

# ENVIRON

## MEMORANDUM

**To:** NETAC Technical Committee

**From:** Greg Yarwood, Sue Kemball-Cook, Jaegun Jung, and Wilson Santamaria

**Date:** August 12, 2009

**Subject:** CAMx Ozone Air Quality Impact Assessment of Expansion of the Norit Americas Marshall, Texas Facility

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### EXECUTIVE SUMMARY

Northeast Texas Air Care (NETAC) has evaluated the ozone impacts of emissions from the proposed expansion of the Norit Americas Marshall, Texas facility. Ozone impacts were assessed using NETAC's ozone model of the May-June, 2005 period. The modeling results indicate that the proposed Norit emissions increases do not result in any changes to the 8-hour ozone design values of the three Northeast Texas TCEQ CAMS ozone monitors. The maximum increase in Northeast Texas daily 8-hour maximum ozone during the modeled episode due to the proposed Norit emissions is 1.2 ppb and the average increase in the daily 8-hour maximum ozone across the modeled episode is 0.26 ppb or less. Therefore, the proposed expansion of the Norit facility is expected to have a minimal effect on ozone levels in Northeast Texas.

### BACKGROUND

Norit Americas Inc. operates an activated carbon manufacturing facility located in Marshall, TX (Figure 1). This facility is undergoing an expansion which is expected to increase its emissions of ozone precursors. Nearby Gregg, Rusk and Smith Counties have been recommended for designation as nonattainment areas under the 2008 National Ambient Air Quality Standard for ozone. Norit Americas has therefore requested that Northeast Texas Air Care (NETAC) evaluate the potential ozone air quality impacts of the expansion of the Marshall facility. NETAC has recently completed development of a SIP-quality ozone model for the year 2005 which has 4 km grid resolution over Northeast Texas, including the Norit Americas facility (Figure 2). This model has been extensively evaluated against observations of ozone and its precursors, and was used for the ozone impact assessment of the expansion of the Norit facility. Norit provided an inventory of the changes in ozone precursor emissions (VOCs, NO<sub>x</sub>, and CO) that will result from the expansion of the Marshall, TX Norit Americas facility. ENVIRON added these emissions changes to the existing CAMx 2005 ozone model emissions inventory and reran the model's May-June 2005 episode with the additional Norit emissions. Impacts of the additional Norit emissions on ozone values within the 4 km grid encompassing the 5-county area were assessed. In the following technical memorandum, we document the development of the emission inventory, the CAMx modeling methodology, and the modeling results.

### METHOD

### Photochemical Grid Model

The ozone model was run for a May-June 2005 Northeast Texas ozone episode with an augmented emission inventory that included the emissions from the expansion of the Norit Americas facility. Apart from the addition of these Norit emissions, the CAMx model configuration (meteorology, chemical mechanism, boundary conditions etc.) for this run was identical to that of the May-June 2005 ozone model Base Case developed by NETAC for ozone air quality planning and documented in Kembal-Cook et al. (2008). As in the Base Case, the Norit modeling for May-June of 2005 was performed using version 4.50 of the Comprehensive Air quality Model with extensions (CAMx; ENVIRON, 2008). The modeling used the CB05 Carbon Bond chemical mechanism (Yarwood et al., 2005).

### Emission Inventory

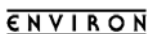
Norit Americas supplied ENVIRON with NO<sub>x</sub>, VOC, and CO emissions data, source category codes (SCC), and stack parameters for each proposed new source (Tables 1 and 2). Sources emitting NO<sub>x</sub>, VOC, and CO were vents and stacks associated with furnaces. For all sources listed in Tables 1 and 2, the SCC provided by Norit was 10200602 (External Combustion Boilers, Industrial, Natural Gas, 10-100 MMBtu/hr). Norit notes that this emission inventory accounts for changes in the maximum potential permitted emissions and therefore represents a conservative estimate of emissions changes likely to result from the expansion of the Marshall facility.

From the data provided by Norit, ENVIRON developed a model-ready emission inventory of ozone precursors (VOCs, NO<sub>x</sub>, CO) that included the proposed new sources resulting from the expansion of the Marshall, TX facility as well as all other sources in the existing emission inventory in the 2005 Base Case ozone model. A summary of the emissions from the Norit Americas Marshall Facility in the 2005 Base Case and in the Norit Case (2005 Base Case emissions + emissions from Norit Expansion) is shown in Table 3. The emissions increases due to the proposed expansion are large in terms of percentage of the original Norit emissions, but small in absolute magnitude. For example, the sum of NO<sub>x</sub> emissions from all compressor engines used in natural gas production and transmission in the 5-county area is approximately 40 tons/day, while the new Norit NO<sub>x</sub> emissions are 0.74 tons/day.

