File
Dominion
9/16

Memorandum To : Assistant Executive Director - Enforcement

From : Director, Region VI

Subject : Short Term Impacts of Fugitive Emissions from the Massey and Dominion Coal Terminals

Enclosure : (1) Calculations on the impacts of fugitive TSP emissions on the 24 hour particulate concentrations from the Massey and Dominion coal terminals

Date : September 14, 1983

Serial No. : 0497-83

During our meeting on August 31, 1983 to discuss various formulae for estimating emissions from coal terminals the question came up as to whether or not PSD increment usage must be considered when evaluating a proposed terminal facility even though said facility is not being processed as a PSD permit. Since it appears that EPA expects the states to take PSD increment usage into consideration in such cases, the next obvious question was, "how do the Massey and Dominion Terminals fare in this regard in view of the fact that the proposed Virginia Port Authority Terminal appears to violate the 24 hour increment". In order to gain some appreciation of the impact of fugitive coal dust emissions from these two (2) terminals without going through an extensive modeling exercise, you requested Region VI to make an initial evaluation using a simple mathematical model of Gaussian distributions.

Inasmuch as the ISC model of the Virginia Port Authority Terminal indicated that the only significant impact was on the 24 hour increment, the initial evaluation was restricted to the 24 hour concentrations.

First, each terminal was evaluated using the data (emission factors, wind, etc.) that was available when the permit was processed. Then each terminal was re-evaluated using the latest emission factors, the worse case wind data from the Virginia Port Authority permit, and a maximum of 80% efficiency for control of the coal pile emissions. In all cases the terminal was assumed to be operating at maximum capacity and throughput. The evaluations were conducted for both C and D Stability Conditions since these are the only conditions under which higher winds are experienced. The procedure used is described in Turner's Workbook, page 39, under "area sources". Each terminal was assumed to be a square area containing all the emission points and a "virtual point" was determined for each stability condition. The impact was then estimated for the closest point downwind off the property line. (For the purpose of these evaluations railroad property was considered terminal property.) On the re-evaluations "worse case" wind data was utilized, but since this data was not available at the time these permits were originally processed, average wind (4.78 m/sec) was used in the first evaluation.

As noted on page A-1 of enclosure (1) the estimated 24 hour concentrations from the Massey terminal using the original emission rate (55.84 lbs/hour) and average wind are 25.94 ug/m^3 and 14.25 ug/m^3 for Stability Conditions D and C respectively. Pages A-2 and A-3 describe the re-evaluation of the terminal and

explain the various revisions to emission estimates, plus the effects of using "worse case" wind. Note that the wind blew out of 280° for 8 hours or 1/3 of the 24 hour period. Normally, when estimating 24 hour concentrations we use 25% of the estimated instantaneous impact, but in this case we used 33%. Note also that the maximum hourly emission rate increased from 55.84 lbs/hour to 188.19 lbs/hour. Well over half of this increase was due to using E=1.1(U) for coal pile emissions and using an efficiency of 80% versus 90%. Under these conditions and revised rates the impact on the 24 hour concentrations is estimated to be 40.69 ug/m^3 for D Stability and 20.19 ug/m^3 for C Stability, as indicated on page A-4.

In a similar fashion the impact of the Dominion terminal is estimated on pages A-5/6/7. First, as originally submitted and then using the latest emission factors plus "worse case" wind. As noted on page A-6 the Dominion permit was submitted a year after the Massey permit and consequently used more up-to-date emission factors than was used in the Massey permit. As originally evaluated the Dominion terminal is estimated to have a 13.25 ug/m^3 impact on the 24 hour concentrations at D Stability and a 6.95 ug/m^3 impact at C Stability. When considering "worse case" wind and latest emission factors, the impact is 25.86 ug/m^3 at D Stability and 11.25 ug/m^3 at C Stability. Note that the closest point off the property is further away from the terminal center at Dominion than it is at Massey and this is the principal reason the impact is less.

