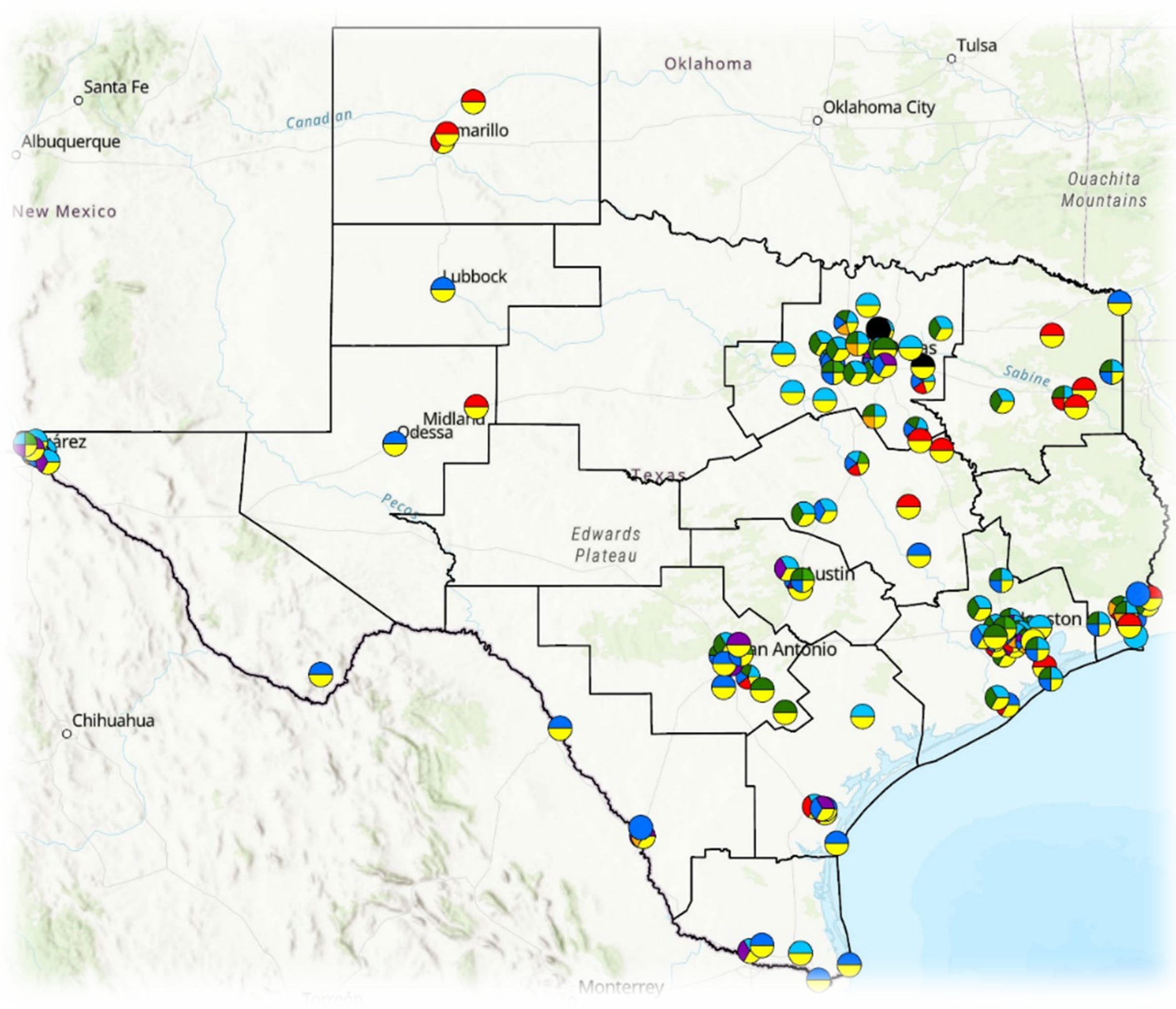
Comisión de Calidad Ambiental de Texas (TCEQ) Respuesta a los comentarios recibidos sobre la *evaluación de la Red de Monitoreo del Aire Ambiente de cinco años de Texas 2025*



Introducción

La Comisión de Calidad Ambiental de Texas (TCEQ) llevó a cabo la *Evaluación de la Red de Monitoreo del Aire Ambiental (FYA) de Texas 2025* de conformidad con 40 Código de Regulaciones Federales (CFR) Sección (§) 58.10. La FYA evaluó la red federal existente para confirmar que continuaba cumpliendo con los objetivos de 40 CFR Parte 58, Apéndice D y para evaluar si los monitores individuales de la red federal deben agregarse, reubicarse o desmantelarse para comprender y evaluar mejor la calidad del aire con los recursos existentes.

El FYA de la TCEQ se limita a la parte de la red de monitoreo del aire de la TCEQ diseñada para cumplir con los requisitos federales de monitoreo y respaldada por fondos federales, denominada "red de monitoreo federal". La red federal de monitoreo incluye los datos de monitoreo de la calidad del aire que la TCEQ envía al Sistema de Calidad del Aire (AQS) de la Agencia de Protección Ambiental (EPA) y se certifican anualmente.

La TCEQ analiza el cumplimiento de la red de monitoreo de Texas con los requisitos federales de diseño de la red de monitoreo bajo 40 CFR Parte 58 en su plan anual de red de monitoreo. La EPA aprobó el *Plan Anual de la Red de Monitoreo (AMNP) de la TCEQ 2024* en una carta el 15 de enero de 2025, indicando que la red existente cumplía con los requisitos de monitoreo actuales. Se proporcionó un análisis actualizado a la EPA el 1 de julio de 2025, como el Plan de la *Red de Monitoreo Anual TCEQ 2025*, que se puso a disposición del público para revisión y comentarios desde el 15 de abril de 2025 hasta el 14 de mayo de 2025.

La TCEQ y sus socios de monitoreo (ciudad, condado, privado e industria) también operan una sólida red de monitores adicionales de iniciativas estatales que apoyan una variedad de propósitos, incluida la evaluación de posibles efectos en la salud; sin embargo, estos monitores están fuera del alcance de este documento y no están incluidos. La TCEQ utiliza los datos de estos monitores de iniciativa estatal para muchos propósitos y, a menudo, los ubica para abordar las preocupaciones locales de salud pública y bienestar. La información y los datos de los monitores de iniciativas federales y estatales están disponibles para el público en el Sistema de Información de Monitoreo del Aire de Texas (TAMIS) de la TCEQ.

Aunque no es requerido por 40 CFR §58.10, la TCEQ publicó el FYA para comentarios públicos. Durante el período de comentarios públicos de FYA del 30 de mayo de 2025 al 30 de junio de 2025, Earthjustice y el Fondo de Defensa Ambiental (EDF) enviaron comentarios. Los comentarios de Earthjustice se enviaron en nombre de sus signatarios: Air Alliance Houston, Coalition for Responsible Environmental Aggregate Mining (CREAM), Environment Texas Research and Policy Center, EDF, Environmental Integrity Project, Lone Star Chapter of the Sierra Club, Midlothian Breathe, Public Citizen, Rethink35, Save our Springs Alliance y Texas Streets Coalition. La carta de comentarios de Earthjustice incluía documentos de respaldo e indicaba que los comentarios al Plan de la Red de Monitoreo Anual propuesto por la TCEQ para 2025 también eran aplicables y, por lo tanto, se incorporaban por referencia. Además, EDF proporcionó comentarios para sí mismo y para Citizens Caring for the Future, New Mexico and El Paso Interfaith Power and Light, Texas Permian Future Generations y Sierra Club. Los comentarios de EDF FYA se consideraron consistentes con los presentados en el AMNP 2025 de la TCEQ y se reiteraron muchas de las mismas preocupaciones ya que la red de monitoreo del aire de la TCEQ no midió los niveles de contaminación por ozono en la Cuenca Pérmica (como parte de las áreas de planificación del Panhandle y el oeste de Texas de la FYA).

Los comentarios recibidos por la TCEQ durante el período de comentarios se resumen a continuación y se abordan con respuestas. Los comentarios completos recibidos sobre el año fiscal 2025 se proporcionan en el archivo adjunto de la cartera.

La TCEQ se esfuerza por equilibrar estratégicamente el cumplimiento de los requisitos de monitoreo federal y las necesidades estatales y locales con los fondos disponibles y los recursos de personal, y por esas razones, no siempre puede satisfacer todas las solicitudes de monitoreo. La TCEQ recibe, y aprecia, oportunidades ocasionales de subvenciones federales únicas y a corto plazo que se pueden utilizar para financiar recursos de monitoreo adicionales. Estos recursos de subvenciones a corto plazo pueden permitir a la TCEQ comprar y actualizar equipos de monitoreo del aire antiguos y cumplir con los cambios en los requisitos técnicos de monitoreo. Sin embargo, se necesitan recursos a largo plazo para operar y auditar los monitores del aire y para garantizar la calidad y validar los datos para la expansión de la red de monitoreo del aire. Los fondos de subvenciones federales para apoyar los recursos a largo plazo no han aumentado durante décadas, a pesar de que los requisitos de monitoreo del aire han aumentado durante ese mismo período. La TCEQ continuará evaluando las necesidades de monitoreo del aire en función de los requisitos federales de monitoreo existentes y los recursos disponibles en el AMNP de 2026.

Resúmenes de comentarios y respuestas de la TCEQ

Comentario 1:

Earthjustice comentó que la TCEQ debe cumplir con la regulación vigente para las evaluaciones quinquenales al proporcionar un análisis de los impactos de la contaminación del aire en las poblaciones susceptibles y realizar una revisión tecnológica. Earthjustice comentó que la TCEQ no identificó claramente cómo la evaluación consideraba a las poblaciones con mayor riesgo de daño debido a la mala calidad del aire. Earthjustice comentó que la evaluación de la TCEQ equiparaba el cumplimiento de los Estándares Nacionales de Calidad del Aire Ambiental (NAAQS) como lo mismo que proteger a las personas susceptibles y que la TCEQ estaba obligada a hacer más por las personas susceptibles o en riesgo. Earthjustice imploró a la TCEQ que utilice datos del Departamento de Servicios de Salud del Estado de Texas y otros servicios de salud pública relevantes, al revisar la ubicación y la ubicación propuesta de monitores adicionales, para controlar mejor la cantidad de contaminación permitida en estas poblaciones.

Earthjustice solicitó a la TCEQ que reconozca una oportunidad única en la vista previa y la adopción de tecnología que protegería mejor a los residentes de Texas. Earthjustice comentó que la TCEQ podría apoyar la implementación de un sólido monitoreo de la ciencia ciudadana y/o integrar la flota de satélites de observación de la Tierra de la Administración Nacional de Aeronáutica y del Espacio (NASA) que sean científicamente precisos y estén disponibles para determinar dónde se deben colocar los monitores de aire.

Respuesta 1:

La TCEQ no está de acuerdo en que la FYA no cumplió con la obligación de considerar la capacidad de la red para apoyar la caracterización de la calidad del aire para áreas con poblaciones relativamente altas de individuos susceptibles o en la evaluación de nuevas tecnologías. Los requisitos federales establecen que la FYA debe considerar la capacidad de la red de monitoreo para respaldar la caracterización de la calidad del aire para áreas con poblaciones relativamente altas de individuos susceptibles; Sin embargo, no se proporciona una definición de "individuos susceptibles" ni se proporciona orientación sobre el término "relativamente alto" o cómo realizar dicha evaluación. En 71 Federal Register (FR) 61236 (17 de octubre de 2006), con respecto a la adición del requisito FYA, varios comentaristas señalaron que este requisito sería difícil de implementar, y la EPA reconoció el desafío de obtener información sobre la distribución de individuos susceptibles en áreas geográficas específicas. Sin embargo, la TCEQ evaluó la capacidad de la red federal de monitoreo para respaldar la caracterización de la calidad del aire mediante la evaluación del cumplimiento de la red con 40 CFR Parte 58 y sus apéndices, así como la evaluación de la ubicación del monitor. La TCEQ continúa apoyando el análisis de FYA.

El Título 40 CFR Parte 58.10 (d) requiere que los estados incluyan una evaluación de si las nuevas tecnologías son apropiadas para su incorporación a la red de monitoreo del aire ambiente. La TCEQ abordó esto en el FYA al señalar que la TCEQ evalúa continuamente los avances en la tecnología de monitoreo del aire ambiente y propone cambios de método a través del AMNP, cumpliendo así con los requisitos de 40 CFR Parte 58.10 (d). El Título 40 CFR Parte 58.10 (d) no requiere que los estados evalúen todas las tecnologías disponibles, como la ciencia ciudadana no regulatoria y / o los datos satelitales de la NASA, en el FYA. Los monitores regulatorios de TCEQ cumplen con los requisitos del método de monitoreo existente y proporcionan datos consistentes y de alta calidad. La TCEQ continúa evaluando tecnologías más nuevas para cumplir con los objetivos de monitoreo de la red a partir de los criterios aprobados de los métodos de monitoreo del aire contaminante enumerados en la página web de la EPA (https://www.epa.gov/amtic/air-monitoring-methods-criteria-pollutants). La TCEQ propone cambios en los equipos de monitoreo del aire (incluido el uso de nuevas tecnologías) y cambios de método anualmente a través del AMNP. Por ejemplo, la TCEQ ha reemplazado los monitores continuos de partículas comparables no NAAQS de 2.5 micrómetros o menos de diámetro ($PM_{2.5}$) y los monitores $PM_{2.5}$ no continuos con nueva tecnología avanzada, monitores continuos $PM_{2.5}$ equivalentes a nivel federal, desde el último FYA, documentado anualmente en el AMNP de la TCEQ.

Comentario 2:

Earthjustice comentó que la TCEQ debería agregar plantas de lotes de cemento (CBP) y operaciones de procesamiento de agregados (APO) a su evaluación general. Earthjustice apoyó la adición de nuevos monitores propuestos por la TCEQ y solicitó que la TCEQ considere retirar su solicitud de exclusión de datos $PM_{2.5}$ cerca de la carretera para el área de Austin. Earthjustice señaló que pronto se requerirá que Austin tenga un monitor adicional cerca de la carretera en el corredor de la Interestatal 35 y que ahora se podría instalar un monitor. Además, Earthjustice solicitó a la TCEQ que agregara fuentes menores a su análisis, ya que la mayoría de los CBP faltan en los mapas FYA y el inventario de emisiones de la TCEQ. Earthjustice comentó que, acumulativamente, las contribuciones de partículas (PM) de CBP fueron significativas. Earthjustice declaró que, dado que los mapas de la TCEQ no ilustraban las ubicaciones de CBP, el análisis de FYA estaba incompleto en cuanto a si los monitores de PM existentes o nuevos se colocaron correctamente. Earthjustice señaló preocupaciones relacionadas con las ubicaciones de los grupos de CBP en todo el estado y recomendó a la TCEQ que identifique sus ubicaciones, resalte los grupos y determine si se necesitan monitores adicionales de $PM_{2.5}$. Además, Earthjustice comentó que el análisis FYA de la TCEQ estaba incompleto en cuanto a si los monitores de PM existentes o nuevos se colocaron correctamente, ya que no ilustraba la ubicación y las emisiones de los APO. Earthjustice señaló que la TCEQ ignoró las emisiones fugitivas de polvo en su planificación; por lo tanto, la TCEQ debe identificar todas las ubicaciones de APO, mejorar la metodología de evaluación de emisiones y determinar dónde se necesitan monitores adicionales de $PM_{2.5}$.

Respuesta 2:

El FYA de la TCEQ evaluó las emisiones atmosféricas de fuentes puntuales, ya que los datos de emisiones se informan anualmente de acuerdo con los requisitos del 30 Código Administrativo de Texas §101.10. La TCEQ reconoce que los datos de emisiones de fuentes puntuales provienen de las fuentes estacionarias más grandes y no incluyen fuentes menores como CBP y APO. La TCEQ tiene información de ubicación de APO y CBP, sin embargo, las fuentes menores no informan las emisiones y estos datos no están disponibles para cuantificar los impactos potenciales. Por lo tanto, la TCEQ no está de acuerdo con la recomendación de incluir las emisiones de fuentes menores, como CBP y APO, la evaluación y el mapeo en el FYA. La TCEQ no está de acuerdo con la recomendación de Earthjustice de retirar la solicitud de exclusión de datos de $PM_{2.5}$ cerca de la carretera para el área de Austin, ya que estos monitores proporcionan mediciones de microambientes localizados cerca de carreteras con mucho tráfico que no son representativas de una cuenca atmosférica más amplia. De acuerdo con 40 CFR §58.30, los datos de medición de $PM_{2.5}$ de los monitores que no son representativos de la calidad del aire en toda el área, sino más bien de puntos calientes localizados a microescala relativamente únicos o sitios de impacto únicos a escala media, no son elegibles para la comparación con el NAAQS de $PM_{2.5}$. El sitio de monitoreo de $PM_{2.5}$ a microescala cerca de la carretera del área de Austin está adyacente a una fuente local única de $PM_{2.5}$ dominante. En consecuencia, los datos de medición de $PM_{2.5}$ a microescala del monitor de la Interestatal 35 de Austin North solo deberían ser elegibles para la comparación con el NAAQS de $PM_{2.5}$ de 24 horas. La TCEQ aclara que el FYA 2025 señaló que el área estadística basada en el núcleo (CBSA) de Austin-Round Rock-San Marcos (Austin) requerirá un sitio adicional de monitoreo de dióxido de nitrógeno (NO_2) cerca de la carretera cuando la población supere los 2,500,000, probablemente antes de 2030 según las proyecciones de población, consulte la página 113 del FYA 2025. Según lo requerido por 40 CFR Parte 58, Apéndice D § 4.3.2, la TCEQ evaluará las áreas diferenciadas del sitio existente cerca de la carretera de Austin, Austin North Interstate 35, con al menos uno de los siguientes requisitos: combinación de flota; patrones de congestión; terreno; área geográfica de CBSA; y/o designación diferente de ruta, interestatal o autopista. La TCEQ hará la recomendación de un segundo sitio de monitoreo cercano a la carretera de Austin CBSA en el AMNP cuando las estimaciones de población superen los 2,500,000. Los comentarios relacionados con la metodología de evaluación de emisiones, incluidos los de fuentes menores, están fuera del alcance de este FYA.

Comentario 3:

Earthjustice comentó que el monitor de $PM_{2.5}$ inactivo del condado de Ellis, Midlothian, debe reubicarse lo más rápido posible, y se debe colocar un monitor de PM adicional donde pueda evaluar con precisión las partículas liberadas por las principales plantas de cemento del condado. Earthjustice comentó que la TCEQ también debería agregar un nuevo sitio al norte/noroeste de Holcim, Texas, basado en el FYA, para capturar mejor las emisiones de partículas para esta comunidad. Earthjustice comentó que esto podría lograrse moviendo el antiguo monitor del método de referencia federal (FRM) de Midlothian Old Fort Worth (OFW) al norte/noroeste de Holcim para capturar mejor los problemas regionales y los datos que el nuevo monitor pasaría por alto cerca de Martin Marietta y Gerdau. Earthjustice comentó que el área tenía una población creciente, tres plantas de cemento y una fábrica de acero que justificaba otro monitor. Earthjustice comentó que se debería monitorear algo más que PM, ya que es probable que el área de Midlothian no cumpla con el NAAQS de ozono. Earthjustice comentó que la TCEQ debería usar el FYA para afirmar que comenzará a trabajar con grupos comunitarios u organizaciones sin fines de lucro para encontrar ubicaciones adecuadas para monitorear el aire.

Respuesta 3:

La TCEQ reconoce los comentarios sobre el monitoreo del aire en Midlothian y la reubicación del sitio de monitoreo del aire de Midlothian OFW. Se requirió que la TCEQ desactivara temporalmente el sitio de monitoreo del aire de Midlothian debido a que el dueño de la propiedad revocó el acceso de la TCEQ al sitio. Como se discutió en la *sección Cronograma de implementación del sitio de monitoreo de la calidad del aire nuevo y reubicado*, las reubicaciones de sitios implican un proceso largo que generalmente toma entre dos y cuatro años (pero podría ser más largo) debido a la complejidad de cada paso y la dependencia de socios externos. La TCEQ evaluó las ubicaciones de los sitios de monitoreo que caracterizarían de manera adecuada y suficiente la calidad del aire regional en un área con múltiples fuentes. La TCEQ consideró colectivamente el acuerdo del propietario, el flujo de viento predominante y las limitaciones logísticas como el espacio, la disponibilidad de energía, el terreno, la pendiente y el drenaje. La TCEQ se aseguró de que las posibles ubicaciones de los sitios cumplieran con los requisitos federales enumerados en 40 CFR Parte 58, Apéndice E con respecto a los criterios de ubicación. Dada la presencia de múltiples instalaciones en las inmediaciones del antiguo sitio de Midlothian OFW, la reubicación del sitio cerca de su ubicación original, dentro de los límites de la ciudad, todavía está justificada y respaldada por inventarios de emisiones de instalaciones en el área general.

La TCEQ aseguró un acuerdo de uso del sitio en una ubicación que cumple con los requisitos logísticos, los criterios federales de ubicación y proporcionará datos de calidad del aire representativos del área regional alrededor de Midlothian. Sin embargo, la TCEQ continúa experimentando retrasos con la ciudad de Midlothian en la obtención de permisos para la construcción (plataforma del sitio, cerca y electricidad) del nuevo sitio de Midlothian North Ward Road. TCEQ está abordando los desafíos actuales y agradece el apoyo de las comunidades locales para garantizar un despliegue oportuno del sitio de Midlothian North Ward Road. La TCEQ trabaja rutinariamente para identificar múltiples sitios alternativos de monitoreo del aire durante el proceso de reubicación del sitio; sin embargo, en Midlothian, la Ciudad negó cinco ubicaciones alternativas viables identificadas en la propiedad de la Ciudad de Midlothian. La ciudad de Midlothian respondió a las solicitudes de la TCEQ señalando que todos los sitios deben ser estéticamente presentables y que, según la apariencia, un remolque de monitoreo de aire en propiedad de la ciudad no se prestaría a ser permitido. La Ciudad finalmente sugirió que la TCEQ colocara el sitio de monitoreo de la calidad del aire fuera de los límites corporativos de la ciudad, en un área de desarrollo privado predominantemente ocupada por residencias unifamiliares y algunos negocios privados. Esta área desarrollada no cumple con los requisitos logísticos del sitio de monitoreo del aire de la TCEQ.

La TCEQ señala que Midlothian se encuentra dentro de la CBSA de Dallas-Fort Worth-Arlington (DFW), y la TCEQ cumple y/o supera los requisitos de monitoreo del aire en esta CBSA (que se muestra en el Apéndice C del AMNP 2025 de la TCEQ). Earthjustice recomendó que la TCEQ monitoree algo más que PM en Midlothian. La TCEQ aclara que una vez que el nuevo sitio de calidad del aire de Midlothian sea reubicado y activado, múltiples monitores individuales de aire ambiente que miden óxidos de nitrógeno (NO_x), ozono, $PM_{2.5}$ con metales especiados, dióxido de azufre (SO_2), radiación solar, temperatura exterior, viento y compuestos orgánicos volátiles (VOC) (por iniciativa estatal) estarán operativos, similares a los monitores de calidad del aire que históricamente estaban en Midlothian OFW. La TCEQ continuará evaluando las necesidades de monitoreo del aire en Midlothian en comparación con los requisitos federales de monitoreo existentes y los recursos disponibles.

Comentario 4:

Earthjustice comentó que se debe colocar un monitor FRM $PM_{2.5}$ compatible con NAAQS en el condado de Williamson, dada la densidad de APO y CBP, para comenzar a generar datos de diseño para esta área. Earthjustice comentó que el FYA de la TCEQ debería tener en cuenta mejor todas las fuentes de contaminación, incluidas las CBP y las APO, ya que son extremadamente polvorientas y generan cantidades sustanciales de polvo fugitivo, y la TCEQ debería agregar al menos un sitio de monitoreo de $PM_{2.5}$ al condado de Williamson para determinar más claramente el estado de logro del condado. Earthjustice señaló que los monitores de $PM_{2.5}$ más cercanos estaban en los condados de Travis y Bell, y estos monitores estaban demasiado lejos para proporcionar datos útiles o relevantes para el condado de Williamson. Earthjustice declaró que la comunidad de jubilados de Sun City en Georgetown, Texas, enfrentaba problemas de salud debido a la mala calidad del aire y al polvo fino de las APO y CBP cercanas. Earthjustice declaró que la comunidad de jubilados era una población particularmente sensible que necesitaba información precisa sobre la calidad del aire. Earthjustice comentó que el AMNP 2024 de la TCEQ no dio ninguna indicación de que el monitor de Jarrell se cerraría y que la FYA de la TCEQ no propuso un nuevo sitio de monitoreo en Jarrell para el condado de Williamson.

Respuesta 4:

La TCEQ reconoce las recomendaciones de expandir el monitoreo de $PM_{2.5}$ en áreas con APO y CBP significativos, como el condado de Williamson. Como se indicó en la introducción, el FYA 2025 evaluó la red federal existente para determinar si continúa cumpliendo con los objetivos de 40 CFR Parte 58, Apéndice D y para evaluar si los monitores individuales de la red federal deben agregarse, reubicarse o desmantelarse para comprender y evaluar mejor la calidad del aire con los recursos existentes.

TCEQ señala que el condado de Williamson es parte de Austin CBSA junto con los condados de Travis, Hays, Caldwell y Bastrop, y esta área cumple con todos los requisitos federales de monitoreo. La TCEQ aclara que las regulaciones federales de monitoreo no requieren monitores de aire ambiente en todos los condados de una CBSA. La red de monitoreo del aire de la TCEQ está diseñada para medir las concentraciones de contaminantes para evaluar la calidad del aire regional representativa de las áreas frecuentadas por el público y para proporcionar información sobre el cumplimiento de la NAAQS. Los monitores pueden medir el impacto en la calidad del aire de las fuentes industriales presentes en un área, pero no capturan las emisiones y/o los patrones de dispersión de fuentes individuales.

Como se señaló en la introducción, el FYA se limita a la parte de la red de monitoreo del aire de la TCEQ diseñada para cumplir con los requisitos federales de monitoreo. Sin embargo, la TCEQ también opera una sólida red de monitores de iniciativas estatales que respaldan una variedad de propósitos, incluida la evaluación de posibles efectos en la salud, y estos monitores están fuera del alcance de este FYA y no están incluidos. La TCEQ aclara nuevamente que el monitor Jarrell FM 487 fue un monitor temporal de iniciativa estatal activado para evaluar los impactos locales en la calidad del aire de las fuentes de partículas ubicadas dentro de 0.5 millas del monitor. Dado que el monitoreo del aire por iniciativa estatal no está incluido en el AMNP o FYA, en julio de 2024 se proporcionó un anuncio sobre la interrupción del sitio de monitoreo del aire Jarrell FM 487 a todos los suscriptores públicos de las actualizaciones de la Red de Monitoreo del Aire de la TCEQ. Los datos de Jarrell FM 487 $PM_{2.5}$ de casi cuatro años de operación tuvieron una buena tendencia con los otros tres monitores regionales de $PM_{2.5}$ dentro de Austin CBSA, y las concentraciones diarias medias fueron generalmente inferiores a las de los otros monitores regionales. Los datos del monitor Jarrell FM 487 siguen siendo de acceso público en la página web TAMIS de la TCEQ. Los datos de monitoreo del aire obtenidos en este sitio también se utilizaron en la evaluación de la División de Toxicología, Evaluación de Riesgos e Investigación (Toxicología) de la TCEQ de partículas, incluida la sílice cristalina, cerca de las APO. El proyecto de monitoreo midió concentraciones de sílice cristalina en partículas de 4 micrómetros o menos de diámetro (PM_4) y $PM_{2.5}$ totales en sitios de monitoreo de aire ambiente estacionarios TCEQ existentes que eran de acceso público y a favor del viento de las instalaciones de APO, así como en un sitio de monitoreo de fondo que no estaba ubicado cerca de una instalación de APO. El objetivo era determinar qué contribución, si la hubiera, tenían las instalaciones de APO a las concentraciones en el aire ambiente de sílice cristalina PM_4 y $PM_{2.5}$ total en relación con las concentraciones de fondo en el área central de Texas. En general, este estudio de monitoreo encontró que las concentraciones totales de $PM_{2.5}$ no se vieron afectadas de manera medible por las operaciones APO a favor del viento. La evaluación completa está disponible en la página web de Proyectos de Investigación de la División de Toxicología de la TCEQ, *Monitoreo ambiental de partículas, incluida la sílice cristalina, Informe final de las instalaciones cercanas a APO.*

La TCEQ señala que el 7 de enero de 2025 se activó un monitor de método equivalente federal (FEM) $PM_{2.5}$ de iniciativa estatal en Austin Audubon Society, como se documenta en el AMNP 2025 de la TCEQ. La TCEQ recomendó agregar este monitor a la red federal de monitoreo del aire de la TCEQ en el AMNP de 2025 si la Región 6 de la EPA aprobaba la reclasificación de los monitores cercanos a la carretera a microescala $PM_{2.5}$ como no NAAQS comparables a los NAAQS anuales de $PM_{2.5}$. El sitio de monitoreo de la calidad del aire de la Sociedad Audubon de Austin está ubicado en el norte del condado de Travis, a una milla del condado de Williamson, y cerca de los sitios de preocupación de la industria señalados por el comentarista. Los sitios de monitoreo de la calidad del aire del área de Austin de la TCEQ se muestran a continuación en la Figura A, que ilustra el sitio de la Sociedad Audubon de Austin con el monitor federal $PM_{2.5}$ propuesto. La TCEQ se esfuerza por equilibrar estratégicamente el cumplimiento de los requisitos de monitoreo federal y las necesidades estatales y locales con los fondos disponibles y los recursos de personal, y por esas razones, no siempre puede satisfacer todas las solicitudes de monitoreo. Sin embargo, la TCEQ continuará evaluando las necesidades de monitoreo del aire en la CBSA de Austin, incluido el condado de Williamson, en función de los requisitos federales de monitoreo existentes y los recursos disponibles. Las preocupaciones de salud específicas señaladas por los comentaristas están más allá del alcance de este AMNP.

