Addendum II

BART Exemption Screening Analysis

February 16, 2007

Primary Particulate Model Plant Methodology: Texas PM Model Plants (TPMMP)

This addendum presents a subsequent assessment of the BART exemption screening analysis documented in *Screening Analysis of Potential BART-Eligible Sources in Texas* (Morris and Nopmongcol, 2006). PM screening modeling was conducted following Option 3 in EPA's BART guidance which allows group exemption modeling of potential BART eligible sources' PM emissions. Several rounds of PM modeling were conducted. Three sources did not screen out based on the CAMx analysis and the remaining 104 sources did screen out. The sources that were screened are the basis of the model plant that has been developed as described below.

An introduction and the Methodology will be presented first, followed by the table of Texas PM Model Plants. These are then followed by examples of the methodology. Finally, the derivation of the Methodology is presented.

Introduction

In appendix Y of the final version of EPA's Regional Haze Regulations and Guidelines, published in the Federal Register on July 6, 2005 (70 FR 39104, EPA, 2005), the EPA provides for two "Model Plants" for SO_2 and NO_x. Additionally, Addendum I ("BART Exemption Screening Analysis"), of "Final Report: Screening Analysis of Potential BART-Eligible Sources in Texas", provides additional Texas Model Plants (TMPs) for these pollutants. However, in neither case has a model plant and methodology been set forth for primary particulate matter.

Due to requests from potential BART sources, and a recognized need for such, we have set out to develop a Texas Primary Particulate Model Plant methodology that can be used in such a way as to provide reasonable assurance that visibility impacts of target plants can be expected to be no greater than that of the Texas PM Model Plant (TPMMP).

The Methodology

Given a target plant, of a certain emission class (EGU vs. Non-EGU) with a given set of Primary Particulate emissions ($Q'_{Sulfate}$, $Q'_{Nitrate}$, $Q'_{Organic\ Mass}$, $Q'_{Elemental\ Carbon}$, $Q'_{Fine\ Soil}$, and $Q'_{Coarse\ Mass}$; scaling the Sulfate and Nitrate), at a certain distance (D') from a given Class I area, we can compare to model plants, of the same emission class, that are closer to the Class I area ($D \le D'$). Given such a model plant, we use the Sulfate and Nitrate growth factor ($f(RH)$), at the Class I area on the relevant modeling day used in modeling this (model) plant, to calculate

$$\tilde{Q}_f = \begin{pmatrix} 3 \times f(RH) \times Q_{Sulfate} \\ + 3 \times f(RH) \times Q_{Nitrate} \\ + 4 \times Q_{Organic\ Mass} \\ + 10 \times Q_{Elemental\ Carbon} \\ + 1 \times Q_{Fine\ Soil} \end{pmatrix}$$

and $\tilde{Q}_c = 0.6 \times Q_{Coarse\ Mass}$, for both the model and target plants.[1]

Since the Methodology really doesn't depend on the effective extinction efficiency (e), all comparisons can be carried out with the $\tilde{Q}$ ($= eQ$). (The only real need for the effective extinction efficiency, e, is in order to provide a comparison that has the same units as that with SO_2 and NO_x.[2])

So, having calculated $\tilde{Q}'_f$, and $\tilde{Q}'_c$ (and having $\tilde{Q}_f$, and $\tilde{Q}_c$ in hand), if we have $r = k_c / k_f$ from the modeling[3], the target plant passes if $\tilde{Q}'_f + r\tilde{Q}'_c \le \tilde{Q}_f + r\tilde{Q}_c$. Otherwise, if the target plant's coarse mass is less than the model plant's coarse mass ($\tilde{Q}'_c \le \tilde{Q}_c$), then the target plant passes provided $\tilde{Q}'_f \le \tilde{Q}_f$, while, other wise (when the target plant's coarse mass is greater than that of the model plant), the target plant passes if we have $\tilde{Q}'_f + \tilde{Q}'_c \le \tilde{Q}_f + \tilde{Q}_c$.

---

[1] In practice, since these quantities are all known beforehand, for the model plants, they can simply be calculated ahead of time and included in the table of information provided for such.

[2] However, for those that desire such, it can be argued that e should be a weighted mean of the extinction efficiencies, where the weighting is such as to have the same impact over each species. It is quite straightforward to show that this yields a Harmonic mean of the extinction efficiencies. So $e = 6/\left(2/\left(3 \times f(RH)\right) + 1/4 + 1/10 + 1/1 + 1/0.6\right) = 360/\left(181 + 40/f(RH)\right)$, which depends on relative humidity, but is always in the range 360/221 to 360/181 (~1.6 to 2.0).
If we note that the extinction efficiency coefficients are really only good to a single digit, then we see that e is simply 2 (to one digit), over its entire range. Alternatively, if we take the extinction efficiency coefficients to be accurate to 10% (which may be generous), we see that e is consistent with 1.8, over its entire range (which happens to be quite close to the actual values).

[3] The transport coefficients, k_f and k_c, are discussed in the section on Deriving the Methodology.

The Texas PM Model Plants

As a result of the CAMx Primary Particulate Zero-out runs, TCEQ has compiled a number of Texas PM Model Plants. These plants are shown in Table B-1: The Texas PM Model Plants.

The distances are computed using Great Circle distances[4] (using 6367 km as the radius of the Earth's curvature) from the Latitude and Longitude shown (in decimal degrees), and the National Park Service's Receptor Grids for the Class I Areas. The Modeled JDate is the date modeled that was the 8th worst (98th percentile) impact for the group of plants to which the model plant belongs[5]. The $f(RH)$ used is for the monthly average relative humidity, as recommended by the EPA in 40 CFR 51 Appendix Y.

The original table had PM Model Plants grouped by Closest Class I Area, but this designation used only the distance to the Class I area's monitoring station. Therefore, since the new distance calculations changed which Class I area was closest for some of the PM Model Plants, there is some mixing of which model plants are closest to which Class I areas within this table.

The emissions used to calculate $\tilde{Q}_f$ and $\tilde{Q}_c$ are the average typical actual emissions for potential BART-eligible sources in the CENRAP 2002 typical base B base case emissions scenario, rather than the doubled values that were used in the actual modeling (to approximate maximum actual 24-hour emissions), as discussed in the Final report, *Screening Analysis of Potential BART-Eligible Sources in Texas* (Morris and Nopmongcol, 2006).

[4] It can be argued that the distances that should be used are the Euclidian distances using the Lambert Conformal Projection used in the modeling. However, the error between these two measures appears to be no more than about 12 km, between the most distant pairs of Class I areas used in the modeling, and is much smaller than the error that would be caused if the distances from Class I areas were computed as the distances from the single monitor representing such areas. (Besides, the Great Circle distance has only the radius of the Earth's curvature as a parameter, vs. the five parameters that must be specified for the Lambert Conformal distances.)

[5] Account HG0659W, PM Model Plant #77, was the only model plant that was modeled as a single source in the CAMx modeling. All other model plants were members of groups containing at least five (5) sources.

Table B-1: The Texas PM Model Plants

PM Model Plant	Account	EGU/ Non-EGU	Latitude	Longitude	Closest Class I Area	Closest Distance to Class I Area (km)	Modeled JDate	Modeled Month	f(RH)	$\tilde{Q}_f=eQ_f$	$\tilde{Q}_c=eQ_c$	e	Q_f/D (tpy/km)	Q_c/D (tpy/km)	Q/D (tpy/km)
1	BG0057U	EGU	29.300878	-98.31936	BIBE1	440.16	1	1	1.79	2032.73	449.20	1.77	2.61	0.58	3.18
2	BG0186I	EGU	29.258518	-98.38231	BIBE1	434.25	298	10	1.68	232.14	0.00	1.76	0.30	0.00	0.30
3	CD0013K	EGU	26.131898	-97.63768	BIBE1	620.64	301	10	1.68	98.75	0.96	1.76	0.09	0.00	0.09
4	NE0024E	EGU	27.604537	-97.31139	BIBE1	574.03	301	10	1.68	265.88	0.00	1.76	0.26	0.00	0.26
5	NE0025C	EGU	27.848611	-97.61638	BIBE1	536.90	1	1	1.79	35.06	0.21	1.77	0.04	0.00	0.04
6	NE0026A	EGU	27.815525	-97.41697	BIBE1	556.68	298	10	1.68	154.63	0.00	1.76	0.16	0.00	0.16
7	TG0044C	EGU	31.391587	-100.49266	BIBE1	316.21	298	10	1.68	90.97	0.00	1.76	0.16	0.00	0.16
8	VC0003D	EGU	28.786428	-97.00730	BIBE1	572.12	1	1	1.79	28.74	0.18	1.77	0.03	0.00	0.03
9	WE0005G	EGU	27.565370	-99.50574	BIBE1	378.74	301	10	1.68	66.42	0.34	1.76	0.10	0.00	0.10
10	OC0013O	EGU	30.021230	-93.87690	BRET1	471.85	6	1	3.51	1302.20	0.00	1.87	1.47	0.00	1.47
11	FB0025U	EGU	33.628964	-96.36760	CACR1	220.26	164	6	3.18	305.19	0.00	1.86	0.75	0.00	0.75
12	FC0018G	EGU	29.916858	-96.75242	CACR1	554.10	351	12	3.31	1384.66	531.14	1.86	1.34	0.51	1.85
13	FG0020V	EGU	29.474962	-95.63579	CACR1	564.11	351	12	3.31	1086.04	6.39	1.86	1.03	0.01	1.04
14	FI0020W	EGU	31.822443	-96.05277	CACR1	335.74	164	6	3.18	1447.75	322.56	1.86	2.32	0.52	2.84
15	GB0037T	EGU	29.485370	-94.97947	CACR1	549.86	13	1	3.28	326.03	0.00	1.86	0.32	0.00	0.32
16	GJ0043K	EGU	32.373055	-94.64222	CACR1	228.61	351	12	3.31	128.85	0.00	1.86	0.30	0.00	0.30
17	ME0006A	EGU	32.846555	-94.54716	CACR1	175.42	351	12	3.31	302.97	0.05	1.86	0.93	0.00	0.93
18	MQ0009F	EGU	30.433722	-95.52227	CACR1	458.38	351	12	3.31	480.22	0.00	1.86	0.56	0.00	0.56
19	RL0020K	EGU	32.259515	-94.56852	CACR1	239.43	13	1	3.28	2224.18	172.86	1.86	4.99	0.39	5.37
20	EE0029T	EGU	31.759166	-106.37500	GUMO1	128.56	345	12	2.33	247.04	0.00	1.82	1.06	0.00	1.06
21	WC0028Q	EGU	31.582315	-102.96017	GUMO1	149.73	253	9	2.36	370.73	0.17	1.82	1.36	0.00	1.36
22	LN0081B	EGU	33.522361	-101.73908	SACR1	244.61	241	8	1.86	5.29	49.63	1.78	0.01	0.11	0.13
23	BC0015L	EGU	30.146436	-97.27095	WIMO1	524.20	49	2	2.55	247.69	0.01	1.83	0.26	0.00	0.26
24	DB0251U	EGU	32.948703	-96.97634	WIMO1	252.46	170	6	2.51	127.90	0.00	1.83	0.28	0.00	0.28
25	HQ0012T	EGU	32.403642	-97.69978	WIMO1	272.30	170	6	2.51	534.39	0.09	1.83	1.07	0.00	1.07
26	JI0030K	EGU	32.581722	-99.68383	WIMO1	251.04	60	3	2.35	164.17	0.00	1.82	0.36	0.00	0.36
27	MB0116C	EGU	31.572430	-96.96502	WIMO1	384.11	49	2	2.55	551.47	0.00	1.83	0.78	0.00	0.78