In accordance with PSD Regulations the maximum "allowable" 24 hour increment consumption for TSP is 37 ug/m^3. At D Stability and "worse case" wind while operating at maximum capacity, the impact of the Massey terminal is estimated to be 40.69 ug/m^3 which exceeds this limit by 3.69 ug/m^3. However, one should consider that practical limitations prevent operation of the terminal at maximum capacity (5000 tons/hour) for more than a few minutes at a time due to railcar handling problems inherent to the dumper operation. A more practical maximum would be closer to 4000 tons/hour versus 5000 tons/hour. The lower rate, of course, would result in less emissions and consequently less impact. In addition, the Gaussian dispersion equations do not take deposition into account and, as a result, over estimate the impact. At D Stability, 12.775 m/sec wind and at a distance of 488 m downwind there would be an estimated fall out of approximately 16% of the TSP. This fall out, plus a more reasonable maximum operating rate, is estimated to reduce the maximum impact from 40.69 ug/m^3 to approximately 30.41 ug/m^3 and well within the maximum allowable increment.

In summary, it appears that individually neither terminal will violate the PSD increment. However, one must realize that a lot of assumptions were made in this evaluation and its entirely possible that, if a more detailed evaluation was made, including modeling the entire terminal area, the results may be different.

RPM/LWH/cf
cc: Director, Division of Compliance
Director, Division of Engineering

Ramon P. Minx
Director, Region VI

John Galop
Acting

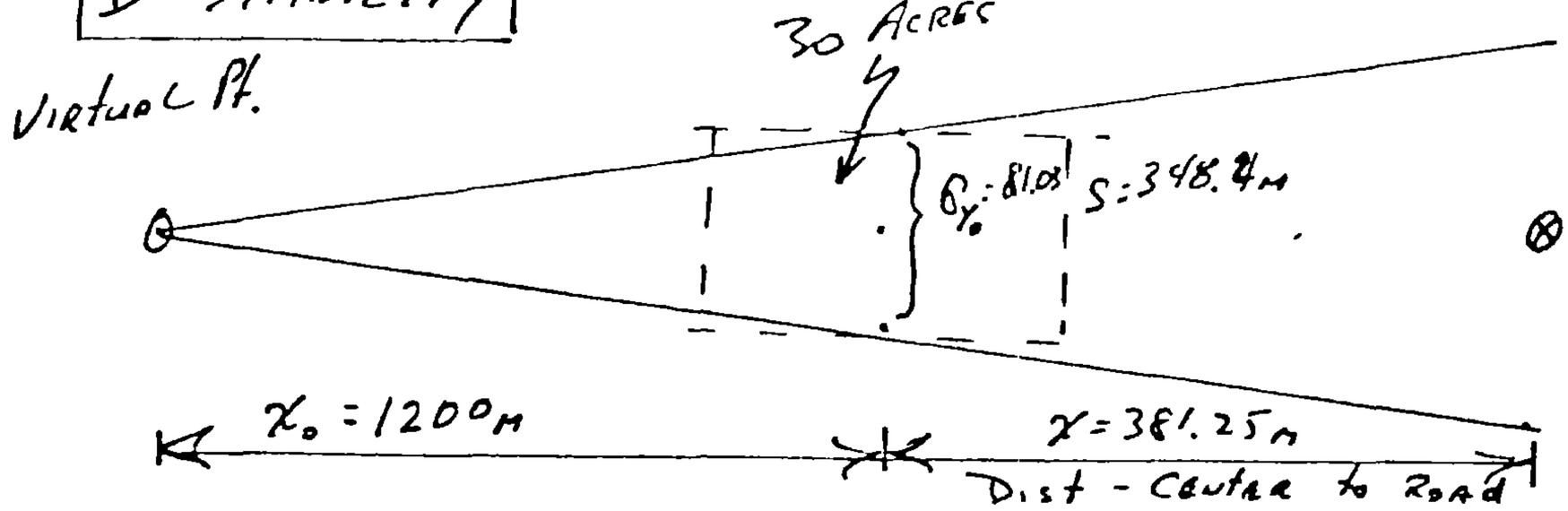
ENCLOSURE (1)

MASSEY (AS OF 9/9/80)

ORIGINAL PERMIT APPLICATION

MAX POTENTIAL HOUELY EMISSIONS (OLD EMISSION FACTORS) 55.

