New York State Department of Environmental Conservation
50 Wolf Road, Albany, New York 12233-0001

Henry G. Williams
Commissioner

March 14, 1985

Mr. Raymond Werner
U.S. EPA - Region II
Room 1005
26 Federal Plaza
New York, New York 10278

Dear Ray:

As requested at our February 5 meeting the enclosed details the procedures which will be used to address the cumulative short term TSP impacts of the total emissions inventory for the Niagara Frontier. Our initial results indicate that the limitation imposed by computer funds will not constrain our ability to fully address the projected compliance status in the vicinity of Bethlehem Steel using only a few days of meteorological data.

We would appreciate an expeditious review of the proposed procedures so that, in turn, we can quickly finalize this project.

Sincerely,

Leon Sedefian

Leon Sedefian
Air Pollution Meteorologist IV
Impact Analysis Section
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LS/bjs
Enclosures
cc: Ted Davis
Ed Bennett
Rick Leone
Fran Gombar, U.S. EPA - Region II

<u>Modeling Procedures for the Determination</u>

<u>of Short Term Impacts of</u>

<u>the Niagara Frontier Emissions Inventory</u>

The limits imposed by available computer funds have made it necessary to choose a set of meteorological data days to model the cumulative 24 hour TSP impacts of the total emissions inventory. The choice of this set of days is dictated by the results of five complete years of analyses performed to determine the maximum and highest-second-highest (HSH) impacts of the Bethlehem Steel Corporation's emissions. The latter impacts are expected to constitute by far the largest contribution to the total impacts.

As discussed below, the limitation of total impact determinations to a few days of meteorological data is determined not to curtail our ability to determine the projected compliance status of the area under consideration. The rationale for the set of meteorological days to be chosen can be best presented through the discussion of the analyses done so far.

It is important to note that the need for and the purpose behind the modeling exercise resulted from reservations expressed by EPA on the clear demonstration of projected compliance with the <u>primary annual TSP NAAQS</u> in the previous modeling performed for the SIP. That required demonstration was limited to the area adjacent to Bethlehem Steel. It was further noted that the statistical procedures used for short term standards compliance demonstration were not acceptable and needed to be replaced by modeled projections using five years of meteorological data. This latter analysis was also agreed to be

Not so!

confined to the area adjacent to Bethlehem Steel. This area includes the location of the Lackawanna "hot spot" noted in the previous SIP analyses where observed violations of the primary 24 hour TSP NAAQS of 260 ug/m^3 had been historically recorded (the only other location of observed violations was confined to an area adjacent to a major steel facility which has been completely shut down).

Due to the unique location of the Bethlehem Steel facility, the area of interest has been fully defined by a set of 19 receptors as depicted in Figure 1. (The figure presents an example of the maximum 24 hour impacts due to Bethlehem Steel sources at the 19 receptors for 1973.) Virtually half of the possible wind directions (from N to S) would place receptors over Lake Erie (which were not considered in the modeling) while the other half (from S to N) correspond to basically no other sources contributing simultaneously to Bethlehem Steel impacts. Thus, only for wind directions from NNW to S sector is there any potential for cumulative 24 hour impacts. Some of the sources would require a shift in the wind direction of up to 180 degrees.

Resolution not good enough

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In addition to the unique limitations imposed by the source-receptor considerations it is further noted that the emission inventory used for the post-1984 analyses is void of a number of major TSP sources (steel production facilities) in the vicinity of Bethlehem Steel which have ceased operation. The remaining sources in the inventory are relatively small point are area sources of direct and fugitive TSP emissions. Therefore, it is anticipated that the contribution of the approximately 1300 sources to total impacts at receptors modeled would be relatively small compared to the Bethlehem Steel's 160 source's impacts.

In order to check the validity of the last assumption a limited number of days have been modeled using the total emissions inventory. In terms of the final number of days to be modeled it was determined that at least all of the days associated with the maximum and HSH impacts must be considered for each of the five years (i.e. ten days) since the contribution of the other sources might redefine the days and the value of the HSH impacts to be used for compliance determination.

The results of the complete five years of calculations are presented in the attached Table 1 in terms of the top 2 or 3 maximum and HSH short term impacts and the corresponding Julian days. It should be noted that the modeling was conducted using 39 sources to conservatively represent the impacts of the full 160 sources (the validity of that phase of the analysis has already been found acceptable by EPA). The 22 distinct days associated with Table 1 impacts were reviewed to determine the meteorological conditions associated with the high Bethlehem Steel impacts.

