requirements themselves, not exemptions from 20.2.70 NMAC or 20.2.72 NMAC.

Table for Applicable STATE REGULATIONS:

STATE REGU-LATIONS CITATION	Title	Applies to Entire Facility	Applies to Unit No(s).	Federally Enforce-able	Does Not Apply	JUSTIFICATION: Identify the applicability criteria, numbering each (i.e. 1. Post 7/23/84, 2. 75 m^3, 3. VOL)
20.2.3 NMAC	Ambient Air Quality Standards NMAAQS	Yes		Yes		20.2.3 NMAC is a State Implementation Plan-approved regulation that limits the maximum allowable concentration of total suspended particulates, sulfur compounds, carbon monoxide and nitrogen dioxide.
20.2.7 NMAC	Excess Emissions	Yes		Yes		Sources subject to 20.2.74 Prevention of Signification Deterioration (PSD) are subject to the requirements of this regulation. The facility will establish, implement, and maintain a plan to minimize routine or predictable emissions during startup, shutdown, and scheduled maintenance through work practice standards and good combustion practices.
20.2.33 NMAC	Gas Burning Equipment - Nitrogen Dioxide		S18A,B,C, S34, S73A,B, S90, S113, S196, S197	Yes		This facility has new gas burning equipment having a heat input of greater than 1,000,000 million British Thermal Units per year per unit
20.2.34 NMAC	Oil Burning Equipment: NO_2				X	This facility does not have oil burning equipment having a heat input of greater than 1,000,000 million British Thermal Units per year per unit.
20.2.61.109 NMAC	Smoke & Visible Emissions		S18A,B,C, S34, S73A,B, S90, S113, S196, S197	Yes		The facility stationary combustion equipment are subject to this regulation which has a 20 percent opacity limit. The units may be exempt from these rule requirements if there are more stringent opacity limits in other applicable regulations.

STATE REGU-LATIONS CITATION	Title	Applies to Entire Facility	Applies to Unit No(s).	Federally Enforce-able	Does Not Apply	JUSTIFICATION: Identify the applicability criteria, numbering each (i.e. 1. Post 7/23/84, 2. 75 m^3, 3. VOL)
20.2.70 NMAC	Operating Permits	Yes		Yes		The facility is major for NOx, CO, PM, and Greenhouse Gases. The facility will apply for a Title V operating permit after start of operation after construction.
20.2.71 NMAC	Operating Permit Fees	Yes		Yes		Yes, this facility is subject to 20.2.70 NMAC and is in turn subject to 20.2.71 NMAC. The facility will be applying for a Title V operating permit after start of operation after construction. At that time the facility will pay all Operating Permit Fees.
20.2.72 NMAC	Construction Permits	Yes		Yes		This facility is a new source and is subject to 20.2.72 NMAC.
20.2.73 NMAC	NOI & Emissions Inventory Requirements	Yes		Yes		**NOI:** 20.2.73.200 NMAC applies (requiring a NOI application) **Emissions Inventory Reporting:** 20.2.73.300 NMAC applies. All Title V major sources meet the applicability requirements of 20.2.73.300 NMAC.
20.2.74 NMAC	Permits – PSD	Yes		Yes		This facility is PSD major as defined by: Any stationary source not listed in Table 1 of this Part (20.2.74.501 NMAC) and which emits or has the potential to emit two hundred fifty (250) tons per year or more of any regulated pollutant.
20.2.75 NMAC	Construction Permit Fees	Yes		Yes		This facility is subject to 20.2.72 NMAC and is in turn subject to 20.2.75 NMAC.
20.2.77 NMAC	New Source Performance		S196, S197, EG1, FP1	Yes		Listed emission sources are subject to the requirements of 40 CFR Part 60, as amended through December 31, 2010.
20.2.78 NMAC	Emission Standards for HAPS				X	This facility emits hazardous air pollutants which are subject to the requirements of 40 CFR Part 61, as amended through December 31, 2010.
20.2.79 NMAC	Permits – Nonattainment Areas				X	This facility will be located in an Attainment Area.
20.2.80 NMAC	Stack Heights	Yes		Yes		The objective of this Part is to establish requirements for the evaluation of stack heights and other dispersion techniques in permitting decisions. The Department shall give no credit for reductions in emissions due to the length of a source's stack height that exceeds good engineering practice or due to any other dispersion technique. The facility will met all requirements of good engineering practices.
20.2.82 NMAC	MACT Standards for source categories of HAPS		EG1, FP1		X	Emission sources EG1 and FP1 are subject to this subpart because they are stationary RICE.

Table for Applicable FEDERAL REGULATIONS:

FEDERAL REGU-LATIONS CITATION	Title	Applies to **Entire Facility**	Applies to **Unit No(s).**	**Federally Enforce-able**	**Does Not Apply**	**JUSTIFICATION:**
40 CFR 50	NAAQS	Yes		Yes		Defined as applicable at 20.2.70.7.E.11, Any national ambient air quality standard
NSPS 40 CFR 60, Subpart A	General Provisions		S196, S197, EG1, FP1	Yes		Applies if any other NSPS subpart applies.
NSPS 40 CFR60.40 a, Subpart Da	Subpart Da, Performance Standards for **Electric Utility Steam Generating Units**				X	Establishes PM, SO_2 and NOx emission limits/standards of performance for Electric Utility Steam Generating Units. The facility does not have Electric Utility Steam Generating Units.
NSPS 40 CFR60.40b Subpart Db	Standards of Performance for **Industrial-Commercial-Institutional Steam Generating Units**		S196, S197	Yes		The affected facility to which this subpart applies is each steam generating unit that commences construction, modification, or reconstruction after June 19, 1984, and that has a heat input capacity from fuels combusted in the steam generating unit of greater than 29 MW (100 million Btu/hour). Establishes NOx emission limit for Boiler Units S196 and S197. The boilers have heat input ratings of 155.9 MMBtu/hr heat input, which exceeds the 100 MMBtu/hr threshold. Construction will commence, after the 6/19/1984 applicability date.
NSPS 40 CFR 60, Subpart Kb	Standards of Performance for **Volatile Organic Liquid Storage Vessels** (Including Petroleum Liquid Storage Vessels) for Which Construction, Reconstruction, or Modification Commenced **After** July 23, 1984				X	This facility has no storage vessels with a capacity greater than or equal to 75 cubic meters (m^3) that is used to store volatile organic liquids (VOL) for which construction, reconstruction, or modification is commenced after July 23, 1984.
NSPS 40 CFR 60, Subpart 000	Standards of Performance for **Nonmetallic Mineral Processing Plants**				X	This subpart is not applicable to potash processing facilities.
NSPS 40 CFR 60, Subpart UUU	Standards of Performance for **Calciners and Dryers in Mineral Industries**				X	This subpart is not applicable to potash processing facilities.

FEDERAL REGU-LATIONS CITATION	Title	Applies to **Entire Facility**	Applies to **Unit No(s).**	**Federally Enforce-able**	**Does Not Apply**	**JUSTIFICATION:**
NSPS 40 CFR 60, Subpart IIII	Standards of Performance for **Stationary Compression Ignition Internal Combustion Engines**		EG1, FP1	X		The provisions of this subpart are applicable to manufacturers, owners, and operators of stationary compression ignition (CI) internal combustion engines (ICE). Units EG1 and FP1 are applicable to Subpart IIII.
NESHAP 40 CFR 61 Subpart A	General Provisions				X	This part applies to the owner or operator of any stationary source for which a standard is prescribed under this part.
MACT 40 CFR 63, Subpart A	General Provisions		EG1, FP1	Yes		Applies if any other subpart applies.
MACT 40 CFR 63 Subpart ZZZZ	National Emissions Standards for Hazardous Air Pollutants for **Stationary Reciprocating Internal Combustion Engines (RICE MACT)**		EG1, FP1	Yes		Emission sources EG1 and FP1 are subject to this subpart because they are stationary RICE.
MACT 40 CFR 63 Subpart JJJJJJ	National Emissions Standards for Hazardous Air Pollutants for **Industrial, Commercial, and Institutional Boilers Area Sources**				X	This subpart is not subject to gas-fired boiler burning gaseous fuels (e.g., natural gas, process gas, landfill gas, coal-derived gas, refinery gas, hydrogen, or biogas) not combined with any solid fuels, or if your unit burns liquid fuel only during periods of gas curtailment, gas supply emergencies, or periodic testing. Units S196 and S197 are gas-fired boilers and not subject to this part.
40 CFR 64	Compliance Assurance Monitoring (CAM)	Yes		Yes		CAM applicability will be addressed in the Title V application.
NESHAP 40 CFR 68	Chemical Accident Prevention			Yes	X	These provisions do not apply to the proposed project which will not have more than a threshold quantity of a regulated substance in a process, as determined under §68.115.
CAA Section 112(r)	Accidental Release Prevention			Yes	X	The Chemical Accident Prevention Provisions do not apply to the proposed project

Section 14

Operational Plan to Mitigate Emissions

(submitting under 20.2.70, 20.2.72, 20.2.74 NMAC)

☐ **Title V Sources** (20.2.70 NMAC)**:** By checking this box and certifying this application the permittee certifies that it has developed an **Operational Plan to Mitigate Emissions During Startups, Shutdowns, and Emergencies** defining the measures to be taken to mitigate source emissions during startups, shutdowns, and emergencies as required by 20.2.70.300.D.5(f) and (g) NMAC. This plan shall be kept on site to be made available to the Department upon request. This plan should not be submitted with this application.