PM Model Plant	Account	EGU/ Non-EGU	Latitude	Longitude	Closest Class I Area	Closest Distance to Class I Area (km)	Modeled JDate	Modeled Month	f(RH)	$\tilde{Q}_f=eQ_f$	$\tilde{Q}_c=eQ_c$	e	Q_f/D (tpy/km)	Q_c/D (tpy/km)	Q/D (tpy/km)
28	MM0023J	EGU	30.565037	-97.06307	WIMO1	485.15	60	3	2.35	2025.93	51.48	1.82	2.30	0.06	2.36
29	MO0014L	EGU	32.330000	-100.91614	GUMO1	325.80	296	10	1.68	129.30	0.00	1.76	0.23	0.00	0.23
30	PG0040T	EGU	35.281944	-101.74550	WIMO1	277.11	60	3	2.35	0.08	11.18	1.82	0.00	0.02	0.02
31	PG0041R	EGU	35.299537	-101.74934	WIMO1	277.87	170	6	2.51	96.31	908.62	1.83	0.19	1.79	1.98
32	TA0352I	EGU	32.906944	-97.48027	WIMO1	229.85	60	3	2.35	122.07	0.00	1.82	0.29	0.00	0.29
33	TH0004D	EGU	30.305892	-97.61287	WIMO1	499.49	60	3	2.35	317.87	0.00	1.82	0.35	0.00	0.35
34	YB0017V	EGU	33.135000	-98.61166	WIMO1	174.62	170	6	2.51	124.50	0.24	1.83	0.39	0.00	0.39
35	BG0045E	Non-EGU	29.542481	-98.41941	BIBE1	430.43	249	9	1.91	84.63	11.14	1.78	0.11	0.01	0.12
36	CB0003M	Non-EGU	28.649614	-96.55940	BIBE1	617.50	168	6	1.47	265.44	106.88	1.73	0.25	0.10	0.35
37	CB0028T	Non-EGU	28.509979	-96.76933	BIBE1	599.90	168	6	1.47	173.17	5.85	1.73	0.17	0.01	0.17
38	HK0014M	Non-EGU	30.050687	-97.85742	BIBE1	489.23	339	12	1.74	301.82	113.68	1.76	0.35	0.13	0.48
39	JB0016M	Non-EGU	28.758280	-96.59324	BIBE1	612.50	249	9	1.91	52.64	0.00	1.78	0.05	0.00	0.05
40	NE0022I	Non-EGU	27.564046	-97.82570	BIBE1	528.21	343	12	1.74	123.15	0.37	1.76	0.13	0.00	0.13
41	NE0027V	Non-EGU	27.788339	-97.42228	BIBE1	557.11	168	6	1.47	2053.09	26.37	1.73	2.13	0.03	2.16
42	NE0043A	Non-EGU	27.805575	-97.44566	BIBE1	554.34	343	12	1.74	462.88	0.00	1.76	0.47	0.00	0.47
43	NE0120H	Non-EGU	27.805207	-97.42187	BIBE1	556.57	343	12	1.74	908.78	0.00	1.76	0.93	0.00	0.93
44	NE0122D	Non-EGU	27.832346	-97.52683	BIBE1	545.83	168	6	1.47	51.18	0.07	1.73	0.05	0.00	0.05
45	VC0008Q	Non-EGU	28.672906	-96.95393	BIBE1	579.09	296	10	1.68	497.64	27.35	1.76	0.49	0.03	0.52
46	BL0002S	Non-EGU	29.229993	-95.19961	CACR1	581.41	351	12	3.31	680.56	2.02	1.86	0.63	0.00	0.63
47	BL0038U	Non-EGU	29.247419	-95.21234	CACR1	579.74	40	2	2.95	90.62	0.59	1.85	0.08	0.00	0.09
48	BL0082R	Non-EGU	28.980220	-95.37605	CACR1	611.92	65	3	2.71	355.38	3.72	1.84	0.32	0.00	0.32
49	BL0113I	Non-EGU	29.249779	-95.21656	CACR1	579.55	351	12	3.31	343.81	0.20	1.86	0.32	0.00	0.32
50	BL0268B	Non-EGU	29.231396	-95.19084	CACR1	581.11	105	4	2.79	18.42	3.08	1.84	0.02	0.00	0.02
51	GB0001R	Non-EGU	29.362452	-94.92178	CACR1	562.54	105	4	2.79	350.86	3.40	1.84	0.34	0.00	0.34
52	GB0004L	Non-EGU	29.371564	-94.93055	CACR1	561.66	313	11	3.14	3437.96	56.38	1.86	3.29	0.05	3.35
53	GB0055R	Non-EGU	29.373313	-94.90727	CACR1	561.15	105	4	2.79	1640.97	0.00	1.84	1.59	0.00	1.59
54	GB0073P	Non-EGU	29.366709	-94.90604	CACR1	561.86	105	4	2.79	905.30	0.00	1.84	0.87	0.00	0.87
55	JE0005H	Non-EGU	29.954656	-93.88376	BRET1	472.02	303	10	3.40	2115.41	34.82	1.87	2.40	0.04	2.44