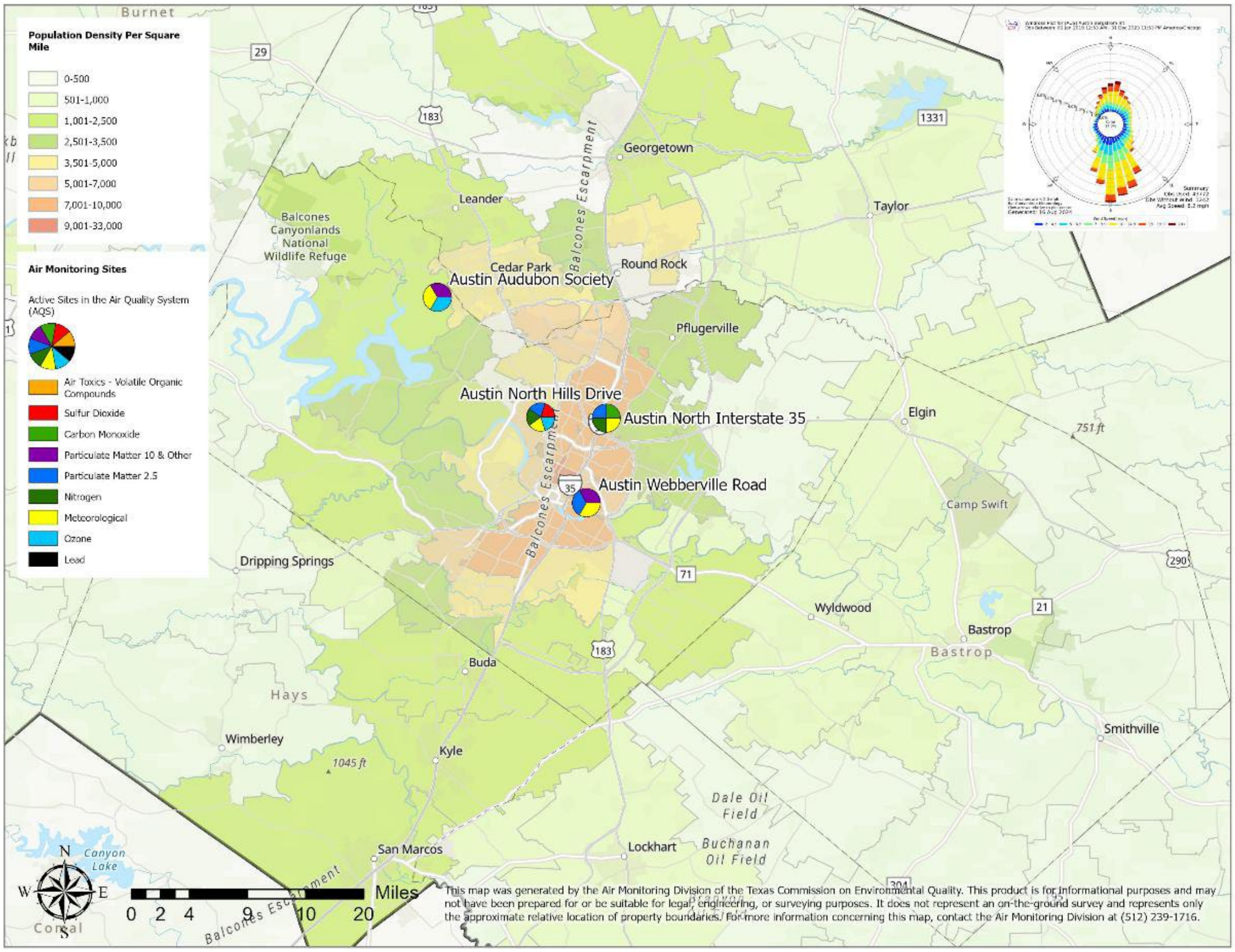


Figura A: Sitios activos y monitores del área de Austin , densidad de población y rosa de los vientos

Comentario 5:

Earthjustice comentó que los monitores inactivos de El Paso deben reubicarse lo más rápido posible y señaló que la TCEQ no ha podido cumplir con los requisitos mínimos según 40 CFR Parte 58 y Apéndices, incluidas las secciones 58.10 y 58.14, para monitorear NO_x, ozono, $PM_{2.5}$ y meteorología en el sitio de la Universidad de Texas El Paso (UTEP). Earthjustice comentó que la falta de datos de $PM_{2.5}$ de El Paso era una barrera para comprender si el área cumple con el nuevo NAAQS de $PM_{2.5}$. Earthjustice comentó que la TCEQ podría satisfacer las necesidades de monitoreo mediante el uso de monitores temporales o móviles que estén estacionados de manera más permanente para continuar con la recopilación de datos. Earthjustice comentó que la TCEQ debería considerar la elaboración de un diagrama de flujo de priorización para asignar mejor los fondos a las comunidades afectadas por las preocupaciones sobre la calidad del aire para proporcionar una mayor transparencia con respecto al presupuesto de este plan y debería asociarse con las comunidades locales para obtener la aceptación de las posibles ubicaciones de los sitios. Earthjustice comentó que el FYA de la TCEQ no tuvo en cuenta la brecha de datos de UTEP en El Paso y que el FYA debería discutir las brechas con más detalle para cumplir con los requisitos para evaluar adecuadamente la calidad del aire.

Respuesta 5:

La TCEQ reconoce las recomendaciones con respecto al sitio de monitoreo del aire de la Universidad de Texas en El Paso (UTEP) y no está de acuerdo con que la reubicación del sitio de El Paso UTEP no se incluyó en el FYA. Como se discutió en la Evaluación de la Red de Monitoreo del Lejano Oeste de Texas FYA 2025, el sitio de monitoreo de la calidad del aire de El Paso UTEP se desactivó temporalmente para su reubicación en noviembre de 2021 debido a que el dueño de la propiedad revocó el acuerdo de uso del sitio para la expansión del edificio. Las áreas dentro de una milla del sitio anterior de monitoreo del aire UTEP de El Paso ofrecen desafíos únicos, como terreno montañoso desnivelado, uso denso de la tierra, edificios altos, infraestructura vial densa y la frontera entre Texas y México. Los sitios de monitoreo del aire de la TCEQ generalmente están ubicados en propiedad pública (es decir, propiedad de entidades federales, estatales o locales), y la TCEQ debe identificar a los propietarios dispuestos a permitir que la TCEQ coloque un sitio de monitoreo del aire en su propiedad. TCEQ ha trabajado con múltiples entidades públicas, incluidas UTEP, la ciudad de El Paso, la EPA, el Departamento de Transporte de Texas y la Comisión Internacional de Límites y Aguas de EE. UU. en el esfuerzo por identificar una ubicación adecuada dentro de una o dos millas del sitio anterior y no ha tenido éxito hasta la fecha. La TCEQ ha asignado fondos para reubicar este sitio de monitoreo del aire y continúa evaluando posibles ubicaciones.

La TCEQ no está de acuerdo en que los requisitos mínimos de monitoreo en la CBSA de El Paso no se cumplan como lo requiere 40 CFR Parte 58 y sus apéndices; por lo tanto, no se requieren monitores móviles estacionados temporalmente o permanentemente. La TCEQ aclara que el uso de sitios de monitoreo temporales y/o monitores móviles no son métodos aprobados de calidad del aire para generar datos con el fin de demostrar el cumplimiento de la NAAQS. Los fondos recibidos para implementar los requisitos federales de monitoreo del aire se asignan en función del diseño de la red, impulsados por los requisitos federales bajo 40 CFR Parte 58; por lo tanto, no se necesita un diagrama de flujo para determinar la asignación de fondos.

La TCEQ cumple o supera todos los requisitos mínimos de la CBSA de El Paso, incluidos los de $PM_{2.5}$, como se documenta en el AMNP 2025 de la TCEQ y se evalúa más a fondo en el FYA 2025 de la TCEQ. Se requiere que la TCEQ opere entre 17 y 21 monitores en la CBSA de El Paso y excede los requisitos al operar 25 monitores (incluso en ausencia de monitoreo en El Paso UTEP). Además, la TCEQ activó un nuevo $PM_{2.5}$ monitores en el sitio de monitoreo del aire de Skyline Park en agosto de 2025, aumentando los monitores $PM_{2.5}$ existentes en el área a siete en total, superando los requisitos federales. Los monitores activos del aire ambiente de El Paso y los requisitos de monitoreo se enumeran en la Tabla 1, y los sitios y monitores activos se ilustran en la Figura B a continuación.

Tabla 1: Monitores requeridos en el área de El Paso y monitores activos existentes

Tipo de monitor activo del área estadística basada en el núcleo de El Paso	Monitores mínimos requeridos según 40 CFR Parte 58	Monitores existentes
Monóxido de carbono	1	2
NO_2 y NO_y	2	3
$PM_{2.5}$	6	7
PM_{10}	4-8	6
Ozono	3	6
Dióxido de azufre	1	1

CFR – Código de Regulaciones Federales
NO_2 – dióxido de nitrógeno
NO_y – compuestos de nitrógeno reactivos totales
$PM_{2.5}$ – material particulado de 2.5 micrómetros o menos de diámetro
PM_{10} – partículas de 10 micrómetros o menos de diámetro

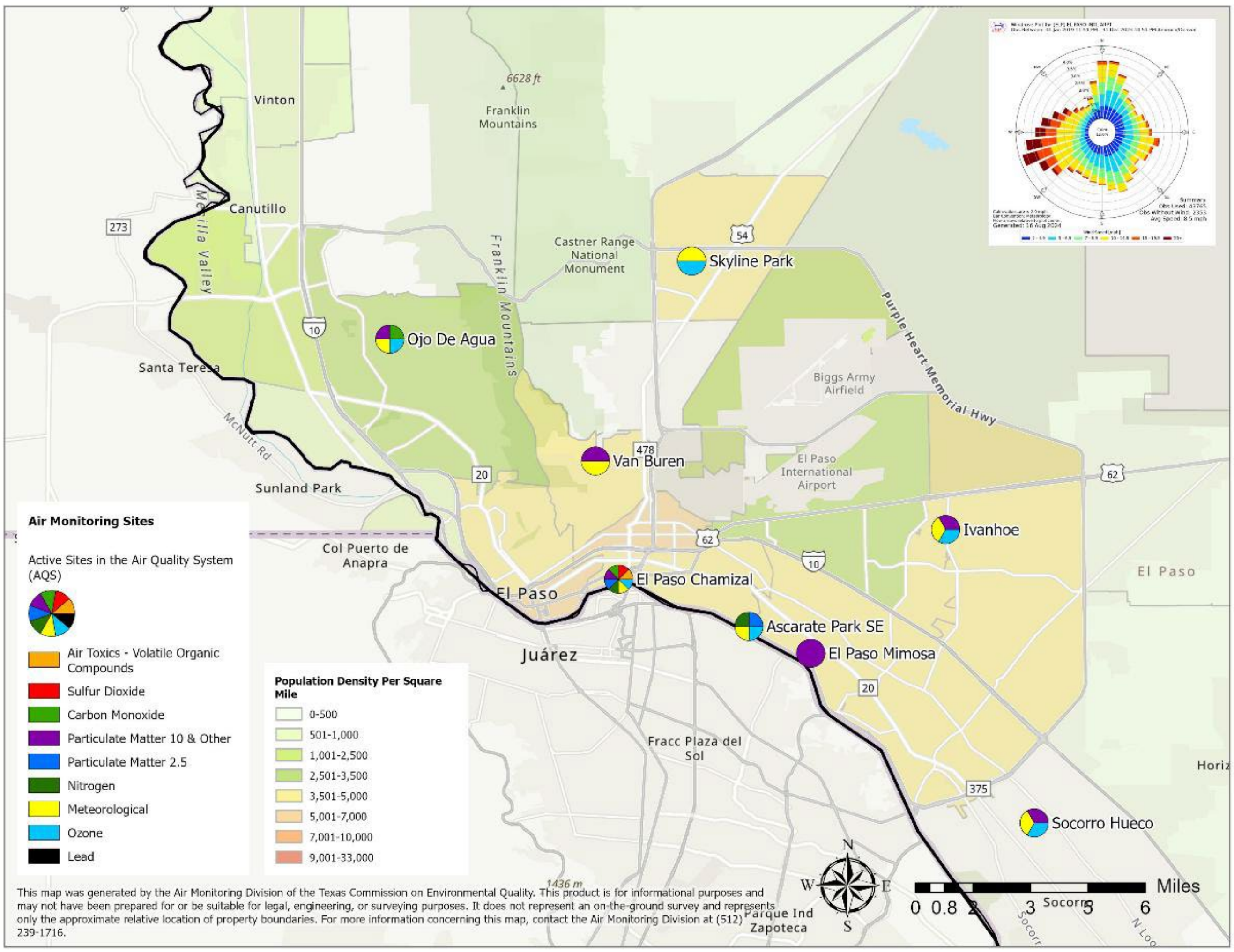


Figura B: Sitios activos y monitores del área de El Paso, densidad de población y rosa de los vientos

Comentario 6:

Earthjustice comentó que la Cuenca Pérmica requería monitoreo del aire, dado el crecimiento explosivo en el desarrollo de petróleo y gas en toda el área. Earthjustice declaró que se requería el monitor $PM_{2.5}$ de Odessa Gonzales para que se aprobara el AMNP de la TCEQ, y todavía estaba inactivo, nuevamente, cinco años después. Earthjustice comentó que la EPA tenía preocupaciones continuas relacionadas con el ozono en la Cuenca Pérmica y que la TCEQ debería desplegar uno o más monitores de ozono allí y que la FYA de la TCEQ no tuvo en cuenta esta ausencia ni priorizó su monitoreo en la Cuenca Pérmica, un conocido campo de petróleo y gas, donde las antorchas, las estaciones compresoras y los equipos de petróleo y gas contribuyen a la preocupaciones de contaminación a nivel estatal y regional entre estados.

Respuesta 6:

Earthjustice parece haber malinterpretado la información publicada en el AMNP de julio de 2021, donde la TCEQ señaló la preocupación de que el monitor de $PM_{2.5}$ de Odessa Gonzales requiriera un ajuste de ocho pies para cumplir con los criterios de ubicación. El monitor Odessa Gonzales $PM_{2.5}$ continúa funcionando hoy, aunque la ubicación precisa del monitor se ajustó en agosto de 2021 para cumplir con los criterios federales de ubicación. La TCEQ aclara además que el monitor Odessa Gonzales $PM_{2.5}$ ha estado operativo durante más de 20 años, desde 2002, con un monitor continuo de $PM_{2.5}$ comparable a NAAQS y se actualizó a un monitor $PM_{2.5}$ FEM en 2019. Las tendencias históricas y de valor de diseño del monitor Odessa Gonzales $PM_{2.5}$ se incluyen en el FYA 2025 de TCEQ.

La TCEQ reconoce los comentarios sobre las preocupaciones de la EPA relacionadas con el ozono en la Cuenca Pérmica; sin embargo, no es necesario un monitoreo adicional para cumplir con los requisitos federales diseñados para garantizar una cobertura adecuada para el monitoreo del aire ambiente. La TCEQ cumple con todos los requisitos federales de monitoreo del aire para todas las CBSA en la Cuenca Pérmica. La red de monitoreo del aire se utiliza para caracterizar la calidad del aire regional en áreas a lo largo del tiempo, pero generalmente no está destinada a evaluar las emisiones de las fuentes. La TCEQ evalúa la ubicación de sus monitores de aire utilizando datos de población, así como datos de inventario de emisiones informados, lo que da como resultado la colocación de monitores de aire en áreas donde grandes sectores de la población se cruzan con una presencia significativa de la industria. La TCEQ opera múltiples monitores de aire en la vasta área de la Cuenca Pérmica con monitores que cumplen con los objetivos de monitoreo de la iniciativa federal y estatal, incluidos algunos monitores de precursores de ozono.

El monitoreo del aire iniciado por el estado está fuera del alcance de este Plan y, por lo tanto, no está incluido. Sin embargo, la TCEQ activó tres nuevos sitios de monitoreo del aire de iniciativa estatal de la Cuenca Pérmica con sistemas de cromatógrafo de gases automatizado continuo (autoGC) para VOC, SO_2 y sulfuro de hidrógeno (H_2S) en Goldsmith, Odessa y Midland en 2020 y 2021. Los costos iniciales de implementación del sitio para los tres nuevos sitios de la Cuenca Pérmica totalizaron aproximadamente $ 1.3 millones con costos operativos recurrentes de aproximadamente $ 500,000 por año.

Además, TCEQ operó un muestreador de recipiente de VOC no continuo en el sitio de monitoreo del aire de Odessa Hays de 1993 a 1999, un sistema de autoGC continuo para VOC de 1999 a 2015, y ha operado un muestreador de recipiente de VOC no continuo desde 2015. Los sitios y monitores activos del aire de la Cuenca Pérmica, incluido el monitoreo de iniciativas estatales, se ilustran a continuación en la Figura C. La información más reciente sobre la red de monitoreo del aire de Texas y los datos de monitoreo, incluida la información sobre los sitios de la Cuenca Pérmica, están disponibles en la página web de la [TCEQ Calidad del aire y monitoreo de la TCEQ](#).

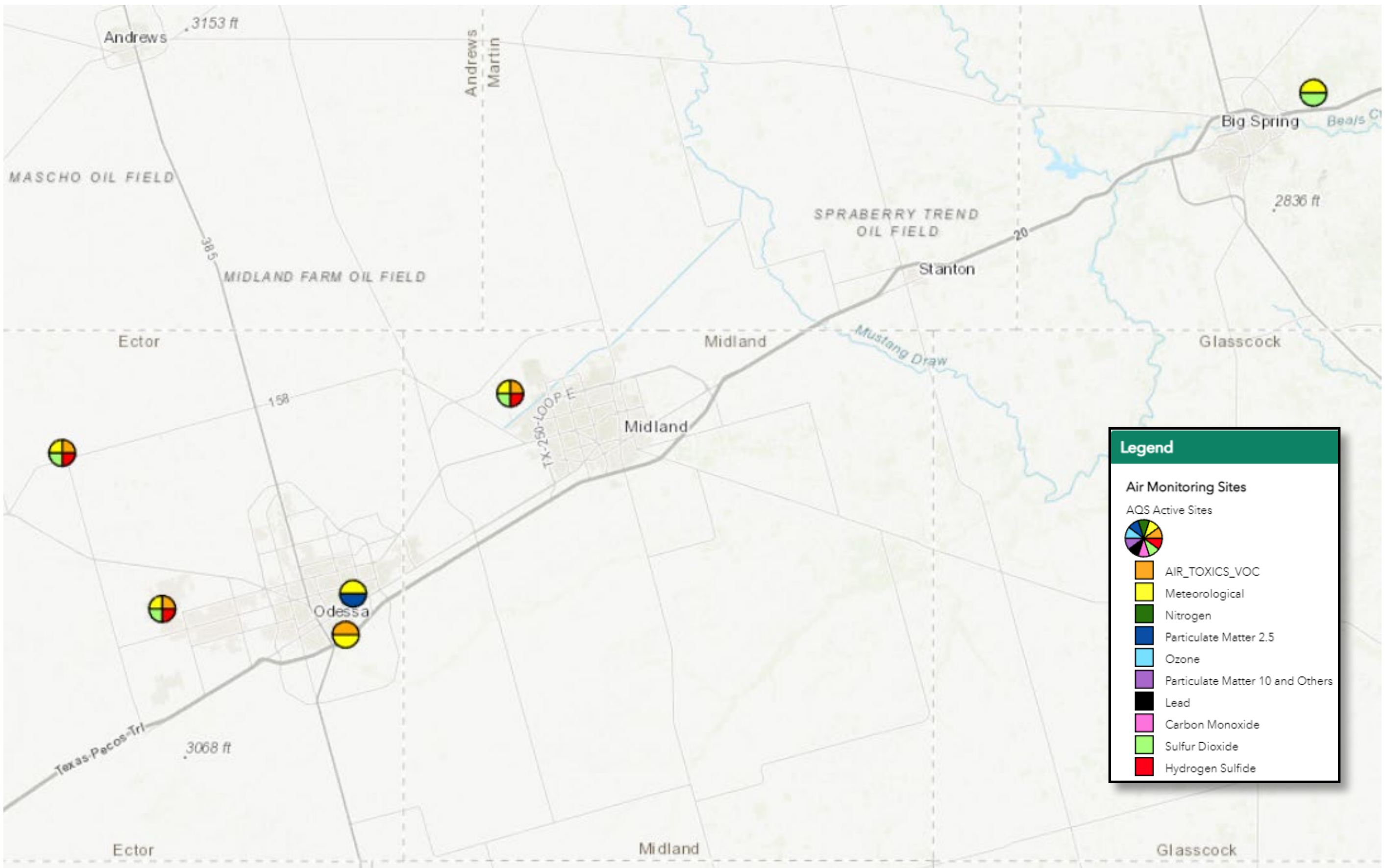


Figura C: Sitios y monitores del área de la cuenca pérmica

Comentario 7:

Earthjustice comentó que el condado de Fort Bend no tenía monitoreo regulatorio a pesar de que era uno de los condados de más rápido crecimiento en Texas y el hogar de la planta de energía de carbón más grande del estado. Earthjustice comentó que el condado de Fort Bend necesitaba monitoreo de SO_2, ozono, $PM_{2.5}$ y monóxido de carbono (CO) y necesitaba monitoreo de emisiones que fueran relevantes y presentes. Earthjustice comentó que la TCEQ debería reconocer que la contaminación del aire estaba empeorando en el condado de Fort Bend y que se necesitaban monitores federales adicionales. Earthjustice señaló que a pesar de que la TCEQ cumplió con el número de monitores SO_2 en la CBSA de Houston-Pasadena-The Woodlands (Houston), todos los monitores estaban ubicados en el condado de Harris y el monitor SO_2 más cercano estaba a 14 millas de distancia. Earthjustice comentó que la TCEQ debería trasladar el monitor de SO_2 propuesto para su desactivación en Park Place al condado de Fort Bend para determinar si las protecciones de las centrales eléctricas de carbón (como los depuradores) funcionaban eficazmente.

Earthjustice comentó que dado que el condado de Fort Bend fue designado como incumplimiento del ozono, el área no podía abordar la contaminación por ozono utilizando datos de modelado y, por lo tanto, el condado requería un monitor de ozono. Earthjustice comentó que el monitor de $PM_{2.5}$ más cercano al condado de Fort Bend, ubicado en el condado de Harris, estaba ubicado fuera de la pluma concentrada de W.A. Parish y que era necesario monitorear la contaminación por $PM_{2.5}$ en el condado de Fort Bend. Earthjustice declaró que el monitoreo regulado del aire para SO_2, ozono, $PM_{2.5}$ y CO estaba atrasado y era necesario para alcanzar el estado, informar al público y responsabilizar a los contaminadores por sus emisiones.

Respuesta 7:

La TCEQ reconoce la solicitud de colocar monitores de calidad del aire en el condado de Fort Bend para monitorear las emisiones. La TCEQ aclara que las regulaciones federales de monitoreo no requieren monitores de aire ambiente en todos los condados delineados en una CBSA. La red de monitoreo del aire de la TCEQ está diseñada para medir las concentraciones de contaminantes para evaluar la calidad del aire regional representativa de las áreas frecuentadas por el público y para proporcionar información sobre el cumplimiento de la NAAQS. Los monitores pueden medir el impacto en la calidad del aire de las fuentes industriales presentes en un área, pero no están destinados a medir las emisiones o evaluar si los controles de emisiones de una instalación están funcionando.

La red de monitoreo de aire estacionario de TCEQ está diseñada para cumplir con los requisitos federales de monitoreo del aire de la Ley de Aire Limpio que dictan la cantidad de monitores requeridos para cada uno de los seis contaminantes criterio en áreas pobladas o CBSA en todo el estado. El condado de Fort Bend es parte de la CBSA de Houston. Si bien Texas actualmente está excediendo todos los requisitos federales mínimos para monitorear los contaminantes de criterio en la CBSA de Houston-Pasadena-The Woodlands (Houston) (la TCEQ está obligada a operar entre 27 y 31 monitores, pero excede los requisitos con 75), la TCEQ reconoce que ninguno de estos monitores está ubicado específicamente en el condado de Fort Bend. La TCEQ evalúa la ubicación de sus monitores de aire utilizando datos de población, así como datos de inventario de emisiones informados, lo que da como resultado la colocación de monitores de aire en áreas donde grandes sectores de la población se cruzan con una presencia significativa de la industria. Los monitores más cercanos al condado de Fort Bend incluyen los del sitio del parque Manvel Croix de TCEQ (condado de Brazoria) que monitorea el ozono y el NO_x y el sitio de Houston Croquet (condado de Harris) que monitorea el ozono y el SO_2, a menos de tres millas de la línea del condado de Fort Bend. Los datos de estos monitores, así como de otros monitores en la CBSA, están disponibles públicamente en la página web de la TCEQ [Calidad del aire y monitoreo de la TCEQ], e informan el [pronóstico diario de la calidad del aire] para el área. Estas herramientas ayudan a informar a las comunidades sobre las condiciones actuales de calidad del aire en el área general.

Como se documenta en el Apéndice F del AMNP 2025 de la TCEQ, el condado de Fort Bend y las áreas alrededor de la central eléctrica de carbón (fuente relevante) se caracterizaron y designaron en función de las emisiones reales de SO_2 modeladas de conformidad con el NAAQS de SO_2 de una hora de 2010. Dado que el área se caracterizó por el método de modelado preferido por la EPA, y las emisiones reportadas han disminuido aproximadamente un 25 por ciento (%) desde que se realizó el modelo, no se requiere más caracterización de la calidad del aire por parte de monitores de aire ambiente en el condado de Fort Bend.

Si bien la TCEQ se esfuerza por equilibrar estratégicamente el cumplimiento de los requisitos federales de monitoreo del aire con las preocupaciones estatales y locales, las limitaciones de fondos y recursos afectan la capacidad de realizar el monitoreo del aire en respuesta a todas las solicitudes. Como resultado, la TCEQ prioriza el monitoreo del aire para evaluar la calidad del aire para el cumplimiento de los estándares federales de calidad del aire y en áreas con actividad industrial concentrada y/o principales fuentes o emisiones.

La TCEQ continuará evaluando la disponibilidad de recursos de monitoreo del aire y puede considerar la colocación futura de un monitor de aire en el condado de Fort Bend. La TCEQ se compromete a garantizar aire limpio para la gente de Texas y aprecia la oportunidad de considerar esta solicitud.

Comentario 8:

Earthjustice comentó que el FYA fue una oportunidad para que la TCEQ considerara la gama de monitores disponibles para rastrear todos los contaminantes atmosféricos peligrosos (HAP). Earthjustice declaró que la EPA desarrolló la red de Estaciones Nacionales de Tendencias de Tóxicos del Aire (NATTS) para satisfacer la necesidad de monitoreo HAP a largo plazo. Earthjustice solicitó a la TCEQ que devolviera la estación NATTS en el área de Houston y agregara un monitoreo adicional de tóxicos del aire debido a la cantidad de HAP y la cantidad de instalaciones emisoras en el condado de Harris. Earthjustice declaró que los monitores HAP desempeñaron un papel fundamental en el desarrollo de tóxicos del aire y modelos de calidad del aire. Earthjustice señaló que la TCEQ debe considerar agregar monitoreo para formaldehído, óxido de etileno, acrilonitrilo y acroleína mientras se expande el monitoreo actual para benceno y 1,3 butadieno. Earthjustice señaló los dos monitores de formaldehído de la TCEQ y expresó que no estaban ubicados cerca de ninguna área residencial expuesta al formaldehído. Earthjustice recomendó ubicar nuevos monitores cerca de áreas residenciales en asociación con líderes comunitarios para comprender y caracterizar mejor las exposiciones de la comunidad.

Respuesta 8:

La TCEQ no está de acuerdo con estos comentarios. El monitoreo y seguimiento de contaminantes atmosféricos peligrosos están fuera del alcance del FYA y, por lo tanto, esta evaluación no fue requerida ni incluida en el FYA 2025 de la TCEQ. La TCEQ supera el requisito federal de las Estaciones de Monitoreo de Evaluación Fotoquímica (PAMS) bajo 40 CFR Parte 58 Apéndice D, § 5, que requiere un mínimo de un sistema de monitoreo continuo de VOC y un muestreador de carbonilo en la CBSA de Houston. TCEQ supera estos requisitos con tres sistemas de monitoreo continuo de autoGC respaldados por el gobierno federal para VOC y dos muestreadores de carbonilo. Si bien la TCEQ ya no participa formalmente en el programa NATTS, la mayoría de los monitoreos de tóxicos del aire designados bajo ese programa todavía se monitorean en el antiguo sitio NATTS de la TCEQ, Houston Deer Park número (#) 2, incluida la acroleína, el formaldehído, el 1,3 butadieno y el benceno. La TCEQ señala que el sitio de monitoreo del aire de Houston Deer Park #2 también apoya el monitoreo de tendencias de la calidad del aire de las Estaciones Nacionales de Monitoreo de Contaminantes Múltiples (NCore). NCore fue desarrollado por la EPA para proporcionar datos de monitoreo del aire a largo plazo útiles para una variedad de aplicaciones, incluidos análisis de tendencias de calidad del aire, evaluación de modelos y seguimiento de estadísticas del área metropolitana.

La TCEQ supera los requisitos federales de monitoreo del aire de la CBSA de Houston para todos los contaminantes de criterio requeridos bajo 40 CFR Parte 58, como se muestra en el AMNP 2025 de la TCEQ. Además, la TCEQ supera los requisitos de la red PAMS de la CBSA de Houston para los VOC, como se muestra en el Apéndice L del AMNP 2025 de la TCEQ.

Como se indicó en la introducción, el monitoreo de la iniciativa estatal no está incluido en el AMNP o FYA; sin embargo, la TCEQ también opera una sólida red de monitores de iniciativas estatales no federales que apoyan una variedad de propósitos. La red de monitoreo de la iniciativa estatal de TCEQ en el área de Houston incluye seis sistemas adicionales de monitoreo continuo de VOC autoGC (para un total de nueve sistemas continuos de monitoreo de VOC autoGC) y ocho muestreadores de botes de VOC. Los autoGC de TCEQ proporcionan datos completos casi en tiempo real por hora sobre 48 VOC. Los muestreadores de botes de VOC de la TCEQ proporcionan una muestra de 24 horas analizada para 84 VOC, y los muestreadores de carbonilo de la TCEQ proporcionan una muestra de 24 horas analizada para 17 compuestos carbonílicos orgánicos tóxicos. Los sitios y monitores de monitoreo del aire federales y estatales de la TCEQ se muestran a continuación en la Figura D, con tóxicos del aire y VOC (incluidos los carbonilos) indicados por una sección naranja.

Además, la TCEQ mejoró el monitoreo de VOC en el área de Houston en 2024 al agregar un muestreador de botes de VOC de iniciativa estatal en el sitio de monitoreo del aire del este de Houston. La TCEQ señala además que se planean dos muestreadores de botes de VOC más de iniciativa estatal para Houston Finnigan Park y Houston Pleasantville Elementary a finales de 2025. La colocación de estos tres muestreadores de botes de VOC se coordinó en asociación con las comunidades y están ubicados en áreas residenciales. La TCEQ aclara que, si bien trabajar con las comunidades puede ofrecer ventajas, aún pueden ocurrir demoras prolongadas en los sitios de monitoreo del aire debido a la complejidad del proceso y la dependencia necesaria de socios externos al establecer o reubicar sitios de monitoreo del aire.