☐ **NSR** (20.2.72 NMAC)**, PSD** (20.2.74 NMAC) **& Nonattainment** (20.2.79 NMAC) **Sources:** By checking this box and certifying this application the permittee certifies that it has developed an **Operational Plan to Mitigate Source Emissions During Malfunction, Startup, or Shutdown** defining the measures to be taken to mitigate source emissions during malfunction, startup, or shutdown as required by 20.2.72.203.A.5 NMAC. This plan shall be kept on site to be made available to the Department upon request. This plan should not be submitted with this application.

☐ **Title V** (20.2.70 NMAC)**, NSR** (20.2.72 NMAC)**, PSD** (20.2.74 NMAC) **& Nonattainment** (20.2.79 NMAC) **Sources:** By checking this box and certifying this application the permittee certifies that it has established and implemented a Plan to Minimize Emissions During Routine or Predictable Startup, Shutdown, and Scheduled Maintenance through work practice standards and good air pollution control practices as required by 20.2.7.14.A and B NMAC. This plan shall be kept on site or at the nearest field office to be made available to the Department upon request. This plan should not be submitted with this application.

The Operational Plan to mitigate source emissions during malfunction, startup, or shutdown, as well as the plan to minimize emissions during routine or predictable startup, shutdown, and scheduled maintenance, will be prepared once the permit to construct has been issued and prior to facility startup.

Section 15

Alternative Operating Scenarios

(submitting under 20.2.70, 20.2.72, 20.2.74 NMAC)

Alternative Operating Scenarios: Provide all information required by the department to define alternative operating scenarios. This includes process, material and product changes; facility emissions information; air pollution control equipment requirements; any applicable requirements; monitoring, recordkeeping, and reporting requirements; and compliance certification requirements. Please ensure applicable Tables in this application are clearly marked to show alternative operating scenario.

No alternate operating scenarios are proposed at this time.

Section 16

Air Dispersion Modeling

NSR (20.2.72 NMAC) and PSD (20.2.74 NMAC) Modeling: Provide an air quality **dispersion modeling** demonstration (if applicable) as outlined in the Air Quality Bureau's Dispersion Modeling Guidelines. If air dispersion modeling has been waived for this permit application, attach the AQB Modeling Section modeling waiver documentation.

SSM Modeling: Applicants must conduct dispersion modeling for the total short term emissions using realistic worst case scenarios following guidance from the Air Quality Bureau's dispersion modeling section. Refer to "Guidance for Submittal of Startup, Shutdown, Maintenance Emissions in Permit Applications (http://www.nmenv.state.nm.us/aqb/permit/app_form.html) for more detailed instructions on SSM emissions modeling requirements.

Title V (20.2.70 NMAC) Modeling: Title V applications must specify the NSR Permit number for which air quality dispersion modeling was last submitted. Additionally, Title V facilities reporting new SSM emissions require modeling or a modeling waiver to demonstrate compliance with standards.

INTRODUCTION

This document presents a summary of the results for the Dispersion Model Analysis that was used to evaluate potential air quality impacts from the Intercontinental Potash Corp. (USA) (ICP) – Ochoa Polyhalite Processing Plant (Ochoa Plant), Jal Loadout Facility (Jal Loadout), and Groundwater Pre-Treatment Plant (collectively referred to as the Ochoa Project). The purpose of this modeling analysis is to provide a determination of the impacts from the Ochoa Plant, Jal Loadout, and Groundwater Pre-Treatment Plant on the surrounding ambient air. The objective of this evaluation is to determine if ambient air concentrations from the maximum operation of the Ochoa Project for nitrogen dioxide (NO_2); carbon monoxide (CO); sulfur dioxide (SO_2); hydrogen sulfide (H_2S); particulate matter, total suspended particles (TSP), and both 10 microns or less (PM_{10}) and 2.5 microns or less ($PM_{2.5}$); are below Class II federal and state ambient air quality standards (NAAQS and NMAAQS) found in Environmental Protection Agency's (USEPA's) 40 CFR part 50 and New Mexico air quality regulation 20.2.3 NMAC. The NAAQS were designed by the USEPA to protect public health (Primary NAAQS) and welfare (Secondary NAAQS) from the effects of criteria pollutants. This was accomplished by determining the radius of impact (ROI) for each pollutant model along with the applicable averaging period. The ROI modeling was conducted in flat terrain mode and no building downwash. The receptor grids determined from the ROI modeling for each pollutant was then used to perform cumulative impact analysis (CIA) modeling with a refined grid, complex terrain, building downwash, neighboring sources, and appropriate regional background concentrations as discussed in Section 16.9 of this report. Additionally, Class I and II increment analysis modeling was performed for pollutants where the major and minor source baseline date has been triggered. The most recent version of AERMOD was used.

ICP is proposing to develop the Ochoa Project in southeastern Lea County, New Mexico to extract polyhalite ore for the production of sulphate of potash (SOP) and langbeinite (SOPM) for use as fertilizer. There are two primary operations to get the ore to a finished fertilizer product. The first operation is to mine raw polyhalite approximately 1,500 feet underground in the Rustler Formation. Once mined, the polyhalite is transported conveyed underground and via a covered conveyor to the processing facilities at the surface where it is crushed, ground, washed, calcined, leached, crystallized, and granulated to produce SOP and SOPM, the saleable products. The final product will be moved by truck to a load-out facility near Jal, New Mexico, to be loaded on trains and shipped to distributors selling to farmers. The Ochoa Project location is in attainment for all pollutants.

This section identifies the technical approach proposed for Class II federal and state ambient air quality standards, and Class I and II increment analysis for the facility. New Mexico Environmental Department, Air Quality Bureau (NMED-AQB) requires that all applicable criteria pollutant emissions be modeled using the most recent versions of USEPA approved models and compared with National Ambient Air Quality Standards (NAAQS), New Mexico Ambient Air Quality Standards

(NMAAQS), and Prevention of Significant Deterioration (PSD) Class I and II Increments. The modeling protocol was reviewed and approved by Gi-Dong Kim of the NMED-AQD Modeling Section on November 26, 2013 by email.

The dispersion modeling analysis was performed to estimate the total pollutant concentrations resulting from the operation of the Ochoa Project using the maximum daily or annual emission rates while all emission sources are operating. The modeling calculated the maximum offsite concentrations for each criteria pollutant and applicable averaging periods for comparison with modeling significance impact levels (SILs) and national/ New Mexico ambient air quality standards (AAQS). The pollutants included CO, NO_2, SO_2, H_2S, TSP, PM_{10}, and $PM_{2.5}$. The modeling approach followed the guidance and protocols outlined in the NMED-AQB "Air Dispersion Modeling Guidelines", and the most up to date USEPA's *Guideline on Air Quality Model.*

During the analysis, all emission sources from the Ochoa Project were modeled together to determine worst-case impacts from the proposed facilities. Potential pollutant emissions came from point sources (stacks), volume sources (fugitive), and areapoly sources (fugitive). Step 1 in the analysis was determining the ROI. The ROI for each modeled pollutant and averaging period was run in flat terrain mode, without building downwash, and compared with the applicable pollutant SIL. Once a receptor grid was determined from the ROI modeling, refined cumulative impact analysis modeling (CIA), included neighboring sources within 10 kilometers for particulate sources only, and background concentrations were performed for all pollutants over the significant impact levels (SILs).

16.1 DISPERSION MODEL SELECTION

The dispersion modeling was conducted using the American Meteorological Society/Environmental Protection Agency Regulatory Model Improvement Committee Dispersion Model (AERMOD), *Version 12345*. This model is recommended by USEPA for determining Class II impacts within 50 km of the facility being assessed. Additionally, AERMOD was developed to handle complex terrain. In this analysis, AERMOD was used to estimate pollutant concentrations of CO, NO_2, TSP, PM_{10}, $PM_{2.5}$ and SO_2 in the ambient air from Ochoa Plant and Jal Loadout emission sources. AERMOD was also used to estimate pollutant concentrations of H_2S in the ambient air from Groundwater Pre-Treatment Plant emission source.

AERMOD is a Gaussian plume dispersion model that is based on planetary boundary layer principles for characterizing atmospheric stability. The model evaluates the non-Gaussian vertical behavior of plumes during convective conditions with the probability density function and the superposition of several Gaussian plumes. AERMOD modeling system has three components: AERMAP, AERMET, and AERMOD. AERMAP is the terrain preprocessor program. AERMET is the meteorological data preprocessor. AERMOD includes the dispersion modeling algorithms and was developed to handle simple and complex terrain issues using improved algorithms. AERMOD uses the dividing streamline concept to address plume interactions with elevated terrain.