## **RESULTS**

The ozone air quality impacts of the expansion were determined by comparing the results of the run with the inventory containing the increased Norit emissions (Norit Case) to the results of the Northeast Texas 2005 Base Case. The comparison was performed using two different methods. In the first method, the raw modeled Norit CAMx ozone model results were compared directly with the Base Case ozone modeling results, and in the second method, the CAMx model results from the two runs were used in a relative sense following EPA guidance (EPA, 2007) to determine the Norit ozone impacts.

### *Raw CAMx Model Results*



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Differences in surface layer 1-hour average ozone values at the TCEQ's Northeast Texas Continuous Air Monitoring Stations CAMS 19 (Longview), CAMS 82 (Tyler), and CAMS 85 (Karnack) monitors were calculated. Time series of 1-hour ozone for the Base Case and the Norit Case were plotted together for the three monitors. Because the only difference between the Norit Case and the Base Case is the Norit emissions, examining the differences between these two time series isolates the impact of the proposed expansion of the Norit facility. Figure 3 shows the 1-hour ozone time series for the Norit Case and the Base Case for the Longview CAMS 19 monitor for the May and June high ozone periods. Differences between the Base Case and the Norit Case are sufficiently small that the two time series generally cannot be distinguished from one another. This was true for the C82 and C85 monitors as well (not shown).

Isopleths of the daily maximum 8-hour ozone difference between the Norit and Base Case runs were plotted in order to evaluate impacts away from the three Northeast Texas CAMS monitors. Episode average and episode maximum 8-hour ozone differences were calculated (Figure 4). No threshold value ozone was used in determining when the comparison would be made; instead, the comparison was made for all days. Figure 4 shows that the episode average difference between the Norit Case and the Base Case is 0.2 ppb or less everywhere within the 4 km domain. The largest differences are found in the vicinity of the Norit facility. Also shown in Figure 4 is the maximum difference in daily maximum 8-hour average ozone between the Base Case and the Norit Case. The maximum difference between the two Cases is less than 1.2 ppb for all grid cells within the 4 km domain. The largest differences are found near the Norit facility and in plumes extending outward from it. There are areas near the facility where ozone is reduced relative to the Base Case as a result of enhanced titration of ozone by Norit's increased NO<sub>x</sub> emissions. The size of maximum and average 8-hour ozone impacts due to the emissions from the Norit expansion are small relative to the peak 8-hour ozone values (~70-90 ppb as shown in Figure 3) typically observed on high ozone days in Northeast Texas.

#### *Norit Impacts Determined Through EPA Projection Method*

In addition to estimating the Norit ozone impacts with the raw model ozone predictions, a second technique developed by the U.S. Environmental Protection Agency (EPA) was used. EPA guidance for estimating future 8-hour ozone concentrations recommends using ozone model base year and future year simulations to scale base year observed 8-hour ozone design values, thereby deriving estimates of future year 8-hour design values (EPA, 2007). The future year ozone concentration at each monitor within the domain is estimated by multiplying the monitor's base year observed design value by a model-derived response factor. The model-derived response factor is the ratio of the model's base year to future year ozone predictions at each monitor and is known as the relative reduction factor (RRF). For the  $i^{\text{th}}$  monitor, the RRF is given by

$$RRF_i = \frac{\text{Future year CAMx 8-hour ozone near monitor } i}{\text{Base year CAMx 8-hour ozone near monitor } i}$$



where both the numerator and denominator represent averages taken over multiple episode days. The future-year design value (DVF) at monitor  $i$  is obtained from the base-year design value (DVB) as follows:

$$DVF_i = DVB_i \times RRF_i$$

This technique is used to minimize the effect of model uncertainties on future year ozone projections. For example, if the model has a bias toward underestimating ozone at a given monitor, using the raw future year ozone predictions may result in an underestimate of future year ozone at that monitor. This can confound control strategy development. However, if the ratio of the future year to base year modeled ozone values at that monitor is multiplied by the observed base year design value to produce a predicted future year value, that future year value will better isolate the change in ozone due to changes in emissions between base and future year cases, and the effect of the model's bias toward lower ozone values will have been reduced.