PM Model Plant	Account	EGU/ Non-EGU	Latitude	Longitude	Closest Class I Area	Closest Distance to Class I Area (km)	Modeled JDate	Modeled Month	f(RH)	$\tilde{Q}_f=eQ_f$	$\tilde{Q}_c=eQ_c$	e	Q_f/D (tpy/km)	Q_c/D (tpy/km)	Q/D (tpy/km)
56	JE0039N	Non-EGU	29.971529	-94.21464	CACR1	489.11	351	12	3.31	177.89	0.00	1.86	0.20	0.00	0.20
57	JE0052V	Non-EGU	29.965827	-93.93339	BRET1	476.87	193	7	3.78	328.40	0.00	1.88	0.37	0.00	0.37
58	JE0067I	Non-EGU	30.067549	-94.06996	CACR1	478.21	105	4	2.79	2798.05	0.00	1.84	3.17	0.00	3.17
59	JE0135Q	Non-EGU	29.890646	-93.97171	BRET1	480.13	303	10	3.40	369.72	0.00	1.87	0.41	0.00	0.41
60	JE0343H	Non-EGU	30.016111	-94.03429	CACR1	483.92	351	12	3.31	173.12	5.62	1.86	0.19	0.01	0.20
61	OC0007J	Non-EGU	30.054077	-93.75198	BRET1	460.15	240	8	3.77	211.00	16.96	1.88	0.24	0.02	0.26
62	BL0758C	Non-EGU	29.073627	-95.75009	CACR1	610.06	351	12	3.31	398.95	4.91	1.86	0.35	0.00	0.36
63	CI0022A	Non-EGU	29.838822	-94.89996	CACR1	509.87	105	4	2.79	99.29	0.00	1.84	0.11	0.00	0.11
64	CR0020C	Non-EGU	29.467254	-96.62400	CACR1	594.79	351	12	3.31	54.39	0.00	1.86	0.05	0.00	0.05
65	FG0036G	Non-EGU	29.693846	-95.71158	CACR1	542.48	351	12	3.31	102.83	20.78	1.86	0.10	0.02	0.12
66	HG0048L	Non-EGU	29.714645	-95.23385	CACR1	529.20	351	12	3.31	1809.24	4.51	1.86	1.83	0.00	1.84
67	HG0126Q	Non-EGU	29.624175	-95.06249	CACR1	535.95	105	4	2.79	1173.29	67.27	1.84	1.19	0.07	1.26
68	HG0130C	Non-EGU	29.720528	-95.25547	CACR1	528.99	65	3	2.71	388.99	47.90	1.84	0.40	0.05	0.45
69	HG0175D	Non-EGU	29.719623	-95.20570	CACR1	528.11	350	12	3.31	1652.66	186.48	1.86	1.68	0.19	1.87
70	HG0218K	Non-EGU	29.699770	-95.03516	CACR1	527.22	105	4	2.79	82.44	2.28	1.84	0.08	0.00	0.09
71	HG0228H	Non-EGU	29.753303	-95.01112	CACR1	520.97	65	3	2.71	240.83	0.61	1.84	0.25	0.00	0.25
72	HG0229F	Non-EGU	29.746300	-95.01898	CACR1	521.86	105	4	2.79	270.21	5.72	1.84	0.28	0.01	0.29
73	HG0232Q	Non-EGU	29.741073	-95.00628	CACR1	522.23	350	12	3.31	4440.41	0.00	1.86	4.56	0.00	4.56
74	HG0310V	Non-EGU	29.823167	-94.92009	CACR1	511.88	351	12	3.31	800.20	10.79	1.86	0.84	0.01	0.85
75	HG0562P	Non-EGU	29.698211	-95.25276	CACR1	531.37	105	4	2.79	159.09	3.27	1.84	0.16	0.00	0.17
76	HG0632T	Non-EGU	29.729325	-95.10364	CACR1	525.16	105	4	2.79	538.40	22.01	1.84	0.56	0.02	0.58
77	HG0659W	Non-EGU	29.721302	-95.12457	CACR1	526.41	105	4	2.79	1943.45	0.00	1.84	2.00	0.00	2.00
78	HG0697O	Non-EGU	29.718739	-95.27087	CACR1	529.50	351	12	3.31	41.13	1.34	1.86	0.04	0.00	0.04
79	HG1451S	Non-EGU	29.724330	-95.13858	CACR1	526.34	65	3	2.71	111.90	0.00	1.84	0.12	0.00	0.12
80	HH0019H	Non-EGU	32.526353	-94.39405	CACR1	207.38	105	4	2.79	106.28	73.82	1.84	0.28	0.19	0.47
81	HH0042M	Non-EGU	32.436703	-94.68814	CACR1	222.83	350	12	3.31	953.15	17.49	1.86	2.29	0.04	2.34
82	JC0003K	Non-EGU	30.340302	-94.06476	CACR1	447.89	313	11	3.14	1176.20	40.56	1.86	1.41	0.05	1.46
83	MH0009H	Non-EGU	28.860300	-96.02010	CACR1	639.71	350	12	3.31	887.79	112.78	1.86	0.74	0.09	0.84

PM Model Plant	Account	EGU/ Non-EGU	Latitude	Longitude	Closest Class I Area	Closest Distance to Class I Area (km)	Modeled JDate	Modeled Month	f(RH)	$\tilde{Q}_f=eQ_f$	$\tilde{Q}_c=eQ_c$	e	Q_f/D (tpy/km)	Q_c/D (tpy/km)	Q/D (tpy/km)
84	NB0037F	Non-EGU	31.911038	-96.34985	CACR1	342.99	105	4	2.79	292.08	46.88	1.84	0.46	0.07	0.54
85	EB0057B	Non-EGU	31.821074	-102.32983	GUMO1	197.36	141	5	1.57	286.60	0.38	1.74	0.83	0.00	0.83
86	AB0012W	Non-EGU	32.418822	-102.80205	GUMO1	150.35	245	9	2.36	93.61	0.00	1.82	0.34	0.00	0.34
87	HT0011Q	Non-EGU	32.260652	-101.41069	GUMO1	279.17	307	11	1.91	348.94	6.28	1.78	0.70	0.01	0.71
88	HT0027B	Non-EGU	32.277569	-101.40808	GUMO1	279.45	303	10	1.68	5.24	10.84	1.76	0.01	0.02	0.03
89	BJ0001T	Non-EGU	31.708324	-97.58790	WIMO1	348.94	346	12	2.78	224.54	86.84	1.84	0.35	0.14	0.48
90	ED0011D	Non-EGU	32.455530	-97.03848	WIMO1	294.03	346	12	2.78	559.75	16.28	1.84	1.03	0.03	1.06
91	ED0034O	Non-EGU	32.518528	-97.00680	WIMO1	289.66	155	6	2.51	1656.16	60.44	1.83	3.13	0.11	3.24
92	ED0051O	Non-EGU	32.439325	-96.84928	WIMO1	305.11	346	12	2.78	627.91	15.04	1.84	1.12	0.03	1.14
93	ED0066B	Non-EGU	32.461653	-97.02522	WIMO1	294.10	50	2	2.55	146.69	32.93	1.83	0.27	0.06	0.33
94	GH0003Q	Non-EGU	35.507927	-101.01549	WIMO1	220.88	346	12	2.78	167.19	8.20	1.84	0.41	0.02	0.43
95	GH0004O	Non-EGU	35.481338	-101.04922	WIMO1	222.65	50	2	2.55	9.97	114.29	1.83	0.02	0.28	0.30
96	HD0029C	Non-EGU	36.495305	-101.47177	WIMO1	311.94	155	6	2.51	154.63	0.00	1.83	0.27	0.00	0.27
97	HW0008S	Non-EGU	35.665733	-101.43254	WIMO1	262.40	285	10	2.50	225.95	11.99	1.83	0.47	0.03	0.50
98	HW0017R	Non-EGU	35.663611	-101.43500	WIMO1	262.51	50	2	2.55	240.00	36.42	1.83	0.50	0.08	0.58
99	HW0018P	Non-EGU	35.696893	-101.36471	WIMO1	258.09	346	12	2.78	130.49	0.00	1.84	0.27	0.00	0.27
100	JH0025O	Non-EGU	32.357418	-97.36470	WIMO1	289.12	285	10	2.50	165.35	41.11	1.83	0.31	0.08	0.39
101	MB0123F	Non-EGU	31.481258	-97.24083	WIMO1	383.44	155	6	2.51	442.56	79.61	1.83	0.63	0.11	0.74
102	MM0001T	Non-EGU	30.565073	-97.07091	WIMO1	484.91	50	2	2.55	261.40	65.26	1.83	0.29	0.07	0.37
103	MR0008T	Non-EGU	35.952893	-101.87962	WIMO1	312.05	345	12	2.78	597.43	5.43	1.84	1.04	0.01	1.05
104	WH0014S	Non-EGU	33.861252	-98.59290	WIMO1	94.31	345	12	2.78	164.68	5.51	1.84	0.95	0.03	0.98

Examples

The first example is that of account CI0012D, that was not included in the PM zero-out modeling runs (Table B-2: Account CI0012D: Didn't model). The second example is that of account HG0659W (PM Model Plant #77), which was the only model plant that was modeled as a single source in the CAMx modeling (Table B-3: Account HG0659W: Single source CAMx). The third example is another account (HW0004D) that was not modeled, but was just recently brought to the attention of TCEQ by the source (Table B-4: Account HW0004D: Recently Found).

The shaded rows in Table B-2 through Table B-4 are for comparisons to Model Plants that are closer to a different Class I area.

All emissions are in tons per year (tpy). The emissions used to calculate $\tilde{Q}'_f$ and $\tilde{Q}'_c$ are average typical actual emissions.

The relationship between the emission species shown in the tables (CM, Soil, OM, EC, SO_4, and NO_3) to the Primary Particulate species that would be used in an Emissions Inventory in the CAMx modeling is: SO_4 = PSO4, NO_3 = PNO3, OM = POA, EC = PEC, Soil = FPRM + FCRS, CM = CPRM + CCRS.[6]

Table B-5: PM Sources That Didn't Pass CAMx PM Zero-out Modeling, shows the three accounts that didn’t pass the CAMx Primary Particulate zero-out screening, even as single sources.[7] Unfortunately, all of these sources are closer to Caney Creek than any of the Texas PM Model Plants. However, it may be of interest to note that, for account CG0010G, while PM_{10}/D (a naive Q/D estimate) is less than 10 tpy/km,[8] the account didn’t pass! On the other hand, the more appropriate Q/D calculation, using $Q = \left(\tilde{Q}_f + \tilde{Q}_c\right)/e$, where $e = 360/\left(181 + 40/f(RH)\right)$, is greater than 10 tpy/km.[9] (Either way, the other two accounts have even larger Q/D ratios.)

---

[6] The CAMx species are discussed in the Final report, *Screening Analysis of Potential BART-Eligible Sources in Texas* (Morris and Nopmongcol, 2006).

[7] Here, again, the emissions used to calculate $\tilde{Q}'_f$ and $\tilde{Q}'_c$, for these sources, are the average typical actual emissions for these potential BART-eligible sources in the CENRAP 2002 typical base B base case emissions scenario, rather than the doubled values that were used in the actual modeling (to approximate maximum actual 24-hour emissions), as discussed in the Final report, *Screening Analysis of Potential BART-Eligible Sources in Texas* (Morris and Nopmongcol, 2006).

[8] Account CG0010G has a PM_{10}/D ratio of approximately 4.66 tpy/km, so even doubling it (the emissions used in the modeling), to approximate a peak 24 hour emission rate, the PM_{10}/D ratio is still below 10 tpy/km.