AERMOD was run using all the regulatory default options including use of:

- Gradual Plume Rise
- Stack-tip Downwash
- Buoyancy-induced Dispersion
- Calms and Missing Data Processing Routine
- Upper-bound downwash concentrations for super-squat buildings
- Default wind speed profile exponents
- Calculate Vertical Potential Temperature Gradient
- No use of gradual plume rise
- Rural Dispersion

These regulatory default options are found in the AERMOD User's Manual. The model incorporated local terrain into the calculations.

Non-default options included the use of "flat" for selected volume sources involved with low release fugitive sources (haul road traffic, etc.).

16.2 BUILDING WAKE EFFECTS

The Ochoa Project has multiple buildings. For CIA modeling analysis, evaluation of building downwash on adjacent stack sources is deemed necessary, since most (if not all) of the stack source heights may be below Good Engineering Practice (GEP) heights. The formula for GEP height estimation is:

$H_s = H_b + 1.50L_b$

where: H_s = GEP stack height
H_b = building height
L_b = the lesser building dimension of the height, length, or width

The effects of aerodynamic downwash due to buildings and other structures was accounted for by using wind direction-specific building parameters calculated by the USEPA-approved Building Parameter Input Program Prime (BPIP-Prime) (*Version 04274*)) and the algorithms included in the AERMOD air dispersion model. Based on the examination of plot plans for the relationship of sources to the location of facility structures, the locations and dimensions of emission sources and facility structures were input to the BPIP-Prime software package, which calculates the direction-specific building dimensions for input into the AERMOD model. A downwash analysis was performed for each point source. The dimensions for Ochoa Project buildings were entered into the dispersion model to assess the potential for downwash effects on emissions from nearby point sources. A building downwash analysis, using the latest version of BPIP-Prime, was conducted and incorporated into the modeling analysis to account for potential effluent downwash due to the tanks and buildings. Output from BPIP-Prime was incorporated into the AERMOD modeling input files.

16.3 METEOROLOGICAL DATA

Meteorological data collected at the Waste Isolation Pilot Plant (WIPP) site meteorological station (2004 – 2008, five year data set), previously submitted and reviewed by the (NMED-AQB), were obtained from WIPP and were used as meteorological data input for the model. The Ochoa Plant will be located approximately 10 miles southeast of the WIPP facility. The similar elevation, topography, terrain, vegetation, and climate of both sites make this meteorological data representative of the model area. WIPP's "*meteorological monitoring program provides on-site meteorological data. Data collected are used for modeling of potential accidental radionuclide releases, effluent monitoring, assessing waste shipment transportation safety, evaluating conditions to promote employee safety for travel to and from the WIPP site, and for monitoring real-time meteorological conditions for responding to events involving spills or releases of hazardous materials*".

AERMET wind speed threshold for onsite data (WIPP) was 0.5 meters per second. Since the WIPP onsite temperature is collected at three levels, the Bulk Richardson method was used in determining stability parameters.

AERMET/AERMOD requires that several additional parameters be input during data processing in AERMET:

- Surface roughness length (m)
- Albedo
- Bowen Ratio

The surface roughness length influences the surface shear stress and is an important factor in determining the magnitude of mechanical turbulence and the stability of the boundary layer. The albedo is the fraction of total incident solar radiation reflected by the surface back to space without absorption. The daytime Bowen ratio, an indicator of surface moisture, is the ratio of sensible heat flux to latent heat flux and, together with albedo and other meteorological observations, is used for determining planetary boundary layer parameters for convective conditions driven by the surface sensible heat flux.

These parameters were obtained using AERSURFACE (*Version 13016*). AERSURFACE requires the input of land cover data from the U.S. Geological Survey (USGS) National Land Cover Data 1992 archives (NLCD92), which it uses to determine the land cover types for the user-specified location. AERSURFACE matches the NLCD92 land cover categories to seasonal values of albedo, Bowen ratio, and surface roughness. Values of surface characteristics are calculated based on the land cover data for the study area and output in a format for input into AERMET Stage 3. The program requires several descriptive input parameters to be set, including the following parameters:

- Meteorological data from airport
- Continuous snowcover in winter
- Arid climate
- Dry climate

For the WIPP meteorological data, NO was checked for airport data, NO was checked for continuous snowcover, YES was checked for arid climate, and YES was checked for dry climate. For each parameter, data were extracted from land cover data for each month of the year and 12 equal sectors radiating from the WIPP site.

The WIPP onsite meteorological data were processed using AERMET (*Version 12345)* and upper air data from Odessa/Midland, Texas and surface air data from Cavern City Air Terminal near Carlsbad, New Mexico for the same time period. The upper air and surface data are considered to be representative and comparable with both the WIPP site and the Ochoa Project site. The WIPP meteorological data files, Odessa/Midland upper air files, and Cavern City Air Terminal surface air files were previously submitted to the NMED-AQB Modeling Section for review.

16.4 RECEPTORS AND TOPOGRAPHY

Modeling was completed using as many receptor locations as necessary to ensure that the maximum estimated impacts were identified. Following USEPA guidelines, receptor locations were identified with sufficient density and spatial coverage to isolate the area with the highest impacts.

The ROI model receptor grid included receptors located 100 meters apart out to 1 kilometer from the property line and 250 meters apart out to 2 kilometers from property line and beyond those 500 meters apart out to 5 kilometers or the pollutant significant impact level. The refined receptor grid included receptors located 100 meters apart out to 1 kilometer from the property line and 250 meters apart out to 2 kilometers from property line and beyond those 500 meters apart out to the pollutant ROI. Fence line receptor spacing was 50 meters.

All refined model receptors were preprocessed using the AERMAP (*Version 11103*) software associated with AERMOD. The AERMAP software establishes a base elevation and a height scale for each receptor location. The height scale is a measure of the receptor's location and base elevation and its relation to the terrain feature that has the greatest influence in dispersion for that receptor. AERMAP was run using U.S. Geological Survey (USGS) digital elevation model (DEM) data. This modeling analysis used 7.5-minute DEM 10 meter resolution data to give a detailed characterization of the terrain through the region. Output from AERMAP was used as input to the AERMOD runstream file for each model run. For fugitive sources of particulate (Volume sources), the model was run using the "FLAT" source mode option.

16.5 NO_2 MODELING – MULTI-TIERED SCREENING APPROACH

The AERMOD model predicts ground-level concentrations of any generic pollutant without chemical transformations. Thus, the modeled NO_X emission rate will give ground-level modeled concentrations of NO_X. NAAQS values are presented as NO_2.

USEPA has a three-tier approach to modeling NO_2 concentrations.

- Tier I – total conversion, or all NOx = NO_2
- Tier II – use a default NO_2/NOx ratio, 1 hour = 80%; Annual = 75%
- Tier III – case-by-case detailed screening methods, such as Ozone Limiting Method (OLM) and Plume Volume Molar Ratio Method (PVMRM)

Initial modeling was performed using both Tier I and Tier II methodologies. If these modeling iterations demonstrated that less conservative methods for determining 1-hour and annual NO_2 compliance would be needed for this project, then ambient impact of 1-hour and annual NOx predicted by the model used Tier III – OLM or PVMRM. Previous modeling experience has shown that at distances close to a modeled source, the modeled NO_2/NO_X ratio (and, thus, the NO_2 concentration) is highly

dependent upon the assumed in-stack ratio. The use of the default ratio of 0.5 can result in large over predictions at a facility fence line. References are available for similar equipment categories (natural gas combustion) with actual in-stack data.

Natural Gas-fired heater – NO_2/NOx ratio = 0.11.

Default Natural Gas NO_2/NOx ratio = 0.10.

Default Natural Gas NO_2/NOx ratio = 0.10.

Based on recent literature, a proposed conservative NO_2/NOx ratio from all stacks combusting natural gas for this modeling analysis is 0.20.

16.6 OZONE IMPACT ANALYSIS – SCREENING APPROACH

Ozone pollution is formed by a photochemical reaction in the atmosphere and is driven by two major classes of directly emitted precursor pollutants: nitrogen oxides (NO_x) and volatile organic compounds (VOC). Because ozone is not directly emitted, ozone modeling is generally done on a regional basis rather than a project specific basis. Only regional scale air quality models for ozone can simulate concentrations over a sufficiently long time and wide area to simulate the ambient ozone impacts from precursor pollutants. These models are generally applied to state and regional air quality planning efforts used for air quality attainment planning. Because the USEPA has no guideline model for assessing ozone impacts from a single stationary source, an ozone screening approach is being performed for this project. This approach is very conservative based on the limited VOCs precursor emissions from the project at 26 tons per year. A two tiered approach was used for ozone impact analysis for the Ochoa Project. Both tiers are similar to NO_X modeling with AERMOD.

Tier I: Rings of receptors were placed with 250-meter spacing from a distance of 7 km from the Ochoa Plant out to 11 km from the facility. The maximum NO_X emission source rates of the Ochoa Project were modeled with the worst case one-year period of meteorological data. The maximum 1-hour NO_2 concentration in the domain was determined, assuming that all of the NO_X is converted to NO_2. Then, the maximum 1-hour NO_2 concentration was converted to a maximum ozone concentration by assuming that 3 ozone molecules are produced per molecule of NO_2 (3 O_3/1 NO_2). The background ozone concentration was then added to the ozone concentration estimate and compare with the 8-hour ozone standard of 75 ppb. The background ozone concentration is 0.069 ppm, which is the 2011, 3-year design value from the Carlsbad Ozone monitor (Monitor ID 5ZR). If the results show a violation of the 8-hour ozone standard, Tier II was used.