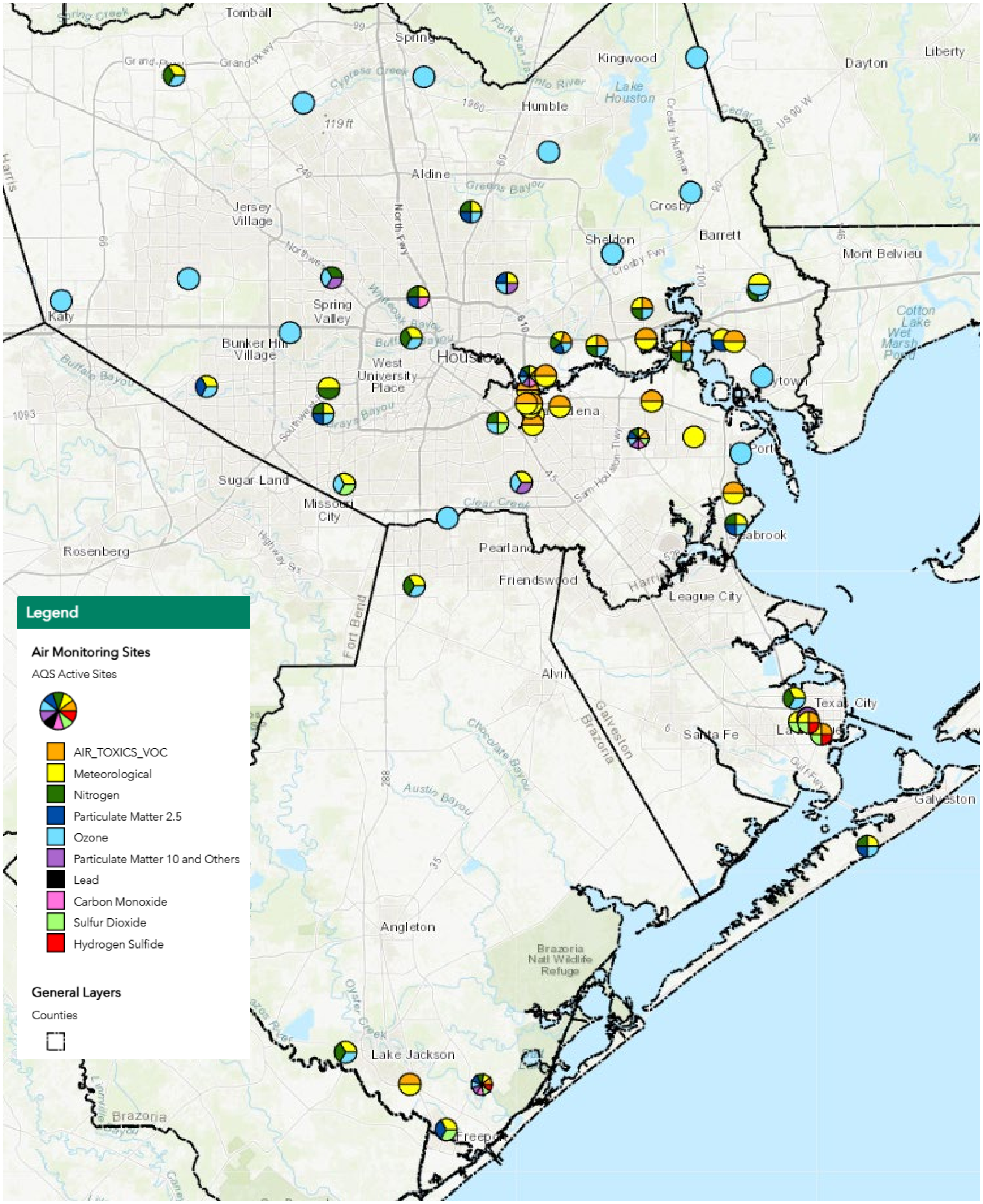


Figura D: Sitios activos y monitores del área de Houston con contornos del condado

Comentario 9:

Earthjustice recomendó un monitor de $PM_{2.5}$, un monitor de NO_2 y un monitor de bote de VOC especificado en el vecindario Sunnyside de Houston. Dentro de las fronteras de Sunnyside, hay una concentración de instalaciones de reciclaje de metales, plantas de hormigón y carreteras de alto tráfico. Earthjustice declaró que los monitores aéreos regionales más cercanos estaban a 8 a 10 millas de distancia en Bayland Park y César Chávez. Earthjustice señaló que partes del vecindario de Sunnyside estaban en el percentil 90 o más para una esperanza de vida más baja con mayores tasas de desarrollo de enfermedades cardíacas y asma. Earthjustice comentó que agregar un monitor de $PM_{2.5}$ y/o VOC en Sunnyside sería una inversión muy necesaria en la salud de los residentes, para garantizar que la calidad del aire cumpla con los estándares y para monitorear qué tan bien las fuentes industriales controlan sus emisiones contaminantes.

Respuesta 9:

La TCEQ reconoce las recomendaciones para ampliar el monitoreo del aire en la comunidad de Sunnyside; sin embargo, no se necesitan monitores adicionales para cumplir con los requisitos federales de monitoreo. Si bien la TCEQ se esfuerza por equilibrar estratégicamente el cumplimiento de los requisitos federales de monitoreo del aire con las preocupaciones estatales y locales, las limitaciones de fondos y recursos afectan la capacidad de realizar el monitoreo del aire en respuesta a todas las solicitudes. Como resultado, la TCEQ prioriza el monitoreo del aire que es requerido y necesario a nivel federal para evaluar la calidad del aire para el cumplimiento de los estándares federales de calidad del aire.

La red federal de monitoreo del aire de la TCEQ en la CBSA de Houston incluye 19 monitores activos de $PM_{2.5}$ en 13 sitios, 18 monitores de NO_2 (el monitor directo de NO_2 y los monitores de NO_x miden NO_2) y tres monitores continuos de autoGC para mediciones de VOC (consulte el AMNP 2025 de la TCEQ). La TCEQ supera el requisito federal de un mínimo de ocho monitores de $PM_{2.5}$, un mínimo de cinco monitores de NO_2 y un mínimo de un sistema continuo de monitoreo de VOC de autoGC en la CBSA de Houston. Como se indicó en la introducción, no se incluye el monitoreo de la iniciativa estatal; sin embargo, la TCEQ también opera una sólida red de monitores de iniciativas estatales no federales que respaldan una variedad de propósitos. La red de monitoreo de iniciativa estatal de TCEQ en el área de Houston incluye seis sistemas adicionales de monitoreo continuo de VOC autoGC (para un total de nueve sistemas continuos de monitoreo de VOC) y ocho muestreadores de botes de VOC. Los sitios y monitores de monitoreo del aire federales y estatales de la TCEQ se muestran arriba en la Figura D, con monitores de $PM_{2.5}$ indicados por una sección azul oscuro, monitores de NO_x / NO_2 indicados por una sección verde oscuro y VOC indicados por una sección naranja. Los datos de estos monitores, así como de otros monitores de la CBSA, están disponibles públicamente en la página web de la TCEQ Calidad del aire y monitoreo de la TCEQ, e informan el pronóstico diario de la calidad del aire para el área. Estas herramientas ayudan a informar a las comunidades sobre las condiciones actuales de calidad del aire en el área general.

Los sitios de monitoreo del aire generalmente se colocan para ser representativos de la calidad del aire regional y no monitorean las emisiones de fuentes específicas. La TCEQ continuará evaluando las necesidades de monitoreo del aire, incluidas las del vecindario de Sunnyside, en comparación con los requisitos federales de monitoreo existentes y los recursos disponibles. La TCEQ se compromete a garantizar un aire limpio para la gente de Texas. Los comentarios relacionados con qué tan bien las fuentes industriales controlan sus emisiones contaminantes están más allá del alcance de la FYA.

Comentario 10:

Earthjustice declaró que las comunidades de Coastal Bend al norte de la Bahía de Corpus Christi necesitaban urgentemente datos de monitoreo del aire para caracterizar la calidad del aire actual y garantizar la protección de la salud pública. Earthjustice declaró que el área había experimentado un desarrollo industrial masivo y una expansión con numerosos sitios permitidos por la TCEQ en el área y más acciones de permisos pendientes, además de la contaminación existente de los grandes barcos que atracan y transportan productos básicos en la Bahía y el Canal de Corpus Christi.

Earthjustice declaró que los residentes afectados y los posibles receptores a favor del viento en el área general necesitan que las autoridades estatales y reguladoras cumplan con la intención de la ley de aire limpio <sic> de monitorear la calidad del aire con el fin de tomar más medidas de permisos que protejan la salud pública y mejoren la calidad del aire.

Respuesta 10:

La TCEQ reconoce las recomendaciones para ampliar el monitoreo en el área de Coastal Bend al norte de la Bahía de Corpus Christi. La TCEQ está trabajando actualmente con la ciudad de Portland para establecer un nuevo sitio de monitoreo de la calidad del aire en el área de Coastal Bend. El nuevo sitio se espera para 2026 y contará con instrumentación para monitorear $PM_{2.5}$ continuo, VOC por bote y meteorología.

La red de monitoreo del aire de la TCEQ está diseñada para medir las concentraciones de contaminantes para evaluar la calidad del aire regional representativa de las áreas frecuentadas por el público y para proporcionar información sobre el cumplimiento de la NAAQS. Los sitios de monitoreo del aire generalmente se colocan para ser representativos de la calidad del aire regional, y aunque los sitios a menudo se colocan donde se cruzan grandes sectores del público y la industria, no miden las emisiones de fuentes específicas. La TCEQ señala que las regulaciones federales de monitoreo no requieren monitores de aire ambiente en todos los condados de una CBSA. Si bien Texas actualmente está excediendo los requisitos federales para monitorear los contaminantes de criterio en Corpus Christi CBSA (TCEQ está obligado a operar entre tres y cuatro monitores, pero excede los requisitos con nueve, más cinco monitores adicionales de iniciativa estatal), reconocemos que ninguno de estos monitores está ubicado en el área de Coastal Bend al norte de la Bahía de Corpus Christi. La TCEQ evalúa la ubicación de sus monitores de aire utilizando datos de población, así como datos de inventario de emisiones informados, lo que resulta en la colocación de monitores de aire en áreas donde grandes sectores de la población se cruzan con una presencia significativa de la industria y tiene planes de agregar un sitio de monitoreo del aire en Portland, Texas, como se discutió anteriormente. Los datos de los monitores activos de Corpus Christi están disponibles públicamente en la página web de la TCEQ Calidad del Aire y Monitoreo de la TCEQ , e informan el pronóstico diario de la calidad del aire para el área. Estas herramientas ayudan a informar a las comunidades sobre las condiciones actuales de calidad del aire en el área general.

La TCEQ siempre ha cumplido con sus requisitos legales para garantizar que la red proporcione la información necesaria para monitorear adecuadamente las áreas dentro de Texas de acuerdo con las regulaciones federales de monitoreo del aire.

Comentario 11:

Earthjustice comentó que los datos de la TCEQ sobre el NO_2 cerca de la carretera deberían proporcionar un "medio claro para determinar si el NAAQS se estaba cumpliendo dentro del entorno cercano a la carretera en un área en particular". Earthjustice comentó que las poblaciones de Houston y DFW CBSA superaron los 7.25 millones de personas, casi tres veces el requisito de población para los requisitos mínimos (2) cerca de la carretera e instó a la TCEQ a ayudar al Departamento de Transporte de Texas (TXDOT) instalando monitores adicionales cerca de la carretera en esos dos CBSA masivos. Los monitores adicionales cerca de la carretera proporcionarían mejores datos para que TXDOT mitigue la contaminación del aire cerca de la carretera para las comunidades urbanas y logre un mejor rendimiento del programa. Earthjustice declaró que FYA debería documentar mejor el crecimiento de la población en toda la región e identificar áreas de crecimiento para un mayor monitoreo. Earthjustice solicitó dos monitores adicionales de NO_2 cerca de la carretera en cada uno de los CBSA masivos para reflejar mejor la cantidad de contaminación en función de la población.

Earthjustice también instó a la TCEQ a agregar monitoreo de ozono cerca de algunas de las mayores fuentes de emisiones de precursores de ozono en el área de Austin, incluso en el condado de Fayette. Señalaron que al menos un monitor en el condado de Fayette proporcionaría al público una mejor comprensión de la calidad del aire y permitiría a la TCEQ y otras entidades gubernamentales planificar mejor.

Respuesta 11:

La TCEQ reconoce las recomendaciones para ampliar el monitoreo del NO_2 cerca de la carretera y el ozono; sin embargo, no es necesario un monitoreo adicional para cumplir con los requisitos federales diseñados para garantizar una cobertura adecuada para el monitoreo del aire ambiente. Los requisitos federales para los contaminantes criterio son establecidos por la EPA para proteger la salud y el bienestar públicos. La TCEQ cumple con los requisitos de monitoreo cerca de la carretera según los últimos datos disponibles de la Oficina del Censo de EE. UU. (2023) en el momento en que se redactó el FYA. Los requisitos de monitoreo de NO_2 cerca de la carretera se basan en la población de la CBSA y los recuentos de tráfico diario promedio anual (AADT) en segmentos de carretera dentro de la CBSA. Se requiere un monitor en las CBSA con una población de un millón o más. Se requiere un segundo monitor en CBSA con una población mayor o igual a 2.5 millones o CBSA con poblaciones mayores o iguales a 1 millón y un AADT de carretera mayor o igual a 250,000 en uno o más segmentos de carretera.

La TCEQ aclara que los requisitos de monitoreo cerca de la carretera bajo 40 CFR Parte 58, Apéndice D, Sección 4.3.2, no requieren más de dos sitios de monitoreo cerca de la carretera para CBSA con más de 2.5 millones de personas, y la TCEQ cumple con estos requisitos en todos los CBSA de Texas. La TCEQ no está de acuerdo con que el FYA 2025 no documentó el crecimiento de la población. El FYA 2025 de la TCEQ evaluó el crecimiento de la población en muchos niveles en todas las áreas de Texas, y abordó específicamente las predicciones de crecimiento de la población del centro de Texas para la CBSA de Austin, como se indica en la página 113 de FYA que "la CBSA de Austin requerirá un sitio adicional de monitoreo de NO_2 cerca de la carretera cuando la población supere los 2,500,000, probablemente antes de 2030 según las proyecciones de población". La TCEQ se complace en asociarse con otras organizaciones estatales; sin embargo, debido a las limitaciones de fondos y recursos, la TCEQ no puede apoyar iniciativas adicionales en este momento.

La TCEQ evalúa la ubicación de sus monitores de aire utilizando datos de población, así como datos de inventario de emisiones informados, lo que da como resultado la colocación de monitores de aire en áreas donde grandes sectores de la población se cruzan con una presencia significativa de la industria. El condado de Fayette no está delineado en ninguna CBSA de Texas y, por lo tanto, no existen requisitos federales de monitoreo del aire para ese condado. Los monitores más cercanos al condado de Fayette incluyen monitores meteorológicos y de ozono no regulatorios en el condado adyacente de Bastrop en el sitio de Bastrop del Consejo de Gobiernos del Área Capital (CAPCOG). La TCEQ financia subvenciones para que las entidades locales realicen un monitoreo adicional del aire en el área a medida que haya fondos disponibles y actualmente se asocia con CAPCOG para proporcionar datos adicionales de monitoreo del aire en las ubicaciones de Austin CBSA. Para obtener información adicional sobre los programas de calidad del aire de CAPCOG, consulte Calidad del aire ⋆ Consejo de Gobiernos del Área Capital (CAPCOG). Los datos de estos monitores, así como de otros monitores de la TCEQ en la CBSA, están disponibles públicamente en la página web de la TCEQ Calidad del aire y monitoreo de la TCEQ. Aunque los datos de estos monitores no reglamentarios no cumplen con los requisitos especificados en 40 CFR Parte 58 para compararlos con los NAAQS, los datos proporcionan una mayor comprensión de la calidad del aire en la región. Estas herramientas ayudan a informar a las comunidades sobre las condiciones actuales de calidad del aire en el área general. La Figura E ilustra los sitios de monitoreo del aire de TCEQ y CAPCOG en Austin CBSA.

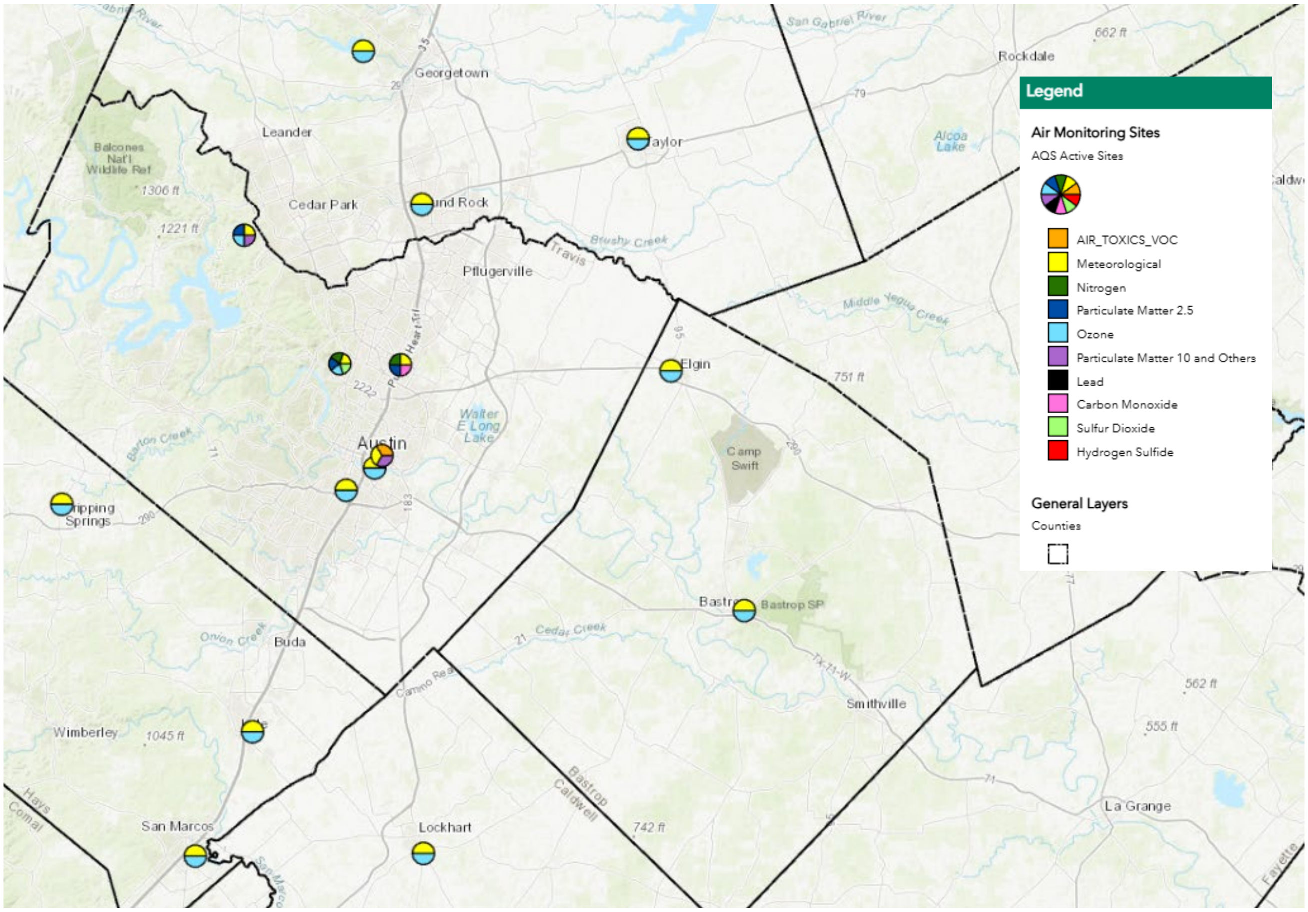


Figura E: Sitios de monitoreo activo del aire del área de Austin y contornos del condado

Comentario 12:

Earthjustice comentó que era imperativo que la TCEQ agregara monitores cerca de las principales fuentes de grandes emisores de $PM_{2.5}$ para cumplir con la directiva principal de proteger la salud pública, incluso en áreas rurales y de baja población. Earthjustice recomendó, como mínimo, monitores cerca de algunas de las fuentes de partículas más grandes del estado en W.A. Parish en el condado de Fort Bend, cerca de la planta de energía de Fayette en el condado de Fayette y cerca de la planta de energía de Martin Lake en el condado de Rusk.

Respuesta 12:

La TCEQ reconoce los comentarios que solicitan la instalación de monitores de $PM_{2.5}$ en condados rurales y de baja población con grandes fuentes de emisión; sin embargo, no es necesario un monitoreo adicional para cumplir con los requisitos federales diseñados para garantizar una cobertura adecuada para el monitoreo del aire ambiente. Los requisitos federales para los contaminantes criterio son establecidos por la EPA para proteger la salud y el bienestar públicos. Si bien la TCEQ se esfuerza por equilibrar estratégicamente el cumplimiento de los requisitos federales de monitoreo del aire con las preocupaciones estatales y locales, las limitaciones de fondos y recursos afectan la capacidad de realizar el monitoreo del aire en respuesta a todas las solicitudes. Como resultado, la TCEQ prioriza el monitoreo del aire que se requiere a nivel federal para evaluar la calidad del aire para el cumplimiento de los estándares federales de calidad del aire.

La red de monitoreo de aire estacionario de TCEQ está diseñada para cumplir con los requisitos federales de monitoreo del aire de la Ley de Aire Limpio que dicta la cantidad de monitores requeridos para cada uno de los seis contaminantes criterio en áreas pobladas o CBSA en todo el estado. La red de monitoreo del aire se utiliza para caracterizar la calidad del aire regional en áreas a lo largo del tiempo, pero no mide las emisiones de las fuentes. La TCEQ actualmente supera los requisitos federales de monitoreo de $PM_{2.5}$ en Texas.

Comentario 13:

EDF instó a la TCEQ a mejorar el monitoreo del ozono y los precursores del ozono en la Cuenca Pérmica debido a los considerables datos que indican que el ozono probablemente excede la NAAQS y es perjudicial para la salud de las poblaciones vulnerables que viven cerca de las instalaciones de petróleo y gas. EDF reiteró muchas de las mismas preocupaciones con respecto a los comentarios sobre el AMNP 2025 de la TCEQ, señalando que la FYA y la red de monitoreo del aire de la TCEQ no midieron la contaminación por ozono en la Cuenca Pérmica y la ausencia de la misma socavó el mandato de la Ley de Aire Limpio para un monitoreo sólido del aire en regiones con altas emisiones como la Cuenca Pérmica.

EDF solicitó un monitor de ozono, (específicamente) en la región de Midland-Odessa, para ayudar a Texas a evaluar los problemas de transporte de ozono. EDF afirmó que los precursores del ozono en la Cuenca Pérmica de Texas justificaban la colocación de más monitores para NO_x, VOC y ozono para cumplir con la aplicación de la Ley de Aire Limpio y la NAAQS. EDF declaró que el aumento en la producción de petróleo y gas ha convertido a la Cuenca Pérmica en la mayor fuente de NO_x y VOC en la región. EDF declaró que los monitores existentes que miden el ozono alrededor de la Cuenca Pérmica mostraron que la región probablemente estaba excediendo el NAAQS de ozono (como el monitor de ozono del Parque Nacional de las Montañas de Guadalupe, desmantelado en 2022). Señalaron que esto estaba respaldado por los valores de diseño del monitor de ozono cercanos que excedían el NAAQS de ozono de 0,70 partes por billón (ppb) recolectado en los últimos tres años calendario consecutivos.

EDF señaló que un número significativo de personas vivía en los condados afectados y también en las proximidades de los sitios de petróleo y gas; por lo tanto, se deben agregar nuevos sitios a la red para lograr un programa integral de monitoreo del ozono y proteger mejor la salud pública de los tejanos que viven en la Cuenca Pérmica. EDF declaró que la TCEQ claramente no monitoreó el pico de contaminación del aire o las fuentes significativas de contaminación del aire. Además, EDF declaró que "dentro de una red de ozono, al menos un sitio de ozono para cada área estadística metropolitana (MSA)... debe diseñarse para registrar la concentración máxima para esa área metropolitana en particular", y como tal, la población combinada para el área estadística combinada (CSA) de Midland-Odessa excedió el umbral para el cual se requería un monitor de ozono, según la Tabla D-2 del Apéndice D de la Parte 58 (Tabla D-2). EDF criticó a la TCEQ por contar las MSA muy grandes (por ejemplo, San Antonio, Dallas-Fort Worth-Arlington, etc.) como "unidades individuales" en la Tabla D-2 y declaró que sería arbitrario y caprichoso tratar a estos grandes conglomerados urbanos como unidades individuales en la Tabla D-2, mientras se niega a hacer lo mismo para la CSA de Midland-Odessa, mucho más pequeña. EDF señaló que incluso si el área de Midland-Odessa se trataba como una MSA en lugar de una CSA, los requisitos de monitoreo del ozono de NAAQS aún eran aplicables. Se alentó a la TCEQ a utilizar los valores de diseño de ozono de los monitores adyacentes / cercanos como la mejor estimación disponible para el valor de diseño de Midland-Odessa. Al determinar dónde colocar monitores, EDF alentó a la TCEQ a pensar y actuar más allá de la Tabla D-2, incluida la consideración de datos de monitoreo privados en lugar de una red de monitores de ozono en la Cuenca Pérmica; EDF afirmó que no había base legal para que la TCEQ no considerara que estos datos indicaban excedencias de NAAQS. Ignorar estos datos se consideraría arbitrario y caprichoso, especialmente cuando la TCEQ utilizó datos de monitoreo privados para tomar determinaciones de ubicación.

Respuesta 13:

La TCEQ reconoce la recomendación de ampliar el monitoreo del aire en la Cuenca Pérmica. Los requisitos federales de monitoreo del ozono, que están diseñados por la EPA para evaluar la calidad del aire, son activados por la población de MSA en función de las últimas cifras del censo disponibles (consulte 40 CFR Parte 58.50 (c) y la Tabla D-2 de 40 CFR Parte 58, Apéndice D). En el cuadro D-2 se clasifican específicamente las necesidades de supervisión en función de las dietas por misión de las EEM. La TCEQ no está de acuerdo en que su uso del área de la Cuenca Pérmica de Texas delineada por la OMB de dos MSA separadas, Odessa y Midland, sea arbitrario o caprichoso.

La TCEQ utiliza definiciones basadas en estadísticas para las MSA, según lo define y delinea la Oficina de Administración y Presupuesto de los Estados Unidos (OMB). Los estándares OMB 2020 (86 FR 37770) establecen que cada MSA debe tener al menos un área urbana de 50,000 o más habitantes. Según los estándares de delimitación de la OMB, las MSA se caracterizan por una densidad de población relativamente alta en su núcleo, que consiste en el condado o condados asociados con al menos un área urbanizada / grupo urbano de al menos 10,000 habitantes o el condado (o condados) en el que reside al menos el 50% de la población. Si se cumplen los criterios especificados, un área estadística metropolitana que contenga un solo núcleo con una población de 2.5 millones o más puede subdividirse para formar agrupaciones más pequeñas de condados denominadas "divisiones metropolitanas". En algunos casos, la OMB ha fusionado áreas anteriormente separadas. La OMB reevaluó la delineación de MSA en 2023 en función del censo decenal de 2020 y no asignó ningún cambio a las MSA de Midland u Odessa en función de estos estándares. La expansión de los desarrollos de petróleo y gas no requiere la instalación y el monitoreo de ozono y sus precursores (NO_x y VOC) para cumplir con los requisitos federales de monitoreo. La TCEQ cumple con los requisitos federales de monitoreo de ozono para las MSA en el área de la Cuenca Pérmica, como se detalla en el Apéndice H del AMNP 2025 de la TCEQ, y no se recomiendan cambios adicionales en este momento.

Como se indicó en la introducción, el monitoreo de iniciativa estatal no está incluido en este Plan; sin embargo, la TCEQ implementó tres sitios de monitoreo del aire de iniciativa estatal de la Cuenca Pérmica que monitorean continuamente los VOC (por autoGC), SO_2 y H_2S en Odessa, Goldsmith y Midland en 2020 y 2021. Además, TCEQ operó un muestreador de bote de VOC no continuo en el sitio de monitoreo del aire de Odessa Hays de 1993 a 1999, un monitor continuo de VOC de 1999 a 2015 y ha operado un muestreador de bote de VOC no continuo desde 2015. Los sitios y monitores activos del aire de la Cuenca Pérmica, incluido el monitoreo por iniciativa estatal, se ilustran a continuación en la Figura F. La información más reciente sobre la red de monitoreo del aire de la TCEQ y los datos de monitoreo, incluida la información sobre los sitios de la Cuenca Pérmica, están disponibles en la página web de la [TCEQ Calidad del aire y monitoreo de la TCEQ](). Los comentarios relacionados con el uso de datos de monitoreo privado están fuera del alcance de la FYA.