The starting point for the application of the EPA technique to the Norit analysis is to calculate the observed 2005 base year design value (DVB) for the Longview, Tyler, and Karnack CAMS monitors. The 8-hour ozone design value is defined as a three-year average of the fourth highest daily maximum 8-hour ozone concentrations at each monitor. The RRFs are the ratio of the future (Norit Case) 8-hour daily maximum concentration predicted near a given monitor (averaged over multiple days) to the base year (Base Case) 8-hour daily maximum concentration predicted near the monitor (averaged over the same days). EPA defines "near the monitor" for a 4 km grid to be a 7 x 7 array of 4 km grid cells centered on the monitor.

$$DVF(\text{Norit Case})_{\text{CAMS}19} = DVB(2005 \text{ obs})_{\text{CAMS}19} \times \frac{\text{Norit Case CAMx 8-hour ozone}_{\text{near CAMS}19}}{\text{Base Case CAMx 8-hour ozone}_{\text{near CAMS}19}}$$

The RRFs are calculated for all days in which the current-year modeled daily maximum 8-hour ozone value is greater than a threshold value. This is done so that the model response to future changes in emissions is considered only on high ozone days with conditions comparable to those days that produced the design values. The threshold value was 60 ppb for the Norit study.

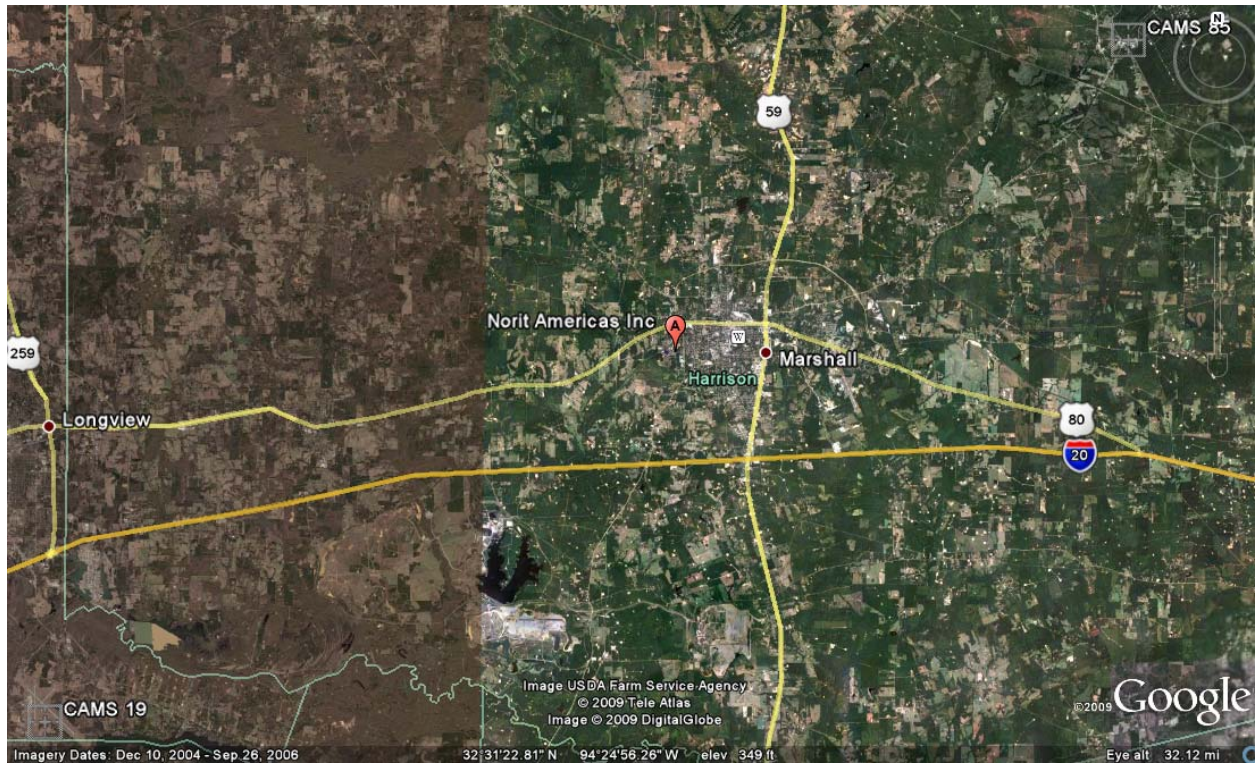
For the Norit ozone impact assessment, the EPA's Modeled Attainment Test Software (MATS; EPA, 2009) was used to carry out the design value scaling calculation described above in order to estimate future year (Norit Case) design values for the Longview, Tyler, and Karnack CAMS monitors. The RRFs, base year (Base Case) design values and future year (Norit Case) design values for the Longview, Tyler and Karnack monitors are shown in Table 4. RRFs at all three monitors are slightly greater than one, indicating that the Norit facility expansion increases the design values for all three monitors by a very small amount. However, the increases are so small that the design values (which are truncated so that they do not retain any digits to the right of the decimal point) do not change. Therefore, the increases in Norit emissions are not expected to cause a change to the ozone design value at any of the three CAMS monitors in Northeast Texas.