D STABILITY



$$\sigma_{yo} = \frac{S}{4.3} = \frac{348.4}{4.3} = 81.03_m$$

FROM TABLES 3-2 & 3-3 TURNER'S WORKBOOK

$X_o + X = 1200_M + 381.25_m = 1581.25_m$

$X_o + X = 1581.25_m$

$\sigma_y = 105_m$

$\sigma_z = 43_m$

$55.84\ lbs/HR = 7.049_m/SEC$

$$\Delta C = \frac{Q}{\pi (u) \sigma_y \sigma_z} = \frac{7.035}{\pi (4.78)(105)(43)} = 103.8 \mu g/m^3$$

$\Delta C_{24} = 103.8 \mu g/m^3 \times .25 =$ **25.94 $\mu g/m^3$ 24 HR CONCENTRATION @ D STABILITY MAX EMISSIONS AVERAGE WIND NO DEPOS.**

SAME PROBLEM @ C STABILITY $X_o = 760_M$

$X_o + X = 760_m + 381.25 = 1141.25_m$

$X_o + X = 1141.25$

$\sigma_y = 119$

$\sigma_z = 69$

$$\Delta C = \frac{Q}{\pi (u) \sigma_y \sigma_z} = \frac{7.035}{\pi (4.78)(119)(69)} = 57.01 \mu g/m^3$$

$\Delta C_{24} = 57.01 \mu g/m^3 \times .25 =$ **14.25 $\mu g/m^3$ – 24 HR CONCENTRATION @ C STAB.L.Y. MAX EMISSIONS, AVERAGE WIND, NO DEPOSITION**

Massey (As of 9/9/83)

This evaluation uses the original application capacities and throughputs, but the emission estimates are based on the latest emission formula revisions, worse case weather, and allowing 80% efficiency for controling coal pile emissions.

a. Car Dumper: $E = \frac{(k)\ .0018\ \left(\frac{s}{5}\right)\left(\frac{u}{5}\right)\left(\frac{H}{5}\right)}{\left(\frac{M}{2}\right)^2\ \left(\frac{Y}{6}\right)^{1/3}}$

The revised emission factor is increased by virtue of higher wind (12.78 m/sec vs 4.78 m/sec), the $(H/5)$ factor in the numerator and the cube root in the denominator $\left[(Y/6)^{1/3}\ \text{vs}\ (Y/6)\right]$. The k factor (.73) causes a reduction. The new emission rate for the dumper operating at max capacity (5000 T/Hr) is 4.91 lbs/hr. (Note: Old emission rate was .094 lbs/hr.)

b. Coal transfer operations: $E = \frac{(k)\ .0018\ \left(\frac{s}{5}\right)\left(\frac{u}{5}\right)\left(\frac{H}{10}\right)}{\left(\frac{H}{2}\right)^2}$

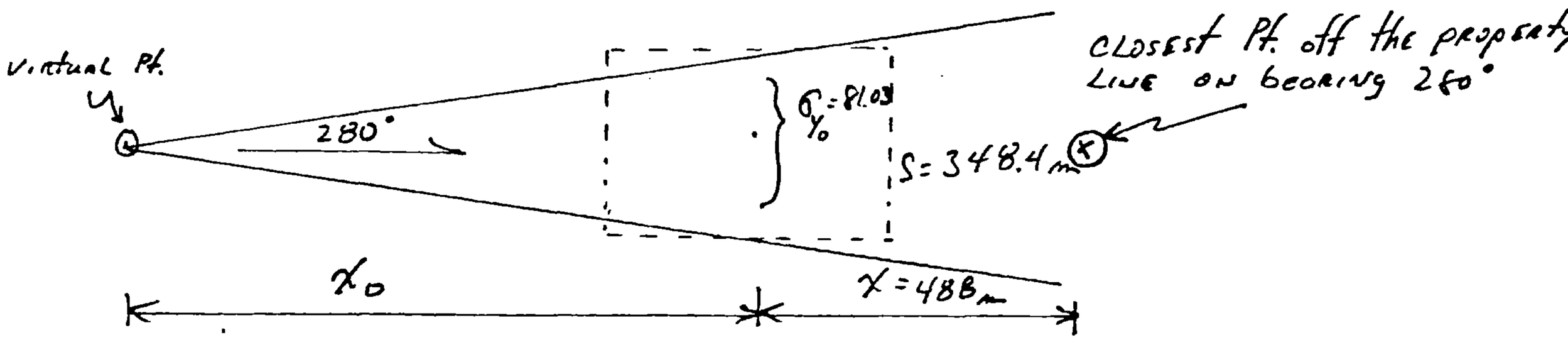
The latest formula has $(H/10)$ in the numerator; however for all practical purposes this factor cancels out for Massey since the average drop height is approximately 10. The higher wind (12.78 vs 4.78) results in an increase, while the k factor (.77) results in a reduction. (Some transfer operations (tunnel) are not effected by wind increases.) The new emission rate for coal transfer operations is 98.93 lbs/hr. The old rate was 50.35 lbs/hr. The above rates computed at max capacity (5000 T/hr).