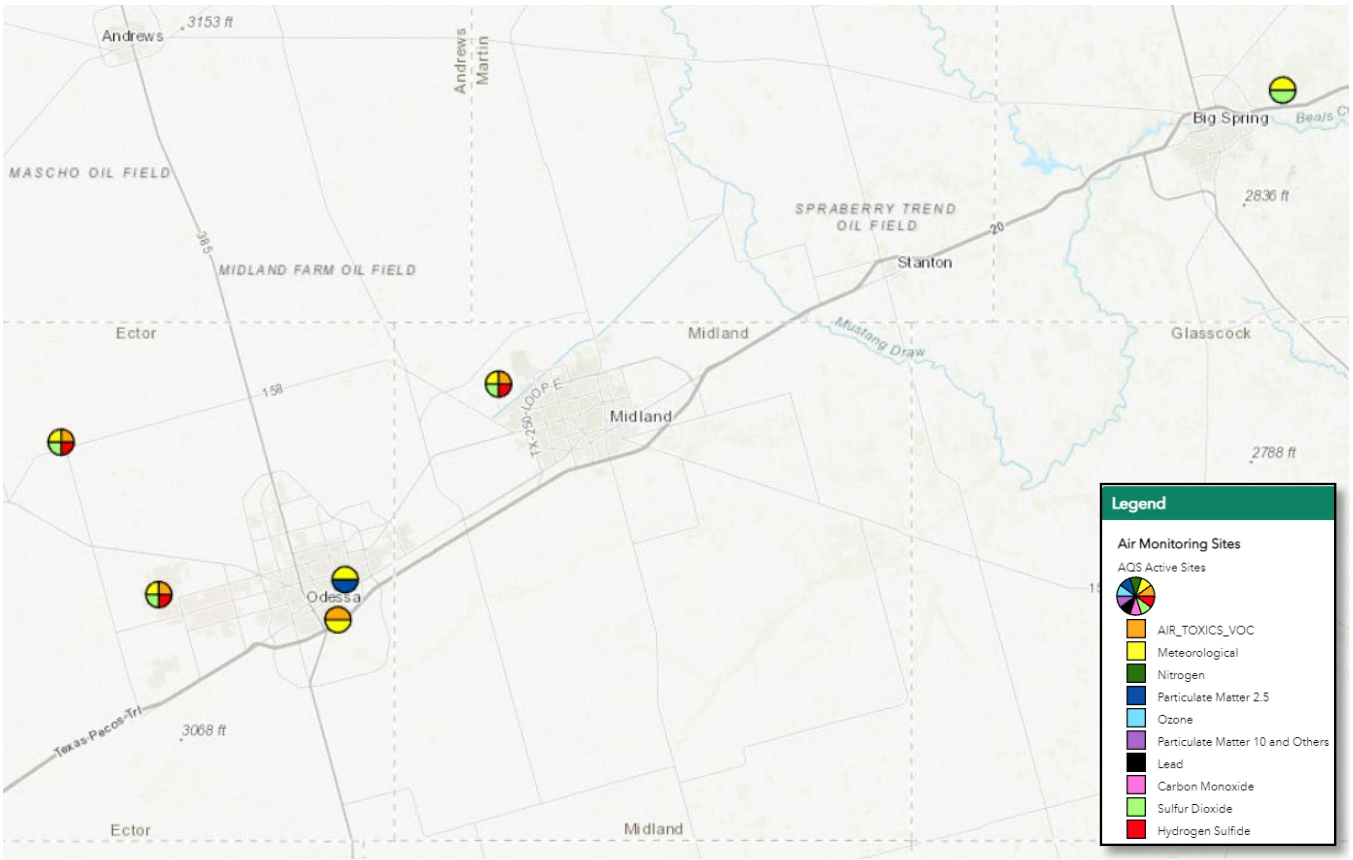


Figura F: Sitios y monitores del área de la cuenca Pérmica

EARTHJUSTICE

June 30, 2025

Via email: tceqamnp@tceq.texas.gov
Texas Commission on Environmental Quality
P.O. Box 13087
Attention: Holly Landuyt, MC-165
Austin, Texas 78711-3087

Re: Texas 2025 Five-Year Ambient Air Monitoring Network Assessment

Dear Ms. Landuyt:

Air Alliance Houston, and the undersigned Commenters, all of whom represent thousands of members and supporters that live, work and recreate in Texas, respectfully submit these comments regarding the Texas Commission on Environmental Quality's ("TCEQ") 2025 Five-Year Ambient Air Monitoring Network Assessment. A response to each suggested revision below is requested.

Many of these same organizations recently offered detailed comments to TCEQ's proposed Annual Monitoring Network Plan for 2025 ("2025 Plan"). Those comments demonstrated that TCEQ's monitoring network fails, in numerous ways, to comply with applicable federal regulations and, most importantly, fails to document how Texans are exposed to dangerous and toxic air pollutants. Those comments are fully applicable here as well and are therefore incorporated by reference and attached.[1]

For years, TCEQ has failed to achieve air quality consistent with public health standards for most of the major metropolitan areas across the state. This failure is due in part to the inability of this air quality monitoring plan to identify specific sources that should be required to add pollution control equipment in order to protect to the highest degree possible the airshed of the surrounding community. According to the American Lung Association's "State of the Air" report, released April 2025, the Houston-Pasadena, Texas air shed is the seventh worst in the U.S. for ozone and the eighth worst for year-round particle pollution. The Dallas, San Antonio and El Paso areas all fall within the top twenty worst cities for ozone and the Brownville area is 16th for year-round particulate pollution.[2] Air quality across the state is dangerous for Texans, and conditions are not improving.

[1] Exhibit A, Earthjustice, Public Hearing Request and Comments on the 2025 Annual Monitoring Network Plan, May 14, 2025 ("Earthjustice Comments").
[2] American Lung Association, "State of the Air 2025 Report," available at https://www.lung.org/getmedia/5d8035e5-4e86-4205-b408-865550860783/State-of-the-Air-2025.pdf; see also American Lung Association, "Most Polluted Cities 2025," available at https://www.lung.org/research/sota/city-rankings/most-polluted-cities

This 2025 Five-Year Ambient Air Monitoring Network Assessment ("FYA") could be a step forward in addressing those failures by seeking to enhance the air pollution measured in growing communities. Only once measured, can TCEQ take the appropriate regulatory steps to lower pollution limits and loads for communities. As such, these comments focus on the statutory requirements that should be included but have been left out, as well as the unique populations throughout the state that require additional investment for air monitoring to address localized, state-wide and regional concerns.

I. Regulatory Requirements for Plan:

A. Susceptible Individuals

TCEQ is required to consider populations most at risk of harm through poor air quality but does not clearly identify how this assessment does so. Under federal law, "[t]he network assessment must consider the ability of existing and proposed sites to support air quality characterization for areas with relatively high populations of susceptible individuals (*e.g.*, children with asthma) and other at-risk populations." [3] 40 CFR part 58.10(d). This concern for susceptible Texans is dismissed in the Assessment because TCEQ equates meeting the minimum NAAQS standards as being the same as protecting susceptible persons.[4] But while the NAAQS standards set the floor for general public health standards for a community, the express delegation of authority to TCEQ requires it to do more for unique and susceptible or at-risk individuals. This is why analysis regarding census tracts, or data readily available from other sister agencies, highlighting the at-risk populations in certain counties, is needed in this document.[5]

For example, a survey of online data and technical resources reveals that TCEQ could have easily identified susceptible individuals and at-risk populations with very little effort and correlated this

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[3] "The State [] agency shall perform and submit to the EPA Regional Administrator an assessment of the air quality surveillance system every 5 years to determine, at a minimum, if the network meets the monitoring objectives [] whether new sites are needed, whether existing sites are no longer needed and can be terminated, and whether new technologies are appropriate for incorporation into the ambient air monitoring network. The network assessment must consider the ability of existing and proposed sites to support air quality characterization for areas with relatively high populations of susceptible individuals (*e.g.*, children with asthma) and other at-risk populations, and, for any sites that are being proposed for discontinuance, the effect on data users . . . ." 40 C.F.R. part 58.10(d).

[4] TCEQ, Texas 2025 Five-Year Ambient Air Monitoring Network Assessment, p. 30-31 ("EPA is required to set health-based NAAQS for pollutants considered harmful to public health and the environment per the FCAA (40 CFR Part 50). The NAAQS are assessed every five years and are set at levels to protect public health within an adequate margin of safety. The standards are set to protect the general public, including sensitive members of the population such as children, the elderly, and those individuals with preexisting health conditions. TCEQ's federal ambient air quality network meets, and in many cases exceeds, the federal monitoring requirements and objectives specified in 40 CFR Part 58 and its appendices, as detailed in each FYA section by pollutant. As such, the number, type, and location of monitors in TCEQ's federal network is sufficient to characterize area air quality for use in evaluations to determine compliance with the NAAQS, for all members of the public, including susceptible individuals."), available at https://www.tceq.texas.gov/downloads/air-quality/air-monitoring/network/draft-tceq-2025-5yr-assessment-english.pdf

[5] *See* American Lung Association, "State of the Air 2025 Report," *supra* note 2.

information with the location of its ambient air monitors. An example of this type of analysis was done by medical researchers and epidemiologists at the University of Washington in a study published in 2018.[6] Researchers recognized that defining susceptibility scientifically required a distinction between the individual level, and the population level. There, the study articulated "[t]he concept of susceptibility, at both the individual and population levels" to "describe[] the characteristics that increase the risk of experiencing adverse health outcomes in response to air pollution exposure."[7] In other words, TCEQ is charged through this assessment to review whether the monitoring plan protects public health both at a communal level, but also on a per person basis, particularly for those most susceptible to air pollution. By doing so, the agency would be better able to ensure that cumulative impacts from air pollution are not impacting already vulnerable communities. Importantly,

> [a]dvances in modern epidemiological methods and exposure assessment methods, combined with experimental studies, have increased confidence in the causal effects of air pollution exposures in communities. . . .Increasingly sophisticated exposure assessments employed in large prospective cohort studies are uncovering evidence that air pollution exposure is linked to new-onset cardiovascular and pulmonary diseases in previously unaffected individuals.[8]

Texas Department of State Health Service (DSHS) provides similar and readily available online mapping tools which illustrate the hospitalization rates and prevalence of asthma and COPD from 2017 – 2022 in each county.[9] This health data could be easily overlaid onto a map showing the locations of TCEQ's federally required ambient air monitors to determine whether additional monitors are needed.

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[6] Hooper, L.G. and Kaufman, J.D., "Ambient Air Pollution and Clinical Implications for Susceptible Populations" in Annals of the American Thoracic Society, April 2018 accessed at: https://pmc.ncbi.nlm.nih.gov/articles/PMC5955035/

[7] *Id*.

[8] *Id*.

[9] Texas Health Data for Asthma and Chronic Obstructive Pulmonary Disorder (COPD), Texas Department of State Health Services accessed at: https://healthdata.dshs.texas.gov/dashboard/surveys-and-profiles/health-facts-profiles/chronic-disease

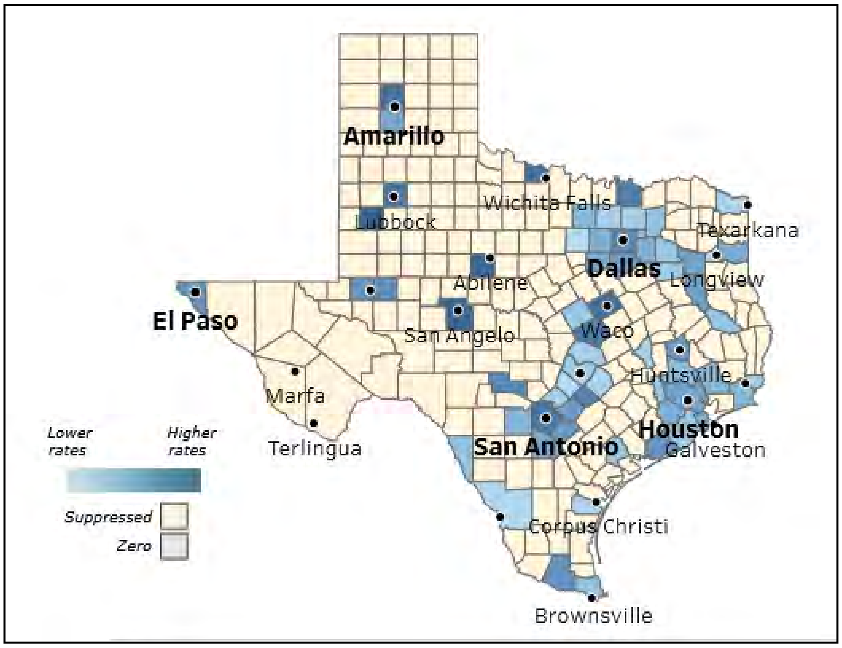


Figure 1. Hospitalization Rates, By County, Texas 2017 - 2020 for Asthma

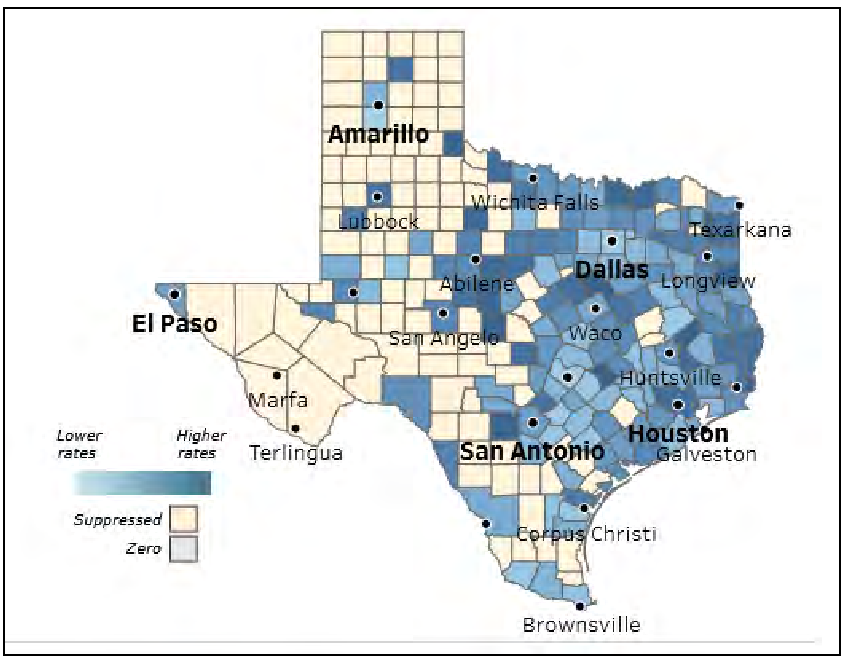
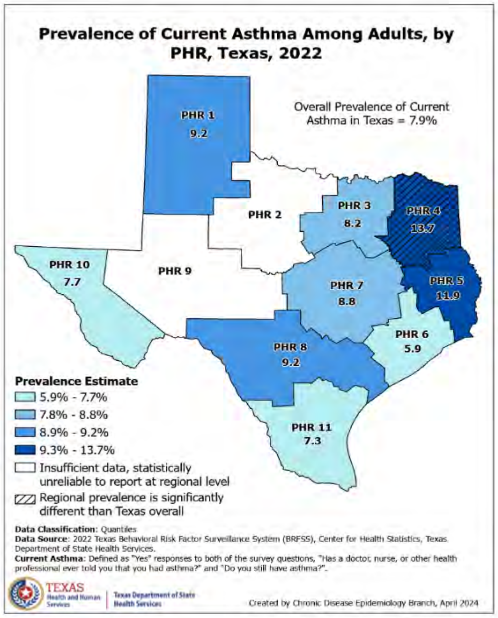


Figure 2. Hospitalization Rates, By County, Texas 2017 - 2020 for COPD

In addition to the mapping tools, DSHS's health data is also available in a downloadable form with hospitalization rates and statistics for each county.

Lastly, Texas DSHS recently published a report named "Impact of Asthma in Texas 2025"[10] which calculated the asthma prevalence rates and identified specific areas where susceptible and at-risk populations are located. "More than 2.2 million adults and children in Texas have asthma. In 2023, uncontrolled asthma among Texans contributed to more than 109,000 emergency department visits and 8,500 hospitalizations. More than $2.2 billion was charged to public and private payers for these encounters. The report was created to accompany the Strategic Plan for Asthma Control in Texas, 2025-2028. Asthma stakeholders can use the data in this report to identify asthma trends, disparities among socio-economic groups, demographic groups, and geographic areas. Data can be used to target priority populations in implementing strategic actions identified in the strategic plan."



DSHS provided maps, analysis results and recommendations to the state in order to minimize air pollution as one of the triggering events for asthma. For example, in figure 3, DSHS concluded that "PHR 4 demonstrated a regional prevalence of 13.7 percent, which is significantly higher than the Texas overall prevalence of 7.9 percent."

Figure 3. Prevalence of Asthma Among Adults by Public Health Region, Texas, 2022

This conclusion thus implies that the region should receive additional monitoring in order to better understand the pollutant load. Had TCEQ utilized sister agency data in this way, this FYA likely would have found that additional federal monitors were necessary in that region. And since TCEQ is charged with using this five-year assessment in order to self-regulate its ability to ensure public health standards are met across the state, we implore TCEQ to utilize the data from DSHS, and other relevant public health services, when reviewing the placement and proposed placement of additional monitors in order to better control the amount of pollution it is routinely permitting into these populations.

B. Review of New Technologies

In the prior five year assessment, many of these same commentors noted that TCEQ is required to consider "whether new technologies are appropriate for incorporation into the ambient air monitoring network." And yet again, TCEQ declines to review any new technology stating that "a full review of available technology was not detailed in this assessment" because the current monitors meet the federal requirements for NAAQS monitors. 40 CFR part 58.10(d). Commenters again request that TCEQ recognize the unique opportunity it has as one of the largest state-run

[10] Impact of Asthma in Texas 2025 Report, Texas Department of State Health Services accessed at: https://www.dshs.texas.gov/sites/default/files/CHI-Asthma/Docs/Reports/Impact-of%20Asthma-in-Texas-2025-Report.pdf

regulatory departments in previewing and adopting technology that will better protect Texas residents. For example, TCEQ could, through this analysis, support the implementation of robust citizen science monitoring in order for it to collect more localized data to better protect health and hold corporate entities responsible for meeting minimizing pollution from various process. By ignoring this opportunity, TCEQ fails to meet the regulatory requirement.

Similarly, NASA's fleet of Earth observing satellites provides detailed information about pollutant loads across the state and nation.[11] By integrating those data points into this assessment, or perhaps into where additional federal monitors should be placed, TCEQ would better meet its objectives. TCEQ should not ignore data points when those data points are scientifically accurate and available.

C. Changes Recommended in the 5 Year Assessment: Add Cement Batch Plants and Aggregate Processing Operations to the Analysis

Table 73 in the Assessment, reproduced below, summarizes the proposed changes in the plan, which includes deactivating two sulfur dioxide monitors and adding a few monitors.[12] Commenters support the addition of any new monitors in part because of the basic belief that TCEQ cannot address reducing air pollution if air pollution is not first measured in the community. The more monitoring done, the better able TCEQ can do its job as the chief regulator. But while

Table 73: Summary of Proposed Changes

Section	Core Based Statistical Area	Air Monitoring Site Name	Parameter(s)	Proposed Action	Estimated Completion Date
Coastal	Corpus Christi	Corpus Christi West	sulfur dioxide	Deactivate SPM monitor, TCEQ 2020 and 2025 Five Year Assessment evaluated monitor as low value	
Coastal	Houston-Pasadena-The Woodlands	Park Place	sulfur dioxide	Deactivate SPM monitor, TCEQ 2020 and 2025 Five Year Assessment evaluated monitor as low value	
Central	Austin-Round Rock-San Marcos	Austin Audubon Society	$PM_{2.5}$	Add state-initiative monitor to federal network if near-road $PM_{2.5}$ data exclusion request is approved	
Central	Austin-Round Rock-San Marcos	To be determined	nitrogen dioxide	Add near-road monitor to meet federal requirements due to increased population estimates	
Central	Killeen-Temple	Temple Georgia	PM_{10}	Add to meet federal requirements due to increased population estimates	
Central	San Antonio-New Braunfels	Frank Wing Municipal Building	site and PM_{10}	Deactivate site and relocate 4.5 miles west to Old Highway 90, improving staff accessibility and safety	December 31, 2025
Central	San Antonio-New Braunfels	Old Highway 90	PM_{10}	Add continuous FEM monitor (relocated from Frank Wing Municipal Building)	December 31, 2025
Panhandle and West Texas	Lubbock	Lubbock 12th Street	ozone	Add monitor to meet federal requirements due to increased population estimates from addition of three counties to the MSA	December 31, 2026

FEM - federal equivalent method
MSA- metropolitan statistical area
NAAQS - National Ambient Air Quality Standard
$PM_{2.5}$ - particulate matter of 2.5 micrometers or less in diameter
PM_{10} - particulate matter of 10 micrometers or less in diameter
SPM - Special Purpose Monitor
TCEQ - Texas Commission on Environmental Quality

the

[11] *See for example*, NASA's Air Quality home page, found here https://airquality.gsfc.nasa.gov/ (last visited June 27, 2025).

[12] 12 TCEQ, Texas 2025 Five-Year Ambient Air Monitoring Network Assessment, p. 267-68, available at https://www.tceq.texas.gov/downloads/air-quality/air-monitoring/network/draft-tceq-2025-5yr-assessment-english.pdf

additional monitors proposed in the Assessment are supported, we request that TCEQ consider withdrawing its near-road $PM_{2.5}$ data exclusion request for the Austin area, as population trends show that additional near-road monitoring in the I-35 corridor around Austin is going to be required sooner rather than later, and a monitor could be installed now, as further set forth in Section H, below. We also request that TCEQ add minor sources to its analysis implicating placement and need of even further additional monitors, as further explained below. [13]

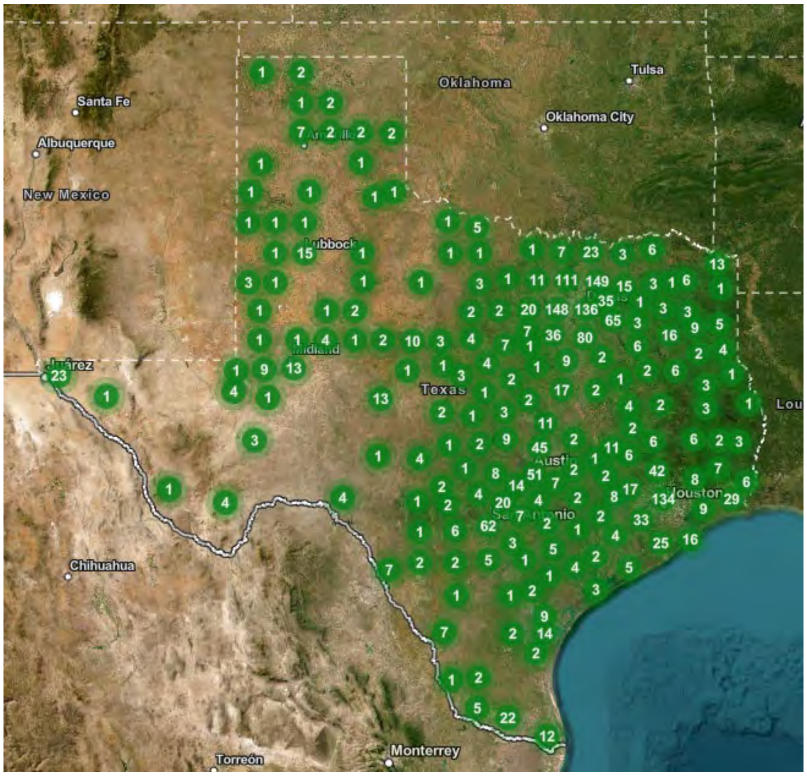


Figure 5. Location of 1,956 CBPs in Texas Source: USEPA ECHO Website for SIC 3273, Ready-Mix Concrete

i. Add Concrete Batch Plants in order to better control PM.

Most concrete batch plants (CBPs) are missing from TCEQ's maps in the FYA and state-wide emission inventory because they are considered minor sources. Cumulatively, however, the contribution of CBPs to particulate matter (PM) emissions are significant. The maps in TCEQ's FYA do not illustrate the location of CBPs, thereby making TCEQ's analysis incomplete as to whether existing or new PM monitors are placed correctly.

Capital Area Coalition of Governments (CAPCOG's) identified the omission of CBPs rather eloquently in their Regional Air Quality Plan[14] in Section 3.10.3:

> In the course of this planning effort, CAPCOG discovered that concrete batch plants appear to not be accounted for anywhere within the National Emissions Inventory (NEI) data for the region. While these facilities are subject to a standard permit from the TCEQ, they do not report emissions annually to TCEQ as a point source, and EPA does not have a non-point source emissions category covering these emissions. There are numerous concrete batch plants across the region, including in locations very close to residential

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[13] "The State . . . [shall] determine, at a minimum, if the network meets the monitoring objectives defined in appendix D to this part, whether new sites are needed . . ."

[14] Addendum to 2019-2023 Austin-Round Rock-Georgetown MSA Regional Air Quality Plan (CAPCOG, November 10, 2021) accessed at: https://www.capcog.org/wp-content/uploads/2024/04/2019-23-ARRG-MSA-RAQP-11-10-21-Addendum.pdf

> areas, and the lack of emissions data from this source is a potentially very significant gap in our understanding of PM pollution within the region. Since there are also controls available that can significantly reduce PM pollution from these facilities as well, the lack of emissions data also limits our understanding of the extent to which emissions from these facilities can be further controlled."

A search in USEPA's ECHO database[15] for SIC 3273 (Ready-Mixed Concrete) revealed 1,956 CBPs in Texas. Figure 5 shows the location of nearly 2,000 CBPs in Texas. TCEQ has not illustrated or considered these CBPs in their maps in its Draft FYA versus the location of existing and planned PM2.5 monitors. In fact, emissions from only 3 CBPs in Texas were reported to the USEPA's National Emission Inventory (NEI) despite Texas having the highest number of CBPs in the country.[16]

This data gap was described in detail in a peer-reviewed study published in the Journal of Environmental Science and Technology in 2023 by Indiana University. This study quantified PM2.5 emissions from 131 CBPs in Houston.[17] The researchers concluded that:

- No previous studies have systematically investigated emissions from all CBPs in a large geographic area.
- CBPs are frequently considered by regulators to be a small industrial source.
- CBPs typically operate under permits with less documentation and regulatory review compared to other types of permits (i.e., Title V).
- Individual CBPs emit modest amounts of PM, but their aggregate emissions as an industrial category are quite substantial.
- CBPs are typically located in proximity to population centers.

The researchers also concluded that CBPs make a substantial contribution to emissions of PM2.5 and are the 80th most polluting industry based on PM2.5 emissions per Figure 6.

[15] USEPA Enforcement and Compliance History Online (ECHO) database accessed at: https://echo.epa.gov/facilities/facility-search/results
[16] Zirogiannis et al, "Polluting under the Radar: Emissions, Inequality, and Concrete Batch Plants in Houston", Environmental Science and Technology 57 (2023), 11410, 11411, accessed at: https://pubs.acs.org/doi/10.1021/acs.est.3c04412?fig=tgr1&ref=pdf
[17] *Id*. at 11410.

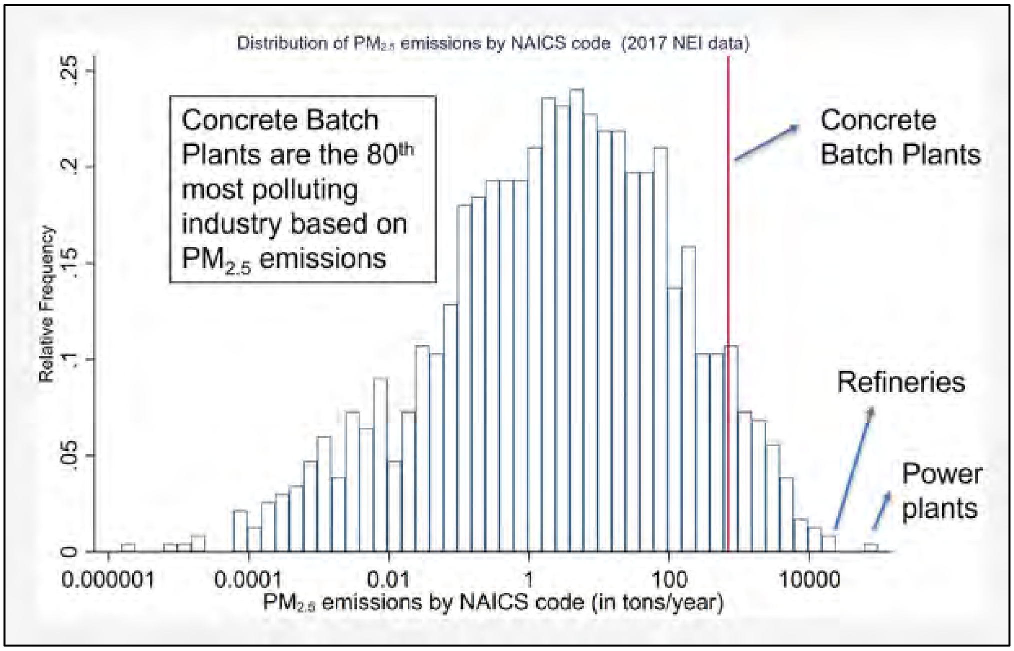

Figure 6. Distribution of PM2.5 Emission by NAICS Code. Source: Indiana University

The researchers at Indiana University also stated:

> The cumulative total of $PM_{2.5}$ emissions from the 101 CBPs in the study's data set that list PM thresholds in their permits, assuming that the plants are emitting at their maximum permitted level, is 111 tons annually.
>
> By comparison, annual $PM_{2.5}$ emissions from the median Title V source in Texas are 1.9 tons. Title V facilities are considered "*major*" sources of pollution for regulatory purposes according to the CAA.[18]

Zirogiannis et al., estimated that annual emissions were 111 tons of $PM_{2.5}$ for 101 CBPs in the Houston area, which corresponds to an average annual emission of 1.1 tons per year (tpy) for each CBP.[19] TCEQ could use this estimate or its own to update its maps showing the location of CBPs throughout the State of Texas.

The EASIUR model (Estimating Air pollution Social Impact Using Regression) is a reduced-complexity model (RCM) used to estimate the social cost or public health cost of air pollution emissions in the United States. For Harris County, Zirogiannis et al., estimated that:

- Using the direct emissions of $PM_{2.5}$ from CBPs in Harris County, the EASIUR model predicts two premature mortalities a year, amounting to $29 million in annual health damages.

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[18] *Id*. at 11414.
[19] *Id*.

- Across all the confidence intervals, the widest range of damages is from 7.6 to 49.4 million dollars (2023 $).[20]

Given the substantial public health cost from clusters of CBPs, it is important that TCEQ does not ignore the location of CBPs throughout the state.

EPA expressed concerns in June 2023 to TCEQ that the PM2.5 emissions from CBPs could potentially exceed the National Ambient Air Quality Standard (NAAQS), especially when there are multiple CBPs located near one another: [21]

- In addition to engineering controls for dust suppression, EPA suggests that TCEQ require all CBPs to install fenceline PM2.5/10 sensors or monitors.
- The protectiveness review should be updated to evaluate and account for possible overlap of impacts of multiple concrete batch plants authorized under the standard permit located in close proximity to each other to fully demonstrate that cumulative impacts from the amended CBP Standard Permit (SP) will not lead to violations of the NAAQS and/or state health effects levels, or cause nuisance level impacts on local residents and businesses.

Given all of these shortcomings with estimating emissions from nearly 2,000 CBPs which currently operate in Texas, TCEQ should identify their locations, highlight where clusters of CBPs exist and determine whether additional PM2.5 monitors are needed.

ii. Add Emission Estimates from Aggregate Production Operations (APOs)

TCEQ's database for APOs reveals a total of 1,104 active quarries in Texas which corresponds to 236 square miles of disturbed land. [22] The maps in TCEQ's FYA do not illustrate the location and emissions from these APOs, thereby making TCEQ's analysis incomplete as to whether existing or new PM monitors are placed correctly.