[9] An even more appropriate Q/D ratio would use $Q_r = \left(\tilde{Q}_f + r\tilde{Q}_c\right)/e$, if one has r, from modeling.

Table B-2: Account CI0012D: Didn't model

Account	EGU/ Non-EGU	Closest Class I Area	Closest Distance to Class I Area (km)	Compare to Model Plant	Pass?	Distance between sources (km)	Modeled JDate	Modeled Month	f(RH)	$\tilde{Q}'_f=eQ'_f$	$\tilde{Q}'_c=eQ'_c$	e	Q'_f/D' (tpy/km)	Q'_c/D' (tpy/km)	Q'/D' (tpy/km)
CI0012D	EGU	CACR1	519.97	10	Yes	105.06	164	6	3.18	828.80	0.00	1.86	0.86	0.00	0.86
Lat:	29.749705	Lon:	-94.92135	11	No[1]	452.24	164	6	3.18	828.80	0.00	1.86	0.86	0.00	0.86
CM:	0	Soil:	30.49755	14	Yes	254.40	164	6	3.18	828.80	0.00	1.86	0.86	0.00	0.86
OM:	94.08	EC:	0	16	No[1]	292.73	351	12	3.31	846.05	0.00	1.86	0.87	0.00	0.87
SO_4:	31.36	NO_3:	0.8624	17	No[1†]	345.97	351	12	3.31	846.05	0.00	1.86	0.87	0.00	0.87
				18	No[1]	95.48	351	12	3.31	846.05	0.00	1.86	0.87	0.00	0.87
				19	Yes	280.92	13	1	3.28	842.07	0.00	1.86	0.87	0.00	0.87
				24	No[1]	405.44	351	12	3.31	846.05	0.00	1.86	0.87	0.00	0.87
				25	No[1]	396.08	351	12	3.31	846.05	0.00	1.86	0.87	0.00	0.87
				27	No[1]	281.39	164	6	3.18	828.80	0.00	1.86	0.86	0.00	0.86
				28	Yes	224.84	13	1	3.28	842.07	0.00	1.86	0.87	0.00	0.87
				32	No[1]	426.69	13	1	3.28	842.07	0.00	1.86	0.87	0.00	0.87
				34	No[1]	513.66	351	12	3.31	846.05	0.00	1.86	0.87	0.00	0.87

[1] $\tilde{Q}'_c \le \tilde{Q}_c$ but $\tilde{Q}'_f > \tilde{Q}_f$.

† While this doesn't pass, the Model Plant's Q/D is larger.

Account	EGU/ Non-EGU	Next Closest Class I Area	Closest Distance to Class I Area (km)	Compare to Model Plant	Pass?	Distance between sources (km)	Modeled JDate	Modeled Month	f(RH)	$\tilde{Q}'_f=eQ'_f$	$\tilde{Q}'_c=eQ'_c$	e	Q'_f/D' (tpy/km)	Q'_c/D' (tpy/km)	Q'/D' (tpy/km)
CI0012D	EGU	BRET1	571.37	10	Yes	105.06	6	1	3.51	872.59	0.00	1.87	0.82	0.00	0.82

Table B-3: Account HG0659W: Single source CAMx

Account	EGU/ Non-EGU	Closest Class I Area	Closest Distance to Class I Area (km)	Compare to Model Plant	Pass?	Distance between sources (km)	Modeled JDate	Modeled Month	f(RH)	$\tilde{Q}'_f = eQ'_f$	$\tilde{Q}'_c = eQ'_c$	e	Q'_f/D' (tpy/km)	Q'_c/D' (tpy/km)	Q'/D' (tpy/km)
HG0659W	Non-EGU	CACR1	526.41	55	No[1†]	122.38	65	3	2.71	1907.10	0.00	1.84	1.97	0.00	1.97
				56	No[1]	92.01	351	12	3.31	2179.73	0.00	1.86	2.22	0.00	2.22
				57	No[1]	117.99	105	4	2.79	1943.45	0.00	1.84	2.00	0.00	2.00
				58	Yes	108.64	105	4	2.79	1943.45	0.00	1.84	2.00	0.00	2.00
				59	No[1]	112.75	313	11	3.14	2102.48	0.00	1.86	2.15	0.00	2.15
				60	No[1]	110.05	351	12	3.31	2179.73	0.00	1.86	2.22	0.00	2.22
				61	No[1]	137.31	40	2	2.95	2016.15	0.00	1.85	2.07	0.00	2.07
				63	No[1]	25.30	105	4	2.79	1943.45	0.00	1.84	2.00	0.00	2.00
				71	No[1]	11.51	65	3	2.71	1907.10	0.00	1.84	1.97	0.00	1.97
				72	No[1]	10.56	105	4	2.79	1943.45	0.00	1.84	2.00	0.00	2.00
				73	Yes	11.62	350	12	3.31	2179.73	0.00	1.86	2.22	0.00	2.22
				74	No[1]	22.74	351	12	3.31	2179.73	0.00	1.86	2.22	0.00	2.22
				76	No[1]	2.21	105	4	2.79	1943.45	0.00	1.84	2.00	0.00	2.00
				79	No[1]	1.39	65	3	2.71	1907.10	0.00	1.84	1.97	0.00	1.97
				80	No[1]	319.36	105	4	2.79	1943.45	0.00	1.84	2.00	0.00	2.00
				81	No[1†]	304.59	350	12	3.31	2179.73	0.00	1.86	2.22	0.00	2.22
				82	No[1]	122.99	313	11	3.14	2102.48	0.00	1.86	2.15	0.00	2.15
				84	No[1]	269.97	105	4	2.79	1943.45	0.00	1.84	2.00	0.00	2.00
				89	No[1]	322.69	105	4	2.79	1943.45	0.00	1.84	2.00	0.00	2.00
				90	No[1]	354.23	105	4	2.79	1943.45	0.00	1.84	2.00	0.00	2.00
				91	No[1†]	358.71	350	12	3.31	2179.73	0.00	1.86	2.22	0.00	2.22
				92	No[1]	343.75	105	4	2.79	1943.45	0.00	1.84	2.00	0.00	2.00
				93	No[1]	354.17	351	12	3.31	2179.73	0.00	1.86	2.22	0.00	2.22
				100	No[1]	362.34	40	2	2.95	2016.15	0.00	1.85	2.07	0.00	2.07
				101	No[1]	281.45	313	11	3.14	2102.48	0.00	1.86	2.15	0.00	2.15
				102	No[1]	209.22	351	12	3.31	2179.73	0.00	1.86	2.22	0.00	2.22

Lat:	29.721302	Lon:	-95.12457
CM:	0	Soil:	106.680085
OM:	141.214988	EC:	0.415584
SO_4:	108.326894	NO_3:	1.949031

[1] $\tilde{Q}'_c \le \tilde{Q}_c$ but $\tilde{Q}'_f > \tilde{Q}_f$.

† While this doesn't pass, the Model Plant's Q/D is larger.

Account	EGU/ Non-EGU	Closest Class I Area	Closest Distance to Class I Area (km)	Compare to Model Plant	Pass?	Distance between sources (km)	Modeled JDate	Modeled Month	f(RH)	$\tilde{Q}'_f=eQ'_f$	$\tilde{Q}'_c=eQ'_c$	e	Q'_f/D' (tpy/km)	Q'_c/D' (tpy/km)	Q'/D' (tpy/km)
				104	No[1]	564.67	65	3	2.71	1907.10	0.00	1.84	1.97	0.00	1.97

Account	EGU/ Non-EGU	Next Closest Class I Area	Closest Distance to Class I Area (km)	Compare to Model Plant	Pass?	Distance between sources (km)	Modeled JDate	Modeled Month	f(RH)	$\tilde{Q}'_f=eQ'_f$	$\tilde{Q}'_c=eQ'_c$	e	Q'_f/D' (tpy/km)	Q'_c/D' (tpy/km)	Q'/D' (tpy/km)
HG0659W	Non-EGU	BRET1	590.99	51	No[1]	44.44	193	7	3.78	2393.29	0.00	1.88	2.16	0.00	2.16
Lat:	29.721302	Lon:	-95.12457	52	Yes	43.15	303	10	3.40	2220.63	0.00	1.87	2.01	0.00	2.01
CM:	0	Soil:	106.680085	53	No[1]	44.01	193	7	3.78	2393.29	0.00	1.88	2.16	0.00	2.16
OM:	141.214988	EC:	0.415584	54	No[1]	44.71	193	7	3.78	2393.29	0.00	1.88	2.16	0.00	2.16
SO_4:	108.326894	NO_3:	1.949031	55	No[1†]	122.38	303	10	3.40	2220.63	0.00	1.87	2.01	0.00	2.01
				56	No[1]	92.01	47	2	3.31	2184.27	0.00	1.86	1.98	0.00	1.98
				57	No[1]	117.99	193	7	2.95	2393.29	0.00	1.88	2.16	0.00	2.16
				58	Yes	108.64	193	7	2.79	2393.29	0.00	1.88	2.16	0.00	2.16
				59	No[1]	112.75	303	10	2.71	2220.63	0.00	1.87	2.01	0.00	2.01
				60	No[1]	110.05	47	2	2.79	2184.27	0.00	1.86	1.98	0.00	1.98
				61	No[1]	137.31	240	8	3.31	2388.75	0.00	1.88	2.15	0.00	2.15
				63	No[1]	25.30	193	7	3.31	2393.29	0.00	1.88	2.16	0.00	2.16
				67	No[1]	12.35	193	7	2.79	2393.29	0.00	1.88	2.16	0.00	2.16
				70	No[1]	8.96	193	7	2.71	2393.29	0.00	1.88	2.16	0.00	2.16
				71	No[1]	11.51	303	10	2.79	2220.63	0.00	1.87	2.01	0.00	2.01
				72	No[1]	10.56	193	7	3.31	2393.29	0.00	1.88	2.16	0.00	2.16
				73	Yes	11.62	240	8	3.14	2388.75	0.00	1.88	2.15	0.00	2.15
				74	No[1]	22.74	47	2	3.14	2184.27	0.00	1.86	1.98	0.00	1.98
				76	No[1]	2.21	193	7	3.31	2393.29	0.00	1.88	2.16	0.00	2.16
				82	No[1]	122.99	303	10	2.71	2220.63	0.00	1.87	2.01	0.00	2.01

[1] $\tilde{Q}'_c \leq \tilde{Q}_c$ but $\tilde{Q}'_f > \tilde{Q}_f$.