C. Coal Storage Pile Emissions: Short Term (24 hrs or less) $E = 1.1(4)$.
Using an efficiency of 80% for wet suppression coal pile emissions
are: $E = (1.1)(12.78)\frac{lbs}{acre/hr} \times 30\,acres \times (1.00 - .80) = 84.35\,lbs/hr$. The old re
was 5.4 lbs/hr.

∴ Total hourly emissions at max capacity under "worst case"
weather condition = 4.91 lbs/hr + 98.93 lbs/hr + 84.35 lbs/hr = 188.19 lbs/

As initially evaluated using unrevised emission factor
and average weather conditions the hourly rate was 55.84 lbs/

The wind on the worse day (3/1/68) blew from 280° fo
a total of 8 hours at an average velocity of 12.775 m/sec (28.58
On a bearing of 280° from the center of the terminal the closest
property line is 1600 ft downwind (488 m).



$$\sigma_{y_0} = \frac{S}{4.3} = \frac{348.4}{4.3} = 81.03_m$$

@ D Stability

$x_0 = 1200\ m$

$x_0 + x = 1200 + 488 = 1688\ m$

$x_0 + x = 1688\ m$

$\sigma_y = 110\ m$

$\sigma_z = 44\ m$

$Q = 188.19\ \#/hr = 23.7\ g/sec$

$$\Delta C = \frac{Q}{\pi (12.775)(110)(44)} = \frac{23.7}{\pi (12.775)(110)(44)} = 122.07\ \mu g/m^3$$

$$24\ hr\ concentration = \Delta C_{24} = \frac{8}{24} \times 122.07\ \mu g/m^3 = 40.69\ \mu g/m^3$$

40.69 $\mu g/m^3$ is 24 hour concentration @ D Stability, max capacity, worst case weather, No deposition @ closest pt. downwind

@ C Stability

$x_0 = 760\ m$

$x_0 + x = 760 + 488 = 1248$

$x_0 + x = 1248\ m$

$\sigma_y = 130\ m$

$\sigma_z = 75\ m$

$Q = 188.19\ \#/hr = 23.7\ g/sec$

$$\Delta C = \frac{Q}{\pi u \sigma_y \sigma_z} = \frac{23.7}{\pi (12.775)(130)(75)} = 60.57\ \mu g/m^3$$

$$24\ hr\ concentration = \Delta C_{24} = \frac{8}{24} \times 60.57 = 20.19\ \mu g/m^3$$