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[20] *Id*. at 11415-16.

[21] EPA provided written comments to TCEQ on June 14, 2023, for the proposed amendments to the Non-Rule Air Quality Standard Permit for Concrete Batch Plants.

[22] TCEQ Search for Active Aggregate Production Operations accessed at: https://data.texas.gov/stories/s/Search-for-Active-Aggregate-Production-Operations/9kvs-ig69/

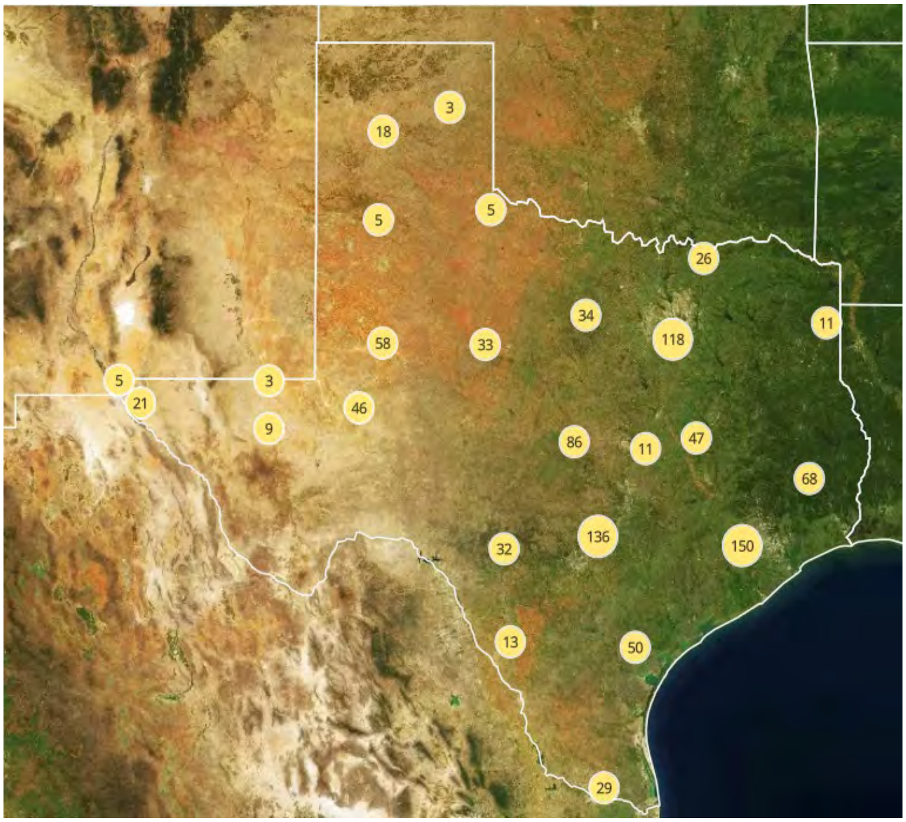

Figure 7. Location of 1,014 APOs in Texas Corresponding to 236 Square Miles of Disturbed Land (Source: TCEQ APO Database)

CAPCOG initially estimated that mining and quarry operations contribute to 3% of regional PM emissions.[23]

Table 6-1. Largest sources of $PM_{2.5}$ and Organic Carbon $PM_{2.5}$ Emissions in the region, 2017

Source Category	Tons per year $PM_{2.5}$	% of Total $PM_{2.5}$ Emissions	Tons per year OC $PM_{2.5}$	% of Total OC $PM_{2.5}$ Emissions
Road Dust	2,325	22%	153	6%
Construction Dust	1,693	16%	78	3%
Open Burning	1,574	15%	611	26%
Prescribed Fires	861	8%	403	17%
Agricultural Dust	793	8%	24	1%
Commercial Cooking	417	4%	279	12%
Mining and Quarrying	326	3%	0	0%
Subtotal	**7,989**	**76%**	**1,548**	**65%**

Figure 8. Table Excerpt from CAPCOG

[23] CAPCOG, Addendum to 2019-2023 Austin-Round Rock-Georgetown MSA Regional Air Quality Plan (Nov.10, 2021), Table 6-1 on p. 39, accessed at: https://www.capcog.org/wp-content/uploads/2024/04/2019-23-ARRG-MSA-RAQP-11-10-21-Addendum.pdf

However, CAPCOG pointed out that these estimates are likely too low and incomplete in the discussion about data gaps and they identified a high degree of uncertainty within national/state/regional emission inventories.

CAPCOG described how EPA's NEI[24] only includes certain activities for nonpoint mining and quarrying emissions estimates:[25]

- Overburden removal;
- Drilling and blasting; and
- Loading and unloading activities.

EPA's estimates do not include the following activities which may be significant sources of PM emissions:

- Emissions from any internal combustion engines used on-site for either mobile or stationary equipment;
- Fugitive dust emissions from paved and unpaved roads; and
- Any offsite emissions from stationary plants.

Recognizing the significance of the data gap, CAPCOG added fugitive dust emissions from two large quarries (Austin White Lime and Texas Lehigh Cement Company) to its Regional Air Quality Plan. TCEQ, however, continues to ignore these emissions in its planning.

Given all of these shortcomings with estimating emissions from 1,014 APOs which currently operate state-wide in Texas, TCEQ should identify all their locations, improve its emission estimation methodology and determine whether additional PM2.5 monitors are needed.

II. Individual Communities Should Receive Additional Monitoring Based on the FYA

Commenters believe that this FYA provides another opportunity for community groups to engage with TCEQ and urge the inclusion of additional monitors to meet the intended objective of ensuring TCEQ is reducing pollution throughout the state by adequately measuring pollution in the first place. As such, the comments below reiterate the request from communities to add specific monitors to better assess air quality in the future and mirror comments previously submitted:

A. Ellis County and Midlothian, Texas

Midlothian Breathe is a group of local residents in Midlothian, Texas, the proclaimed "cement capital" of Texas. Since April 2022, the Midlothian Old Fort Road monitor has been off-line and

[24] 2020 National Emissions Inventory Technical Support Document: Industrial Processes – Mining and Quarrying, EPA-454/R-23-001bb (USEPA, March 2023) accessed at: https://www.epa.gov/system/files/documents/2023-03/NEI2020_TSD_Section28_MiningQuarrying.pdf

[25] Addendum to 2019-023 Austin-Round Rock-Georgetown MSA Regional Air Quality Plan, (CAPCOG, November 10, 2021) accessed at: https://www.capcog.org/wp-content/uploads/2021/12/2019-23-ARRG-MSA-RAQP-11-10-21-Addendum.pdf

though slated to be relocated and activated by the end of August 2024, was never activated due to on-going problems with siting and city ordinances, as TCEQ notes in the annual plan:[26]

Midlothian OFW	Midlothian North Ward Road	891 North Ward Road, Midlothian, Texas (pending permit approval by the City of Midlothian Development Review Committee)	Relocation approximately 0.7 mile southwest on current property due to property owner revocation of site access (new property owners), approved by the EPA in a letter dated November 17, 2023.Site construction permit denied, site logistical updates to meet city Development Review Committee requirements and local ordinances under continued negotiation with City of Midlothian.	Site temporarily deactivated April 22, 2022, relocation expected by December 2026

Since the (idled) monitor provides the only actionable data used to safeguard public health, Midlothian Breathe has been very concerned about this long, protracted gap in air quality information. The community group has made continual efforts to raise this issue with local governments and with the TCEQ, to no avail. TCEQ's gap of data for Midlothian will stretch into an unacceptable period of 4.6 years. Despite this, the Midlothian data gap and idled monitor are not addressed in the FYA.

The FYA should articulate this failure and identify a defined date to implement a back-up location in order to ensure that a monitor is placed as quickly as possible. Instead, however, the FYA states that it often takes a year or more to fine suitable locations. Though traditionally TCEQ does not work with local nonprofits, or individual citizens, if TCEQ began working with those most interested in ensuring a reduction in air pollution in their community, TCEQ may more readily identify viable locations, including back-up sites, by gaining community buy-in to the process at the outset.

Per 40 C.F.R. Part 58 Appendix D, TCEQ should also add a new site based on this five year assessment north/northwest of Holcim, Texas in order to better capture particulate matter emissions for this community. This could be achieved in a cost-effective way through moving the former Midlothian FRM monitor to the north/northwest of Holcim, which means data could be collected downwind of the area's most significant particulate matter (PM) emitter. If a monitor is placed there, it would better capture regional issues and capture data that would be missed by the proposed new monitor near Martin Marietta and Gerdau. Because this area has three cement plants and a steel mill, with a growing population that includes the Dallas-Ft. Worth-Arlington CSBA of 7.9 million residents, another monitor is justified and this five year annual review provides support for both the growth in population in that area as well as the continued failure of the area to improve its air quality.

Further, more than just PM should be monitored; the Midlothian area is likely to be in nonattainment of the ozone NAAQS and, in the 10-county North Texas region, Ellis County

[26] TCEQ, Annual Network Monitoring Plan, 2025, p. 43 ("Air Monitoring Site Relocations").

accounts for over 40% of the point source emissions for Nox, according to TCEQ 2022 emissions data.

Midlothian area residents have fallen into a data gap for years because of TCEQ's failure to adequately address worsening air quality and willingness to let the required monitor sit idle. Because members of Midlothian Breathe are ready to assist with garnering community input and support in finding monitoring sites, TCEQ should use this FYA to state it will begin working with community groups or nonprofits to find suitable locations for air monitoring when local conditions show a worsening air shed.

B. Williamson County

Coalition for Responsible Environmental Aggregate Mining (CREAM) is a non-profit organization which seeks to minimize the impacts of Aggregate Production Operations (APOs) and Concrete Batch Plants (CBPs) on local communities. CREAM has over 250 members, many of whom live in or are affected by fugitive dust and fine particulate matter from APOs and CBPs in Williamson County. TCEQ's Annual Draft Plan does not include any $PM_{2.5}$ monitoring systems in Williamson County despite there being 32 active APOs and 45 CBPs within the county boundaries (see full discussion of Aps and CBPs above).[27] And this FYA fails to include CBP's or recognize the central Texas region as a worsening air shed in order to recommend more monitoring. Because CBPs and APOs are extremely dusty and generate substantial quantities of fugitive dust which travels off-site and negatively impacts nearby residents, TCEQ FYA should better account for all sources of pollution and suggest more monitoring in this location.

TCEQ should add at least one $PM_{2.5}$ monitor to Williamson County in order to more clearly determine the county's attainment status according to the NAAQS. At present, the nearest regulatory $PM_{2.5}$ monitors operated by TCEQ are located in Travis and Bell Counties. These are too far away to provide any useful or relevant data for Williamson County.

Sun City is a Williamson County retirement community located in Georgetown, Texas with 9,300 homes and 18,500 senior residents. Poor air quality and fine dust from nearby APOs and CBPs are a concern because of the adverse impact to the health of senior citizens who are more likely to have heart disease and lung disease. This is a particularly sensitive population that needs accurate information about air quality.

CREAM has similar concerns as Midlothian Breathe about monitors taken out of service and/or ignored data. TCEQ placed a temporary monitor (No. 1094) for compliance purposes near several quarries in Jarrell in Williamson County. It was removed in June 2024 after operating for 3.5 years.[28] In its 2024 air monitoring plan, TCEQ gave no indication that the monitor would be shut

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[27] EPA Enforcement and Compliance History Online (ECHO) website queried for Standard Industrial Code 1422, Crushed and Broken Limestone on May 13, 2025 at: https://echo.epa.gov/facilities/facility-search/results; EPA's Website queried for Wiliamson County and SIC code 3273 for Ready-Mixed Concrete on May 13, 2025, at: https://echo.epa.gov/facilities/facility-search/results

[28] "This monitoring site was brought onto the TCEQ real-time data collection system on **Thursday, July 23, 2020** and was deactivated on **Wednesday, June 26, 2024**." TCEQ, "Jarrell FM 487 C1094 Data by

down and instead emphasized its importance to the area: "The TCEQ would like to further clarify that the Jarrell FM487 monitor was not deployed as a result of an enforcement action but was sited on a temporary basis to assess local air quality impacts of nearby particulate matter sources."[29] However, by June of 2024 the Jarrell monitor was deactivated and no new PM monitoring in the area replaced it. The FYA's proposed new monitoring sites does not include Jarrell. Williamson County is categorized as "unclassified" under the $PM_{2.5}$ NAAQS due to a lack of regulatory monitoring data, despite having a dense collection of particulate matter-intense industry throughout the county and despite that monitor indicating the same.

C. El Paso

Similarly, since 2021, TCEQ has not been able to meet the minimum requirements per 40 CFR Part 58 and Appendices, including Section 58.10 and Section 58.14 for monitoring nitric oxide (NO), nitrogen dioxide (NO_2), nitrogen oxides (NO_X), ozone (O_3), particulate matter 2.5 ($PM_{2.5}$), and meteorology at the University of Texas El Paso (UTEP) site.[30]

El Paso UTEP	Pending site selection	Pending site selection	Relocation pending due to property owner revocation of usage agreement (building expansion over site location)	Site temporarily deactivated November 2021, relocation expected by December 2026

That site has not been operational since November 2021 and each year, TCEQ has opined that the site would be relocated, and yet, nearly 5 years later, the site is still not operational. This is particularly problematic in the context of particulate matter because the lack of $PM_{2.5}$ data for El Paso is a barrier to understanding whether the area is in compliance with the new $PM_{2.5}$ NAAQS. Again, this gap is not resolved in the FYA, nor does the list of proposed new monitors include this site.

While many of TCEQ's air monitors require third-party agreements to site the monitors, TCEQ could meet the needs of protecting this community through the use of temporary monitors or even a mobile monitoring unit more permanently parked in order to continue this data collection. Commenters recognize that Texas historically underfunds TCEQ for air monitoring work, and yet, the community of El Paso, like the community in Midlothian, has sought this monitor for years to no avail. TCEQ should consider crafting a prioritization flow chart to better allocate its funds to communities most impacted by air quality concerns to provide for greater transparency and more accountability to the public with respect to the budget for this plan and should partner with local communities to get buy-in for potential site locations. Similarly, this FYA fails to account for this data gap, like its failure with the Ellis County monitor. The FYA should discuss these data gaps in more detail in order to meet the statutory requirements that adequately "assess" air quality.

Site by Date (all parameters)," available at https://www.tceq.texas.gov/cgi-bin/compliance/monops/daily_summary.pl?cams=1094#.

[29] TCEQ, Annual Network Monitoring Plan, 2024, p. 162, available at https://www.tceq.texas.gov/downloads/air-quality/air-monitoring/network/historical/2024-amnp.pdf

[30] TCEQ, Annual Network Monitoring Plan, 2025, p. 43 ("Air Monitoring Site Relocations").

D. Permian Basin

In 2021, EPA stated that the Odessa Gonzalez $PM_{2.5}$ monitor was required in order for the state annual plan to be approved in its entirety.[31] That monitor is still inactive, again, 5 years later, and now EPA has recognized the ongoing concerns related to ozone in that region. Yet, TCEQ's five year assessment fails again to account for this absence or to prioritize its placement. The Permian basin, a world-known oil and gas field, contains countless flares, compressor stations, and other oil and gas equipment all which contribute to local, state-wide and indeed, regional cross-state pollution concerns.

This concern was again expressed in May 2023, where EPA expressly stated to TCEQ that it "should deploy one or more ozone monitors in the Permian Basin."[32]

E. Fort Bend County

Fort Bend County, one of the fastest-growing and most diverse counties in Texas, is also home to the largest coal-fired power plant in the state. The W.A. Parish Electric Generation Station accounts for 66% of the toxic release emissions in the county,[33] and yet Fort Bend has no regulatory air monitoring.

Across the state, over half of the counties with coal plants already have monitors provided by TCEQ or EPA. The Martin Lake and Oak Grove coal plants have scrubbers to reduce SO_2 pollution but also have SO_2 monitoring. The JK Spruce coal plant has baghouses to reduce $PM_{2.5}$ pollution but also has $PM_{2.5}$ monitoring. In contrast, the W.A. Parish is missing three scrubbers on the four coal stacks and lacks SO_2 monitoring.

Fort Bend has had TCEQ monitors over the years, including a one-year Ozone monitor in Rosenberg (deactivated in 1990) and one monitor for Carbon Monoxide and Ozone in Sugar Land (deactivated in 2018). As a result, any data relevant to Fort Bend County has required modeling or extrapolated data from bordering counties. Not only does the county need monitoring, but it needs monitoring for emissions that are relevant and present. Based on a FYA, TCEQ should recognize that air pollution in the county is worsening, and as such, recognize that additional federal monitors are necessary.

i. Sulfur Dioxide

According to the 2021 National Emissions Inventory, facilities in Fort Bend County emitted nearly 34,000 tons of sulfur dioxide (SO_2).[34] Air in the area is completely uncharacterized as there are no

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[31] EPA to TCEQ, Oct. 20, 2021, providing EPA's response to proposed draft monitoring plan; available at https://www.tceq.texas.gov/downloads/air-quality/air-monitoring/network/historical/epa-response-to-tceq-2021-amnp.pdf

[32] EPA to TCEQ, Mar. 3, 2023, providing EPA's response to proposed draft monitoring plan; available at https://www.tceq.texas.gov/downloads/air-quality/air-monitoring/network/historical/epa-response-to-2022-amnp.pdf

[33] EPA, TRI Facility Report: W.A. Parish Electric Generating Station, accessed May 13, 2025, at https://enviro.epa.gov/facts/tri/ef-facilities/#/Facility/77481WPRSHYUJON

[34] EPA, "2021 Air Emissions Data," Jan. 15, 2025, available at

regulatory monitors in Fort Bend even though the population of Fort Bend County is nearly 1 million.[35] Short-term exposures to SO_2 is harmful to the human respiratory system and people with asthma, particularly children, are sensitive to these effects of SO_2. Additionally, high concentrations of SO_2 generally also lead to the formation of other sulfur oxides (SO_x). SO_x can react with other compounds in the atmosphere that can contribute to PM pollution.[36]

W.A. Parish is the largest SO_2 point source in the greater Houston region and exacerbates pollution in said region. The plant's owner, NRG Energy, only controls SO_2 emissions on one of the four coal units with one scrubber. The permit to operate W.A. Parish is based on modeling only with no regulatory monitors in the vicinity, or by utilizing self-reported data.

Although TCEQ may comply with the number of SO_2 monitors for the Houston-Pasadena-the Woodlands area, all SO_2 monitors are located in Harris County, with the closest SO_2 monitor to W.A. Parish 14 miles away. SO_2 monitors were loaned by the New Hampshire Department of Environmental Services and placed at the University of Houston – Sugar Land branch in May 2019, where the previous CO and ozone monitor was located. During those monitor readings, it was confirmed W.A. Parish is the most dominant SO_2 source in the region and requires closer monitoring.

TCEQ should move the SO_2 monitor that is proposed to be inactivated at Park Place to Fort Bend County. Moving the SO_2 monitor to Fort Bend would provide an instrument/measurable data to ensure public health protections, compliance with federal criteria pollution standards and a way to determine coal power plant protections such as scrubbers are effectively working.

ii. Ozone

Fort Bend County is also in non-attainment for ozone,[37] and has been for several years running, indicating that more tracking, measuring, and improvement could be made to reach attainment status. Fort Bend County cannot proactively address ozone pollution using modeling data, thus requiring ozone monitoring directly in the county.

iii. Particulate Matter 2.5

Plume tracking from W.A. Parish indicates $PM_{2.5}$ travels in a northwestern arc, reaching impacting most of western Harris Couty:[38]

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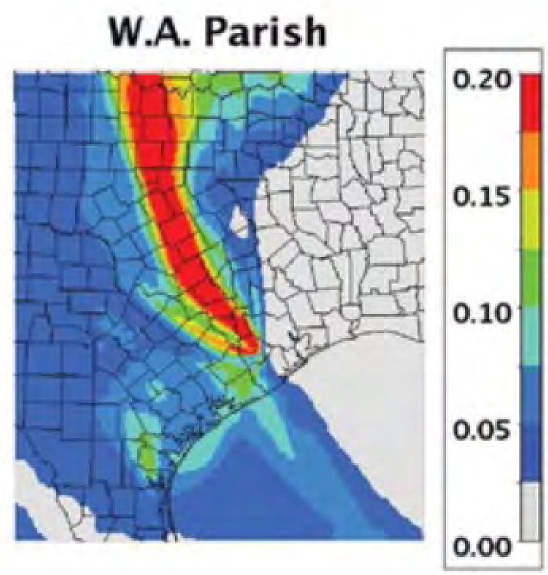
https://www.epa.gov/air-emissions-inventories/2021-air-emissions-data

[35] U.S. Census Bureau,, "QuickFacts Fort Bend County, Texas," accessed May 15, 2025, available at https://www.census.gov/quickfacts/fact/table/fortbendcountytexas/PST045224

[36] EPA, "Sulfur Dioxide Basics," Jan. 10, 2025, available at https://www.epa.gov/so2-pollution/sulfur-dioxide-basics#effects

[37] EPA, "Texas Nonattainment/Maintenance Status for Each County by Year for All Criteria Pollutants," April 30, 2025, https://www3.epa.gov/airquality/greenbook/anayo_tx.html (Fort Bend County in nonattainment under both the 2008 and 2015 ozone NAAQS).

[38] Strasert, B., Teh, S. C., & Cohan, D. S. (2019). Air quality and health benefits from potential coal power plant closures in Texas. *Journal of the Air & Waste Management Association, 69*(3), 333–350. https://doi.org/10.1080/10962247.2018.1537984;



The $PM_{2.5}$ monitor located 17 miles north of the facility is just outside the concentrated plume, missing critical data.

Based on TCEQ's Point Source Emissions Inventory, W.A. Parish is the second worst $PM_{2.5}$ polluter in the state. Within Fort Bend and Harris counties, the second leading cause of death is cancer, with lung cancer being the most common. $PM_{2.5}$ is directly linked to the development of lung cancer, along with development of asthma and decreased lung function in children. In 2022, W.A. Parish released 66% of the total amount of $PM_{2.5}$ released by Harris County's 47 largest industrial facilities. There is a necessity for monitoring $PM_{2.5}$ pollution in Fort Bend County.

iv. Carbon Monoxide

In December 2024, W.A. Parish was in violation of its Federal Operating Permit with a failure to comply with permitted Carbon Monoxide concentrations. The public, however, was not notified of this violation and was given no opportunity to protect themselves from this exposure. Residents deserve regulated and independent air monitoring rather than relying on W.A. Parish to self-report violations long after the fact.

Regulated air monitoring of Sulfur Dioxide, Ozone, Particulate Matter 2.5, and Carbon Monoxide are overdue and needed to monitor attainment status, inform the public, and hold polluters accountable for their emissions to remain in line with regulatory thresholds.

F. Houston

i. National Air Toxics Trends Station (NATTS) Network was developed to fulfill the need for long-term HAP monitoring data of consistent quality

This FYA is an opportunity for TCEQ to consider the range of monitors available (hence the required technology review, which TCEQ omits) to track all hazardous air pollutants. The National Air Toxics Trends Station (NATTS) Network was developed by EPA to fulfill the need for long-term HAP monitoring data of consistent quality. The Houston area had a NATTS monitoring station for 15 years, although it was decommissioned in 2018. We request the return of a NATTS station in the Houston area, given the amount of hazardous air pollutants and the number of emitting facilities in Harris County and the surrounding 8-county non-attainment region. These monitors play a critical role in developing air quality models for air toxics modeling and it seems

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https://www.tandfonline.com/doi/full/10.1080/10962247.2018.1537984#abstract (also attached as "Exhibit C" to Exhibit A, Earthjustice Comments).

a real oversight to leave Houston data out of these models.[39] This air pollution infrastructure is also critical given the potential exemptions in the Clean Air Act and number (n=24) in Harris county is the largest number of requested exemptions nationally – meaning that reported data will potentially be inaccurate as facilities get exemptions from various legal requirements.[40]

Beyond the NATTS request, TCEQ must consider adding monitoring for formaldehyde, ethylene oxide, acrylonitrile, and acrolein, and also expand current monitoring for benzene and1,3-butadiene. These priority urban air toxics represent some of our greater health risks regionally and statewide. There is sufficient evidence from researchers of high levels of exposure to formaldehyde in East Houston communities.[41] Additionally, a recent National Academies of Science publication reported on an ethylene oxide study that concluded that TCEQ's approach to higher exposure limits for ethylene oxide was unacceptable.[42] Houston has no ethylene oxide monitoring in our region despite having the highest concentration of EtO-emitting facilities nationally.

Currently Houston has two formaldehyde monitors, but neither monitor is close to any residential areas that are exposed to formaldehyde. Likewise, the number and placement of Houston's 1,3-butadiene monitors fail to adequately capture area exposure. Benzene fenceline monitoring near Texas City show exceedances of recommended exposure limits but Commenters know of no action by the state to address this issue.[43] Further, the benzene fenceline monitoring data is not released with enough frequency for actionable enforcement.[44]

We recommend siting new monitors near residential areas in partnership with community leaders to better understand and characterize community exposures, which can better elucidate health impacts to overburdened communities and inform consideration of cumulative exposures in land use development. Moreover, a more cooperative approach to monitor placement will provide

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[39] *See* EPA, "Air Toxics - National Air Toxics Trends Stations," available at https://www3.epa.gov/ttnamti1/natts.html (Accessed June 29, 2025).

[40] *See* Environmental Defense Fund, Trump Pollution Pass Map, available at https://www.edf.org/maps/epa-pollution-pass/ (accessed June 29, 2025).

[41] Loren Hopkins and Air Phillips, "Formaldehyde Air Pollution in Houston," July 1, 2021, available at https://environmentalintegrity.org/wp-content/uploads/2021/07/Houston-Formaldehyde-Report-Final-2021.pdf

[42] National Academies of Sciences, Engineering, and Medicine. 2025. Review of Texas Commission on Environmental Quality's Ethylene Oxide Development Support Document. Washington, DC: National Academies Press. https://doi.org/10.17226/28592.

[43] *See* Erin Douglas, "Five Texas refineries polluted above federal limit on cancer-causing benzene last year, report found," Texas Tribune, May 12, 2022, available at https://www.texastribune.org/2022/05/12/texas-refineries-benzene/#:~:text=The%20data%20shows%20that%20some,process%20units%20that%20contained%20benzene; Environmental Integrity Project, "Monitoring for Benzene at Refinery Fencelines," Feb. 6, 2020, available at https://environmentalintegrity.org/wp-content/uploads/2020/02/Benzene-Report-2.6.20.pdf

[44] *See* EPA Office of the Inspector General, "The EPA Should Enhance Oversight to Ensure that All Refineries Comply with the Benzene Fenceline Monitoring Regulations," Sept. 6, 2023, p. 12 (discussing quarterly benzene reporting), available at https://www.epaoig.gov/sites/default/files/reports/2023-09/_epaoig_20230906-23-p-0030_2.pdf

additional potential sites for new monitors without the long delays TCEQ often experiences when trying singlehandedly to site additional or relocated monitors.

ii. Sunnyside – Houston

Commentors recommend deploying a new continuous multipollutant regulatory site to monitor $PM_{2.5}$, NO_2 and speciated volatile organic compounds (VOCs) in the Sunnyside neighborhood of Houston (zip code 77021, 77033, 77045, 77051, 77054) to ensure air quality meets standards to protect public health and to monitor how well industrial sources are controlling their pollutant emissions.

According to EPA, parts of Sunnyside are in the 90th percentile or above for lower life expectancy with some of the highest rates of heart disease and asthma compared to the rest of the country. Four out of five of Sunnyside's zip codes were identified by the City of Houston Public Health department to be asthma high burden zip codes defined as "high rates of ambulance utilization to treat asthma attacks" and roughly 10-11% of adults have been diagnosed with asthma by a doctor, compared to 5.8% of adults in Harris County as a whole.[45]

Harris County has the highest concentration of facilities emitting urban air toxics in the nation and residents benefit from speciated VOC data to understand levels of hazardous air pollutants. Within the borders of Sunnyside, there is a concentration of metal recycling facilities, concrete batch/crushing facilities, and high-traffic roads. The EPA regulates three brownfields, three facilities for air pollution and twelve facilities for hazardous waste.

The nearest $PM_{2.5}$ monitor is about 10 miles away at Bayland Park and the closest instrument measuring VOCs is about 8 miles away at Cesar Chavez location. Given the industrial activity and transportation sources of air pollution from nearby 610 and 288 freeways, regional air monitoring for criteria and hazardous air pollutants in this blind spot of the Houston region are critically needed. Indeed, the community air monitoring network of low-cost Clarity S-node sensors operated by Sunnyside Community Redevelopment Organization shows that on average 35% of monthly $PM_{2.5}$ measurements in their network are at or above 9 $\mu g/m^3$ over the past 12 months. Adding a $PM_{2.5}$ and or VOC monitor in Sunnyside would be a much-needed investment in the health of residents of this part of the Houston region.

iii. Coastal Bend

Texas Coastal Bend communities north of Corpus Christi Bay are in urgent need of air monitoring data that characterizes current air quality to ensure public health protection. There has been massive industrial development and expansion in the relevant geographic area that not only includes Ingleside on the Bay residents, but also the communities of Taft, Gregory, Portland, Ingleside, and Arkansas Pass. The development of TCEQ-permitted industrial sites in the Coastal Bend area since 2015 includes, but is not limited to: Gibson Energy - South Texas Gateway Terminal, Cheniere - Corpus Christi LNG Facility, Enbridge - Ingleside Energy Center, Flint Hills Resources - Ingleside LLC Marine Terminal, Gulf Coast Growth Ventures-an ExxonMobil and

[45] Houston State of Health; Adults with Current Asthma, Harris County (accessed May 14, 2025), https://www.houstonstateofhealth.com/indicators/index/view?indicatorId=79&localeId=2675

SABIC joint venture, Midstream Texas Operating LLC Corporation, TPCO, Kiewitt, Plains Pipeline LP - Taft Station, voestalpine Texas LLC, in addition to the two other large industrial processing facilities that were built prior to 2015 - Oxy Occidental Chemical and the Chemours Ingleside Texas facility. There are numerous permitting actions that are pending that, if/when approved, will include additional industrial sites that will greatly increase existing air emissions (and water pollution) in the area. This of course does not account for the dozens of large ships and barges that both dock and transport commodities within Corpus Christi Bay and the Corpus Christi Channel, both of which lie just south and adjacent to Ingleside on the Bay Community Watch Association members' homes and businesses, on a daily basis since the massive industrial expansion.[46]

Affected residents and potential downwind receptors in the general area need state and regulatory authorities to meet the intent of the clean air –to monitor air quality in order to further take permitting actions that protect public health and **improve** air quality.

iv. Additional Near-Road Monitoring is Necessary in Multiple Locations

Part of the Five Year Assessment requirements include a determination about whether new sites are needed.[47] Per the Code of Federal Regulations, monitoring sites must be capable of informing managers about many things including the peak air pollution levels, typical levels in populated areas, air pollution transported into and outside of a city or region, and air pollution levels near specific sources.[48] This requires a mix of micro-scale, middle-scale, and neighborhood and urban scale monitors.

v. Population Trends and Census Numbers Call for Multiple Additional Monitors

Since 2009, EPA and the states have recognized that roadway-associated exposures account for a majority of the ambient exposures to peak NO_2 concentrations. This finding, in part, led to new minimum monitoring requirements for NO_2 near roadways and also created a national near road network to support further understanding of the role transportation plays in poor air quality for communities. For Texas, TCEQ's near road NO_2 data should provide "a clear means to determine whether the NAAQS is being met within the near road environment throughout a particular area."[49]

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[46] Ships and barges are known to be the source of fugitive emissions. *See* Thoma, E. D., M. Modrak, AND D. J. Williams. Investigation of fugitive emissions from petrochemical transport barges using optical remote sensing. U.S. Environmental Protection Agency, Washington, DC, 2009 (available at https://cfpub.epa.gov/si/si_public_record_report.cfm?Lab=NRMRL&dirEntryID=213705) (reporting on EPA study of barges using optical remote sensing and locating numerous emissions leaks from barges and ships in port).