Tier II: Tier II is similar to Tier I except the maximum 8-hour NO_2 concentration in the domain was used instead of the maximum 1-hour NO_2 concentration. For Tier II, the maximum 8-hour NO_2 concentration was converted to a maximum ozone concentration by assuming that 3 ozone molecules are produced per molecule of NO_2 (3 O_3/1 NO_2). The background ozone concentration was added to the ozone concentration estimate and compare with the 8-hour ozone standard of 75 ppb.

16.7 $PM_{2.5}$ SECONDARY FORMATION IMPACT ANALYSIS

Particles are made up of different chemical components. The major components, or species, are carbon, sulfate and nitrate compounds, and crustal materials such as mineral or organic material and ash. The different components that make up particle pollution come from specific sources and are often formed in the atmosphere. Particulate matter includes both "primary" PM, which is directly emitted into the air, and "secondary" PM, which forms indirectly from fuel combustion and other sources. Primary PM consists of carbon (soot)—emitted from cars, trucks, heavy equipment, forest fires, and burning waste—and crustal material from unpaved roads, stone crushing, construction sites, and metallurgical operations. Secondary PM forms in the atmosphere from gases. Some of these reactions require sunlight and/or water vapor. Secondary PM includes:

- Sulfates formed from sulfur dioxide emissions from power plants and industrial facilities;
- Nitrates formed from nitrogen oxide emissions from cars, trucks, industrial facilities, and power plants; and
- Carbon formed from reactive organic gas emissions from cars, trucks, industrial facilities, forest fires, and biogenic sources such as trees.

AERMOD does not account for secondary formation of $PM_{2.5}$ for near-field modeling. Any secondary contribution of the Ochoa Project's source emissions is not explicitly accounted for in the model results. While representative background monitoring data for $PM_{2.5}$ should adequately account for secondary contribution from existing background sources, if the

facility emits significant quantities of $PM_{2.5}$ precursors (NO_X, SO_2, VOC), some assessment of their potential contribution to cumulative impacts as secondary $PM_{2.5}$ is necessary. In determining whether such contributions may be important, keep in mind that peak impacts due to facility primary and secondary $PM_{2.5}$ are not likely to be well-correlated in space or time, and these relationships may vary for different precursors. Total Ochoa Project emissions of precursors include:

- Nitrogen Oxides (NO_X) – 157 tons per year (exceeds significant emission rates (SER))
- Sulfur Dioxides(SO_2) – 2.8 tons per year (below SER)
- Volatile Organic Compounds (VOC) – 28 tons per year (below SER).

Jal Loadout Facility $PM_{2.5}$ Modeling

For the Ochoa Project, secondary emissions of $PM_{2.5}$ potentially will occur from combustion sources at the Ochoa Plant only, since no air emissions from the Jal Loadout Facility and Groundwater Pre-Treatment Plant are precursors (combustion sources). The interaction between the two facilities is limited by the prevailing wind direction at the sites from southeast to northwest. The Ochoa Plant is located 19 miles (30.5 km) due west of the Jal Loadout Facility. To determine potential impacts from combustion source at the Ochoa Plant, a 1 hour NOx model was performed for all receptors found significant in $PM_{2.5}$ ROI modeling for the Jal Loadout Facility. If modeled concentrations of NOx are less than the NOx 1 hour SILs, than it can be assumed that conversion to nitrates at locations near the Jal Loadout Facility by combustion sources from the Ochoa Plant was insignificant and not included in the comparison with showing compliance with federal $PM_{2.5}$ annual and 24 hour average AAQS.

If significant, an analysis was performed to determine the impact from the conversion of NOx to nitrates in conjunction with the impacts of direct (primary) $PM_{2.5}$ concentrations from the Jal Loadout facility compared to the $PM_{2.5}$ NAAQS and Class II Increment.

Ochoa Plant $PM_{2.5}$ Modeling

For the Ochoa Plant, direct "primary" $PM_{2.5}$ emission rates were greater than 10 tons per year (SER), and NO_X emission rates were greater than 40 tons per year (SER), falling into category "Case 3" in USEPA's March, 2012 "Draft Guidance for $PM_{2.5}$ Permit Modeling". For Case 3, where the source's direct "primary" $PM_{2.5}$ emissions and emissions of at least one precursor exceed their respective SERs, the applicable SIL comparison will address both primary and secondary $PM_{2.5}$ ambient impacts associated with the Ochoa Project. Direct "primary" $PM_{2.5}$ emissions were estimated using the AERMOD dispersion model. However, the comparison to the applicable SIL depends on the type of assessment conducted for the secondary $PM_{2.5}$ impacts from the source. Moreover, the assessment of the precursor emission impacts on secondary $PM_{2.5}$ formation was based on a hybrid of qualitative and quantitative assessments utilizing the direct "primary" $PM_{2.5}$ modeling analysis. This assessment showed negligible impact from direct "primary" $PM_{2.5}$ from the Ochoa Plant at 2 kilometers from the Ochoa Plant. Where modeling results demonstrate a negligible impact at 2 kilometers, it is not necessary to consider the impact of secondary $PM_{2.5}$ combined or overlapped with the direct "primary" $PM_{2.5}$ concentrations.

To show that direct "primary" $PM_{2.5}$ significantly drops off nearby the emission release points from the Ochoa Plant, receptors were placed at 50-meter intervals around the property boundary of the main facility for $PM_{2.5}$ dispersion modeling. A 100-meter spacing was extended out to 2 kilometers from the property boundary in each direction. If model results show direct "primary" $PM_{2.5}$ significantly drops off at 2 kilometers, then only the results from direct "primary" $PM_{2.5}$ dispersion modeling concentrations are used to show compliance with federal $PM_{2.5}$ annual and 24 hour average Increment Limits. The direct "primary" $PM_{2.5}$ modeled concentrations were then added to the modeled impacts from $PM_{2.5}$ significant neighboring sources within 10 kilometers of the Ochoa Plant and representative $PM_{2.5}$ background concentrations found in Section 16.9 to show compliance with federal $PM_{2.5}$ annual and 24 hour average AAQS.

16.8 OCHOA PROJECT – GROUNDWATER PRE-TREATMENT PLANT H_2S EMISSIONS MODELING

The dispersion modeling analysis will be performed to estimate the total H_2S concentrations resulting from the operation of the Groundwater Pre-Treatment Plant using the maximum H_2S hourly emission rate from the bio-trickling filter. The location of the Groundwater Pre-Treatment Plant is within the Pecos-Permian Basin Intrastate Air Quality Control Region (AQCR). For this region, the state ambient standard for H_2S is 100 parts per billion (ppb) for a ½ hour averaging period. Following NMED - AQB "Air Dispersion Modeling Guidelines", Section 2.5.1 "Gaseous Conversion Factor for Elevation and Temperature Correction", the ppb concentration is converted to µg/m^3 by the following equation:

$C = ppb/1000 \times M_W / (T \times (4.533\ E\text{-}5) \times (10^{Z \times 1.598\ E\text{-}5}))$

C = Concentration in µg/m^3

M_W = Molecular Weight

Z = site elevation, 3394 feet

T = average summer morning temperature in Rankin at site (typically 530 R)

$C = 100/1000 \times 34.1 / (530 \times (4.553\ E\text{-}5) \times (10^{3394 \times 1.598\ E\text{-}5}))$

$C = 124.7\ \mu g/m^3$

The modeling followed the guidance and protocols outlined in the NMED - AQB "Air Dispersion Modeling Guidelines" and the most up to date USEPA's *Guideline on Air Quality Models.* Since the AERMOD models smallest averaging period is 1 hour, the highest 1 hour model result was compared to the ½ hour ambient standard.

16.9 REGIONAL BACKGROUND CONCENTRATIONS

Ambient background concentrations represent the contribution of pollutant sources that are not included in the modeling analysis, including naturally occurring sources. If the modeled concentration of a criteria pollutant is above the modeling significance level, the background concentration for each criteria pollutant was added to the maximum modeled concentration to calculate the total estimated pollutant concentration for comparison with the AAQS. For neighboring sources within 65 kilometers of the Ochoa Project, the latest neighboring sources were obtained from the NMED-AQB, Modeling Section.

The ambient background concentrations listed in the AQB Guidelines for Carlsbad or Hobbs was used. For particulate matter, refined backgrounds from Hobbs (Monitor ID 5ZS) were used. For NO_2, background concentrations from Hobbs (Monitor ID 5ZS) were used. For SO_2 and CO, the background value was the default for the rest of the state of New Mexico. For Ozone, background concentrations from Carlsbad (Monitor ID 5ZR) were used.