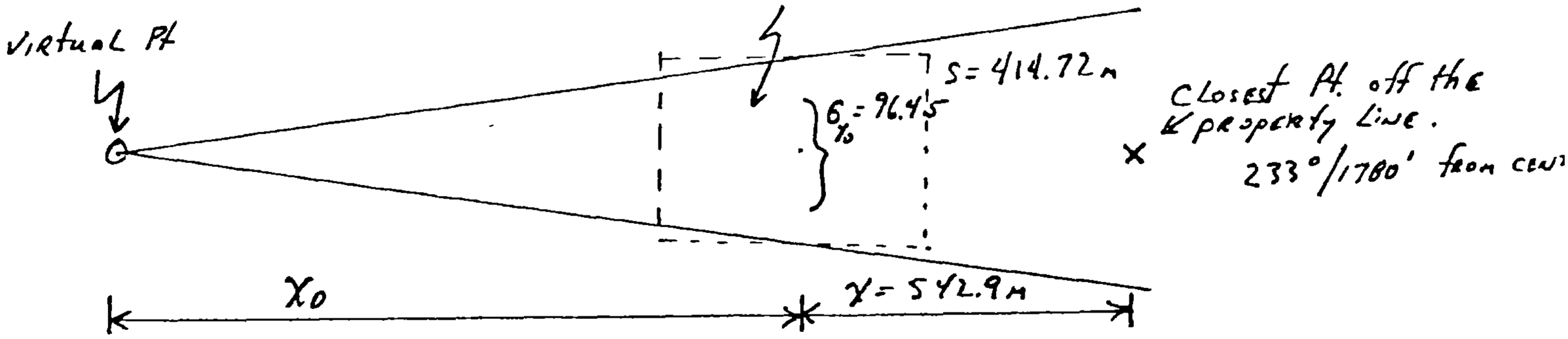
20.19 $\mu g/m^3$ is 24 hour concentration @ C Stability, Max capacity, worst case weather, no deposition @ closest pt downwind.

DOMINION (AS OF 9/10/81)

ORIGINAL PERMIT APPLICATION

MAX POTENTIAL HOURLY EMISSION RATE = 41.06 #/hr (UNMODIFIED FACTORS

D Stability



$\sigma_{y_0} = \frac{S}{4.3} = \frac{414.72}{4.3} = 96.45 m$

$X_0 = 1430$ @ D STABILITY

$X_0 + X = 1430 + 542.9 = 1972.9 m$

$X_0 + X = 1972.9 m$

$\sigma_y = 130 m$

$\sigma_z = 50 m$

$Q = 41.06 \#/hr = 5.18 g/$

$\Delta C = \frac{Q}{\pi u \sigma_y \sigma_z} = \frac{5.18}{\pi (4.78)(130)(50)} = 53.0 \mu g/m^3$

$\Delta C_{24} = .25 \times 53.0 \mu g/m^3 =$ 13.25 $\mu g/m^3$ 24 hr concentration @ D Stabil:
MAX CAPACITY, AVERAGE WIND, NO DEPOSITION

C Stability

$X_0 = 900 m$ @ C Stability

$X_0 + X = 1442.92 m$

$\sigma_y = 146 m$

$\sigma_z = 85 m$

$Q = 5.18 g/sec$

$\Delta C = \frac{5.18}{\pi (4.78)(146)(85)} = 27.8 \mu g/m^3$

$\Delta C_{24} = .25 \times 27.8 \mu g/m^3 =$ 6.95 $\mu g/m^3$ 24 hr concentration @ C Stability, Max Capacity, averag wind, no depostion.

DOMINION (AS OF 9/9/83)

Unlike Massey, the Dominion application was submitted one year later and was able to utilize the revised emission formulas for the "Car Dumper" and transfer operations, with the exception of the (K) factor which was not promulgated until 1983. The following evaluation takes into consideration the (K) factor, "worse case" weather conditions (increased wind) plus a new short term emission factor for coal storage piles with 80% efficiency for wet suppression.

a. Maximum hourly emissions from the dumper and transfer operations are 37.78 lbs/hr (1.08 lbs/hr + 36.70 lbs/hr)

$$\text{New Car Dumper emissions} = 1.08 \text{ lbs/hr} \times (.73)^{K} \times \left(\frac{12.775}{4.78}\right)^{\text{WIND}} = 2.11 \text{ lbs/hr}$$

$$\text{New transfer emissions} = 36.7 \text{ lbs/hr} \times (.77)^{K} \times \left(\frac{12.775}{4.78}\right) = 75.52 \text{ lbs/hr}$$