[47] 40 C.F.R. part 58.10(d).

[48] 40 CFR Appendix D to Part 58 - Network Design Criteria for Ambient Air Quality Monitoring, part 1.1.1.

[49] EPA, NO_2 Near-Road Monitoring Network in EPA's Quality Assurance Handbook for Air Pollution Measurement Systems, volume 2, Ambient Air Quality Monitoring Program, last visited April 28, 2025 at 17, published January 2017, available at https://www3.epa.gov/ttnamti1/files/ambient/pm25/qa/Final%20Handbook%20Document%201_17.pdf

While the pending Annual Monitoring Network Plan draft articulates the minimum requirements for two near road monitors in any core based statistical areas (CBSA) with over 2.5 million residents, TCEQ ignores the fact that the Houston-Pasadena-The Woodlands CBSA and Dallas-Fort Worth-Arlington CBSA both exceed 7.25 million residents—nearly 3 times the amount of the minimum required for the two monitors.[50] As such, we urge TCEQ to assist its sister agency, Texas Department of Transportation (TXDOT), by installing additional near road monitors in those two massive CBSA's in order to provide better data for TXDOT to actively take steps to mitigate near road air pollution for urban communities. Similarly, this FYA should better document population growth throughout the region and identify areas of growth for more monitoring.

This is particularly important because transportation control measures such as programs for improved public transportation, restricting certain roads to high occupancy vehicles (HOV), or traffic flow improvement programs could be enhanced with better data identifying the impact of traffic in these massive urban areas that have historically not achieved attainment for a variety of pollutants (including ozone which NO_2 is a precursor for).[51] Thus, with more data from TCEQ on near road emissions, TXDOT could achieve better programmatic performance.

As such, we request an additional two near-road NO_2 monitors in each of those massive CSBA's to better reflect the amount of pollution on a population basis.

Given recent exceedances of the 2015 ozone NAAQS in Travis County, we also urge TCEQ to add ozone monitoring near some of the largest sources of ozone precursor emissions in the area, including the Fayette power plant (also known as Sam Seymour) in Fayette County. EPA's most-recent, verified design value data indicates that Travis County is in violation of the 2015 ozone NAAQS.[52] The Fayette power plant is, by far, the largest source of nitrogen oxide pollution in the greater Austin area,[53] and is a likely contributor to ozone exceedances in Travis County. To provide the public with a better understanding of air quality in the region, and to allow TCEQ and other governmental entities to better plan, we urge the agency to add at least one monitor to Fayette County.

III. The FYA Should Reassess PM2.5 Nonattainment to Add More Monitors

Scientific, peer-reviewed literature has provided a wealth of evidence that both short-term and long-term exposure to Particulate Matter (PM) can harm human health. Because PM is so small, it can be inhaled deeply into the lungs and can cross into the bloodstream. $PM_{2.5}$ exposure can lead to heart attacks, irregular heartbeat, decreased lung function, irritation of the airways and

[50] Populations in 2022 provided by Comptroller of Texas at https://comptroller.texas.gov/economy/economic-data/regions/2024/statewide.php
[51] See for example Texas Department of Transportation Air Quality Guidelines from 1999 at https://www.dot.state.tx.us/env/pdf/resources/airqualityguidelines1999.pdf
[52] *See* EPA, Ozone Design Values 2023, https://www.epa.gov/system/files/documents/2024-06/o3_designvalues_2021_2023_final_06_04_24.xlsx (Table 2, Other Violations) (attached and highlighted as "Exhibit D" to Exhibit A, Earthjustice Comments).
[53] *See* https://campd.epa.gov/data (query 2023 annual emissions data for Texas) (accessed May 15, 2025).

difficulty breathing, asthma attacks, and premature death. Children, older adults, and people with lung or heart conditions are more susceptible to risks of adverse health effects from $PM_{2.5}$.[54]

The Governor's complete disregard of all $PM_{2.5}$ nonattainment data in his submission to the EPA with regard to the new $PM_{2.5}$ NAAQS limit demonstrates how vital it is that this Five Year Assessment support a network that covers the state in order to demonstrate actual air quality conditions, rather than ignoring the health of Texans throughout the state.

TCEQ initially considered 12 counties as potentially in nonattainment with the 9.0 $\mu g/m^3$ PM2.5 standard, relying on data generated through its own FRM network.[55] However, by the end of the process of responding to the new $PM_{2.5}$ NAAQS, TCEQ had been removed from the decision-making and the Governor assumed the duty of determining and reporting that all Texas counties were either in attainment or unclassifiable. Those initial 12 counties had recorded at least 3 consecutive years of data indicating that average $PM_{2.5}$ concentrations exceeded the new standard.

In a scientific study using NASA data and 2016 $PM_{2.5}$ data, the below map of Texas census blocks by $PM_{2.5}$ concentration was developed: [56]

[54] EPA, "Research on Health Effects from Air Pollution," April 11, 2025, available at https://www.epa.gov/air-research/research-health-effects-air-pollution

[55] Slide from TCEQ Presentation, "Public Information Meeting: Particulate Matter (PM) Standard Revision," June 26, 2024, available at https://www.tceq.texas.gov/downloads/air-quality/sip/pm/designations/naaqs-pm25-2012/pm-naaqs-revision-outreach_houston_2024.pdf (attached as "Exhibit F" to Exhibit A, Earthjustice Comments).

[56] Bryan L, Landrigan P. "$PM_{2.5}$ pollution in Texas: a geospatial analysis of health impact functions." Front Public Health. 2023 Dec 1;11:1286755. doi: 10.3389/fpubh.2023.1286755. PMID: 38106908; PMCID: PMC10722416; https://pmc.ncbi.nlm.nih.gov/articles/PMC10722416/ (attached as "Exhibit G" to Exhibit A, Earthjustice Comments).

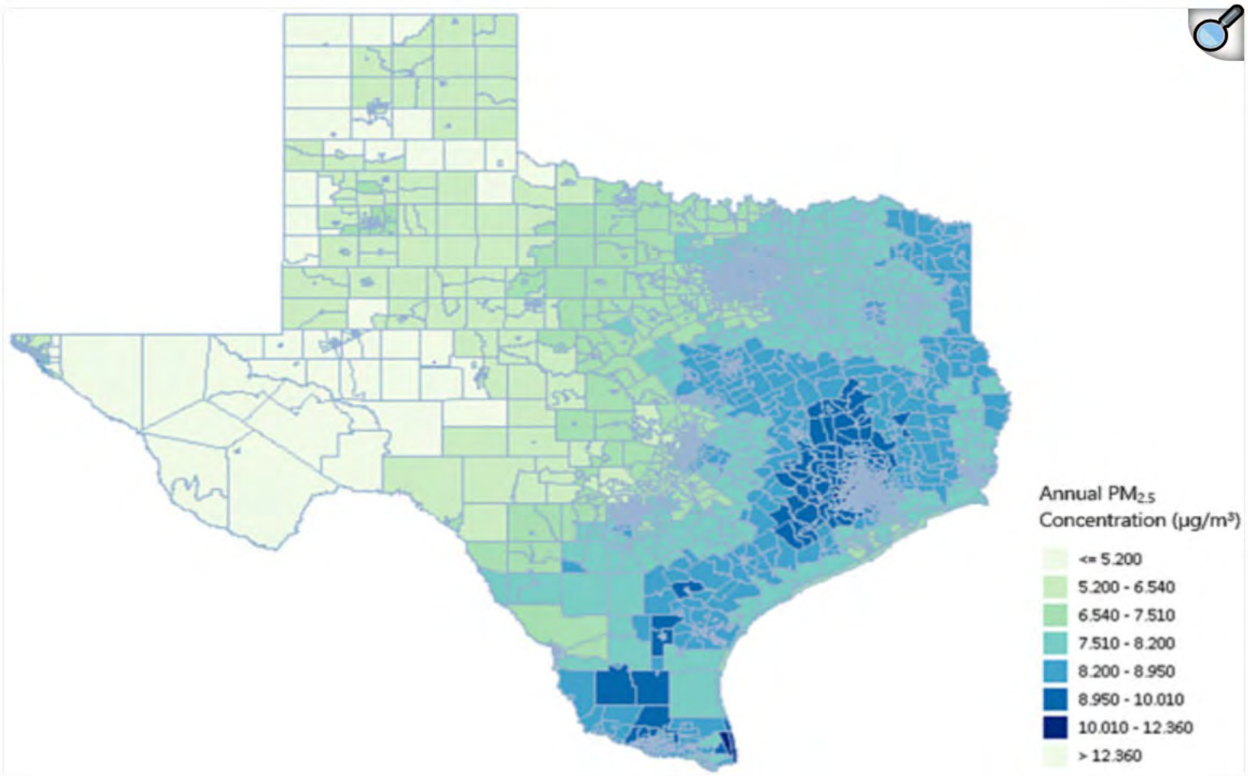

Figure 10. Excerpt from Bryan et al., Texas Census Blocks by PM2.5 Concentration.

Using 2016 emissions data and population data, the authors of this study predicted that:

> The main finding of this study is that air pollution by fine airborne particulate matter ($PM_{2.5}$) is a major cause of disease and premature death in the state of Texas . . . These findings indicate that improving air quality in Texas could save thousands of lives from disease, disability, and premature death.
>
> We found that there were 8,405 premature deaths due to $PM_{2.5}$ pollution in Texas in 2016, comprising 4.3% of all deaths in the state. Harris, Dallas, Tarrant, and Bexar counties had air-pollution-related death tolls of 500–1,400. Statewide increases in air-pollution-related morbidity and mortality were seen for stroke, low birthweight, non-fatal lung cancers, new onset Alzheimer's, and new onset asthma.[57]

The authors point out that the NASA data used to generate the statewide map of $PM_{2.5}$ emissions was the best available data, but *their analysis was hampered by the lack of actual $PM_{2.5}$ monitoring data across large swaths of the state*. Particulate matter – especially $PM_{2.5}$ – is plainly a problem for Texas residents; even this older and incomplete data from 2016 shows that deaths are occurring as a result of Texans' constant exposure to particulate matter. Now that the NAAQS standard has been lowered to 9.0 $\mu g/m^3$, additional monitoring is necessary in order to detect areas where

[57] *Id.*

particulate matter is a public health hazard but would not have previously triggered NAAQS nonattainment under the prior standard.

As evidence from emissions sources shows, there are large $PM_{2.5}$ emitters in counties without any monitors. It is therefore imperative that TCEQ add monitors near major sources in order to protect public health – even in more rural and low-population areas – in order to comply with the primary directive to protect public health. Specifically, we recommend monitors near some of the state's largest sources of particulate matter pollution in the state, including, at a minimum, W.A. Parish in Fort Bend County, the Fayette power plant in Fayette County, and the Martin Lake power plant in Rusk County. These coal-burning power plants are significant sources of particulate matter, yet there are no monitors in any of those counties.

IV. Conclusion

TCEQ is vital in protecting the environment for all Texans, and Commenters appreciate the work that goes in to placing and maintaining the existing monitoring network. We specifically commend the dedication TCEQ has shown in working with various communities throughout the state but urge TCEQ to prioritize the needs of those same communities even more through this assessment to identify where existing data gaps are in the monitoring network and suggest additions. Rather than meet the bare minimum, we urge TCEQ to take this opportunity to measure known pollutants. Only with more data, can TCEQ do its job effectively.

Commenters provide the following overall recommendations and urge EPA and TCEQ to consider revising the Five Year Assessment accordingly:

1. TCEQ must comply with the governing regulation for Five Year Assessments by providing analysis of air pollution impacts on susceptible populations and conducting a technology review.
2. TCEQ should add Cement Batch Plants and Aggregate Processing Operations to its overall assessment
3. The idled Ellis County $PM_{2.5}$ monitor must be relocated as quickly as possible, and an additional PM monitor should be placed where it can accurately assess the particulate matter released by the major cement plants in the county
4. A NAAQS-compliant FRM $PM_{2.5}$ monitor must be placed in Williamson County, given the density of APOs and CBP, in order to start generating design data for this area.
5. El Paso's inactive monitors must be relocated as quickly as possible.
6. The Permian Basin requires air monitoring, given the explosive growth in oil and gas development throughout the area.
7. Fort Bend County needs monitoring for sulfur dioxide, ozone, $PM_{2.5}$ and carbon monoxide.
8. Coastal Bend communities need monitoring for NAAQS.
9. Houston's idled NATTS monitor should be brought back online, with consideration given for additional air toxics monitoring in the Houston area.
10. Additional near-road monitors are needed in the Houston and Dallas areas, as well as the Austin and San Antonio metropolitan areas.

11. Statewide $PM_{2.5}$ monitoring must be increased, given available data and the new NAAQS. Specifically, TCEQ should consider siting monitors near some of the state's largest sources of particulate matter pollution in the state, including, at a minimum, W.A. Parish in Fort Bend County, the Fayette power plant in Fayette County, and the Martin Lake power plant in Rusk County.

Respectfully submitted by,

/s/ Lauren E. Godshall

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EXHIBIT A

Public Hearing Request and Comments on the 2025 Annual Monitoring Network Plan

EARTHJUSTICE

May 14, 2025

Via email: tceqamnp@tceq.texas.gov
Texas Commission on Environmental Quality
P.O. Box 13087
Attention: Holly Landuyt, MC-165
Austin, Texas 78711-3087

Re: Public Hearing Request and Comments on the 2025 Annual Monitoring Network Plan

Dear Ms. Landuyt:

On behalf of the undersigned Commenters, who represent members and supporters that live, work and recreate in Texas, we respectfully submit these comments regarding the Texas Commission on Environmental Quality ("TCEQ") proposed 2025 Annual Monitoring Network Plan ("Plan").

Because the proposed 2025 Annual Monitoring Network Plan is a revision to Texas's State Implementation Plan, it should be subject to notice and comment rulemaking. Commenters request that Texas Commission on Environmental Quality ("TCEQ") allow the public an additional opportunity to provide comments on the proposed plan and suggest new monitoring sites based on needs across the state through public hearings. Commenters further request that these comments be considered and incorporated by TCEQ into the 2025 Annual Monitoring Network Plan to ensure that air quality is effectively monitored for dangerous pollutants. Commenters urge TCEQ not simply to look at federal standards, which provide a floor of minimum criteria, but also pressing public health threats to assess the air quality monitoring needs of all Texans.

Commentors also adopt and incorporate by reference comments submitted on behalf of the groups in Port Arthur that appropriately seek additional monitors, as well as any other comments received from groups and individuals seeking better air quality monitoring throughout the state.

Under any scenario, broad deployment of zero- and near-zero emission technologies in the Houston and Dallas air basins will be needed in the 2025 to 2035 timeframe to attain current national health-based air quality standards as required by federal law. While the Annual Monitoring Network Plan cannot by itself implement such transitions, TCEQ must utilize the Plan for data that will allow it to meet these required public health standards. In order to do that, TCEQ should utilize this opportunity to address particular pollutant loads from transportation corridors, as well as siting federal regulatory monitors at neighborhood or urban scales at known hot spots and dense areas as requested below.

Commentors that have signed on reflect a broad Texas-wide coalition of entities uniquely concerned about the negative public health effects from exposure to air pollution when the state of Texas refuses to utilize its regulatory power to reduce overall emissions. This is apparent from both the Governor's letter seeking "serious" nonattainment for ozone, providing industry a license to pollute more, as well as the Governor's letter declaring all counties in attainment for the $PM_{2.5}$ NAAQS standards despite monitoring evidence to the contrary.[1]

For years, TCEQ has failed to achieve air quality consistent with public health standards for most of the major metropolitan areas across the state. This failure is due in part to the inability of this air quality monitoring plan to identify specifically sources that should be required to add pollution control equipment in order to protect the highest degree possible the airshed of the surrounding community. According to the American Lung Association's "State of the Air" report, released April 2025, the Houston-Pasadena, Texas is the seventh worst city in the U.S. for ozone and the eighth worst for year-round particle pollution. The Dallas, San Antonio and El Paso areas all fall within the top twenty worst cities for ozone and the Brownville area is 16th for year-round particle pollution.[2] Air quality across the state is dangerous for Texans, and conditions are not improving.

Under the Network Design Criteria for ambient air quality monitoring, TCEQ is required to design a plan to meet the following three criteria:

1. Provide air pollution data to the general public in a timely way
2. Support compliance with the ambient air quality standards and emissions strategy development
3. Support for air pollution research studies.[3]

Beyond these general goals, however, TCEQ is required to craft a monitoring program based on a variety of factors such as population, air pollution sources, and an *intent* to achieve compliance with the National Ambient Air Quality Standards (NAAQS) for a variety of pollutants. TCEQ must go beyond the bare minimum requirements in order to accurately assess air quality throughout the state and to ensure that sister agencies, such as the Texas Department of Transportation (TXDOT) or local Metropolitan Planning Organizations (like Houston-Galveston Area Council) can use reliable data in planning for future growth scenarios.

In 2036, Texas will celebrate its 200th birthday. In order to continue the growth trajectory and the "Texas miracle," policymakers recognize the need to better protect air quality, ensuring better public health and the opportunity for robust investment. In order to plan for the years ahead, we

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[1] *See* Exhibit A, Oct. 12, 2023 Letter to Michael Regan from Gov. Abbott re: "Voluntary Reclassification of Texas 2015 Ozone Standard Moderate Nonattainment Areas;" Exhibit B, Feb. 6, 2025 Letter to Lee Zeldin from Gov. Abbott re "State Designations for the 2024 Revised Primary Annual Fine Particulate Matter National Ambient Air Quality Standard (NAAQS or Standard)."

[2] American Lung Association, "State of the Air 2025 Report," available at https://www.lung.org/getmedia/5d8035e5-4e86-4205-b408-865550860783/State-of-the-Air-2025.pdf; see also American Lung Association, "Most Polluted Cities 2025," available at https://www.lung.org/research/sota/city-rankings/most-polluted-cities

[3] Title 40 C.F.R. part 58 appendix D1.1(a-c).

urge TCEQ to amend the proposed AQMP during this year's assessment to address the following concerns:

I. Clean Air Act Background

A. Texas must maintain an air quality monitoring network.

The Clean Air Act ("CAA" or "Act") requires Texas to establish and maintain an air quality monitoring network. This monitoring plan must be included in the applicable State Implementation Plan ("SIP"). 42 U.S.C. § 7410(a)(2)(B). Texas's network must meet three criteria: "(a) Provide air pollution data to the general public in a timely manner … (b) Support compliance with ambient air quality standards and emissions strategy development … (c) Support for air pollution research studies…" 40 C.F.R. Part 58 App. D ¶ 1.1.

Crucially, monitoring data are used to determine compliance with National Ambient Air Quality Standards ("NAAQS"). 40 C.F.R. Part 58 App. A ¶ 1.1(a). The U.S. Environmental Protection Agency ("EPA") has established NAAQS for six criteria pollutants: ozone (O_3), particulate matter ($PM_{2.5}$ and PM_{10}), carbon monoxide (CO), lead (Pb), sulfur dioxide (SO_2) and nitrogen dioxide (NO_2). To determine whether an area meets a NAAQS, EPA compares monitoring data to the NAAQS. 40 C.F.R. Part 58 App. D ¶ 1.1(b). Areas that fail to meet a NAAQS are subject to more stringent public health protections under the Act. For areas that fail to attain the NAAQS, for example, major sources of pollution must install and operate reasonably available control technology ("RACT"). 42 U.S.C. § 7502(c)(1). The Act further requires new major sources to conduct prevention of significant deterioration ("PSD") permits and requires polluters will have to reduce their ozone-forming emissions or secure offsets to more than offset the new pollution they will emit. 42 U.S.C. §§ 7503, 7511a.

Each year, Texas must demonstrate compliance with federal minimum monitoring requirements. 40 C.F.R. § 58.10(a)(1), (b). The state's monitoring network plan must include detailed information about the network's design, including the exact location of each monitor in the network, how each monitor operates, and proposed changes to individual monitors. 40 C.F.R. § 58.10(b)(1)-(5), Part 58 App. D. Plans that propose new monitoring sites or other modifications, like the TCEQ plan here, must be approved or denied by the EPA Regional Administrator within 120 days of submission. 40 C.F.R. §§ 58.10(a), (e), 58.11(c), 58.14.

Federal regulations prescribe only minimum design criteria for State and Local Area Monitoring Stations ("SLAMS") networks to monitor for criteria pollutants, leaving room for states to establish enhanced air monitoring as areas in their states may require. *See* 40 C.F.R. § 58.1; *see also* 40 C.F.R. Part 58 App. D ¶¶ 4.1-4.8.1 (establishing "Pollutant-Specific Design Criteria" for monitoring networks). SLAMS networks are a collection of devices in various locations that sample the ambient air (or outdoor air) to detect the level of a particular pollutant.[4]

The design of a monitoring network—the number of monitors, their specific placement, how frequently they take samples—is critical to getting accurate and representative results. *See*

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[4] A map of the Texas air monitoring network is available here: https://tceq.maps.arcgis.com/apps/webappviewer/index.html?id=ab6f85198bda483a997a6956a8486539.

generally 40 C.F.R. Part 58 App. D (establishing mandatory "Network Design Criteria for Ambient Air Quality Monitoring"). Because different pollutants and standards are especially sensitive to particular design criteria, such as the choice of monitor location, EPA provides monitoring network design guidance documents.[5] In part, the purpose of the network is "to provide support to the [SIP], national air quality assessments, and policy decisions." 40 C.F.R. § 58.2(a)(5) (emphasis added). Thus, network design and operating procedures are critical to assessing compliance with the public health goals of the Clean Air Act and for state and regional air quality planning efforts.

Apart from Clean Air Act compliance, there are other uses for air quality data that call on Texas to enhance its monitoring network for the protection of public health. Federal regulations envision members of the public making use of publicly available air quality data—the regulations themselves require data dissemination in urban centers, 40 C.F.R. § 58.50, and EPA maintains daily reports via AirNow, available at https://airnow.gov/.[6] Because air quality data from Texas's network is publicly available near real-time,[7] and is used to assess health risks, it is imperative that the data is accurate and complete.

B. The public process afforded to TCEQ's proposed Monitoring Network Plan violates the Clean Air Act.

TCEQ's proposed Monitoring Network Plan ("Plan") is a SIP revision that should be subject to notice and comment rulemaking. The CAA and its implementing regulations make it clear that a State's monitoring plan is part of its SIP.[8] Because an update to the monitoring plan is a SIP

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[5] *See, e.g.*, EPA, Guidance for Network Design and Optimum Site Exposure for $PM_{2.5}$ and PM_{10} at 2-7 (1997) ("A PM sampler location, especially its proximity to local sources, can play a large role in its ability to assess spatial variability and source contributions") (available at: https://www3.epa.gov/ttn/amtic/files/ambient/pm25/network/r-99-022.pdf); *see also* EPA, Guidance for Using Continuous Monitors in $PM_{2.5}$ Monitoring Networks at 6-1 to 6-2 (1998) (discussing the difference between Community Representative or "CORE" $PM_{2.5}$ monitors located where people live, work and play in comparison to hot spot monitor sites "located near an emitter with a microscale or middle-scale zone of influence" and Special Purpose Monitors ("SPMs") "used to understand the nature and causes of excessive concentrations measured at [CORE] or hot spot compliance monitoring sites.") (available at: https://www3.epa.gov/ttnamti1/files/ambient/pm25/r-98-012.pdf); *see also* EPA, Photochemical Assessment Monitoring Stations Implementation Manual at 2-6 (1994) ("Site selection is one of the most important tasks associated with monitoring network design and must result in the most representative location to monitor the air quality conditions being assessed.") (available at: https://www3.epa.gov/ttn/amtic/files/ambient/pams/b93-051a.pdf).

[6] AirNow data is also shared with and broadcast by major media outlets that disseminate air quality forecasts to individuals. *See* https://www.airnow.gov/index.cfm?action=ani.airnowUS (AirNow "[d]istributes air quality forecasts and data with The Weather Channel, USA Today, CNN, weather service providers, NOAA National Weather Service").

[7] TCEQ, AutoGC Data by Day by Site (all parameters), available at: https://www.tceq.texas.gov/cgi-bin/compliance/monops/agc_daily_summary.pl; *see also* TCEQ, Today's Texas Air Quality Forecast, https://www.tceq.texas.gov/airquality/monops/forecast_today.html

[8] *See* 42 U.S.C. § 7410(A)(2)(b) (each SIP must "provide for establishment and operation of . . . systems . . . necessary to . . . monitor, compile, and analyze data on ambient air quality"); 40 C.F.R. § 51.17(b)(1)-(6) (each SIP "shall include a description of the . . . proposed air quality surveillance system, which shall set forth," among other things: the exact location of the monitors; how each monitor operates; and the timetable for installing any equipment needed to complete the monitoring system").

revision, federal law requires TCEQ to provide notice and undertake a public hearing before promulgating the plan.[9]

On its webpage, TCEQ solicits public comment for the proposed Plan but it also appears that TCEQ did not and will not hold any public meetings or hearings to explain this Plan to the public – particularly the changes it is proposing in this year's plan. Many low-income communities and communities of color throughout Texas suffer from poor air quality and would benefit from greater air quality monitoring in their area. Hearings in English and Spanish would help all Texans understand whether and how extensively the air around them is monitored. However, due to TCEQ's failure to conduct public outreach and hold public meetings or hearings regarding its proposed Plan—again, including Spanish language outreach and hearings—Texans in these communities may be wholly unaware of Texas' air quality monitoring network or that it changes every year.

Commenters request that TCEQ hold a public hearing, with Spanish interpretation services available, in Houston or El Paso to afford the public an opportunity to ask questions about the Plan of TCEQ staff responsible for its creation and implementation.

II. Individual Communities Should Receive Adequate Monitoring in order to Comply with the Minimum Requirements for this Plan.

A. Ellis County and Midlothian, Texas

Midlothian Breathe is a group of local residents in Midlothian, Texas, the proclaimed "cement capital" of Texas. Since April 2022, the Midlothian Old Fort Road monitor has been off-line and though slated to be relocated and activated by the end of August 2024, was never activated due to on-going problems with siting and city ordinances, as TCEQ notes in the Plan:[10]

Midlothian OFW	Midlothian North Ward Road	891 North Ward Road, Midlothian, Texas (pending permit approval by the City of Midlothian Development Review Committee)	Relocation approximately 0.7 mile southwest on current property due to property owner revocation of site access (new property owners), approved by the EPA in a letter dated November 17, 2023.Site construction permit denied, site logistical updates to meet city Development Review Committee requirements and local ordinances under continued negotiation with City of Midlothian.	Site temporarily deactivated April 22, 2022, relocation expected by December 2026

Since the (idled) monitor provides the only actionable data used to safeguard public health, Midlothian Breathe has been very concerned about this long, protracted gap in air quality information. The community group has made continual efforts to raise this issue with local

[9] *See Hall v. EPA*, 273 F.3d 1146, 1162 (9th Cir. 2001) ("The Act requires that SIP revisions 'be adopted by the State after reasonable notice and public hearing.'") (quoting 42 U.S.C. § 7410(l)).
[10] TCEQ, Annual Network Monitoring Plan, 2025, p. 43 ("Air Monitoring Site Relocations").

governments and with the TCEQ, to no avail. TCEQ's gap of data for Midlothian will stretch into an unacceptable period of 4.6 years.

The draft air quality management plan through this air quality monitoring plan could implement a back-up location in order to ensure that a monitor is placed as quickly as possible. Instead, however, the plan continues to stall, pushing off any new data collection for another year and a half, at least. Though traditionally TCEQ does not work with local nonprofits, or individual citizens, if TCEQ began working with those most interested in ensuring a reduction in air pollution in their community, TCEQ may more readily identify viable locations, including back-up sites, by gaining community buy-in to the process at the outset.

Per 40 C.F.R. Part 58 Appendix D, TCEQ should also amend this monitoring plan to include a new additional monitor north/northwest of Holcim, Texas in order to better capture particulate matter emissions. This could be achieved in a cost-effective way through moving the former Midlothian FRM monitor to the north/northwest of Holcim, which means data could be collected downwind of the area's most significant particulate matter (PM) emitter. If a monitor is placed there, it would better capture regional issues and capture data that would be missed by the proposed new monitor near Martin Marietta and Gerdau. Because this area has three cement plants and a steel mill, with a growing population that includes the Dallas-Ft. Worth-Arlington CSBA of 7.9 million residents, another monitor is justified. More than just PM should be monitored; the Midlothian area is likely to be in nonattainment of the ozone NAAQS and, in the 10-county North Texas region, Ellis County accounts for over 40% of the point source emissions for Nox, according to TCEQ 2022 emissions data.

Midlothian area residents have fallen into a data gap for years as we await new monitoring – but this new monitoring must be adequate to be representative of overall Midlothian air quality. And members of Midlothian Breathe are ready to assist with garnering community input and support in finding monitoring sites.

B. Williamson County

Coalition for Responsible Environmental Aggregate Mining (CREAM) is a non-profit organization which seeks to minimize the impacts of Aggregate Production Operations (APOs) and Concrete Batch Plants (CBPs) on local communities. CREAM has over 250 members, many of whom live in or are affected by fugitive dust and fine particulate matter from APOs and CBPs in Williamson County. TCEQ's Draft Plan does not include any $PM_{2.5}$ monitoring systems in Williamson County despite there being 32 active APOs and 45 CBPs within the county boundaries.[11] These two industries are extremely dusty and generate substantial quantities of fugitive dust which travels off-site and negatively impacts nearby residents.