It was determined that virtually all of the impacts were due to paved and unpaved roads under low wind speeds (2 to 4 m/s) and neutral stability and/or emissions from the Coke Ovens under moderate wind speeds (3 to 8 m/s) under neutral stability (see attached source contribution, Table 2). With respect to wind direction all of the high days were associated with four general flow sectors, i.e., SSW to WSW, S to SSE, W to NW to N, and NNW to N.

Representative days for each of these sectors were chosen in the initial determination of the relative contribution of the other sources to the total impacts. Two of the days chosen corresponded to the overall maximum and highest-second-highest impacts while the other two represented flow sectors and receptors not already covered. Twelve of the 19 receptors used in the Bethlehem Steel modeling were used in this analysis. These corresponded to areas where TSP impacts were above 90 ug/m^3 (figure 1).

Only 4 crit. days (see p.7)

Table 3 presents the days analyzed and the wind direction sectors. In addition, the resultant 24 hour total impacts and the contribution of Bethlehem Steel and all other sources are presented. For two of the days total impacts are given for two receptors in accordance with Table 1 results for Bethlehem Steel alone. A number of expected, yet important, conclusions can be made based on the Table 3 results.

It is seen that the maximum contribution from other sources is at most half of the corresponding Bethlehem Steel impacts. More importantly, the larger contributions from other sources occur when the Bethlehem Steel impacts are lower, i.e., there is a trade-off of concentration which does not greatly alter the total impacts (the comparison should be made in terms of HSH or MAX impacts separately). A main reason for this finding is the wind direction persistence effect. For example, on 73/327 the winds were out of the SSW to WSW sector 22 out of the 24 hours and without any upwind sources the total impact is basically the same as Bethlehem Steel's. On the other hand, on 76/27 (and 77/246) the wind direction was considerably more variable and resulted in more hours with flows over other source areas. Furthermore, on these days the receptor locations were more favorable for combined impacts.

Another point of interest in Table 3 is the comparison of Bethlehem Steel impacts from Table 1 for 39 source modeling (presented in last column of Table 3 for convenience) with those using the actual 160 sources. The latter impacts are lower than or equal to the former except for one receptor area when the increase is only 2 ug/m^3. This result confirms the conservatism of using the 39 sources to model the 160 sources. More importantly, it is seen that the difference in these impacts at times totally or more than offsets the contribution from other sources (76/308). Thus, it is expected that the total impacts from all sources would be controlled by Bethlehem Steel impacts and need to be scrutinized only for days when Bethlehem Steel had a substantial contribution.

To arrive at this contribution cut-off and to further solidify the previous conclusions it was decided to project the possible worst case 24 hour impacts from other sources. The approach chosen was to estimate the worst case total one hour impact at the 12 receptors analyzed under a set of meteorological conditions and to use the 0.4 EPA factor for screening purposes. The worst case stability for the Bethlehem Steel impacts was the neutral class (the lowest dispersion allowed in the urban ISC model) which in general corresponds to maximum 24 hour impacts in flat terrain situations.

This stability was assumed for each hour analyzed for the other sources since most of these were ground level or low level emissions similar to the sources which controlled Bethlehem Steel impacts. (Furthermore, the wind direction persistance implied by the 0.4 factor (10 hours) realistically would only correspond to neutral classes). The wind speeds used were 2, 4,6 and 8 m/s which correspond to the conditions of high Bethlehem Steel impacts.

Since sources were distributed throughout the NNW to S direction from Bethlehem Steel only nine of the basic 16 wind directions were modeled for each hour. The mixing depth assumed was 100m which is at the lower end of the hourly values corresponding to the days of Table 1. Thus, a total of 36 hourly combinations were modeled (1 class x 4 wind speeds x 9 wind directions).

In order to maximize the total impacts the maximum hourly value for all nine wind directions were summed for each of the receptors even if the hourly meteorological conditions were not the same for the wind direction maxima. Thus, a conservative hourly and corresponding 24 hour total impact was calculated. These maximum 24 hour impacts from all other sources were added to the largest HSH 24 hour Bethlehem Steel impacts at the corresponding receptors for any of the 5 years modeled.