[†] While this doesn't pass, the Model Plant's Q/D is larger.

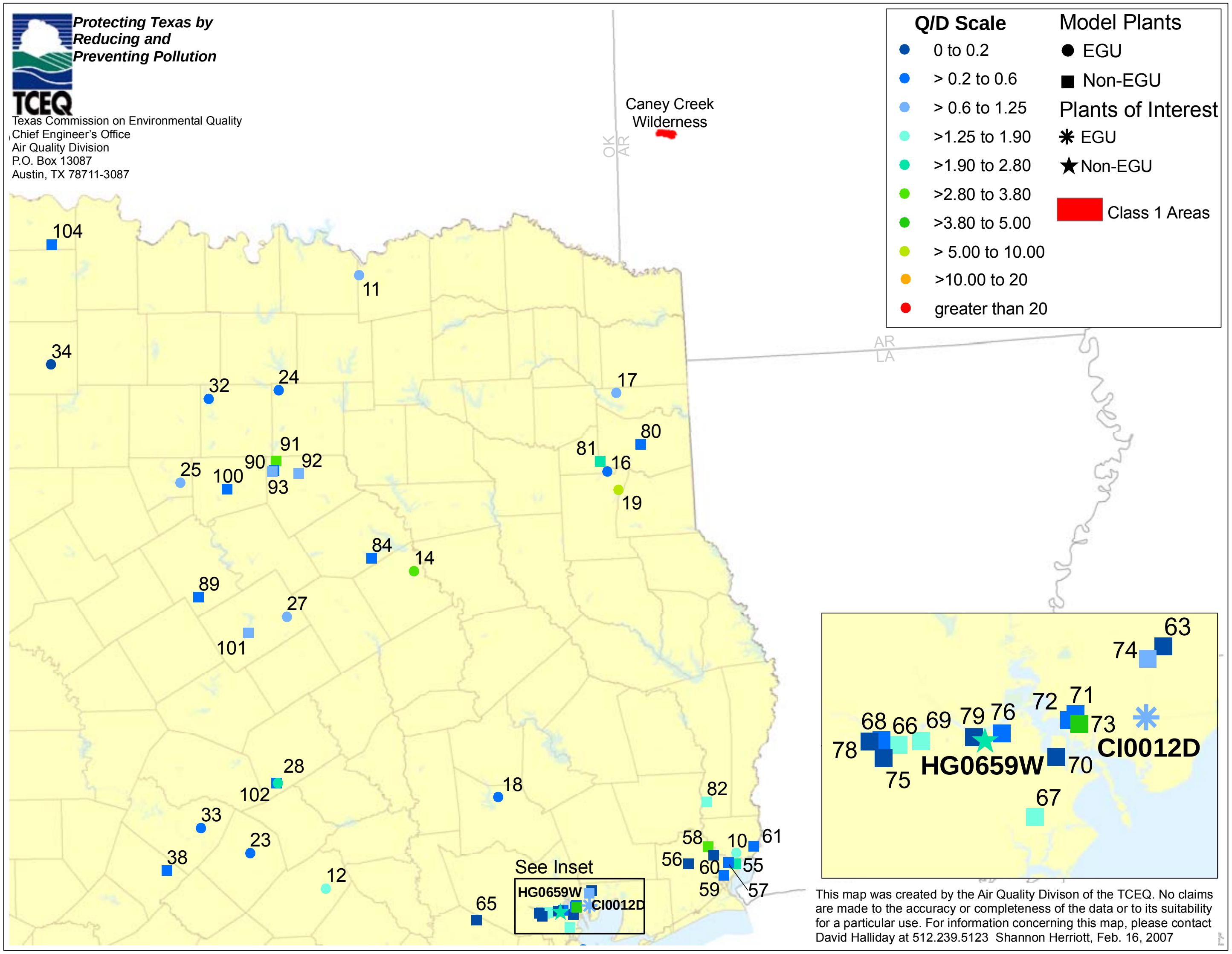

Figure B-1: Accounts CI0012D and HG0659W: For Caney Creek

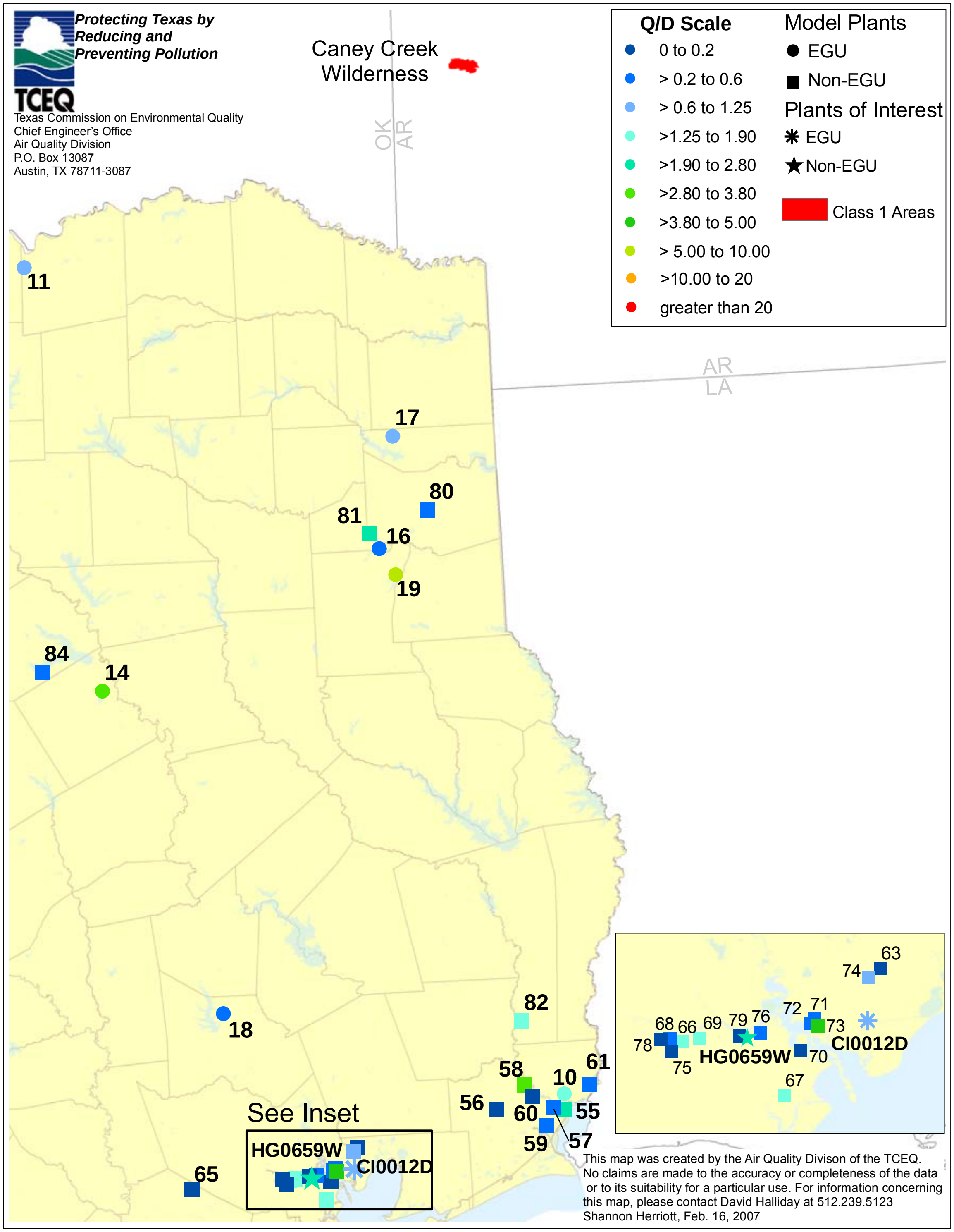

Figure B-2: Accounts CI0012D and HG0659W: For Caney Creek (Closer in)