	1 Hour (ppm)	**8 Hour (ppm)**	**Annual (ppm)**
NO_2	0.03		0.003
CO	2.1	1.5	
Ozone		0.068	
SO_2	0.0073		

Month	**$PM_{2.5}$ ($\mu g/m^3$)**	**PM_{10} ($\mu g/m^3$)**	**TSP ($\mu g/m^3$)**
Jan	10.6	21.0	27.93
Feb	8.8	24.2	32.19
Mar	10.3	22.1	29.39
Apr	9.7	42.4	56.39
May	11.3	21.8	28.99
Jun	10.4	32.0	42.56
Jul	11.4	33.5	44.56
Aug	14.5	36.5	48.55
Sep	13.5	29.4	39.10
Oct	8.2	38.2	50.81
Nov	8.9	37.5	49.88
Dec	7.2	33.3	44.29
Annual	**6.2**	**21.1**	**28.06**

ppm = parts per million
µg/m3= micrograms per cubic meter
TSP = Total suspended particulate

16.10 CLASS I PSD INCREMENT ANALYSIS

If the results of the ROI analysis showed an exceedence of the SILs for PM_{10}, NO_2, SO_2, and $PM_{2.5}$, Class I PSD increment analysis was conducted for Class 1 nearby Class I areas (Carlsbad Caverns National Park). If the initial model with Ochoa Project emissions only showed exceedance with Class I SILs, the PSD analysis was conducted including all PSD increment consuming sources within 50 km of the Class I area (Carlsbad Caverns National Park).

16.11 CLASS II PSD INCREMENT ANALYSIS

If the results of the ROI analysis showed an exceedence of the SILs for PM_{10}, NO_2, SO_2, and $PM_{2.5}$, Class II PSD increment analysis was conducted. The PSD analysis was conducted including all PSD increment consuming sources with the surrounding area within 50 km plus the ROI or 65 km of the facility (whichever is greater). Unlike the CIA, a predicted maximum concentration was compared with the Class II PSD Increment Limit.

16.12 CLASS I AREA AIR QUALITY RELATED VALUES (AQRV)

The National Park Service (NPS) requires an impact analysis be performed for any Class I area located within 300 km of a proposed project and the United States Forest Service (USFS) requires an impact analysis for Class I areas within 100 km of a proposed project. There are several Class I areas within this region, with the Carlsbad Caverns National Park being the closest at approximately 79 km from the facility.

If the results of the ROI analysis showed an exceedence of the SILs for PM_{10}, NO_2, SO_2, and $PM_{2.5}$, Class I PSD increment analysis was conducted. The PSD analysis was conducted including all PSD increment consuming sources surrounding the Class I area. Unlike the CIA, a predicted maximum concentration was compared with the Class I PSD standard.

The NPS, the USFS, and the US Fish & Wildlife Service have developed guidance for performing air quality related values (AQRV) in Class I areas. As part of this updated guidance, the Federal Land Managers (FLM) added an "Initial Screening Test." The "initial screening" was designed to screen out certain sources based on their annul emissions and the distance to the Class I area. A source further than 50 km from a Class I area is considered insignificant if the sum of the annual SO_2, NO_x, PM_{10}, and sulfuric acid (H_2SO_4) emissions (in tons per year) divided by the distance to the Class I area (in km) is less than 10, known as the Q/D ratio. The following provides the greatest Q/D ratio for the Carlsbad Caverns National Park area. Assuming the maximum annual emissions for the three pollutants (no sulfuric acid (H_2SO_4) emissions are expected for this facility) are 169.1 tpy, 11.4 tpy, and 26.3 tpy, respectively, for the Ochoa Plant. Thus the Q/D is:

$$(157 \text{ TPY } NO_x + 2.8 \text{ TPY } SO_2 + 191 \text{ TPY } PM_{10})/77 \text{ km} = 4.6$$

The screening procedure calculated a Q/D ratio that is well below the screening threshold of 10; thus, it is proposed that no further Class I AQRV analysis was required.

16.13 ADDITIONAL IMPACT ANALYSIS

Additional analyses of the impact that would occur as a result of the Ochoa Project included the following:

- Visibility Analysis: A Class II Visibility Analysis to determine impact the Ochoa Project will have upon Class II areas.
- Soils analysis: Potential changes that may occur to soil pH, toxicity, susceptibility to erosion, or other soil characteristics as a result of the Ochoa Project and indirect growth related to the project.
- Vegetation analysis: Potential changes that may occur to type, abundance, vulnerability to parasites, or other vegetation characteristics as a result of the project and indirect growth related to the Ochoa Project.
- Growth analysis: An analysis of the air quality impact projected for the area as a result of general commercial, residential, industrial, and other growth associated with the Ochoa Project.

MODEL RESULTS

This section summarizes the model results following the technical approach found the modeling protocol outline above and in Section 2 of the Full Modeling Summary Report (File: A-XXXX-16-ModelReport) proposed for Class II federal and state AAQS, and Class I and II increment analysis for the facility. Model results shows that all emissions from the Ochoa Project in compliance with all applicable AAQS, and Class I and Class II Increment analysis.

The dispersion modeling analysis was performed to estimate the total pollutant concentrations resulting from the operation of the Ochoa Plant, Jal Loadout, and Groundwater Pre-Treatment Plant using the maximum hourly, daily, or annual emission rates (particulate modeling for road traffic and product truck loading/unloading where the hourly emissions were based on a daily maximum emission rate) while all emission sources are operating. The modeling determined maximum off site concentrations for each criteria pollutant and applicable averaging periods for CO, NO_2, SO_2, H_2S, TSP, PM_{10}, and $PM_{2.5}$. These results were compared with modeling SILs and national/ New Mexico AAQS. The modeling followed the guidance and protocols outlined in the NMED-AQB "Air Dispersion Modeling Guidelines", and the most up to date USEPA's *Guideline on Air Quality Models.* Modeled concentrations of nitrogen oxides (NOx) were converted to NO_2 by multiplying with the USEPA's empirically derived scaling factor of 0.80 for the 1 hour averaging period.

16.14 RADIUS OF IMPACT (ROI) MODELING ANALYSIS

Significant radius of impact (ROI) AERMOD dispersion modeling was completed for TSP, PM_{10}, $PM_{2.5}$, NO_X, CO, and SO_2. All significant impact models were run with no terrain, no building downwash with Ochoa Project emission sources only. For particulate modeling, the Ochoa Plant and Jal Loadout were modeled independently since the interaction between the two facilities is limited by the distance separating them of 18.7 miles and prevailing wind direction from southeast to northwest. Table 16-1 lists the results of the ROI modeling for pollutant and averaging period that falls below the applicable SILs.

TABLE 16-1: Summary of ROI Air Dispersion Modeling Results for Ochoa Project Sources below SILs

Parameter	Maximum Modeled Concentration ($\mu g/m^3$)	Significant Impact Level ($\mu g/m^3$)	% of Standard
CO 1 Hr.	29.7	2000	1.5
CO 8 Hr.	18.9	500	3.8
SO_2 1Hr.	0.51	7.8	6.5
SO_2 3 Hr.	0.47	25	1.9
SO_2 24 Hr.	0.21	5	4.2
SO_2 Annual	0.018	1	1.8
NO_2 24 Hr. (1)	3.0	5	60.0
NO_2 Annual (1)	0.50	1	50.0

(1) NOx 24 hour averaging period highest concentration was converted to NO_2 by multiplying the model result by 0.40. NOx annual averaging period highest concentration was converted to NO_2 by multiplying the model result by 0.75.

16.15 CUMULATIVE IMPACT ANALYSIS (CIA) MODEL RESULTS

The model results using the maximum operation of the Ochoa Project with applicable neighboring sources and approved ambient background are summarized below in Tables 16-2, 16-3, 16-4, 16-5, and 16-6. Dispersion modeling analysis followed the modeling protocol outline above and in Section 2 of the Full Modeling Summary Report. For CIA modeling, only NO_X 1-hour averaging period for the Ochoa Plant, $PM_{2.5}$ 24-hour and annual averaging periods for both the Ochoa Plant and Jal Loadout, PM_{10} 24-hour averaging period for both the Ochoa Plant and Jal Loadout, and TSP 24-hour and annual averaging periods for both the Ochoa Plant and Jal Loadout were above the applicable SILs. Also discussed are the results of the Ochoa Plant ozone screening analysis for the 8-hour averaging period and Groundwater Pre-Treatment Plant hydrogen sulfide modeling analysis for the ½ hour Pecos-Permian Basin ambient standard (will use the 1 hour model result to compare). No SSM modeling was performed for this facility.

TABLE 16-2: Summary of Air Dispersion Modeling Results for Combustion Emissions

Parameter	Maximum Modeled Concentration ($\mu g/m^3$)	Significant Impact Level ($\mu g/m^3$)	Maximum Modeled Concentration With Background ($\mu g/m^3$)	Lowest Applicable Standard ($\mu g/m^3$)	% of Standard
NO_X 1 Hr.	38.4	7.54	88.8	188	47.2

Note: Background concentrations based on "New Mexico Air Pollution Control Bureau, Dispersion Modeling Guidelines" revised July 29, 2011 and approved modeling protocol. Dispersion modeling inputs and settings are presented in Section 2.