[11] EPA Enforcement and Compliance History Online (ECHO) website queried for Standard Industrial Code 1422, Crushed and Broken Limestone on May 13, 2025 at: https://echo.epa.gov/facilities/facility-search/results; EPA's Website queried for Wiliamson County and SIC code 3273 for Ready-Mixed Concrete on May 13, 2025, at: https://echo.epa.gov/facilities/facility-search/results

TCEQ should add at least one $PM_{2.5}$ monitor to Williamson County in order to more clearly determine the county's attainment status according to the NAAQS. At present, the nearest regulatory $PM_{2.5}$ monitors operated by TCEQ are located in Travis and Bell Counties. These are too far away to provide any useful or relevant data for Williamson County.

Sun City is a Williamson County retirement community located in Georgetown, Texas with 9,300 homes and 18,500 senior residents. Poor air quality and fine dust from nearby APOs and CBPs are a concern because of the adverse impact to the health of senior citizens who are more likely to have heart disease and lung disease. This is a particularly sensitive population that needs accurate information about air quality.

CREAM has similar concerns as Midlothian Breathe about monitors taken out of service and/or ignored data. TCEQ placed a temporary monitor (No. 1094) for compliance purposes near several quarries in Jarrell in Williamson County. It was removed in June 2024 after operating for 3.5 years.[12] In its 2024 air monitoring plan, TCEQ gave no indication that the monitor would be shut down and instead emphasized its importance to the area: "The TCEQ would like to further clarify that the Jarrell FM487 monitor was not deployed as a result of an enforcement action but was sited on a temporary basis to assess local air quality impacts of nearby particulate matter sources."[13] However, by June of 2024 the Jarrell monitor was deactivated and no new PM monitoring in the area replaced it. Williamson County is categorized as "unclassified" under the $PM_{2.5}$ NAAQS due to a lack of regulatory monitoring data, despite having a dense collection of particulate matter-intense industry throughout the county.

C. El Paso

Similarly, since 2021, TCEQ has not been able to meet the minimum requirements per 40 CFR Part 58 and Appendices, including Section 58.10 and Section 58.14 for monitoring nitric oxide (NO), nitrogen dioxide (NO_2), nitrogen oxides (NO_X), ozone (O_3), particulate matter 2.5 ($PM_{2.5}$), and meteorology at the University of Texas El Paso (UTEP) site.[14]

El Paso UTEP	Pending site selection	Pending site selection	Relocation pending due to property owner revocation of usage agreement (building expansion over site location)	Site temporarily deactivated November 2021, relocation expected by December 2026

That site has not been operational since November 2021 and each year, TCEQ has opined that the site would be relocated, and yet, nearly 5 years later, the site is still not operational. This is

[12] "This monitoring site was brought onto the TCEQ real-time data collection system on **Thursday, July 23, 2020** and was deactivated on **Wednesday, June 26, 2024**." TCEQ, "Jarrell FM 487 C1094 Data by Site by Date (all parameters)," available at https://www.tceq.texas.gov/cgi-bin/compliance/monops/daily_summary.pl?cams=1094#.
[13] TCEQ, Annual Network Monitoring Plan, 2024, p. 162, available at https://www.tceq.texas.gov/downloads/air-quality/air-monitoring/network/historical/2024-amnp.pdf
[14] TCEQ, Annual Network Monitoring Plan, 2025, p. 43 ("Air Monitoring Site Relocations").

particularly problematic in the context of particulate matter because the lack of $PM_{2.5}$ data for El Paso is a barrier to understanding whether the area is in compliance with the new $PM_{2.5}$ NAAQS.

While many of TCEQ's air monitors require third-party agreements to site the monitors, TCEQ could meet the needs of protecting this community through the use of temporary monitors or even a mobile monitoring unit more permanently parked in order to continue this data collection. Commenters recognize that Texas historically underfunds TCEQ for air monitoring work, and yet, the community of El Paso, like the community in Midlothian, has sought this monitor for years to no avail. TCEQ should consider crafting a prioritization flow chart to better allocate its funds to communities most impacted by air quality concerns to provide for greater transparency and more accountability to the public with respect to the budget for this plan and should partner with local communities to get buy-in for potential site locations.

D. Permian Basin

In 2021, EPA stated that the Odessa Gonzalez $PM_{2.5}$ monitor was required in order for the state annual plan to be approved in its entirety.[15] That monitor is still inactive, again, 5 years later, and now EPA has recognized the ongoing concerns related to ozone in that region. Yet, TCEQ's monitoring plan fails to apportion any funding for air quality monitoring in the Permian basin, a world-known oil and gas field where countless flares, compressor stations, and other oil and gas equipment contribute to local, state-wide and indeed, regional cross-state pollution concerns.

This concern was again expressed in May 2023, where EPA expressly stated to TCEQ that it "should deploy one or more ozone monitors in the Permian Basin."[16] Other groups are submitting contemporaneous comments focused on the Permian Basin, which Commenters adopt and incorporate herein.

E. Fort Bend County

Fort Bend County, one of the fastest-growing and most diverse counties in Texas, is also home to the largest coal-fired power plant in the state. The W.A. Parish Electric Generation Station accounts for 66% of the toxic release emissions in the county,[17] and yet Fort Bend has no regulatory air monitoring.

Across the state, over half of the counties with coal plants already have monitors provided by TCEQ or EPA. The Martin Lake and Oak Grove coal plants have scrubbers to reduce SO_2 pollution but also have SO_2 monitoring. The JK Spruce coal plant has baghouses to reduce $PM_{2.5}$

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[15] EPA to TCEQ, Oct. 20, 2021, providing EPA's response to proposed draft monitoring plan; available at https://www.tceq.texas.gov/downloads/air-quality/air-monitoring/network/historical/epa-response-to-tceq-2021-amnp.pdf

[16] EPA to TCEQ, Mar. 3, 2023, providing EPA's response to proposed draft monitoring plan; available at https://www.tceq.texas.gov/downloads/air-quality/air-monitoring/network/historical/epa-response-to-2022-amnp.pdf

[17] EPA, TRI Facility Report: W.A. Parish Electric Generating Station, accessed May 13, 2025, at https://enviro.epa.gov/facts/tri/ef-facilities/#/Facility/77481WPRSHYUJON

pollution but also has $PM_{2.5}$ monitoring. In contrast, the W.A. Parish is both missing three scrubbers on the four coal stacks and lacks SO_2 monitoring.

Fort Bend has had TCEQ monitors over the years, including a one-year Ozone monitor in Rosenberg (deactivated in 1990) and one monitor for Carbon Monoxide and Ozone in Sugar Land (deactivated in 2018). As a result, any data relevant to Fort Bend County has required modeling or extrapolated data from bordering counties. Not only does the county need monitoring, but it needs monitoring for emissions that are relevant and present.

i. Sulfur Dioxide

According to the 2021 National Emissions Inventory, facilities in Fort Bend County emitted nearly 34,000 tons of sulfur dioxide (SO_2).[18] Air in the area is completely uncharacterized as there are no regulatory monitors in Fort Bend even though the population of Fort Bend County is nearly 1 million.[19] Short-term exposures to SO_2 is harmful to the human respiratory system and people with asthma, particularly children, are sensitive to these effects of SO_2. Additionally, high concentrations of SO_2 generally also lead to the formation of other sulfur oxides (SO_x). SO_x can react with other compounds in the atmosphere that can contribute to PM pollution.[20]

W.A. Parish is the largest SO_2 point source in the greater Houston region and exacerbates pollution in said region. The plant's owner, NRG Energy, only controls SO_2 emissions on one of the four coal units with one scrubber. The permit to operate W.A. Parish is based on modeling only with no regulatory monitors in the vicinity, or by utilizing self-reported data.

Although TCEQ may comply with the number of SO_2 monitors for the Houston-Pasadena-the Woodlands area, all SO_2 monitors are located in Harris County, with the closest SO_2 monitor to W.A. Parish 14 miles away. SO_2 monitors were loaned by the New Hampshire Department of Environmental Services and placed at the University of Houston – Sugar Land branch in May 2019, where the previous CO and ozone monitor was located. During those monitor readings, it was confirmed W.A. Parish is the most dominant SO_2 source in the region and requires closer monitoring.

While the 2025 draft Plan shows a decrease in SO_2 related to the W.A. Parish Electric Generating plant in Fort Bend from 2022 to 2023 (Table 1, page 103), this coal power plant facility was recently granted a MATS (Mercury and Air Toxics Standards) Clean Air Act exemption for at least the next two years. This will certainly result in increased air emissions that can have a negative impact on the health of nearby residents and may have larger detrimental regional air quality implications. Given that there is no air monitoring in Fort Bend currently, it is difficult to

[18] EPA, "2021 Air Emissions Data," Jan. 15, 2025, available at https://www.epa.gov/air-emissions-inventories/2021-air-emissions-data
[19] U.S. Census Bureau,, "QuickFacts Fort Bend County, Texas," accessed May 15, 2025, available at https://www.census.gov/quickfacts/fact/table/fortbendcountytexas/PST045224
[20] EPA, "Sulfur Dioxide Basics," Jan. 10, 2025, available at https://www.epa.gov/so2-pollution/sulfur-dioxide-basics#effects

fully understand the health impacts this will have in the county or in the Houston Pasadena MSA.

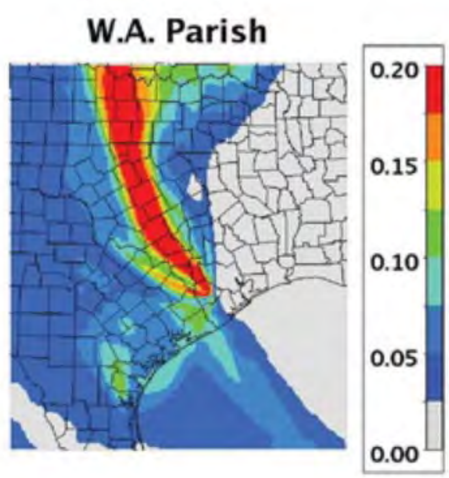
TCEQ should move the SO_2 monitor that is proposed to be inactivated at Park Place to Fort Bend County. Moving the SO_2 monitor to Fort Bend would provide an instrument/measurable data to ensure public health protections, compliance with federal criteria pollution standards and a way to determine coal power plant protections such as scrubbers are effectively working.

ii. Ozone

Fort Bend County is also in non-attainment for ozone,[21] and has been for several years running, indicating there needs to be tracking, measuring, and improvement made to reach attainment status. Fort Bend County cannot proactively address ozone pollution using modeling data, thus requiring ozone monitoring directly in the county.

iii. Particulate Matter 2.5

Plume tracking from W.A. Parish indicates $PM_{2.5}$ travels in a northwestern arc, reaching impacting most of western Harris Couty:[22]



The $PM_{2.5}$ monitor located 17 miles north of the facility is just outside the concentrated plume, missing critical data.

Based on TCEQ's Point Source Emissions Inventory, W.A. Parish is the second worst $PM_{2.5}$ polluter in the state. Within Fort Bend and Harris counties, the second leading cause of death is cancer, with lung cancer being the most common. $PM_{2.5}$ is directly linked to the development of

[21] EPA, "Texas Nonattainment/Maintenance Status for Each County by Year for All Criteria Pollutants," April 30, 2025, https://www3.epa.gov/airquality/greenbook/anayo_tx.html (Fort Bend County in nonattainment under both the 2008 and 2015 ozone NAAQS).
[22] Exhibit C, Strasert, B., Teh, S. C., & Cohan, D. S. (2019). Air quality and health benefits from potential coal power plant closures in Texas. *Journal of the Air & Waste Management Association*, *69*(3), 333–350. https://doi.org/10.1080/10962247.2018.1537984; https://www.tandfonline.com/doi/full/10.1080/10962247.2018.1537984#abstract

lung cancer, along with development of asthma and decreased lung function in children. In 2022, W.A. Parish released 66% of the total amount of $PM_{2.5}$ released by Harris County's 47 largest industrial facilities. There is a necessity for monitoring $PM_{2.5}$ pollution in Fort Bend County.

iv. Carbon Monoxide

In December 2024, W.A. Parish was in violation of its Federal Operating Permit with a failure to comply with permitted Carbon Monoxide concentrations. The public, however, was not notified of this violation and was given no opportunity to protect themselves from this exposure. Residents deserve regulated and independent air monitoring rather than relying on W.A. Parish to self-report violations long after the fact.

Regulated air monitoring of Sulfur Dioxide, Ozone, Particulate Matter 2.5, and Carbon Monoxide are overdue and needed to monitor attainment status, inform the public, and hold polluters accountable for their emissions to remain in line with regulatory thresholds.

F. Sunnyside – Houston

Commentors recommend deploying a new continuous multipollutant regulatory site to monitor $PM_{2.5}$, NO_2 and speciated volatile organic compounds (VOCs) in the Sunnyside neighborhood of Houston (zip code 77021, 77033, 77045, 77051, 77054) to ensure air quality meets standards to protect public health and to monitor how well industrial sources are controlling their pollutant emissions.

According to EPA, parts of Sunnyside are in the 90th percentile or above for lower life expectancy with some of the highest rates of heart disease and asthma compared to the rest of the country. Four out of five of Sunnyside's zip codes were identified by the City of Houston Public Health department to be asthma high burden zip codes defined as "high rates of ambulance utilization to treat asthma attacks" and roughly 10-11% of adults have been diagnosed with asthma by a doctor, compared to 5.8% of adults in Harris County as a whole.[23]

Harris County has the highest concentration of facilities emitting urban air toxics in the nation and residents benefit from speciated VOC data to understand levels of hazardous air pollutants. Within the borders of Sunnyside, there is a concentration of metal recycling facilities, concrete batch/crushing facilities, and high-traffic roads. The EPA regulates three brownfields, three facilities for air pollution and twelve facilities for hazardous waste.

The nearest $PM_{2.5}$ monitor is about 10 miles away at Bayland Park and the closest instrument measuring VOCs is about 8 miles away at Cesar Chavez location. Given the industrial activity and transportation sources of air pollution from nearby 610 and 288 freeways, regional air monitoring for criteria and hazardous air pollutants in this blind spot of the Houston region are critically needed. Indeed, the community air monitoring network of low-cost Clarity S-node sensors operated by Sunnyside Community Redevelopment Organization shows that on average

[23] Houston State of Health; Adults with Current Asthma, Harris County (Accessed May 14, 2025), https://www.houstonstateofhealth.com/indicators/index/view?indicatorId=79&localeId=2675

35% of monthly $PM_{2.5}$ measurements in their network are at or above 9 µg/m^3 over the past 12 months. Adding a $PM_{2.5}$ and or VOC monitor in Sunnyside would be a much-needed investment in the health of residents of this part of the Houston region.

G. Coastal Bend

Texas Coastal Bend communities north of Corpus Christi Bay are in urgent need of air monitoring data that characterizes current air quality to ensure public health protection. There has been massive industrial development and expansion in the relevant geographic area that not only includes Ingleside on the Bay residents, but also the communities of Taft, Gregory, Portland, Ingleside, and Arkansas Pass. The development of TCEQ-permitted industrial sites in the Coastal Bend area since 2015 includes, but is not limited to: Gibson Energy - South Texas Gateway Terminal, Cheniere - Corpus Christi LNG Facility, Enbridge - Ingleside Energy Center, Flint Hills Resources - Ingleside LLC Marine Terminal, Gulf Coast Growth Ventures-an ExxonMobil and SABIC joint venture, Midstream Texas Operating LLC Corporation, TPCO, Kiewitt, Plains Pipeline LP - Taft Station, voestalpine Texas LLC, in addition to the two other large industrial processing facilities that were built prior to 2015 - Oxy Occidental Chemical and the Chemours Ingleside Texas facility. There are numerous permitting actions that are pending that, if/when approved, will include additional industrial sites that will greatly increase existing air emissions (and water pollution) in the area. This of course does not account for the dozens of large ships and barges that both dock and transport commodities within Corpus Christi Bay and the Corpus Christi Channel, both of which lie just south and adjacent to Ingleside on the Bay Community Watch Association members' homes and businesses, on a daily basis since the massive industrial expansion.[24]

Affected residents and potential downwind receptors in the general area need state and regulatory authorities to do what they are statutorily obligated to do whether popular or not with the regulated community. It is obvious from reviewing the 2022, 2023, and 2024 Plans, and the 2025 draft Plan, that TCEQ can request additional federal funding to develop an ambient air monitoring network that would properly characterize air quality in the Coastal Bend area beyond meeting the minimal federal requirements of having monitoring in Corpus Christi area south of Corpus Christi Bay. This conclusion was obvious from the language that was used in the EPA response letters, and the fact that TCEQ is certainly capable of using existing funding and/or requesting additional monetary funding through the Texas legislature to provide protectiveness to its citizens, and thus IOBCWA is respectively requesting it to do so.

III. Additional Near-Road Monitoring is Necessary in Multiple Locations

[24] Ships and barges are known to be the source of fugitive emissions. *See* Thoma, E. D., M. Modrak, AND D. J. Williams. Investigation of fugitive emissions from petrochemical transport barges using optical remote sensing. U.S. Environmental Protection Agency, Washington, DC, 2009 (available at https://cfpub.epa.gov/si/si_public_record_report.cfm?Lab=NRMRL&dirEntryID=213705) (reporting on EPA study of barges using optical remote sensing and locating numerous emissions leaks from barges and ships in port).

Per the Code of Federal Regulations, monitoring sites must be capable of informing managers about many things including the peak air pollution levels, typical levels in populated areas, air pollution transported into and outside of a city or region, and air pollution levels near specific sources.[25] This requires a mix of micro-scale, middle-scale, and neighborhood and urban scale monitors.

A. Population Trends and Census Numbers Call for Multiple Additional Monitors

Since 2009, EPA and the states have recognized that roadway-associated exposures account for a majority of the ambient exposures to peak NO_2 concentrations. This finding, in part, led to new minimum monitoring requirements for NO_2 near roadways and also created a national near road network to support further understanding of the role transportation plays in poor air quality for communities. For Texas, TCEQ's near road NO_2 data should provide "a clear means to determine whether the NAAQS is being met within the near road environment throughout a particular area."[26]

While the pending Annual Monitoring Network Plan draft articulates the minimum requirements for two near road monitors in any core based statistical areas (CBSA) with over 2.5 million residents, TCEQ ignores the fact that the Houston-Pasadena-The Woodlands CBSA and Dallas-Fort Worth-Arlington CBSA both exceed 7.25 million residents—nearly 3 times the amount of the minimum required for the two monitors.[27] As such, we urge TCEQ to assist its sister agency, Texas Department of Transportation (TXDOT), by installing additional near road monitors in those two massive CBSA's in order to provide better data for TXDOT to actively take steps to mitigate near road air pollution for urban communities.

This is particularly important because transportation control measures such as programs for improved public transportation, restricting certain roads to high occupancy vehicles (HOV), or traffic flow improvement programs could be enhanced with better data identifying the impact of traffic in these massive urban areas that have historically not achieved attainment for a variety of pollutants (including ozone which NO_2 is a precursor for).[28] Thus, with more data from TCEQ on near road emissions, TXDOT could achieve better programmatic performance.

As such, we request an additional two near-road NO_2 monitors in each of those massive CSBA's to better reflect the amount of pollution on a population basis.

Similarly, with the Austin CBSA, TCEQ is relying on older census data. According to 2024 numbers, the Austin CBSA exceeds the 2.5 million residents required to justify additional air

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[25] 40 CFR Appendix D to Part 58 - Network Design Criteria for Ambient Air Quality Monitoring, part 1.1.1.

[26] EPA, NO_2 Near-Road Monitoring Network in EPA's Quality Assurance Handbook for Air Pollution Measurement Systems, volume 2, Ambient Air Quality Monitoring Program, last visited April 28, 2025 at 17, published January 2017, available at https://www3.epa.gov/ttnamti1/files/ambient/pm25/qa/Final%20Handbook%20Document%201_17.pdf

[27] Populations in 2022 provided by Comptroller of Texas at https://comptroller.texas.gov/economy/economic-data/regions/2024/statewide.php

[28] See for example Texas Department of Transportation Air Quality Guidelines from 1999 at https://www.dot.state.tx.us/env/pdf/resources/airqualityguidelines1999.pdf

monitoring, as does the San Antonio-New Braunfels area.[29] TCEQ should consider placing an additional monitor along the I-35 stretch between the Austin and San Antonio major urban environments to better reflect the reality of the growth in these communities and does need to start planning for a second monitor in the Austin area regardless. By doing so, TCEQ and TXDOT would be better able to react and plan as the Texas Hill Country continues its unmanageable growth pattern.

Given recent exceedances of the 2015 ozone NAAQS in Travis County, we also urge TCEQ to add ozone monitoring near some of the largest sources of ozone precursor emissions in the area, including the Fayette power plant (also known as Sam Seymour) in Fayette County. EPA's most-recent, verified design value data indicates that Travis County is in violation of the 2015 ozone NAAQS.[30] The Fayette power plant is, by far, the largest source of nitrogen oxide pollution in the greater Austin area,[31] and is a likely contributor to ozone exceedances in Travis County. To provide the public with a better understanding of air quality in the region, and to allow TCEQ and other governmental entities to better plan, we urge the agency to add at least one monitor to Fayette County.

B. TCEQ Must Not Reclassify Four Near-Road $PM_{2.5}$ Monitors

The draft monitoring plan's proposal to reclassify the four Near-Road $PM_{2.5}$ monitors as non-NAAQS comparable does not make sense based on traffic and population data and is otherwise unjustifiable.

TCEQ should not reclassify the four existing near-road $PM_{2.5}$ monitors. They are appropriately designated as NAAQS-comparable for annual PM2.5 concentrations along the high-traffic corridors with densely populated areas of each of the core based statistical areas.

i. The monitoring sites should be classified as "Middle-scale" rather than "Micro-scale"

TCEQ has described the four near-road $PM_{2.5}$ monitoring sites as micro-scale sites (see Plan on pages 28-29). Although monitoring systems should include and incorporate micro-scale monitoring per 40 C.F.R. part 58, these have not been correctly categorized as micro-scale by TCEQ. Based on the distance of these sites from the respective roadways, the monitors should be considered middle-scale sites and are more representative of conditions in the immediate area around the monitors than TCEQ claims.

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[29] US Census Datasets for metropolitan areas from 2024 downloaded from https://www.census.gov/data/tables/time-series/demo/popest/2020s-total-metro-and-micro-statistical-areas.html#v2024

[30] See EPA, Ozone Design Values 2023, https://www.epa.gov/system/files/documents/2024-06/o3_designvalues_2021_2023_final_06_04_24.xlsx (Table 2, Other Violations), attached and highlighted as Exhibit D

[31] *See* https://campd.epa.gov/data (query 2023 annual emissions data for Texas) (accessed May 15, 2025).

40 CFR Appendix E, Section 2.5 provides siting requirements for monitoring sites near roadways. Paragraph 2.5.3(b) states that "For microscale traffic corridor sites, the location must be greater than or equal 5.0 meters and less than or equal to 15 meters from the major roadway." According to Table 12 (see Plan page 29), none of the sites are closer than 15 meters to the nearest traffic lane. As detailed in Figure E-1 (copied below), monitors more than 15 feet from the major roadway are considered "Middle scale" sites. For the Houston North Loop Monitor, the distance from the interstate is shown as exactly 15 meters, but TCEQ has not provided sufficient information to demonstrate that the monitor could be considered micro-scale. The height of the monitor inlet must also be considered when the monitor is within 15 feet of the roadway. Therefore, based on the data provided in the Plan, we contend that these spatial scale for these sites is actually "middle scale."

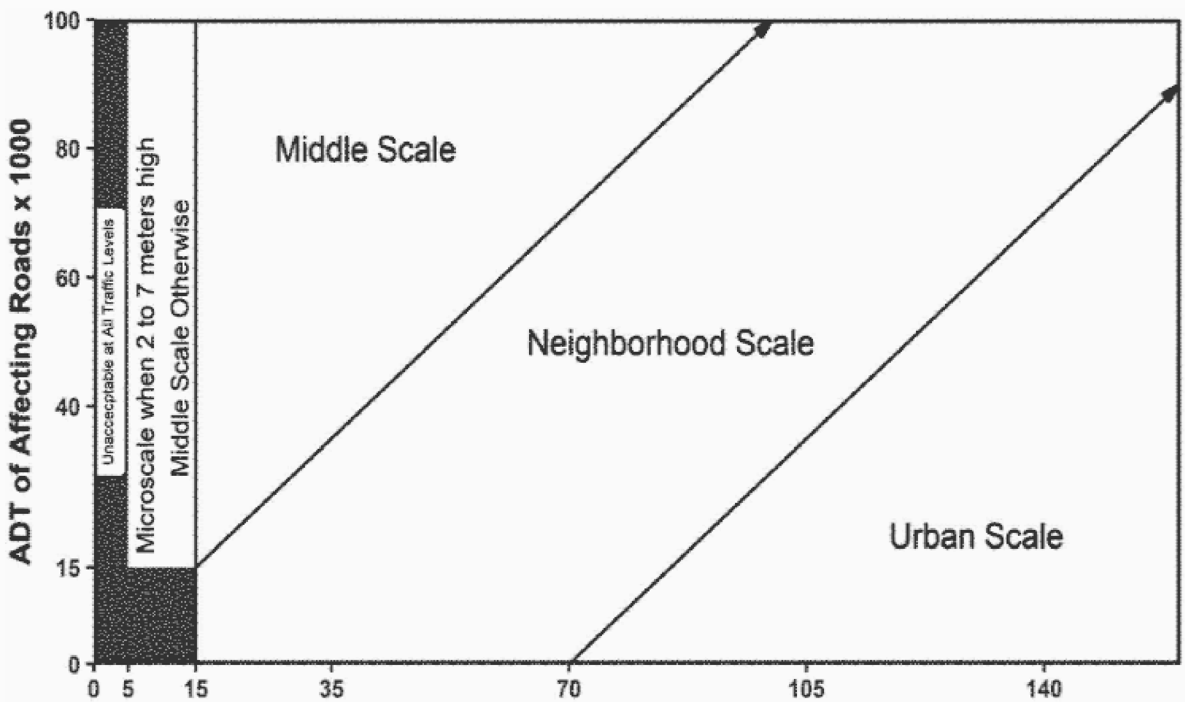

Figure E-1. Distance of PM Samplers to nearest traffic lane (meters)

Notes: Microscale street canyon sites must reside between 2 and 10 meters from the roadway.
Near-Road sites must be within 50 meters of the roadway.
The slopes of the lines between monitoring scales are one to one.

ii. The monitoring sites are representative of traffic conditions along the high-traffic corridors where they are located.

TCEQ claims that the near-road monitoring sites are not representative of the conditions in their respective CBSAs because they are among the highest traffic interstate locations in each CBSA (Plan, pages 29, 30, 32-33, 35, 37). This claim, however, is not supported by the evidence provided by TCEQ. These sites *are* representative of conditions along the extended highway corridors and the $PM_{2.5}$ concentrations measured at these sites are appropriate for comparison to both the short-term and annual $PM_{2.5}$ NAAQS.

40 CFR Appendix D Section 4.7 provides the network design criteria for $PM_{2.5}$ monitors and while the regulations state that monitoring stations are typically at the neighborhood or urban scale, "micro-or middle-scale $PM_{2.5}$ monitoring sites that represent many such locations throughout a metropolitan area are considered to represent area-wide air quality."

While TCEQ claims that the roadways are not-representative of the nearby interstates because of their high traffic counts, each of these near-road $PM_{2.5}$ monitoring sites are located along traffic corridors where annual average daily traffic ("AADT") counts are just as high or higher for extended portions of the roadway. None of the sites represent the highest AADT for the CBSA, as evidenced by the roadway rankings provided by TCEQ in Plan Table 12, which shows that the AADT ranks at the monitoring sites range from 10^{th} highest (San Antonio) to 52^{nd} highest (Houston). In terms of actual counts, the highest AADT counts in each CBSA are significantly higher, with counts at the monitoring sites lower than the highest traffic counts in their respective CBSAs by 24% to 49%, as shown in Exhibit E.

Traffic corridors with similar traffic counts extend along these interstates or adjacent highways for several miles and road segments with higher traffic counts can be found within just a few miles of each site, as shown in Exhibit E. The road segments where these challenged monitors are located are plainly representative of the surrounding area.

TCEQ tries to compare the traffic counts at the monitoring sites (along interstate highways) with traffic counts along local surface roads to show that these high traffic roads are not typical or representative (*See* Plan Figures 4, 8, 12, and 16 (pages 29-39)). The near-road monitors, however, are not intended to be representative of conditions on low-traffic surface streets but rather are precisely intended to capture typical emissions in the high-volume traffic corridors which extend well beyond the limited area shown in TCEQ's Figures.

These middle-scale monitors are capturing and recording important data about the air quality around these major highways; important information for public health purposes as well in order to understand emissions patterns and changes over time.

iii. TCEQ should not classify Houston North Loop as ineligible for comparison to the annual $PM_{2.5}$ NAAQS

Unfortunately, traffic in Houston is not an exceptional event and, as is demonstrated in Figure 9 and 12 of the draft 2025 Plan, many homes are situated almost as close to the interstate as the monitor. The Houston North Loop appropriately characterizes the area-wide air quality in

Houston for those residents living adjacent to the 557 miles of interstates in the Houston CBSA.[32]

As per page 14 of the TCEQ 2025 draft Plan, the Houston North Loop location was purposefully chosen to measure near-road traffic related air quality. Certainly, TCEQ gave a lot of consideration in selecting this location previously and those conditions have not changed. This is by far not the most congested road in the Houston region. Major freeways like I-10, I-69, State highway 288 and 290 have many more lanes. A broad range of vehicles traverse the Houston North Loop location, consistent with road conditions and transportation sources in other parts of the Houston-Pasadena MSA and a good representation of mobile $PM_{2.5}$ contributions to the Houston region's airshed. As per page 35 of the draft Plan, "2021-2023 annual $PM_{2.5}$ design values ranging between 8.3 to 12.5 $\mu g/m^3$." This sensor has had the second highest $PM_{2.5}$ measurements consistently in the region since its deployment and several times over the past few years exceeded the previous health protective annual $PM_{2.5}$ standard of 12 $\mu g/m^3$. As such its utility in assessing our performance in meeting federal regulatory air standards and protecting public health is obvious and imperative. Given Houston is already not compliant with the 2024 revision of the $PM_{2.5}$ NAAQS annual standard of 9 $\mu g/m^3$ and not expected to be in attainment by 2032, it is even more critical that this air monitor and its design value continue to be contribute toward the annual standard. The data it provides will be critical to develop strategies including the State Implementation Plan to reduce regional $PM_{2.5}$ conditions particularly from mobile sources. Its design value will give Houston and TCEQ a valuable metric to show improvements to the air shed. Its contribution to the 24-hour standard alone is insufficient. We need to understand the overall picture throughout the year, in aggregate, not just short-term daily average spikes in air quality.