## CONCLUSIONS

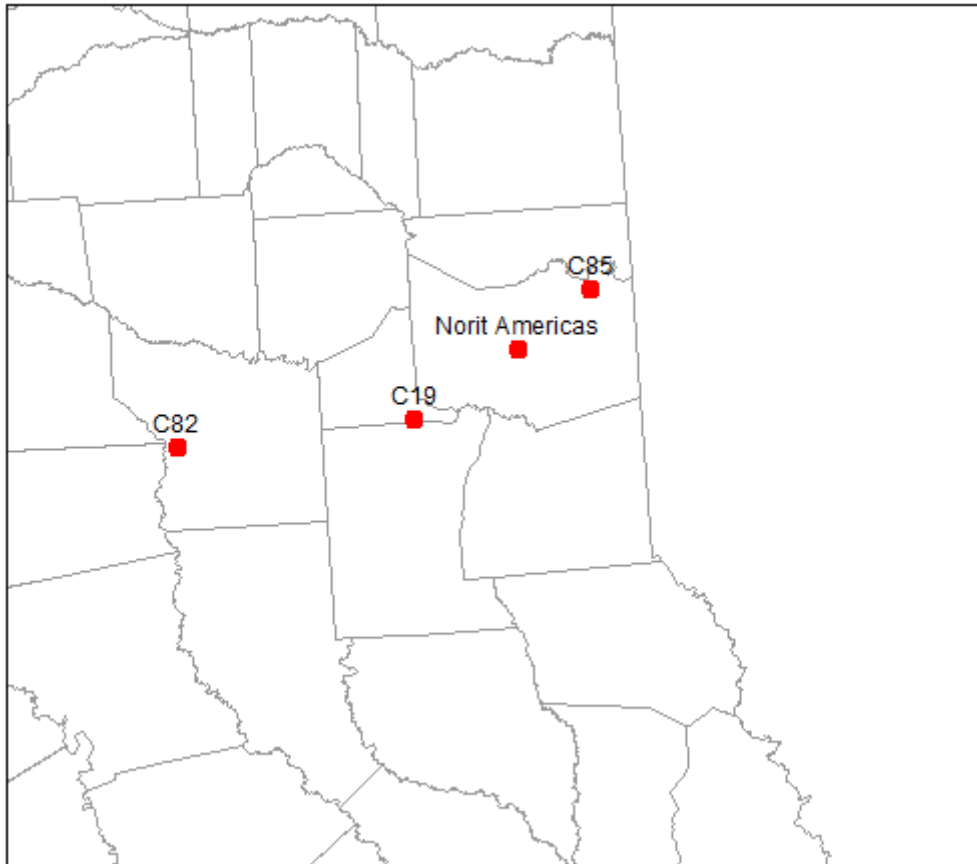
The expansion of the Norit Americas Marshall, TX facility will result in increased emissions of ozone precursors, however, the emissions increases are a small percentage of the total inventory for Northeast Texas. The comparison of the 2005 ozone model Base Case with the Norit Case that included the additional Norit emissions showed that 8-hour ozone impacts of the expansion are predicted to be small (on the order of 1 ppb or less) and that no change to the ozone design values of the three CAMS monitors is expected to occur as a result of the increased emissions. Impacts calculated here represent an upper bound because the emissions increases used here are a conservative scenario based on the maximum possible permitted emissions.