TABLE 16-3: Summary of Air Dispersion Modeling Results for Ozone

Parameter	Maximum Modeled Concentration (ppb) (1)	Maximum Modeled Concentration With Background (ppb)	Lowest Applicable Standard (ppb)	% of Standard
Ozone 8 Hr.	3.5	72.5	75	96.7

(1) Based on NO_X 8 hour averaging period modeling results converted to ozone.

TABLE 16-4: Summary of Air Dispersion Modeling Results for Ozone and Hydrogen Sulfide

Parameter	Maximum Modeled Concentration ($\mu g/m^3$)	Lowest Applicable Standard ($\mu g/m^3$)	% of Standard
H_2S ½ Hr. (Based on 1 Hour Model Results)	118.0	124.7	94.6

TABLE 16-5: Summary of Air Dispersion Modeling Results for Particulate Emitting Sources Ochoa Processing Plant

Parameter	Maximum Modeled Concentration ($\mu g/m^3$)	Significant Impact Level ($\mu g/m^3$)	Maximum Modeled Concentration With Background ($\mu g/m^3$)	Lowest Applicable Standard ($\mu g/m^3$)	% of Standard
$PM_{2.5}$ 24 Hr. High 8th High	7.1	1.2	20.0	35	57.1
$PM_{2.5}$ Annual	2.8	0.3	9.0	12	75.0
PM_{10} 24 Hr. High 2nd High	27.7	5	62.9	150	41.9
PM_{10} Annual	7.2	1	28.3	50	56.6
TSP 24 Hr.	39.6	5	89.4	150	59.6
TSP Annual	14.5	1	42.6	60	71.0

Note: Background concentrations based on "New Mexico Air Pollution Control Bureau, Dispersion Modeling Guidelines" revised July 29, 2011 and approved modeling protocol. Dispersion modeling inputs and settings are presented in Section 2.

TABLE 16-6: Summary of Air Dispersion Modeling Results for Particulate Emitting Sources Jal Loadout Facility

Parameter	Maximum Modeled Concentration ($\mu g/m^3$)	Significant Impact Level ($\mu g/m^3$)	Maximum Modeled Concentration With Background ($\mu g/m^3$)	Lowest Applicable Standard ($\mu g/m^3$)	% of Standard
$PM_{2.5}$ 24 Hr. High 8th High	3.1	1.2	16.0	35	45.7
$PM_{2.5}$ Annual	0.87	0.3	7.1	12	59.2
PM_{10} 24 Hr. High 2nd High	28.6	5	63.7	150	42.7
PM_{10} Annual	6.6	1	27.7	50	55.4
TSP 24 Hr.	94.4	5	122.3	150	81.5
TSP Annual	9.8	1	37.9	60	63.2

Note: Background concentrations based on "New Mexico Air Pollution Control Bureau, Dispersion Modeling Guidelines" revised July 29, 2011 and approved modeling protocol. Dispersion modeling inputs and settings are presented in Section 2.

16.16 CLASS I PSD INCREMENT ANALYSIS

The Ochoa Project is located in air quality control region (AQRC) 155 where the major source baseline date has been triggered for PM_{10}, SO_2, NO_2, and $PM_{2.5}$ and the minor source baseline date has been triggered for PM_{10} (02/20/1979), SO_2 (07/28/1978), and NO_2 (03/16/1988). Results of the ROI analysis show an exceedance of the NAAQS SILs for PM_{10} 24 hour and annual averaging periods, and $PM_{2.5}$ 24 hour and annual averaging periods. For these two pollutants Class I PSD increment analysis was conducted for the nearby Class I area (Carlsbad Caverns National Park). Initial modeling for this analysis included only Ochoa Project sources to compare with the PSD Class I SILs.

$PM_{2.5}$ PSD Class I Increment Analysis Modeling Results

Direct "primary" $PM_{2.5}$ modeling was performed with building downwash and terrain elevations for point sources and "flat" for volume, area, and areapoly sources. Modeling was performed for both 24 hour and annual averaging periods. $PM_{2.5}$ emissions rates represented the maximum hourly rate (based on grain loading) for point sources and maximum daily emission rate (based on the maximum daily plant throughputs and production rates) for volume, area, and areapoly sources. For this analysis only Ochoa Project $PM_{2.5}$ sources were included to determine if the Ochoa Project sources exceeded the $PM_{2.5}$ PSD Class I SILs. Receptors for the modeling analysis were spaced at 500 meters both along the Carlsbad Cavern National Park boundary and within the boundary. Results of the model (Table 16-7) showed no exceedance of the $PM_{2.5}$ PSD Class I SILs, 0.07 $\mu g/m^3$ for the 24 hour averaging period and 0.06 $\mu g/m^3$ for the annual averaging period.

Table 16-7: $PM_{2.5}$ PSD Class I Increment – Ochoa Project

Pollutant	Averaging Period	2004 ($\mu g/m^3$)	2005 ($\mu g/m^3$)	2006 ($\mu g/m^3$)	2007 ($\mu g/m^3$)	2008 ($\mu g/m^3$)
$PM_{2.5}$	24 Hour Highest High	0.036	**0.067**	0.049	0.042	0.047
$PM_{2.5}$	Annual	0.0031	**0.0035**	0.0030	0.0030	0.0027

PM_{10} PSD Class I Increment Analysis Modeling Results

PM_{10} modeling was performed with building downwash and terrain elevations for point sources and "flat" for volume, area, and areapoly sources. Modeling was performed for both 24 hour and annual averaging periods. PM_{10} emissions rates represented the maximum hourly rate (based on grain loading) for point sources and maximum daily emission rate (based on the maximum daily plant throughputs and production rates) for volume, area, and areapoly sources. For this analysis only Ochoa Project PM_{10} sources were included to determine if the Ochoa Project sources exceeded the PM_{10} PSD Class I SILs. Receptors for the modeling analysis were spaced at 500 meters both along the Carlsbad Cavern National Park boundary and within the boundary. Results of the model (Table 16-8) showed no exceedance of the PM_{10} PSD Class I SILs, 0.3 $\mu g/m^3$ for the 24 hour averaging period and 0.2 $\mu g/m^3$ for the annual averaging period.

Table 16-8: PM_{10} PSD Class I Increment – Ochoa Project

Pollutant	Averaging Period	2004 ($\mu g/m^3$)	2005 ($\mu g/m^3$)	2006 ($\mu g/m^3$)	2007 ($\mu g/m^3$)	2008 ($\mu g/m^3$)
PM_{10}	24 Hour Highest High	0.072	0.100	0.096	0.088	**0.106**
PM_{10}	Annual	0.0071	**0.0085**	0.0072	0.0069	0.0066

16.17 CLASS II PSD INCREMENT ANALYSIS

The Ochoa Project is located in air quality control region (AQRC) 155 where the major source baseline date has been triggered for PM_{10}, SO_2, NO_2, and $PM_{2.5}$ and the minor source baseline date has been triggered for PM_{10} (02/20/1979), SO_2 (07/28/1978), and NO_2 (03/16/1988). Results of the ROI analysis show an exceedance of the NAAQS SILs for PM_{10} 24 hour and annual averaging periods, and $PM_{2.5}$ 24 hour and annual averaging periods. For these two pollutants, Class II PSD increment analysis was conducted. Table 16-9 summarizes the model results for Class II PSD Increment.

TABLE 16-9: Summary of Air Dispersion Modeling Results for Class II PSD Increment Analysis

Parameter	Maximum Modeled Concentration ($\mu g/m^3$)	PSD Class II Increment ($\mu g/m^3$)	% of Standard
$PM_{2.5}$ 24 Hr. Class II Increment High 2nd High	8.9	9	98.9
$PM_{2.5}$ Annual Class II Increment	3.0	4	75.0
PM_{10} 24 Hr. Class II Increment High 2nd High	29.5	30	98.3
PM_{10} Annual Class II Increment	7.6	17	44.7

16.18 CLASS I AREA AIR QUALITY RELATED VALUES (AQRV)

The National Park Service (NPS) requires an impact analysis be performed for any Class I area located within 300 km of a proposed project and the United States Forest Service (USFS) requires an impact analysis for Class I areas within 100 km of a proposed project. There are several Class I areas within this region, with the Carlsbad Caverns National Park being the closest at approximately 79 km from the facility.

The NPS, the USFS, and the US Fish & Wildlife Service have developed guidance for performing AQRV in Class I areas. As part of this updated guidance, the Federal Land Managers (FLM) has added an "Initial Screening Test". The "initial screening" was designed to screen out certain sources based on their annul emissions and the distance to the Class I area. A source further than 50 km from a Class I area is considered insignificant if the sum of the annual SO_2, NO_x, PM_{10}, and sulfuric acid (H_2SO_4) emissions (in tons per year) divided by the distance to the Class I area (in km) is less than 10, known as the Q/D ratio. The following provides the greatest Q/D ratio for the Carlsbad Caverns National Park area. The maximum annual emissions for the three pollutants, annual SO_2, NO_x, PM_{10}, (no sulfuric acid (H_2SO_4) emissions are expected for this facility) are 2.8 tpy, 157 tpy, and 191 tpy, respectively, for the Ochoa Project. Thus the Q/D is:

$$(157 \text{ TPY } NO_x + 2.8 \text{ TPY } SO_2 + 191 \text{ TPY } PM_{10})/77 \text{ km} = 4.6$$

The screening procedure calculated a Q/D ratio that is well below the screening threshold of 10; thus, no further Class I AQRV analysis was performed.