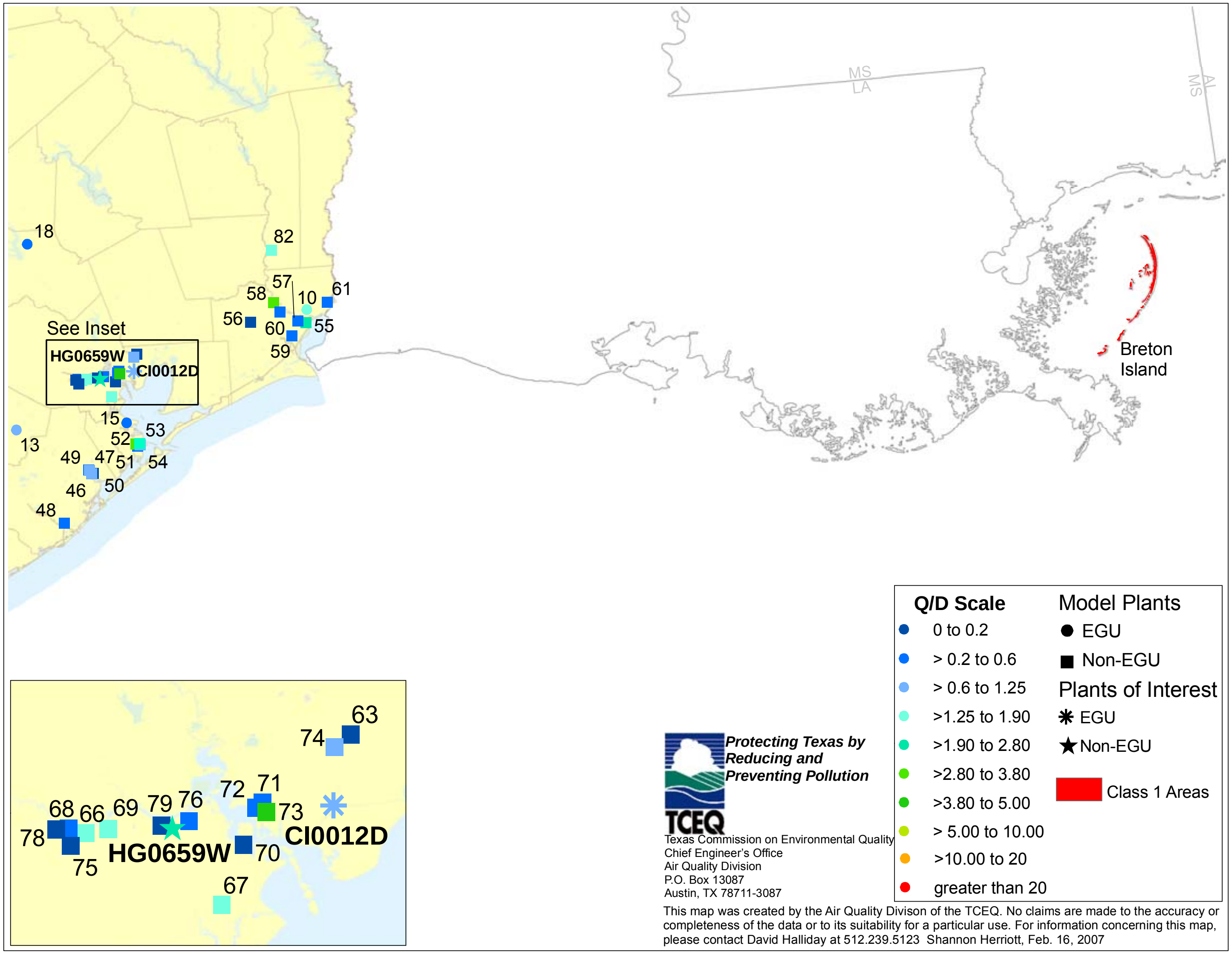

Figure B-3: Accounts CI0012D and HG0659W: For Breton Island

Table B-4: Account HW0004D: Recently Found

Account	EGU/ Non-EGU	Closest Class I Area	Closest Distance to Class I Area (km)	Compare to Model Plant	Pass?	Distance between sources (km)	Modeled JDate	Modeled Month	f(RH)	$\tilde{Q}'_f=eQ'_f$	$\tilde{Q}'_c=eQ'_c$	e	Q'_f/D' (tpy/km)	Q'_c/D' (tpy/km)	Q'/D' (tpy/km)
HW0004D	Non-EGU	WIMO1	236.68	94	Yes	25.51	346	12	2.78	34.81	41.64	1.84	0.08	0.10	0.18
Lat:	35.384700	Lon:	-101.25320	95	No[1†]	21.36	50	2	2.55	33.98	41.64	1.83	0.08	0.10	0.17
CM:	69.402	Soil:	24.1131	104	Yes[2]	296.36	345	12	2.78	34.81	41.64	1.84	0.08	0.10	0.18
OM:	0.148428	EC:	0.00798												
SO_4:	0.790675	NO_3:	0.08882												

[1] $\tilde{Q}'_c \le \tilde{Q}_c$ but $\tilde{Q}'_f > \tilde{Q}_f$.

[2] While Model Plant #104 is closer to WIMO1 than HW0004D, it is not in the same general direction.

Account	EGU/ Non-EGU	Next Closest Class I Area	Closest Distance to Class I Area (km)	Compare to Model Plant	Pass?	Distance between sources (km)	Modeled JDate	Modeled Month	f(RH)	$\tilde{Q}'_f=eQ'_f$	$\tilde{Q}'_c=eQ'_c$	e	Q'_f/D' (tpy/km)	Q'_c/D' (tpy/km)	Q'/D' (tpy/km)
HW0004D	Non-EGU	SACR1	347.45	85	Yes[4]	408.34	141	5	1.61	30.59	41.64	1.75	0.05	0.07	0.12
Lat:	35.384700	Lon:	-101.25320	86	Yes[4]	359.20	217	8	1.86	31.49	41.64	1.78	0.05	0.07	0.12
CM:	69.402	Soil:	24.1131	87	Yes[4]	347.46	187	7	1.67	30.81	41.64	1.76	0.05	0.07	0.12
OM:	0.148428	EC:	0.00798	88	No[3]	345.58	145	5	1.61	30.59	41.64	1.75	0.05	0.07	0.12
SO_4:	0.790675	NO_3:	0.08882	103	Yes	84.76	145	5	1.61	30.59	41.64	1.75	0.05	0.07	0.12

[†] While this doesn't pass, the Model Plant's Q/D is larger.

[3] $\tilde{Q}'_c > \tilde{Q}_c$ and $\tilde{Q}'_f + \tilde{Q}'_c > \tilde{Q}_f + \tilde{Q}_c$.

[4] While Model Plants #85 through #87 are closer to SACR1 than HW0004D, they are not in the same general direction.