## REFERENCES

- ENVIRON. 2008. “The User’s Guide to the Comprehensive Air Quality Model with Extensions Version 4.50” Available from Environ International Corporation, 773 San Marin Drive, Novato, CA. 94998 and at <http://www.camx.com>. May, 2008.
- EPA, 2007. Guidance on the Use of Models and other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, PM<sub>2.5</sub> and Regional Haze. Office of Air Quality Planning and Standards, Air Modeling Group. Research Triangle Park, North Carolina (<http://www.epa.gov/scram001/guidance/guide/final-03-pm-rh-guidance.pdf>).
- EPA, 2009. Modeled Attainment Test Software User’s Manual. Prepared for Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Research Triangle Park, NC. Prepared by Abt Associates Inc. ([http://www.epa.gov/scram001/guidance/guide/MATS-2-2-1\\_manual.pdf](http://www.epa.gov/scram001/guidance/guide/MATS-2-2-1_manual.pdf)).
- Kemball-Cook, S., J. Johnson, E. Tai, M. Jimenez, G. Mansell, and G. Yarwood. 2008. “Modeling Northeast Texas Ozone for May-June 2005”. Prepared for the East Texas Council of Governments. 3800 Stone Road, Kilgore, TX, 75662. August 31.
- Yarwood. G., G.Z. Whitten and S. Rao. 2005. “Updates to the Carbon Bond 4 Photochemical Mechanism.” Prepared for the Lake Michigan Air Directors Consortium. March.



**Figure 1.** Location of the Norit Americas facility in Marshall, TX.



**Figure 2.** CAMx 4 km modeling domain showing locations of TCEQ CAMS Monitors and the Norit Americas Marshall, TX facility in Harrison County.

**Table 1.** List of new sources expected to emit ozone precursors as a result of Norit facility expansion and their emissions.

**Norit Americas Inc. - Marshall Facility**  
**EPN Maximum Achievable Emission Rates (MAERT) Summary**  
**Future Potential-to-Emit**

This spreadsheet is provided to ENVIRON to use for ozone modeling. It shows Norit Marshall's future PTE for only new and modified units pertaining to the 10/29/08 PSD application. Only NOx, CO, and VOC emissions are included.

Last Updated: 5/5/09

EPN	Associated FIN(s)	Description	NOx		CO		VOC		Permit Number	Source Type	PSD Change	Comment	Data Source	
			lb/hr	tpy	lb/hr	tpy	lb/hr	tpy						
			<b>Modified Sources</b>											
<b>Proposed Sources (all are project increases)</b>														
8	MHF2STACK	M2FURNACE	MHF#2 Stack (Normal Operation)	9.10	39.9	6.6	28.9	1.90	8.32	78421	Point	Y	Revised UTM coordinates	Permit 78421
9	MHF2VENT	M2FURNACE	MHF #2 Vent (MSS)	1.21	0.121	3.17	0.317	0.208	0.021	78421	Point	Y	Revised dischg. params., UTM coord, and emission rates. Couldn't verify original emission calculation methodology. Now using AP-42 Section 1.4 (Natural Gas Combustion) emission factors.	Permit 78421; Curtis Miles - 4/22/09
23	MHF3STACK	M3FURNACE	MHF#3 Stack (Normal Operation)	9.10	39.9	6.6	28.9	1.90	8.32	-	Point	Y	New Facility	Curtis Miles - 2/27/08
24	MHF3VENT	M3FURNACE	MHF #3 Vent (MSS)	1.21	0.121	3.17	0.317	0.208	0.021	-	Point	Y	New Facility	Curtis Miles - 2/27/08
45	MHF4STACK	M4FURNACE	MHF#4 Stack (Normal Operation)	9.10	39.9	6.6	28.9	1.90	8.32	-	Point	Y	New Facility	Curtis Miles - 2/27/08
46	MHF4VENT	M4FURNACE	MHF #4 Vent (MSS)	1.21	0.121	3.17	0.317	0.208	0.021	-	Point	Y	New Facility	Curtis Miles - 2/27/08
48	MHF5STACK	M5FURNACE	MHF#5 Stack (Normal Operation)	9.10	39.9	6.6	28.9	1.90	8.32	-	Point	Y	New Facility	Curtis Miles - 2/27/08
49	MHF5VENT	M5FURNACE	MHF #5 Vent (MSS)	1.21	0.121	3.17	0.317	0.208	0.021	-	Point	Y	New Facility	Curtis Miles - 2/27/08
53	MHF6STACK	M6FURNACE	MHF#6 Stack (Normal Operation)	9.10	39.9	6.6	28.9	1.90	8.32	-	Point	Y	New Facility	Curtis Miles - 2/27/08
54	MHF6VENT	M6FURNACE	MHF #6 Vent (MSS)	1.21	0.121	3.17	0.317	0.208	0.021	-	Point	Y	New Facility	Curtis Miles - 2/27/08
56	MHF7STACK	M7FURNACE	MHF#7 Stack (Normal Operation)	9.10	39.9	6.6	28.9	1.90	8.32	-	Point	Y	New Facility	Curtis Miles - 2/27/08
57	MHF7VENT	M7FURNACE	MHF #7 Vent (MSS)	1.21	0.121	3.17	0.317	0.208	0.021	-	Point	Y	New Facility	Curtis Miles - 2/27/08
Project Future PTE				61.85	240.12	58.62	175.30	12.65	50.06					