16.19 ADDITIONAL IMPACT ANALYSIS

The results of the additional analyses of the impact are discussed in detail below. Soil, vegetation and growth analyses information were obtained from the BLM's draft Environmental Impact Statement (EIS) for the Ochoa Project, August 2013, (BLM/NM/PL-13-05-1610).

Class II Visibility Analysis

For the Ochoa Project, BACT controls and methodologies will be used to minimize pollutants emitted to the ambient air. Natural gas will be fired for all process combustion equipment. The Class I AQRV Q/D ratio is less than half of the screening level. No further visibility analysis was performed.

Soils and Vegetation Analysis

The Ochoa Project area consists of arid rangeland. Portions of the project area have been previously disturbed primarily by oil and gas activities and livestock grazing. The soils range in texture from loamy sands to sandy clays with limited use for agriculture purposes.

The Ochoa Project area generally consists of Mesquite Upland Scrub vegetation cover type with no established agriculture. Land use within the proposed Ochoa Project area is rangeland for cattle and oil and gas development sites. For the proposed Ochoa Project, 2,397 acres would be removed or impacted due to surface disturbance associated with construction and operation of the proposed mining project. Long-term disturbance would equal approximately 1,362 acres, the majority of which would be the Ochoa Plant site. Project-related surface disturbance activities include construction of the Ochoa Plant facilities, mine shaft, ramp, waste rock piles, pipelines, Jal Loadout, and associated access roads. The majority of the disturbance would occur in the Mesquite Upland Scrub vegetation cover type. There would be minimal surface disturbance in the barren/un-vegetated wash cover type. In addition, vegetation along existing and new access roads may be affected by a reduction in plant growth rate as a result of dust deposition until road surfaces are stabilized. Short-term impacts from project-related activities would include the crushing of herbaceous vegetation and removal of vegetation during construction activities. Indirect effects to vegetation may include increased soil erosion from disturbed areas, sedimentation, fugitive dust generation, the spread and establishment of noxious and invasive weed species.

Because of BACT proposed controls and methodology during normal operation of the facility, the impact of the Ochoa Project on soils and vegetation is judged to be insignificant.

Growth Analysis

The Ochoa Project would involve construction of the proposed mining, processing, and water treatment and piping facilities over an approximate 24-month period, followed by a 50-year period of operations during which underground mineral resources would be mined, brought to the surface, processed at the Ochoa Plant, and then transported to a Jal Loadout for shipment to market. Construction and operation of the proposed mine, processing facility and rail loadout, and water treatment and piping facilities would introduce additional economic stimulus into the regional economy, expanding the work force, population and tax base. ICP anticipates a 24-month construction and development phase, with the transition to operations beginning approximately 18 months after the onset of construction.

Employment in the region will increase, with up to 1,440 people employed for construction and up to 465 permanent and contract employees during operations. The increases in regional employment would create more demand for housing and services in the nearby communities and would create an increase in indirect and induced jobs, as well. Some workers and their families will move to either the Hobbs, Jal, Carlsbad, or Eunice areas for the duration of the construction. Of the permanent jobs associated with the project, most will be filled by the present work force in the area, but some nonlocal employees are expected to relocate to the vicinity of Hobbs, Jal, Carlsbad, or Eunice. There would be a substantial increase in public sector revenues that would result from federal and state mineral royalties, state severance taxes and resource excise taxes, local property taxes, state and local gross receipts taxes, personal and corporate income taxes, and federal payment in lieu of taxes. There may be a need for more public service expenditures for utilities, law enforcement staff, teachers, and to serve the other demands for services.

Currently, the largest employers in the area of the Ochoa Project are oil and gas development activities, and construction and operation of URENCO NEF near Eunice.

If oil and gas prices were to fall and development activities were to decrease from current levels, housing resources in affected communities would likely become available and local government services would likely have the capacity to accommodate growth from other sources.

Ongoing construction at the URENCO NEF near Eunice also has accumulative social and economic effects. URENCO NEF is currently completing Phase 2 of construction and also beginning construction activities for Phase 3. Ongoing construction at

the NEF would essentially result in a continuation of current housing and community infrastructure and service conditions in the study area, particularly in Eunice and Hobbs, where a sizeable share of the ICP construction work force would be attracted. With completion of Phase 2 construction activities, temporary housing resources and community infrastructure and service capacities that are now accommodating the Phase 2 construction work force could become available for construction workers associated with the Ochoa Project. Moreover, local businesses that provide goods and services to URENCO NEF construction workers would experience continued economic activity.

If oil and gas development is curtailed or work at URENCO NEF is decreased, present housing should be able to accommodate the work force for the proposed Ochoa Project.

Other uses common in the area that could be affected include cattle grazing. Long-term disturbance would equal approximately 1,362 acres, the majority of which would be the Ochoa Plant site. This long-term disturbance area would displace existing surface land uses, such as cattle grazing. Local landowners also may have cattle facilities and access impacted as well. ICP would work with local landowners to ensure that impacts to cattle facilities and access to ranching operations would be minimized.

Heavy equipment would be mobilized and moved into and out of the project area, depending on specific activities, during the construction period. During some construction activities, there would be frequent traffic on NM 128 and local roads by such vehicles as concrete trucks and service trucks, in addition to the daily travel by construction workers. While the greatest impact to transportation would be increased traffic and the use of new and existing roads during construction, the current traffic to, from, and within the project area is relatively light and is anticipated to be well within the capacity of the existing roads.

During project operations, trucks would transport the finished product to a loadout facility at Jal to be shipped via rail. The route to the Jal Loadout Facility is approximately 21.5 miles and would consist of Highway 128 and an access road to be improved by ICP. Use of this access road would avoid project traffic traveling Highway 18 through Jal. It is predicted that project traffic associated with the movement of product to the Jal Loadout Facility would consist of seven 24-ton trucks making 183 round trips per day, 365 days a year. This increase in operations traffic would elevate the annual average daily traffic values to approximately 1,392 vehicles, a 10 percent increase over 2010 levels, but an 11 percent decrease from 2007 levels. There also would be daily travel by the employees (465) to the plant facilities and mine area. It is assumed 35 percent of the operation work force would commute from Carlsbad, 30 percent from Hobbs, 20 percent from Eunice, 10 percent from Jal, and 5 percent would be unknown. The work force would utilize NM 128 east and west of the project area, as well as the local road network such as Delaware Basin Road. It is anticipated that some employees may choose to carpool reducing the amount of vehicle trips. The modest increase in traffic relative to recent traffic data would not significantly affect normal traffic levels, resulting in little impact to transportation resources.

Although new industrial jobs often lead to new support jobs as well (i.e., grocers, merchants, cleaners, etc.), the number of new people brought into the community through employment at the plant is not expected to generate substantial commercial growth. With no significant commercial or industrial growth projected following the Ochoa Project, it then follows that there will be no growth related air pollution impacts.

Section 17

Compliance Test History

(submitting under 20.2.70, 20.2.72, 20.2.74 NMAC)

To show compliance with existing NSR permits conditions, you must submit a compliance test history. The table below provides an example.

Not applicable to the proposed new facility.

Section 20

Other Relevant Information

Other relevant information. Use this attachment to clarify any part in the application that you think needs explaining. Reference the section, table, column, and/or field. Include any additional text, tables, calculations or clarifying information.

Additionally, the applicant may propose specific permit language for AQB consideration. In the case of a revision to an existing permit, the applicant should provide the old language and the new language in track changes format to highlight the proposed changes. If proposing language for a new facility or language for a new unit, submit the proposed operating condition(s), along with the associated monitoring, recordkeeping, and reporting conditions. In either case, please limit the proposed language to the affected portion of the permit.

No additional relevant information applies to the proposed project.

Section 22

Green House Gas Applicability

(submitting under 20.2.70, 20.2.72, 20.2.73, 20.2.74 NMAC)

Title V (20.2.70 NMAC), NSR (20.2.72 NMAC), NOI (20.2.73 NMAC) and PSD (20.2.74 NMAC) applicants must determine if they are subject to Title V permitting and/or PSD permitting for green house gas (GHG) emissions. GHG emissions are the sum of the aggregate group of six green house gases that include carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). There are two thresholds that must be computed to determine applicability. The first threshold is the sum of GHG mass emissions in TPY. GHG mass emissions are the sum of the total annual tons of green house gases without adjusting with the GWPs. The second threshold is the sum of CO_2 equivalent (CO_2e) emissions in TPY GHG. CO_2e emissions are the sum of the mass emissions of each individual GHG multiplied by its global warming potential (GWP) found in Table A-1 in 40 CFR 98 Mandatory Greenhouse Gas Reporting.