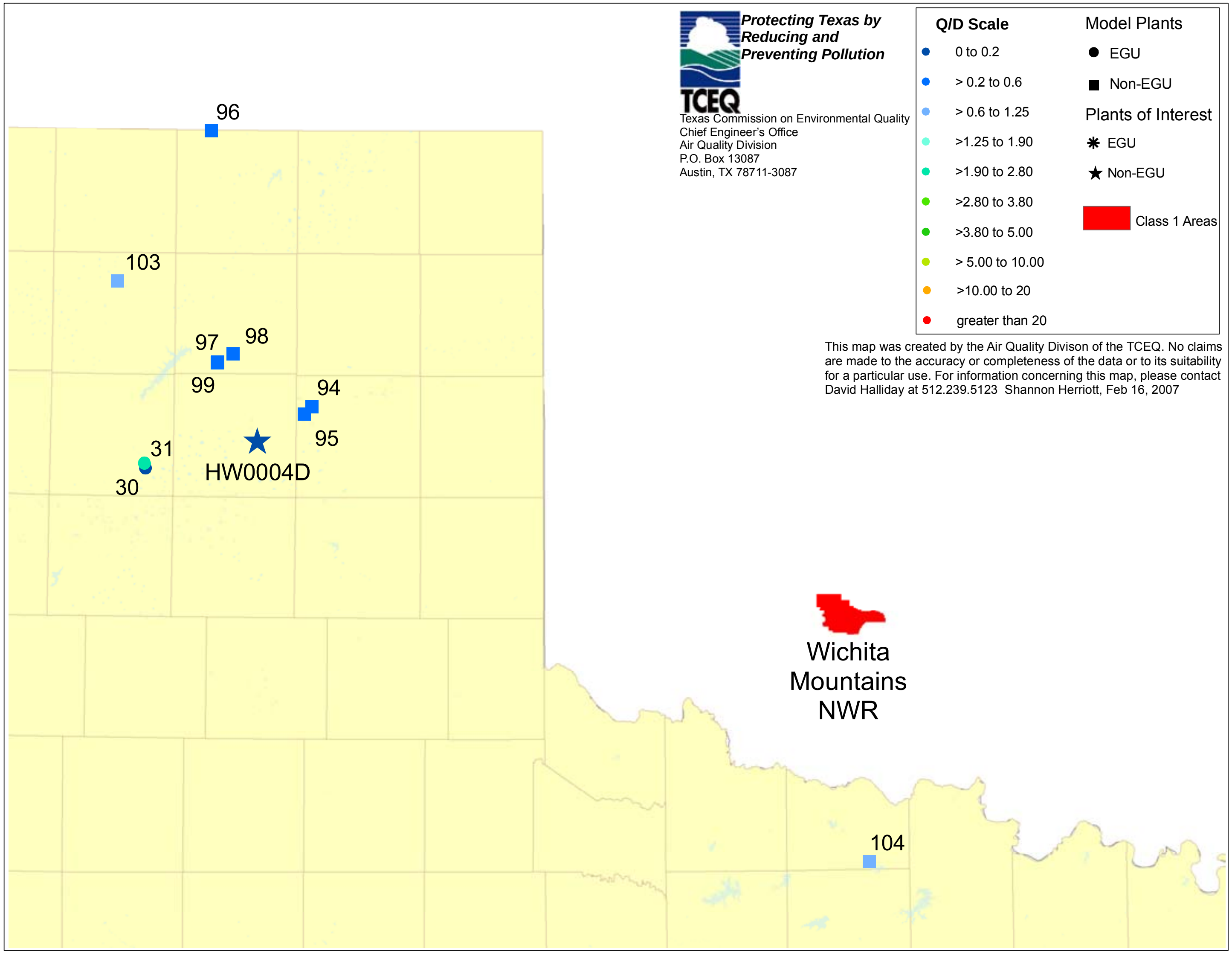

Figure B-4: Account HW0004D: Recently found: For Wichita Mountains

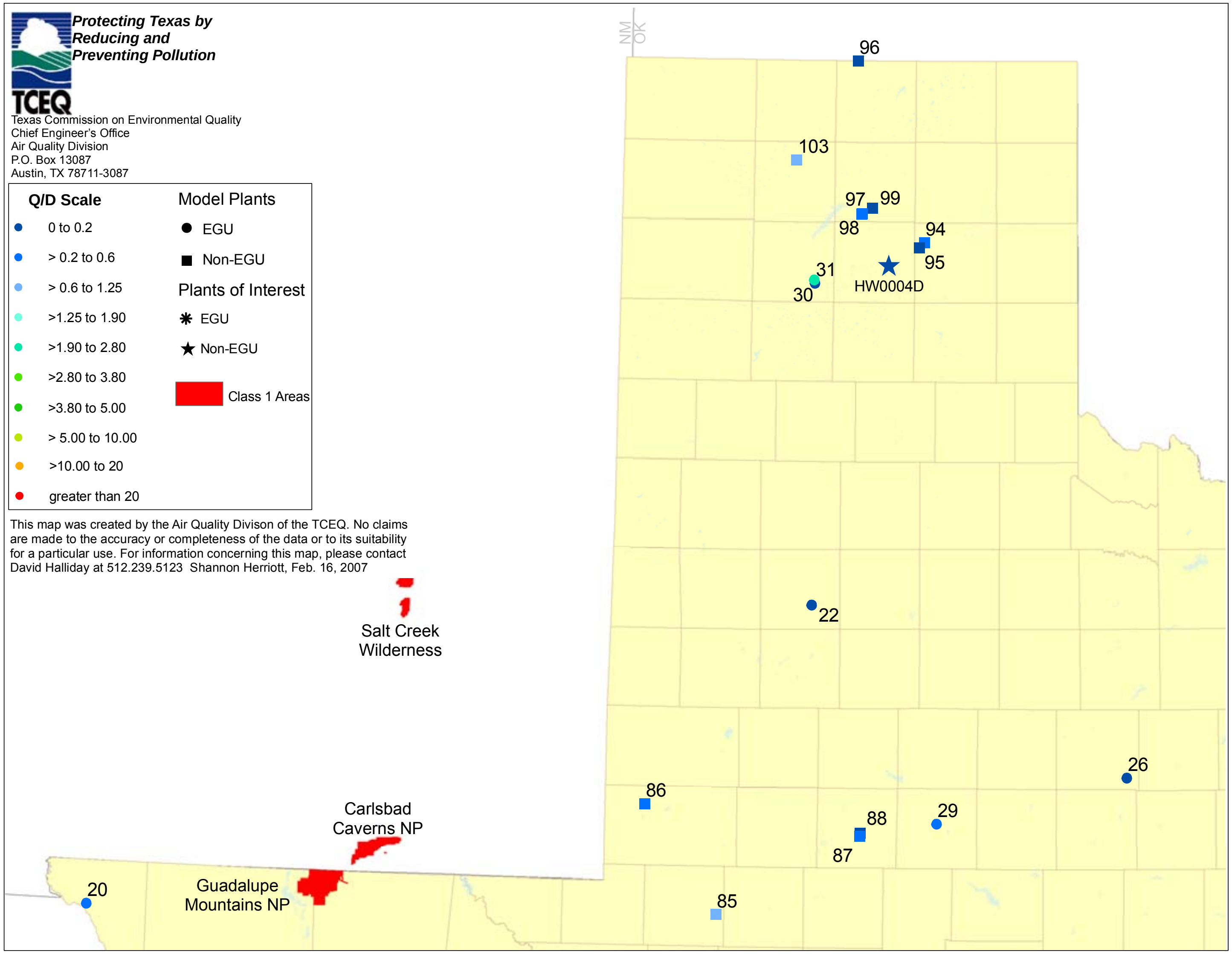

Figure B-5: Account HW0004D: Recently found: For Salt Creek Wilderness

Table B-5: PM Sources That Didn't Pass CAMx PM Zero-out Modeling

Source ID	Account	EGU/ Non-EGU	Latitude	Longitude	Closest Class I Area	Closest Distance to Class I Area (km)	Modeled JDate	Modeled Month	f(RH)	$\tilde{Q}_f$=eQ_f	$\tilde{Q}_c$=eQ_c	e	Q_f/D (tpy/km)	Q_c/D (tpy/km)	Q/D (tpy/km)
1	CG0010G	Non-EGU	33.253608	-94.06948	CACR1	124.16	341	12	3.31	3265.01	34.44	1.86	14.10	0.15	14.25
2	TF0012D	EGU	33.055597	-94.84483	CACR1	161.73	29	1	3.28	6555.83	2.59	1.86	21.75	0.01	21.76
3	TF0013B	EGU	33.092931	-95.03694	CACR1	165.80	312	11	3.14	5282.70	1110.03	1.86	17.15	3.60	20.75

Since we have individual plant modeling for these three plants, we can calculate $r = k_c / k_f$ from the modeling. From Table B-6, we see that the small r values, along with the relatively small $\tilde{Q}_c$, causes Q/D to be very close to Q_r/D.

Table B-6: PM Sources That Didn't Pass CAMx PM Zero-out Modeling, Q_r/D

Source ID	Account	EGU/ Non-EGU	Closest Class I Area	Closest Distance to Class I Area (km)	Modeled JDate	Modeled Month	f(RH)	$\tilde{Q}_f$=eQ_f	$\tilde{Q}_c$=eQ_c	e	Q_f/D (tpy/km)	Q_c/D (tpy/km)	r=k_c/k_f	Q_r/D (tpy/km)
1	CG0010G	Non-EGU	CACR1	124.16	341	12	3.31	3265.01	34.44	1.86	14.10	0.15	0.48	14.18
2	TF0012D	EGU	CACR1	161.73	29	1	3.28	6555.83	2.59	1.86	21.75	0.01	0.16	21.75
3	TF0013B	EGU	CACR1	165.80	312	11	3.14	5282.70	1110.03	1.86	17.15	3.60	0.34	18.36

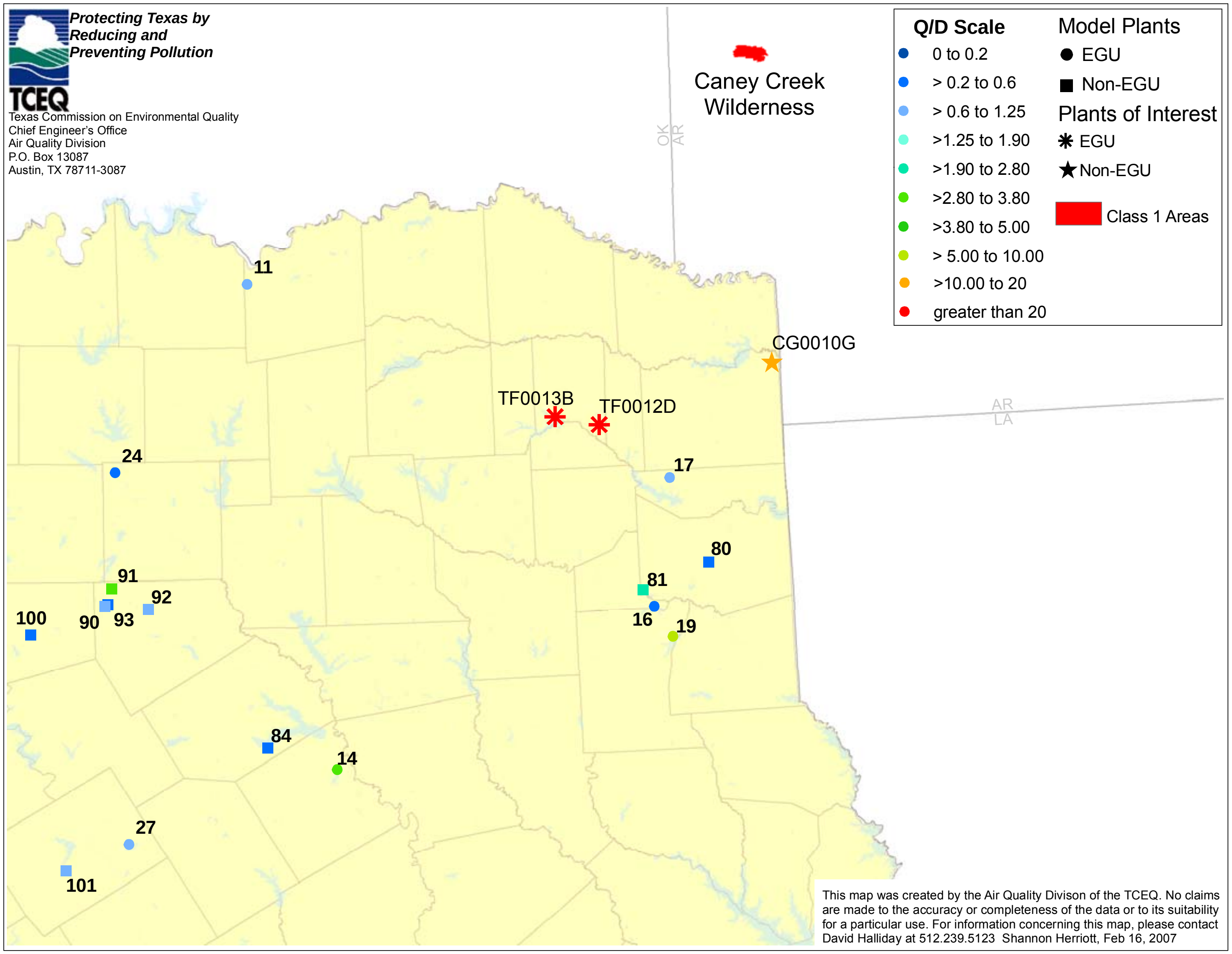

Figure B-6: PM Sources That Didn't Pass CAMx PM Zero-out Modeling

Deriving the Methodology

Since the quantity of importance is visibility, the extinction equation will be used in order to relate concentrations, at a Class I site, to this quantity. The extinction equation used for this analysis is the older[10] IMPROVE equation given by