**Table 2.** Stack parameters for sources shown in Table 1

**Norit Americas Inc. - Marshall Facility**  
**EPN Modeling Data Summary**

This spreadsheet is provided to ENVIRON to use for ozone modeling. It shows Norit Marshall's future PTE for only new and modified units pertaining to the 10/29/08 PSD application. Only NOx, CO, and VOC emissions are included.

NAD 27 (Based on Prop  
Line/Build Map/Aerial) - Used  
in Model

Last Updated: 5/5/09

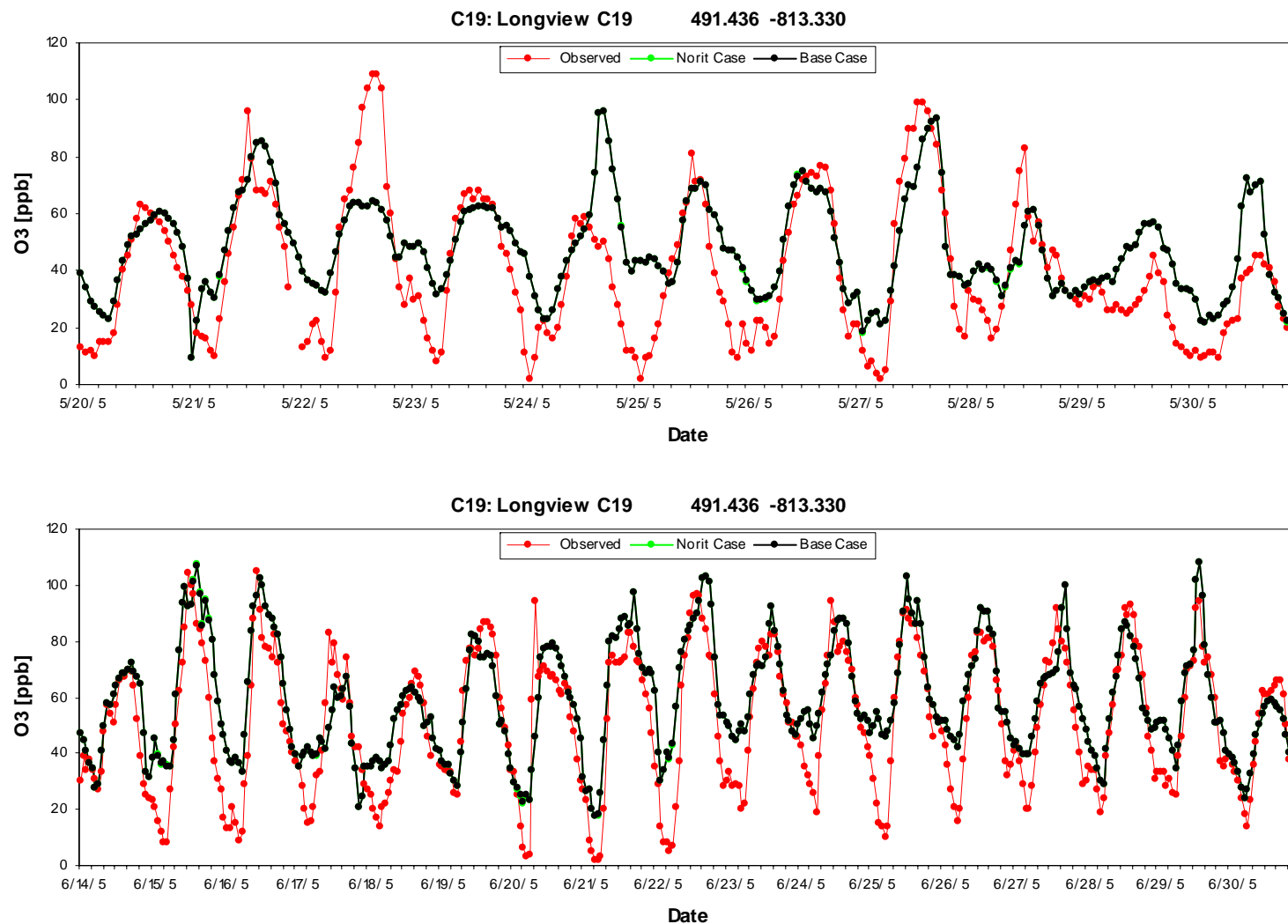
EPN	EPN Description	UTM E (m)	UTM N (m)	Source Type	Release Type	Stack					Fugitive			Data Source		
						Diameter (ft)	Height (ft)	Horiz. Dischg?	Temp (deg F)	Velocity (ft/sec)	Axis Degrees	Of North	Height (ft)		Length (Easterly) (ft)	Width (Northerly) (ft)
<b>Proposed Sources</b>																
8	MHF2STACK	MHF#2 Stack (Normal Operation)	368484	3600442	Stack	Default	6	150	No	198	24.5	-	-	-	-	3/17/06 MHF App
9	MHF2VENT	MHF #2 Vent (Upset Condition)	368471	3600463	Stack	Default	2	88	No	198	65	-	-	-	-	3/17/06 MHF App; Curtis Miles - 11/29/07; Assumption
23	MHF3VENT	MHF #3 Vent (Upset Condition)	368448	3600454	Stack	Default	2	88	No	198	65	-	-	-	-	Curtis Miles - 2/27/08