Results for four highest impact receptors are presented in Table 4. The maximum from all other sources occurs at a receptor close to but not at the Bethlehem Steel HSH impact. However, the impact of other sources at the latter receptor is only slightly less. The worst case maximum 24 hour impact from other sources is still lower than the Bethlehem Steel impacts.

To determine compliance with the 260 ug/m^3 NAAQS a background must be defined. For the latest available year of 1983 the 24 hour backgrounds corresponding to the wind direction sectors and meteorological conditions were calculated at the Angola monitor which is south of the total emission inventory near Lake Erie. The 24 hour average corresponding to the general N to NE direction was 36 ug/m^3 and was the highest for any wind direction sector. ?
This background implies that three of the four values in Table 4 would meet the standard. The fourth value needs some discussion. oh boy!

As noted previously the 151 ug/m^3 Bethlehem Steel impact in Table 4 is associated with almost a 100% persistence of wind direction from the SSW to WSW sector. As noted in Table 3 the contribution from other sources on that day was only 4 ug/m^3 and not the worst case value of 98 ug/m^3 of Table 4. Furthermore, the latter value is the sum of maximum 24 hour values from sources in the N (56 ug/m^3), NE (32 ug/m^3) and E (10 ug/m^3) directions and unrealistically assumes 10 hour persistence of each of these directions over a 24 hour period. Therefore, the total value in Table 4 corresponding to receptor (185, 749) can be easily dismissed.

The above discussions and findings support the following procedures which we plan to use to complete the determination of the total 24 hour TSP impacts. The meteorological days to be considered will include the 22 days of Table 1 plus additional days from these results for which Bethlehem Steel impacts are above 90 ug/m^3. The latter cutoff is based on the finding that the worst case possible 24 hour contribution from other sources is 101 ug/m^3(Table 4) while the maximum 24 hour observed TSP value at Angola (as background) was 62 ug/m^3 for 1983. Thus the "allowable increment" for Bethlehem Steel impact is at least 97 ug/m^3. OK

A review of the results indicate only four additional days than those already included in Table 1 which had impacts from Bethlehem Steel above 90 ug/m^3. Thus a total of 26 days will be considered but not necessarily modeled. The actual number of days to be modeled will include at least the ten days corresponding to the maximum and highest-second-highest values of Table 1. The maximum days will be included even though the partial results for the four days already analyzed did not indicate a redefinition of the days or locations of total HSH impacts to be used for compliance purposes.

Of the additional 16 days only those days which do not correspond to the same general ~~wind direction~~ met cond sectors or receptor locations already covered by the 10 days will be analyzed. A quick review indicates that at most 5 more days will be in need of analysis.

The determination of compliance with the NAAQS will be initially attempted using the maximum projected impacts since Table 3 results indicate it to be feasible with the 36 ug/m^3 background noted previously. However, the ultimate compliance status will be based on the largest HSH total impact predicted. This is valid even though we will not model each day of each year using the total inventory since the result above show that the contribution from other sources will not in themselves control any of the expected high impacts. These contributions are only critical for the days when Bethlehem Steel impacts are high. This is analogous to the method of determining the background values to be added to the HSH facility impacts in any normal source review process where the impacts are limited to near the facility and have been modeled using 5 years of meteorological data (as in the Bethlehem Steel case).

The number of receptors to be modeled will be limited to the 12 used in the partial results. These receptors were chosen on the basis of impacts above 90 ug/m^3 and represent all of the receptors on or near the boundary of the ambient air ? facility. The other 7 receptors consistently showed lower impacts and are not near the maximum worst case area predicted for all other sources (Table 4).

Their purpose was to show concentration decreases from the location of maximum impacts.

The analysis of total impacts will be supplemental by the results of the worst case 24 hour results discussed above (if acceptable, we would only present these results and will not address actual expected daily impacts beyond the four days analyzed). Some additional work will be performed in this phase of the analysis to assure that for 1973 and at receptor (185,749) there are no other impacts below the 151 ug/m^3 of Table 4 which might jeopardize the assurance that total impacts are below the 260 ug/m^3. That is, Bethlehem Steel impacts will have to be less than 126 ug/m^3 (260-36 (Background) - 98 (worst case other sources)) at that receptor without day 327.