$$77.63 \text{ lbs/hr}$$

b. Coal Storage Pile emissions (short term): $E = 1.1(4)$

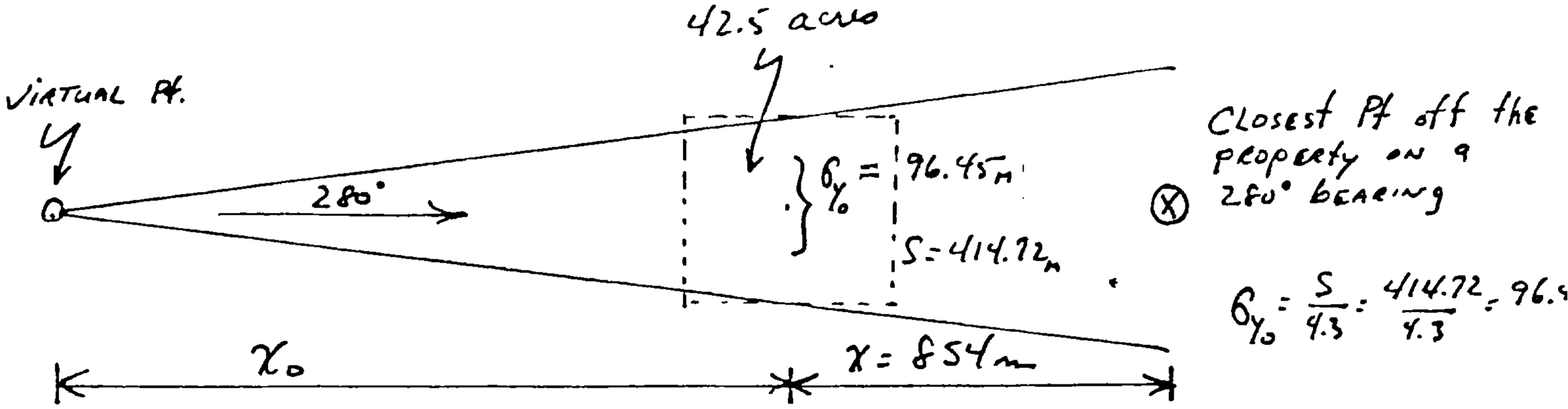
$$E = (1.1)(12.775)\frac{\text{lbs}}{\text{acre/hr}} \times 42.5 \text{ acres} \times (1.00 - .80) = 119.45 \text{ lbs/hr}$$

c. Total hourly emissions @ max capacity = 77.63 lbs/hr + 119.45 lbs/hr = 197.

197.08 lbs/hr = 24.83 gm/sec

Note: Original max emission rate was estimated to be 41.06 lbs/hr

The wind on the worse day (3/1/04) blew from 280° for a total of 8 hours at an average velocity of 12.775 m/sec (28.57 mph). On a bearing of 280° from the center of the terminal the closest property line is 2800' (854m) downwind.



D Stability $x_0 = 1430$ @ D Stability

$x_0 + x = 1430 + 854 = 2284m$

$x_0 + x = 2284$

$\sigma_y = 145m$

$\sigma_z = 55m$

$Q = 24.83$ gm/sec

$$\Delta C = \frac{Q}{\pi u \sigma_y \sigma_z} = \frac{24.83}{\pi (12.775)(145)(55)} = 77.58 \mu g/m^3$$

24 hr Concentration = $\Delta C_{24} = 77.58 \mu g/m^3 \times \frac{8 hr}{24 hr} =$ **25.86 μg/m³ @ D Stability Max Capacity, Worse case wind no deposition**

C Stability $x_0 = 930m$ @ C Stability

$x_0 + x = 930 + 854 = 1784m$

$x_0 + x = 1784m$

$\sigma_y = 178m$

$\sigma_z = 103m$

$Q = 24.83$ gm/sec

$$\Delta C = \frac{Q}{\pi u \sigma_y \sigma_z} = \frac{24.83}{\pi (12.775)(178)(103)} = 33.74 \mu g/m^3$$

24 hr Concentration = $\Delta C_{24} = 33.74 \mu g/m^3 \times \frac{8 hr}{24 hr} =$ **11.25 μg/m³ @ C Stability, Max capacity, Worse case wind, No deposit**

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The following pages contain the Optical Character Recognition text of the preceding scanned images.

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