24	M3FDBNDCVT	MHF #3 Feed Bin DC Vent	368444	3600463	Stack	Default	0.5	89	No	68	65	-	-	-	-	Curtis Miles - 2/27/08; 4/9/08
45	MHF4VENT	MHF #4 Vent (Upset Condition)	368427	3600308	Stack	Default	2	88	No	198	65	-	-	-	-	Curtis Miles - 2/27/08
46	M4FDBNDCVT	MHF #4 Feed Bin DC Vent	368416	3600306	Stack	Default	0.5	89	No	68	65	-	-	-	-	Curtis Miles - 2/27/08; 4/9/08
48	22BKBNDCSK	#22 Bulk Bin DC Stack	368359	3600362	Stack	Default	0.5	88.5	No	68	65	-	-	-	-	Curtis Miles - 2/27/08; 4/9/08
49	23BKBNDCSK	#23 Bulk Bin DC Stack	368353	3600362	Stack	Default	0.5	88.5	No	68	65	-	-	-	-	Curtis Miles - 2/27/08; 4/9/08
53	M5FDBNDCVT	MHF #5 Feed Bin DC Vent	368416	3600289	Stack	Default	0.5	89	No	68	65	-	-	-	-	Curtis Miles - 2/27/08; 4/9/08
54	25BKBNDCSK	#25 Bulk Bin DC Stack	368366	3600356	Stack	Default	0.5	88.5	No	68	65	-	-	-	-	Curtis Miles - 2/27/08; 4/9/08
56	27BKBNDCSK	#27 Bulk Bin DC Stack	368352	3600355	Stack	Default	0.5	88.5	No	68	65	-	-	-	-	Curtis Miles - 2/27/08; 4/9/08
57	28BKBNDCSK	#28 Bulk Bin DC Stack	368346	3600355	Stack	Default	0.5	88.5	No	68	65	-	-	-	-	Curtis Miles - 2/27/08; 4/9/08