The above is the general procedures that will be utilized. However, any reasonable modifications suggested by EPA (within the funding and time constraints) will be included in the final analysis. For example, the requirement to use the maximum values for compliance determination would necessitate the recalculation of 1976 results since it has come to our attention that the two largest maximum values of Table 1 (in 1976) were associated with two hours in day 308 with very low mixing depths (1m and 16m). These unrealistic mixing depth are an artifact of the interpolation scheme used by the meteorological preprocessor (they are also not representative of urban mixing depths). These mixing depths are the reason for the abnormally high maximum values in 1976 versus any of the other years and completely misrepresent the contribution of ground level source impacts (Table 2 indicates that the latter are essentially responsible for the total Bethlehem Steel impact for day 308).

ISCST Post 1984 Highest 24 Hr. TSP Impacts ($\mu g/m^3$)
No Background
Using Combined Beth Steel Inventory w/ 1973 Met Data

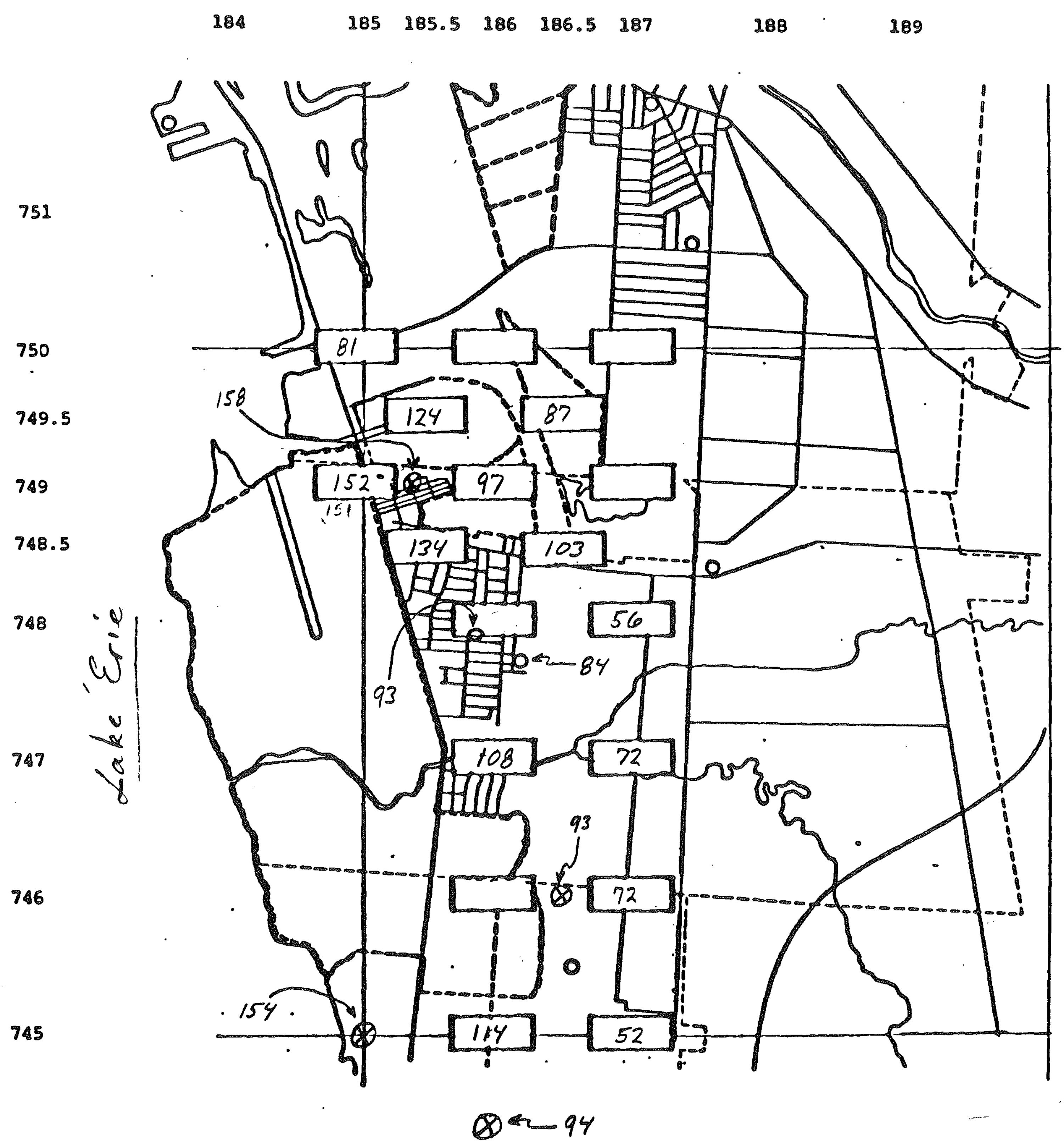

Table 1

1973 (19 Receptors, 39 Sources)