$$
\begin{aligned}
b_{ext} \approx\ & 3 \times f(RH) \times [Sulfate] \\
& + 3 \times f(RH) \times [Nitrate] \\
& + 4 \times [Organic\ Mass] \\
& + 10 \times [Elemental\ Carbon] \\
& + 1 \times [Fine\ Soil] \\
& + 0.6 \times [Coarse\ Mass] \\
& + 10
\end{aligned}
$$

where the component concentrations are shown in brackets, and are in micrograms per cubic meter (μg/m^3).[11] This equation can be further broken down into fine and coarse contributions

$$
\begin{aligned}
b^{f}_{ext} \approx\ & 3 \times f(RH) \times [Sulfate] \\
& + 3 \times f(RH) \times [Nitrate] \\
& + 4 \times [Organic\ Mass] \\
& + 10 \times [Elemental\ Carbon] \\
& + 1 \times [Fine\ Soil]
\end{aligned}
$$

$$
b^{c}_{ext} \approx\ 0.6 \times [Coarse\ Mass]
$$

(along with the Rayleigh contribution, given by the constant 10, in the IMPROVE equation).

If the interactions with primary particulates are sufficiently small, we expect the concentrations at the receptor (Class I area) to be proportional to the emissions (Q). Thus, for each concentration ($[i]$) at the receptor we have $[i] = k_i Q_i$, where

[10] The new IMPROVE equation is non-linear for Sulfate, Nitrate, and Organic Mass for concentrations below 20 μg/m^3. This will lead to non-linear dependence on the "transport coefficients" (unless the concentrations are always above 20 ug/m^3), and would therefore (unduly) complicate the analysis.

[11] It must be noted that the Sulfate and Nitrate concentrations used are assumed to be Ammonium Sulfate ([(NH4)2SO4] = 1.375 × [SO4$^+$]) and Ammonium Nitrate ([NH4NO3] = 1.290 × [NO3$^+$]). So the emissions must be similarly scaled, based on the emission species that would be modeled.

the coefficient of proportionality (k_i), which we shall refer to as a transport coefficient, depends on the meteorology, emission characteristics, and distance from the Class I area. If we assume that the various fine (and coarse) primary particulate species have similar transport characteristics, then transport coefficients for all the fine (and coarse) species will be the same[12], and the extinction from the fine particulates can be expressed as

$$b_{ext}^{f} \approx k_f \begin{pmatrix} 3 \times f(RH) \times Q_{Sulfate} \\ + 3 \times f(RH) \times Q_{Nitrate} \\ + 4 \times Q_{Organic\ Mass} \\ + 10 \times Q_{Elemental\ Carbon} \\ + 1 \times Q_{Fine\ Soil} \end{pmatrix} = k_f \tilde{Q}_f = k_f e Q_f$$

(and similarly for the coarse contribution), where e is an effective extinction efficiency, used to convert between

$$\tilde{Q}_f = \begin{pmatrix} 3 \times f(RH) \times Q_{Sulfate} \\ + 3 \times f(RH) \times Q_{Nitrate} \\ + 4 \times Q_{Organic\ Mass} \\ + 10 \times Q_{Elemental\ Carbon} \\ + 1 \times Q_{Fine\ Soil} \end{pmatrix}$$

(which is straightforward to compute) and $Q_f = \frac{\tilde{Q}_f}{e}$, which has the same units as the emissions (Q)[13].

The model plant's impact can then be expressed as $b_{ext} = k_f \tilde{Q}_f + k_c \tilde{Q}_c = e(k_f Q_f + k_c Q_c)$, where the transport coefficients k_f and k_c can be determined by modeling. While the target plant's impact can be characterized by

[12] This has been verified, to a very high degree, using the data obtained from the inert primary particulate zero-out modeling runs. The data allows this to be readily tested for three different days (the first, second, and eighth maxima), at 17 Class I areas in and around Texas, for two EGU and two Non-EGU BART sources.

[13] It is most desirable that the effective extinction efficiency (e) be independent of the emissions, and the same for both fine and course fractions. Though, as can be easily seen, one could role e into the transport coefficients (k_f and k_c), this does not permit the application of certain simplifying limits.

$b'_{ext} = k'_f\tilde{Q}'_f + k'_c\tilde{Q}'_c = e\left(k'_fQ'_f + k'_cQ'_c\right)$, for some appropriate transport coefficients k'_f and k'_c.

When the target plant is at least as far away from the Class I area as the model plant ($D' \geq D$), with the same meteorology, and similar emission characteristics, we expect a relative fine concentration, at the Class I area, that is no greater than that of the model plant (expressed by $k'_f \leq k_f$) and an even lower relative coarse concentration (expressed by $r' = \frac{k'_c}{k'_f} \leq \frac{k_c}{k_f} = r$) due to a higher deposition rate for coarse particulates. So we find that $b'_{ext} \leq b_{ext}$ will always be satisfied provided $Q'_f + rQ'_c \leq Q_f + rQ_c$, as one can see from the following:

$$\frac{b'_{ext}}{e} = \left(Q'_f + r'Q'_c\right)k'_f \leq \begin{Bmatrix} \left(Q'_f + rQ'_c\right)k'_f \\ \left(Q'_f + r'Q'_c\right)k_f \end{Bmatrix} \leq \left(Q'_f + rQ'_c\right)k_f \leq \left(Q_f + rQ_c\right)k_f = \frac{b_{ext}}{e}.$$

Because r can be obtained from the modeling for the model plant, we could provide this ratio and base comparisons of target plants to the model plant on whether $Q'_f + rQ'_c \leq Q_f + rQ_c$. On the other hand, since

$$\begin{aligned} & Q'_f + rQ'_c \leq Q_f + rQ_c \\ \Leftrightarrow\ & Q'_f + Q'_c - Q'_c\left(1-r\right) \leq Q_f + Q_c - Q_c\left(1-r\right) \\ \Leftrightarrow\ & Q'_f + Q'_c \leq Q_f + Q_c + \left(Q'_c - Q_c\right)\left(1-r\right) \end{aligned}$$

we see that $Q'_f + Q'_c \leq Q_f + Q_c$ implies $Q'_f + rQ'_c \leq Q_f + rQ_c$ provided $\left(Q'_c - Q_c\right)\left(1-r\right) \geq 0$.

Furthermore, since we expect the course fraction to deposit out of the air faster than the fine fraction, we expect to have $r \leq 1$.[14] So the requirement that

[14] This has been verified, as far as reasonable, using the data obtained from the inert primary particulate zero-out modeling runs. Of course, when a modeled source emits no primary coarse (or fine) particulates, this ratio cannot be calculated. So the data allows this to be readily tested for three different days (the first, second, and eighth maxima), at 17 Class I areas in and around Texas, for two EGU BART sources and one Non-EGU BART source, since the second Non-EGU source had no Coarse Mass in its emissions inventory.

$(Q_c' - Q_c)(1-r) \geq 0$ translates to a requirement that $Q_c' \geq Q_c$, or, equivalently, $Q'_{Coarse\ Mass} \geq Q_{Coarse\ Mass}$. Yet, we can also see that having both $Q_c' \leq Q_c$ and $Q_f' \leq Q_f$ also implies $Q_f' + rQ_c' \leq Q_f + rQ_c$, independent of the ratio r (since $r \geq 0$).

So, in conclusion, if the target plant's coarse mass is less than the model plant's coarse mass, then we must have $Q_f' \leq Q_f$, while, other wise (when the target plant's coarse mass is greater than that of the model plant), we must have $Q_f' + Q_c' \leq Q_f + Q_c$.[15]

On the other hand, if we calculate r from the modeling, we can simply use the requirement that $Q_f' + rQ_c' \leq Q_f + rQ_c$. However, it must be noted that if a modeled source has no coarse (or fine) emissions then the modeling cannot be used to calculate r, and one must resort to the methodology expressed in the previous paragraph.

[15] It may be useful to note that a modeled plant with no fine primary particulate emissions cannot be compared to a target plant with any amount of such (unless, by some as yet unknown mechanism, one can reasonably limit r to be above some minimum, nonzero, value).