**Table 3.** Summary of Norit Americas Emissions before and after proposed expansion of the Marshall, TX facility.

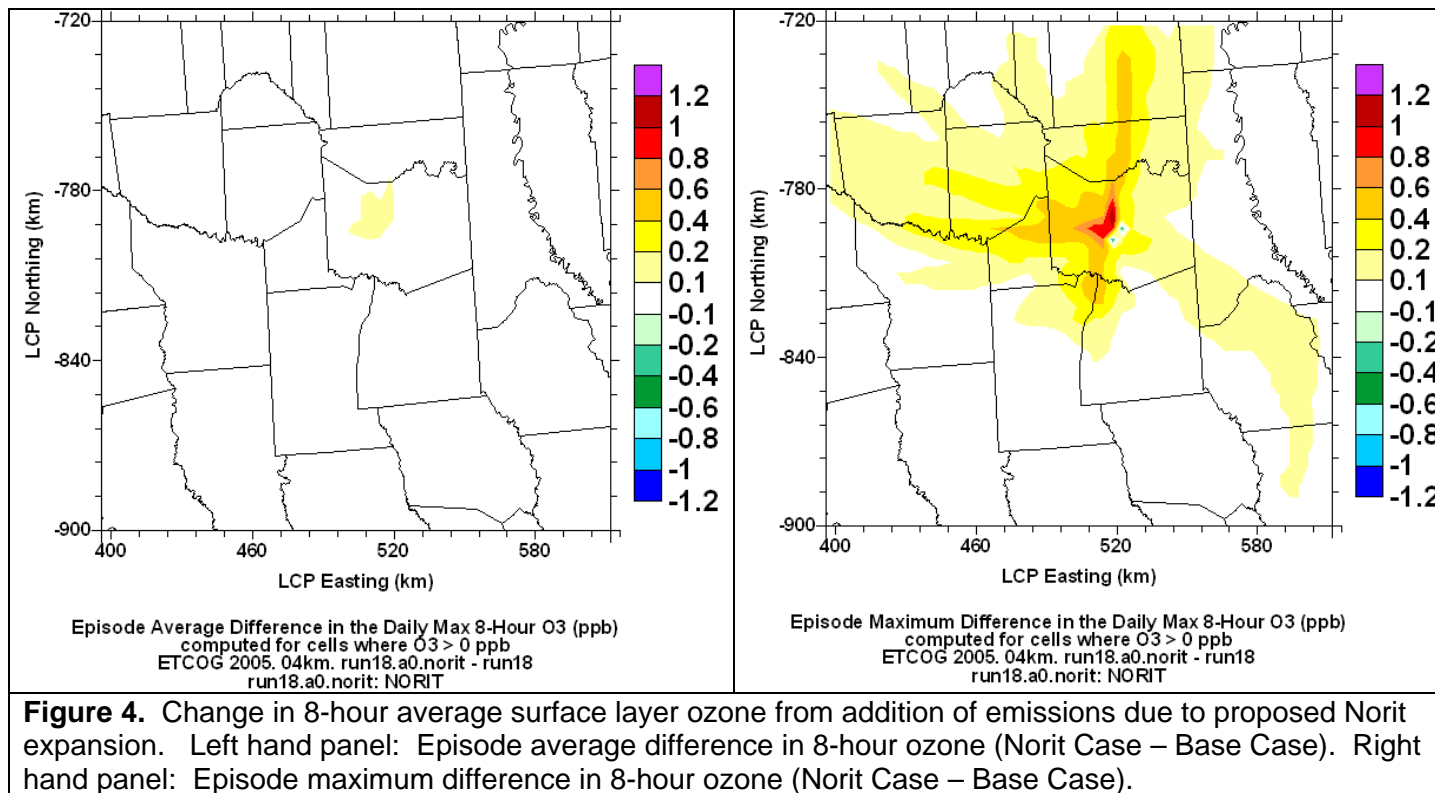
Pollutant	Norit Americas Emissions (tons/day)		
	Original NETAC model 2005 Emission Inventory	Additional Emissions from Proposed Expansion of Facility	Total Norit Emissions after Expansion of Facility
NOx	1.42	0.74	2.16
VOC	0.11	0.15	0.26
CO	1.92	0.70	2.63

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**Figure 3.** Change in 1-hour average surface layer ozone from addition of emissions due to proposed Norit expansion. Top panel: 1-hour average ozone time series for the Longview CAMS 19 monitor showing Norit Case and Base Case for the May high ozone period. Bottom panel: 1-hour average ozone time series for the Longview CAMS 19 monitor showing Norit Case and Base Case for the June high ozone period.



**Table 4.** Summary RRFs and Base Case and Norit Case design values.



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<b>Monitor</b>	<b>Base Case Design Value</b>	<b>Norit Case Design Value</b>	<b>RRF</b>
Longview (CAMS 19)	82	82	1.0004
Tyler (CAMS 82)	76	76	1.0009
Karnack (CAMS 85)	80	80	1.0003