Location	DAY	HIGH	Location	DAY	HSH	Location	Annual
185.3, 748.9	339	158	185, 749	327	151	185, 749	42.0
185, 745	341	154	185, 745	233	114	185.3, 748.9	33.0
185, 749	339	152	186, 745	52	109		

1974 (19 Rec, 39 Sources)

~~Loc.~~ ~~DAY~~

Loc	DAY	HIGH	Loc.	DAY	HSH	Location	Annual
185, 745	201	115	185, 749	148	95	185, 749	42.0
185, 749	358	104	186, 745	329	94	185.3, 748.9	31.0
186, 745	293	101	186.5, 746	259	90		

1975 (19 Rec, 39 Sources)

Loc.	DAY	HIGH	Location	DAY	HSH	Location	Annual
185, 749	209	137	186.5, 746	265	95	185, 749	40.0
186, 747	209	113	185, 749	265	94	185.3, 748.9	28.9
186.5, 746	209	111	186, 747	259	92		

Table 1 (Continued)

1976 (19 Rec, 39 Sources)

Location	DAY	HIGH	Location	DAY	HSH	Location	Annual
185.5, 749.5	308	219	186, 747	27	126	185, 749	41.0
185.5, 748.5	308	217	186, 745	98	114	185.3, 748.9	31.0
186.5, 746	27	204	185.5, 748.5	256	107		

1977 (21 Rec, 160 Sources)

Location	DAY	HIGH	Location	DAY	HSH	Location	Annual
186, 745	246	103	185, 749	337	95	185, 749	39
185, 749	35	99	186, 745	275	82	185.3, 748.9	30

1977 (8 Rec, 39 Sources)

Location	DAY	HIGH	Location	DAY	HSH	Location	Annual
186, 745	246	120	185, 749	337	107	185, 749	43.0
185, 749	218	109	186, 745	275	97	186, 747	29.0

Table 2

DAILY Source Contribution Runs Beth Steel

X_T M or MSH	Year	JDAY	Rec # Receptor (modified grid boundaries →)	Coke Ovens (172-135, 1713)	Sinter Plant (169-173)	Paved Roads (680-707)	Unpaved Roads (716-731)	Mills (176-184, 256)	Stockpiles (977-79)	Rest (Particles)	Meteorology Data
158 M	73	339	6 85.3/748.9	44	—	30	71	—	7	—	u = 3.0 small mixo for P.R.R.; u = 8-10 m/s for C.O.; D class 3,4
152 M	73	339	2 185/749	55	—	34	55	—	—	—	
151	73	327	185.3/749.9	63	—	12	60	6	5	5	large mixo; u = 3-8 m/s for coke ovens; u = 1-1.5 m/s for U.R. small mixo; D class
115 M	74	201	1 185/745	6	5	20	82	—	—	—	3 m/s D class; low mixo
95 MSH	74	148	5 185/749	40	—	10	44	—	—	—	3-7 m/s persistence [illegible]; D class
7 M	75	209	5 185/749	26	—	12	81	—	14	—	low mixo 7 m/s, high U.R. & P.R.; u = 2-9 m/s low mixo
113 M	75	209	3 186/747	5	—	25	75	—	—	—	
111 M	75	209	8 186.5/746	—	—	82	12	16	—	—	
95 MSH	75	265	8 186.5/746	—	—	61	34	—	—	—	u = 3-5 m/s, high mixo persistence
94 MSH	75	265	5 185/749	45	—	7	21	13	—	6	
219 M	76	308	2 185.5/749.5	20	—	178	18	—	—	—	u = 2-9 m/s ?
204 M	76	27	7 186.5/746	29	—	98	70	—	—	—	u = 2 [illegible]; mixo small
126 M	76	27	3 186/747	43	—	22	52	—	7	—	
120 M	77	246	8 186/745	7	—	91	14	9	—	—	u: 2-3 m/s high persistence
107 MSH	77	337	5 185/749	68	—	8	31	—	—	—	u = 2-4 for U.R. small mixo; 8-9 coke ovens

8 Receptors

Note: (—) is for < 5 µg/m³ contribution