Green House Gas TV and PSD Applicability Determination:

☐ **Notice of Intent Sources** (20.2.73 NMAC): By checking this box and certifying this application the applicant certifies that the facility, based upon the quantity of stack emissions, including start up, shut down, and maintenance emissions, is not subject to 20.2.70 NMAC or 20.2.74 NMAC for Green House Gas (GHG) Emissions. The Department may request the emissions calculations and other documents supporting this determination.

Minor NSR (20.2.72 NMAC), PSD Major (20.2.74 NMAC), and Title V (20.2.70 NMAC) sources must complete the steps outlined below to determine GHG TV and/or PSD applicability.

1. Calculate existing mass GHG and CO_2e emissions from your source. For PSD purposes, if this is a modification to an existing source, you must also calculate the increase in mass GHG and CO_2e emissions due to the modification. Start up, shut down, and maintenance emissions must be included.
2. See Tables 1 and 2 below and compare your mass GHG and CO_2e emissions to the appropriate category for your source.
3. If your source meets all of the criteria within a category, then you must obtain a PSD permit and/or a Title V permit for green house gas emissions.
4. If this is a GHG Major source with an existing BACT or if this is a permit application for a PSD or Title V permit with GHG above the thresholds in Tables 1 or 2, include the emissions calculations and supporting documents in the appropriate sections of this application unless instructed otherwise in Tables 1 or 2. Report GHG mass and CO_2e emissions in Table 2-P of this application unless instructed otherwise in Tables 1 or 2. Emissions are reported in **short** tons per year and represent each emission unit's Potential to Emit (PTE).

NSR (20.2.72 NMAC), PSD Major (20.2.74 NMAC), and Title V (20.2.70 NMAC): Based upon the GHG applicability criteria in this section the applicant certifies that the source is (check all that apply):

☐ Title V Minor and PSD Minor for GHG Emissions [The Department may request the emissions calculations and other documents supporting this determination.]

☐ Title V Major for GHG Emissions
X PSD Major for GHG Emissions

Table 1 - Title V Applicability Criteria		
On or after July 1, 2011, newly constructed source, or existing source that does not have a Title V permit	**On or after July 1, 2011, modification or Renewal to Existing Title V Source**	**Requirement**
Source emits or has potential to emit (PTE) ≥ 100,000 TPY CO_2e **and** 100 TPY GHG mass basis	Source emits or has PTE of ≥100,000 TPY CO_2e **and** 100 TPY GHG mass basis	**For new sources:** For a source that meets the criteria on July 1, 2011, submit a Title V permit application no later than June 30, 2012. For a source that meets the criteria after July 1, 2011, submit a Title V application within 12 months of becoming subject to the GHG operating permit program (12 months from commencement of operation of the new unit or modification that caused the source to be subject to Title V). **For existing sources:** Include GHG with the next Title V application for a renewal or modification. **For both new and existing sources:** Include in the TV application, GHG emissions calculations and supporting documents, report CO_2e and GHG emissions in Table 2-P, and address any applicable CAA requirements (e.g. PSD BACT, NSPS). If there are no applicable requirements and if GHG emissions have been reported to the Department under 20.2.73 NMAC, the requirements of the previous sentence do not apply, but changes in GHG emissions resulting in GHG emission limits must be calculated and reported in Table 2-P for Title V permit modifications. Typically GHG emission limits would be established only when there is an applicable requirement, such as a PSD GHG BACT or limits taken to be GHG synthetic minor.

Table 2 - PSD Applicability Criteria			
On or After July 1, 2011, New Source	**On or After July 1, 2011, Major Modification to Existing PSD Major Source**	**On or After July 1, 2011, Modification to Existing PSD Minor Source**	**Requirement**
Source is subject to PSD for another pollutant **and** GHG PTE is ≥ than 75,000 tpy CO_2e **or** GHG PTE is ≥ 100,000 TPY CO_2e **and** ≥ 100/250 TPY mass basis	Source is subject to PSD for another regulated pollutant **and** net GHG emissions increase is ≥ 75,000 tpy CO_2e and greater than zero TPY mass basis **or** existing source has GHG PTE ≥ 100,000 TPY CO_2e **and** ≥ 100/250 TPY mass basis **and** net emissions GHG increase is ≥ 75,000 TPY CO_2e and greater than zero TPY mass basis	Actual or potential emissions of GHGs from the modification is ≥ 100,000 TPY CO_2e **and** ≥ 100/250 TPY mass basis. Minor PSD sources cannot net out of PSD review.	The source is subject to PSD permitting for GHG emissions and other regulated pollutants that are significant. In the application include GHG emissions calculations and supporting documents, report CO_2e and GHG emissions in Table 2-P, complete a GHG BACT determination, and include the TPY CO_2e and GHG mass emissions in the public notice. **Note:** If a minor source permit is issued after January 2, 2011, but before July 1, 2011, and construction has not commenced by July 1, 2011, the permit must be cancelled, reopened, or an additional PSD permitting action taken, if the approved change/construction would trigger GHG PSD after July 1, 2011.

Additional Information:

Sources for Calculating GHG Emissions:

- Manufacturer's Data
- AP-42 Compilation of Air Pollutant Emission Factors at http://www.epa.gov/ttn/chief/ap42/index.html
- USEPA's Internet emission factor database WebFIRE at http://cfpub.epa.gov/webfire/
- Subparts C through UU of 40 CFR 98 Mandatory Green House Gas Reporting except that tons should be reported in short tons rather than in metric tons for the purpose of PSD and TV applicability.
- API Compendium of Greenhouse Gas Emissions Methodologies for the Oil and Natural Gas Industry. August 2009 or most recent version.
- Sources listed on USEPA's NSR Resources for Estimating GHG Emissions at http://www.epa.gov/nsr/ghgresources.html:
  - ENERGY STAR Industrial Sector Energy Guides and Plant Energy Performance Indicators (benchmarks) http://www.energystar.gov;
  - USEPA National Greenhouse Gas Inventory, http://epa.gov/climatechange/emissions/usinventoryreport.html;
  - USEPA's Climate Leaders, http://www.epa.gov/climateleaders/index.html
  - USEPA Voluntary Partnerships of GHG Reductions that include the landfill methane outreach program, the CHP partnership program, the Green Power Partnership, the Coalbed Methane Outreach program, the Natural Gas STAR program, and the Voluntary Aluminum Industrial Partnership.
  - SF Emission Reduction Partnership for the Magensium Industry http://www.epa.gov/highgwp/magnesium-sf6/index.html
  - PFC Reduction/Climate Partnership for the Semiconductor Industry http://www.epa.gov/highgwp/semiconductor-pfc/index.html

Global Warming Potentials (GWP):

Applicants must use the Global Warming Potentials codified in Table A-1 of the most recent version of 40 CFR 98 Mandatory Greenhouse Gas Reporting. Please note that sources not subject to 40 CFR 98 and/or 20.2.300 NMAC may still be subject to the GHG PSD and/or TV permitting. The GWP for a particular GHG is the ratio of heat trapped by one unit mass of the GHG to that of one unit mass of CO_2 over a specified time period.

"Greenhouse gas" for the purpose of this part is defined as the aggregate group of the following six gases: carbon dioxide, nitrous oxide, methane, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride. **(20.2.70.7.O NMAC, 20.2.74.7.Y NMAC).** You may also find GHGs defined in 40 CFR 86.1818-12(a).

Short Tons:
Short tons for GHGs and other regulated pollutants are the standard unit of measure for PSD and title V permitting programs. 40 CFR 98 Mandatory Greenhouse Reporting requires metric tons.
1 metric ton = 1.10231 short tons (per Table A-2 to Subpart A of Part 98 – Units of Measure Conversions)

USEPA's GHG Tailoring Rule:
To review USEPA's final GHG Tailoring rule and pre-amble, See "Final GHG Tailoring Rule dated May 13, 2010 located on USEPA's NSR Regulations Webpage or Federal Register June 3, 2010 Volume 75, No. 106
http://www.epa.gov/nsr/actions.html

USEPA Permitting Guidance:
USEPA's Permitting Guidance for GHG and other GHG information can be found on USEPA's NSR Clear Air Act Permitting for Greenhouse Gases webpage.
http://www.epa.gov/nsr/ghgpermitting.html

Section 23: Certification

Company Name: Intercontinental Potash Corp. (USA)

I, KAY RANDALL FOOTE, hereby certify that the information and data submitted in this application are true and as accurate as possible, to the best of my knowledge and professional expertise and experience.

Signed this 6 day of NOVEMBER, 2013, upon my oath or affirmation, before a notary of the State of COLORADO.

Kay Randall Foote
*Signature

11/6/13
Date

KAY RANDALL FOOTE
Printed Name

COO
Title

Scribed and sworn before me on this 6 day of November, 2013.

My authorization as a notary of the State of Colorado expires on the 22nd day of April, 2015.

Joahna L. McKinley
Notary's Signature

11/6/2013
Date

Joahna L. McKinley
Notary's Printed Name

JOAHNA L. McKINLEY NOTARY PUBLIC STATE OF COLORADO

My Commission Expires 4/22/2015

*For Title V applications, the signature must be of the Responsible Official as defined in 20.2.70.7.AE NMAC.