IV. The Plan Must Address Statewide Particulate Matter Monitoring Concerns

Scientific, peer-reviewed literature has provided a wealth of evidence that both short-term and long-term exposure to Particulate Matter (PM) can harm human health. Because PM is so small, it can be inhaled deeply into the lungs and can cross into the bloodstream. $PM_{2.5}$ exposure can lead to heart attacks, irregular heartbeat, decreased lung function, irritation of the airways and difficulty breathing, asthma attacks, and premature death. Children, older adults, and people with lung or heart conditions are more susceptible to risks of adverse health effects from $PM_{2.5}$.[33]

The Governor's complete disregard of all $PM_{2.5}$ nonattainment data in his submission to the EPA with regard to the new $PM_{2.5}$ NAAQS limit demonstrates how vital it is that this air quality plan support a network that covers the state in order to demonstrate actual air quality conditions, rather than leaving Texas residents waiting in limbo for clear understanding of their current air quality as existing data sets are undermined as incomplete or inadequate.

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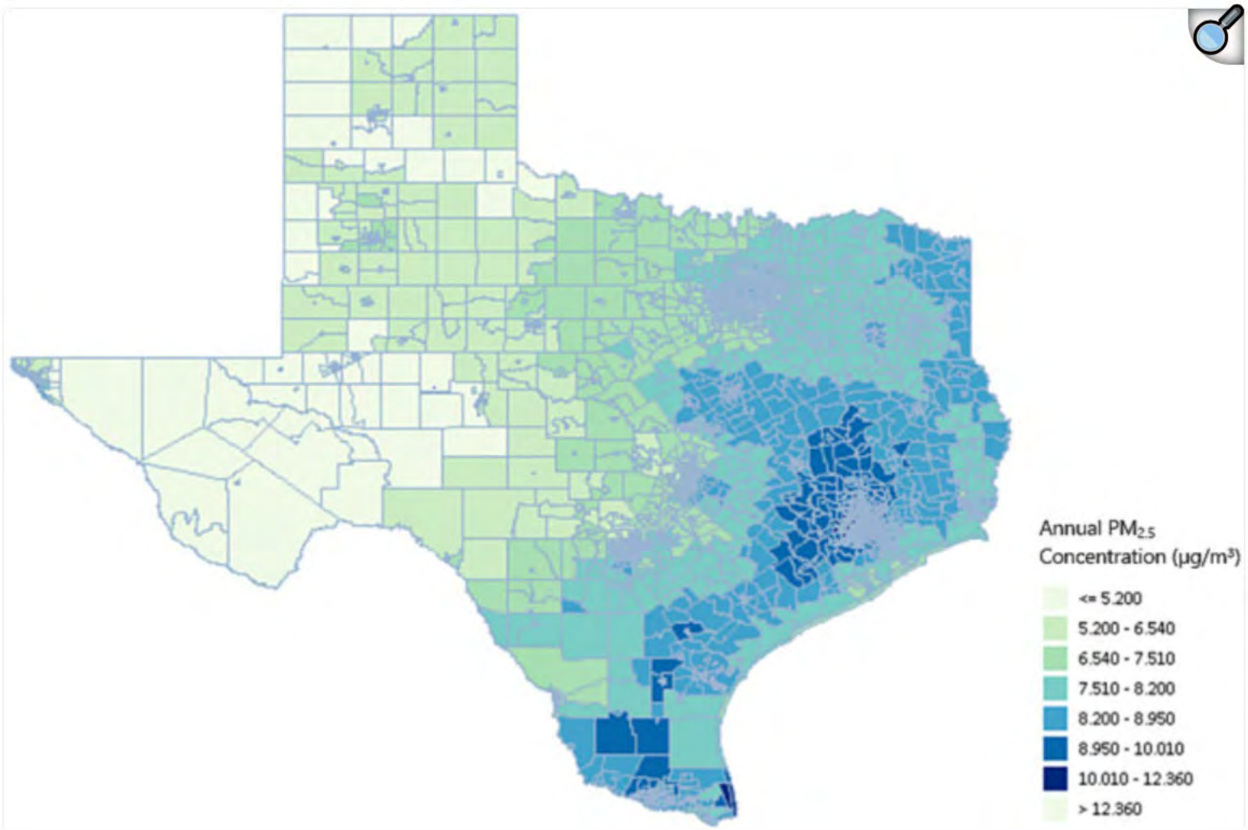
[32] Federal Highway Administration, "Highway Statistics Series; Highway Statistics 2020," October 26, 2021, available at https://www.fhwa.dot.gov/policyinformation/statistics/2020/hm72.cfm

[33] EPA, "Research on Health Effects from Air Pollution," April 11, 2025, available at https://www.epa.gov/air-research/research-health-effects-air-pollution

TCEQ initially considered 12 counties as potentially in nonattainment with the 9.0 µg/m^3 PM2.5 standard, relying on data generated through its own FRM network.[34] However, by the end of the process of responding to the new $PM_{2.5}$ NAAQS, TCEQ had been removed from the decision-making and the Governor assumed the duty of determining and reporting that all Texas counties were either in attainment or unclassifiable. Those initial 12 counties had recorded at least 3 consecutive years of data indicating that average $PM_{2.5}$ concentrations exceeded the new standard.

In a scientific study using NASA data and 2016 $PM_{2.5}$ data, the below map of Texas census blocks by $PM_{2.5}$ concentration was developed: [35]



Using 2016 emissions data and population data, the authors of this study predicted that:

> The main finding of this study is that air pollution by fine airborne particulate matter ($PM_{2.5}$) is a major cause of disease and premature death in the state of Texas . . . These findings indicate that improving air quality in Texas could save thousands of lives from disease, disability, and premature death.

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[34] Exhibit F, Slide from TCEQ Presentation, "Public Information Meeting: Particulate Matter (PM) Standard Revision," June 26, 2024, available at https://www.tceq.texas.gov/downloads/air-quality/sip/pm/designations/naaqs-pm25-2012/pm-naaqs-revision-outreach_houston_2024.pdf

[35] Exhibit G, Bryan L, Landrigan P. "$PM_{2.5}$ pollution in Texas: a geospatial analysis of health impact functions." Front Public Health. 2023 Dec 1;11:1286755. doi: 10.3389/fpubh.2023.1286755. PMID: 38106908; PMCID: PMC10722416; https://pmc.ncbi.nlm.nih.gov/articles/PMC10722416/

> We found that there were 8,405 premature deaths due to $PM_{2.5}$ pollution in Texas in 2016, comprising 4.3% of all deaths in the state. Harris, Dallas, Tarrant, and Bexar counties had air-pollution-related death tolls of 500–1,400. Statewide increases in air-pollution-related morbidity and mortality were seen for stroke, low birthweight, non-fatal lung cancers, new onset Alzheimer's, and new onset asthma.[36]

The authors point out that the NASA data used to generate the statewide map of $PM_{2.5}$ emissions was the best available data, but *their analysis was hampered by the lack of actual $PM_{2.5}$ monitoring data across large swaths of the state*. Particulate matter – especially $PM_{2.5}$ – is plainly a problem for Texas residents; even this older and incomplete data from 2016 shows that real deaths are occurring as a result of our constant exposure to particulate matter. Now that the NAAQS standard has been lowered to 9.0 $\mu g/m^3$, additional monitoring is necessary in order to detect areas where particulate matter is a public health hazard but would not have previously triggered NAAQS nonattainment under the previous standard.

As evidence from emissions sources shows, there are large $PM_{2.5}$ emitters in counties without any monitors. It is therefore imperative that TCEQ add monitors near major sources in order to protect public health – even in more rural and low-population areas – in order to comply with the primary directive to protect public health. Specifically, we recommend monitors near some of the state's largest sources of particulate matter pollution in the state, including, at a minimum, W.A. Parish in Fort Bend County, the Fayette power plant in Fayette County, and the Martin Lake power plant in Rusk County. These coal-burning power plants are significant sources of particulate matter, yet there are no monitors in any of those counties.

V. Ambient Monitoring of H2S in the Plan Is Inadequate to Address Safety Concerns

TCEQ presently has limited continuous monitoring of hydrogen sulfide (H_2S) despite the widespread smell of "rotten eggs" in many areas of Texas. People usually can smell hydrogen sulfide at low concentrations in air ranging from 0.0005 to 0.3 parts per million (ppm). Hydrogen sulfide is one of the leading causes of workplace gas inhalation deaths in the United States. According to the Bureau of Labor Statistics (BLS), hydrogen sulfide caused 46 worker deaths between 2011 and 2017.[37]

For surrounding communities, exposure to low concentrations of hydrogen sulfide may cause irritation to the eyes, nose, or throat. Respiratory distress or arrest has been observed in people exposed to very high concentrations of hydrogen sulfide. It may also cause difficulty in breathing for some asthmatics. Brief exposures to high concentrations of hydrogen sulfide can cause loss of consciousness[38] and possibly death.

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[36] *Id*.

[37] Occupational Safety and Health Administration, Hydrosulfide Overview accessed at: https://www.osha.gov/hydrogen-sulfide

[38] Agency for Toxic Substances and Disease Registry, Hydrogen Sulfide Fact Sheet (Appendix E), Dec 2016 accessed at: https://www.epa.gov/sites/default/files/2017-12/documents/appendix_e-atsdr_h2s_factsheet.pdf

In total, there are only two H_2S monitors in the Beaumont-Port Arthur area, two near Texas City, one near Freeport, two in the Corpus Christi area, three in the Midland-Odessa area and one southeast of San Antonio. Given the large number of refineries and oil and gas wells throughout Texas, this is clearly insufficient to protect Texans. Obviously, many industrial facilities have their own fenceline monitoring as part of permit conditions and many samples are taken by individual companies. In addition, TCEQ does have the ability to provide mobile monitoring for special projects or to respond to particular complaints or other events, but it is a limited universe of monitoring.

A. H_2S Odors are Detected Frequently Throughout the State

Citizens throughout Texas have complained for years to the TCEQ and Texas Railroad Commission about the rotten egg smell, and the resulting sickness and nausea felt by many Texans near oil and gas fields, refineries, wastewater treatment plants and other areas. In Texas, complaints related to H_2S often mention smells like rotten eggs or other indicators of the gas, though some complaints are vague, such as mentioning "oil and gas odors." Multiple state agencies, including the TCEQ and the Railroad Commission, are involved in regulating H_2S and addressing related complaints. TCEQ has received 89 complaints specifically mentioning H_2S since 2018. However, the agency's complaint data often includes only vague summaries, such as "oil and gas odors," making it difficult to track specific instances of H_2S exposure.

B. H_2S Health Impacts are Significant

In October 2024, two workers died and 13 others were injured after a release of hydrogen sulfide gas at the PEMEX Deer Park refinery in Texas.[39] The incident, which occurred while workers were attempting to remove an isolation blind, caused a leak of the toxic gas, leading to the fatalities and injuries. The release also prompted a shelter-in-place order for nearby communities.

In Odessa, Texas, a 2019 hydrogen sulfide release at an Aghorn Operating waterflood station resulted in the deaths of an employee and his spouse. The employee was overcome by the gas in a pump house after responding to an alarm, and his wife was also killed after she came to the facility to look for him.[40] The release occurred due to a malfunction of a water pump, releasing water containing hydrogen sulfide. The incident highlighted deficiencies in the facility's hydrogen sulfide monitoring systems, which were not functioning properly.

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[39] Chemical Safety & Hazard Investigation Board, "U.S. Chemical Safety Board Releases Investigation Update into Fatal Hydrogen Sulfide Release at PEMEX Deer Park Refinery in Deer Park, Texas," Nov. 20, 2024, available at https://www.csb.gov/us-chemical-safety-board-releases-investigation-update-into-fatal-hydrogen-sulfide-release-at-pemex-deer-park-refinery-in-deer-park-texas/#:~:text=In%20addition%20to%20the%20two%20fatalities%20and,Texas%20State%20Highway%20225%20was%20closed%20temporarily.

[40] Chemical Safety & Hazard Investigation Board, "Aghorn Operating Waterflood Station Hydrogen Sulfide Release," May 21, 2021, available at https://www.csb.gov/aghorn-operating-waterflood-station-hydrogen-sulfide-release-/

C. H_2S Monitoring Needs to Expand Across the State

Commenters urge Texas to expand its network of H_2S monitoring stations in the Odessa-Midland, El Paso, Corpus Christi and larger Houston area, in addition to areas of South Texas. We are recommending an additional $1 million per year to expand the hydrogen sulfide network. There is currently a proposal in the House version of the state budget to increase funding to better monitor hydrogen sulfide.[41] TCEQ's resources are limited but this is a dangerous emission that has led to deaths and, as the pending proposal demonstrates, should be a priority for the state.

VI. Conclusion

TCEQ is vital in protecting the environment for all Texans, and Commenters appreciate the work that goes in to placing and maintaining the existing monitoring network. We specifically commend the dedication TCEQ has shown in the addition of the $PM_{2.5}$ and VOC monitors in Pleasantville at the elementary school and Finnegan Park in Fifth Ward (Houston). TCEQ has made a commitment to improving the air quality in these Houston communities and worked closely with local community leaders to place them in the locations prioritized by residents. It has taken two years of work by TCEQ and we all look forward to seeing these important monitors activated by the end of the year. This success demonstrates that community involvement with TCEQ can achieve better air monitoring outcomes.

Commenters appreciate this opportunity to provide input on the pending Annual Network Monitoring Plan and provide the following overall recommendations:

1. TCEQ should hold public hearings on air monitoring, particularly directed at Spanish-speaking Texans
2. The idled Ellis County $PM_{2.5}$ monitor must be relocated as quickly as possible, and an additional PM monitor should be placed where it can accurately assess the particulate matter released by the major cement plants in the county
3. A NAAQS-compliant FRM $PM_{2.5}$ monitor must be placed in Williamson County, given the density of APOs and CBP, in order to start generating design data for this area.
4. El Paso's inactive monitors must be relocated as quickly as possible.
5. The Permian Basin requires air monitoring, given the explosive growth in oil and gas development throughout the area.
6. Fort Bend County needs monitoring for sulfur dioxide, ozone, $PM_{2.5}$ and carbon monoxide.
7. Coastal Bend communities need monitoring for NAAQS.

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[41] Texas Senate Finance Committee Riders - Article VI Adopted March 12, 2025 Legislative Budget Board, p. 23 ("Commission on Environmental Quality, Article VI Proposed Funding and Rider Hydrogen Sulfide Monitoring and Assessment"), available at https://www.lbb.texas.gov/Documents/Appropriations_Bills/89/Senate_Adopted/Art%20VI%20Riders_SFC_89.pdf#:~:text=1.1%2C%20Air%20Quality%20Assessment%20and%20Planning%2C%20of,meet%20state%20and%20federal%20standards%2C%20to%20monitor

8. Additional near-road monitors are needed in the Houston and Dallas areas, as well as the Auston and San Antonio metropolitan areas.
9. TCEQ must not reclassify the four near-road monitors as it proposes.
10. Statewide $PM_{2.5}$ monitoring must be increased, given available data and the new NAAQS. Specifically, TCEQ should consider siting monitors near some of the state's largest sources of particulate matter pollution in the state, including, at a minimum, W.A. Parish in Fort Bend County, the Fayette power plant in Fayette County, and the Martin Lake power plant in Rusk County.
11. Statewide H_2S monitoring must be increased, given dangers associated with H_2S releases.

Respectfully submitted by,

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Preserve our Hill Country Environment
Comal County, Texas

GOVERNOR GREG ABBOTT

October 12, 2023

The Honorable Michael Regan
Administrator
U.S. Environmental Protection Agency
1200 Pennsylvania Avenue, NW
Washington, D.C. 20460

Via Email

Subject: Voluntary Reclassification of Texas 2015 Ozone Standard Moderate Nonattainment Areas

Dear Administrator Regan:

I am exercising my authority under federal Clean Air Act (FCAA), §181(b)(3) to request voluntary reclassification of the Bexar County, Dallas-Fort Worth, and Houston-Galveston Brazoria 2015 ozone standard nonattainment areas from moderate to serious. EPA has left Texas no choice but to request voluntary reclassification of these areas by establishing absurd state implementation plan (SIP) submittal deadlines, changing the accepted approaches for how to meet FCAA requirements while SIP development is in progress, and failing to provide states with timely guidance on how to meet these moving goalposts, all of which demonstrates disrespect for limited state resources.

EPA placed an undue burden on states to develop and implement complex plans for moderate nonattainment areas on an unreasonably compressed timeline. Effective November 7, 2022, EPA established a deadline for states to submit required plans by January 1, 2023, a timeline of less than two months. EPA knowingly set states up to fail by establishing a deadline that was impossible to meet. EPA's compressed timeline did not provide a reasonable amount of time for Texas to develop new attainment plans, evaluate controls, conduct rulemaking, and give affected businesses sufficient time to implement control requirements that could demonstrate attainment by December 2023.

All of these failures on the part of EPA have put Texas at risk of potential sanctions and federal implementation plans that could have lasting detrimental impacts to industry in our state. I am requesting voluntary reclassification of these nonattainment areas to protect the Texas economy and my fellow Texans from the unreasonable consequences of EPA's failures.

Sincerely,

Greg Abbott
Governor

cc: Earthea Nance, EPA Administrator for Region 6
Jon Niermann, Chairman of TCEQ
Kelly Keel, Interim Executive Director of TCEQ

Exhibit A

GOVERNOR GREG ABBOTT

February 6, 2025

The Honorable Lee Zeldin
Administrator
U.S. Environmental Protection Agency
William Jefferson Clinton Building
1200 Pennsylvania Avenue, N.W.
Washington, D.C. 20760

Re: State Designations for the 2024 Revised Primary Annual Fine Particulate Matter National Ambient Air Quality Standard (NAAQS or Standard)

Dear Administrator Zeldin:

On February 7, 2024, the Biden–Harris Administration's U.S. Environmental Protection Agency (EPA) authorized a substantial lowering of the primary annual fine particulate matter ($PM_{2.5}$) NAAQS by pointing to alleged public health benefits. Ironically, the legally required scientific evidence used to support the revision was nearly identical to the evidence the Trump Administration used in 2020 to conclude that the 2020 $PM_{2.5}$ NAAQS was protective of public health.

The State of Texas, along with numerous other states, private entities, and interest groups filed suit challenging the revised $PM_{2.5}$ Standard. The petitioners correctly state that the revised $PM_{2.5}$ NAAQS is unlawful, violates the federal Clean Air Act (FCAA), and should be vacated. S*ee Commonwealth of Kentucky and State of West Virginia, et al. v. EPA*, D.C. Cir. Dkt. No. 24-1050 (consolidated with 24-1051, 24-1052, 24-1073, and 24-1091). Rather than revising the $PM_{2.5}$ NAAQS pursuant to the FCAA's explicit authorization—to focus on "public health"—the previous EPA seems to have heavily relied on President Biden's policies of advancing environmental justice. This is supported by the fact that this is the first time in history EPA has ever voluntarily initiated and effectuated a reconsideration of a NAAQS outside the normal statutory review period. Even though the case remains pending, I reiterate Texas' view that the previous Trump Administration's 2020 decision should be reinstated. I additionally urge EPA to reconsider the 2024 $PM_{2.5}$ NAAQS.

The consequences of arbitrarily revising the $PM_{2.5}$ Standard are significant and far reaching. Designating areas as "nonattainment" results in staggering economic costs and complex permitting requirements. One study estimated the costs to implement the 2015 eight-hour ozone NAAQS to be between \$3.2 and \$36.2 billion dollars for one nonattainment county.[1] These costs include increased expenses for pre-construction permitting (new source review), general and transportation conformity, and other regulatory hurdles for air quality planning. Additionally, there are potential national

[1] Nivin, Steven R. Ph.D., LLC for Alamo Area Council of Governments, Potential Cost of Nonattainment in the San Antonio Metropolitan Area, February 21, 2017, https://aacog.gov/sites/default/files/2022-07/Potential%20Cost%20of%20Nonattainment%20in%20the%20San%20Antonio%20Metropolitan%20Area%20%28Report%29.pdf

Exhibit B

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security implications for areas with military and Department of Defense operations due to delays in, or the constricting of, critical military defense operations.

Section 107(d) of the FCAA requires the governor of each state to submit to EPA a list of all areas with a designation of attainment, nonattainment, or unclassifiable, within one year of the promulgation of a new or revised NAAQS. Because of the Biden–Harris Administration's arbitrary and unlawful adoption of the revised $PM_{2.5}$ NAAQS, I urge EPA to defer all designations. Alternatively, because the FCAA requires that governors submit designations to EPA, I am designating all counties within the State of Texas with regulatory monitors and complete data meeting the 2024 $PM_{2.5}$ NAAQS as attainment, and all remaining counties will continue to be designated as "attainment/unclassifiable."

Sincerely,

Greg Abbott
Governor

GA:bhd

cc: The Honorable John Cornyn, United States Senator
The Honorable Ted Cruz, United States Senator

W. Scott Mason IV, EPA Administrator for Region 6
Brooke Paup, Chairwoman, Texas Commission on Environmental Quality
Kelly Keel, Executive Director, Texas Commission on Environmental Quality

Journal of the Air & Waste Management Association

ISSN: 1096-2247 (Print) 2162-2906 (Online) Journal homepage: www.tandfonline.com/journals/uawm20

Air quality and health benefits from potential coal power plant closures in Texas

Brian Strasert, Su Chen Teh & Daniel S. Cohan

To cite this article: Brian Strasert, Su Chen Teh & Daniel S. Cohan (2019) Air quality and health benefits from potential coal power plant closures in Texas, Journal of the Air & Waste Management Association, 69:3, 333-350, DOI: 10.1080/10962247.2018.1537984

To link to this article: https://doi.org/10.1080/10962247.2018.1537984

Exhibit C

JOURNAL OF THE AIR & WASTE MANAGEMENT ASSOCIATION
2019, VOL. 69, NO. 3, 333–350
https://doi.org/10.1080/10962247.2018.1537984

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TECHNICAL PAPER

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Air quality and health benefits from potential coal power plant closures in Texas

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Department of Civil and Environmental Engineering, Rice University, Houston, TX, USA

ABSTRACT

As power production from renewable energy and natural gas grows, closures of some coal-fired power plants in Texas become increasingly likely. In this study, the potential effects of such closures on air quality and human health were analyzed by linking a regional photochemical model with a health impacts assessment tool. The impacts varied significantly across 13 of the state's largest coal-fired power plants, sometimes by more than an order of magnitude, even after normalizing by generation. While some power plants had negligible impacts on concentrations at important monitors, average impacts up to 0.5 parts per billion (ppb) and 0.2 μg/m^3 and maximum impacts up to 3.3 ppb and 0.9 μg/m^3 were seen for ozone and fine particulate matter ($PM_{2.5}$), respectively. Individual power plants impacted average visibility by up to 0.25 deciviews in Class I Areas. Health impacts arose mostly from $PM_{2.5}$ and were an order of magnitude higher for plants that lack scrubbers for SO_2. Rankings of health impacts were largely consistent across the base model results and two reduced form models. Carbon dioxide emissions were relatively uniform, ranging from 1.00 to 1.26 short tons/MWh, and can be monetized based on a social cost of carbon. Despite all of these unpaid externalities, estimated direct costs of each power plant exceeded wholesale power prices in 2016.

Implications: While their CO_2 emission rates are fairly similar, sharply different NO_x and SO_2 emission rates and spatial factors cause coal-fired power plants to vary by an order of magnitude in their impacts on ozone, particulate matter, and associated health and visibility outcomes. On a monetized basis, the air pollution health impacts often exceed the value of the electricity generated and are of similar magnitude to climate impacts. This suggests that both air pollution and climate should be considered if externalities are used to inform decision making about power-plant dispatch and retirement.

PAPER HISTORY
Received May 30, 2018
Revised October 10, 2018
Accepted October 15, 2018

Introduction

Coal-fired power plants are responsible for a significant though declining portion of the nitrogen oxides (NO_x = NO and NO_2), SO_2, and CO_2 emitted in the United States (US EPA 2017a, 2018a). These emissions impact human health and the environment in a variety of ways (Lim et al. 2012; US EPA 2006, 2008a, 2008b, 2009). Specifically, NO_x contributes to the formation of tropospheric ozone, and NO_x and SO_2 contribute to the formation of fine particulate matter ($PM_{2.5}$). NO_2, SO_2, ozone, and $PM_{2.5}$ are all criteria pollutants subject to EPA ambient air quality standards because of their health impacts, while CO_2 is a greenhouse gas.

Texas has historically led the nation in power-plant emissions of each of these pollutants, emitting nearly twice as much CO_2 as second-ranked Florida (EIA 2018), more than twice as much SO_2 as second-ranked Missouri, and 24% more NO_x than second-ranked Indiana (US EPA 2016a). Utilization of coal-fired power plants has been declining due to stagnant demand and competition with cheaper natural gas and growing amounts of wind and solar power, which have kept power prices low (IEEFA 2016). As a result, four coal-fired power plants in Texas (J T Deely, Monticello, Big Brown, and Sandow) are scheduled to retire in 2018 (Luminant 2017a, 2017b). Analysts from IEEFA (2016), Moody's Investors Service (2016), and UBS Financial (2016) all expect additional closures in coming years.

The impacts of power-plant emissions on air quality have long been a focus of atmospheric research, including airborne observations of power-plant plumes (Ryerson et al. 2001), photochemical modeling (e.g., Bergin et al. 2008), and studies combining observations with modeling (e.g., Zhou et al. 2012). Ozone formation from power-plant NO_x depends strongly upon meteorology and biogenic emissions of hydrocarbons in surrounding areas (Baker, Kotchenruther, and Hudman 2016; Ryerson et al. 2001). Meanwhile, PM formation from NO_x and

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Supplemental data for this paper can be accessed on the publisher's website.

SO_2 depends strongly upon meteorology and concentrations of ammonia downwind of the plant (Karamchandani and Seigneur 1999; Pinder, Dennis, and Bhave 2008). These factors, together with population density and baseline morbidity and mortality rates, influence the health impacts of power-plant pollution per unit of emissions (Levy, Baxter, and Schwartz 2009; Muller and Mendelsohn 2007; Fann, Fulcher, and Hubbell 2009). Similarly, the propensity of a power plant to contribute to regional haze depends upon spatially and temporally varying factors (Odman et al. 2007). By contrast, climate impacts of carbon dioxide are independent of the location or timing of emissions since the greenhouse gas is very long-lived and is well mixed in the atmosphere.

Impacts of power-plant emissions on attainment of air quality standards for ozone, PM, and regional haze are most often simulated with regional-scale Eulerian photochemical models such as the Community Multiscale Air Quality (CMAQ) model (Byun and Schere 2006) or the Comprehensive Air Quality Model with Extensions (CAMx) (www.camx.com). These models provide the best available representation of a wide range of oxidant concentrations and atmospheric conditions that influence formation of ozone and PM from precursor gases. Linking photochemical model sensitivity results with concentration-response functions in a health effects model such as the Benefits Mapping and Analysis Program (BenMAP) (US EPA 2015a) allows associated health effects to be computed (Hubbell, Fann, and Levy 2009). However, these models are computationally intensive to run for testing sensitivity to individual sources (Cohan et al. 2006), often limiting simulations to short episodes for regulatory purposes (Cohan et al. 2007).

Recently, reduced-form models such as the Air Pollution Emission Experiments and Policy (APEEP) (Muller 2014) and the Estimating Air pollution Social Impact Using Regression (EASIUR) (Heo, Adams, and Gao 2016) models have been introduced to more efficiently link point source emissions to health outcomes. The reduced-form models extract pollutant-emission responses from hundreds of runs of dispersion models or regional photochemical models and associate them with population data and concentration-response functions to estimate monetized health impacts (Muller and Mendelsohn 2007). The reduced-form models offer the advantages of fast calculations based on long-term underlying simulation periods, but do not fully represent the temporal variability of individual sources or fine-scale features of regional photochemistry. Because reduced-form models are relatively new, there is a lack of studies comparing them and regional photochemical models.

This work seeks to quantify the impacts of potential closures on greenhouse gas and criteria pollutant emissions, air quality, regulatory attainment, and human health through a modeling analysis of 13 coal-fired power plants in Texas. We compare results from a regional photochemical model (CAMx) and two reduced-form models (APEEP and EASIUR). Quantifying these impacts on a per-megawatt-hour basis allows us to compare how the societal benefits of coal plant closures depend on choices of which facilities are closed. To our knowledge, this is the first study to simultaneously examine the climate, photochemical, health, and regional haze impacts and financial viability of multiple power plants, and the first to compare CAMx with APEEP and EASIUR for point source impacts.

Methods and data

Photochemical modeling

Photochemical modeling was conducted with version 6.30 of CAMx. The gas chemistry mechanism used was Carbon Bond 6 Revision 2 (CB6r2) (Hildebrandt Ruiz and Yarwood 2013), and the aerosol chemistry was solved using the default CAMx processes (RADM-AQ, ISORROPIA, and SOAP), using a static two-mode coarse/fine (CF) size distribution (Chang et al. 1987; Nenes, Pandis, and Pilinis 1998, 1999; Strader, Lurmann, and Pandis 1999).

The model included a modeling domain of three nested grids (Figure 1). These included a coarse grid of 36-km cells covering all of North America, a medium grid of 12-km cells covering all of Texas and some of the surrounding states, and a fine grid of 4-km cells covering just the area of interest within Texas.

Simulation inputs were taken from the Texas Commission on Environmental Quality (TCEQ) Future Year 2017 Case, released December 5, 2016 (TCEQ 2016b), with 2012 meteorology simulated by the Weather Research and Forecasting (WRF) model (Skamarock et al. 2008) and 2017 emissions extrapolated from 2015 emissions provided by US EPA (2017b). To obtain the projected 2017 emissions for the power plants, the emissions for each hour of the day were averaged across every day of each month of 2015, to get a diurnal cycle of emissions that was applied to every day in the respective month (i.e., every day in January had the same emissions cycle, every day in February had the same emissions cycle, etc.). Then the NO_x emissions rates were increased by a scaling factor specific to each plant based on the effects of the Cross State Air Pollution Rule and the Emissions Banking and Trading Programs, but the SO_2 emissions were not. More

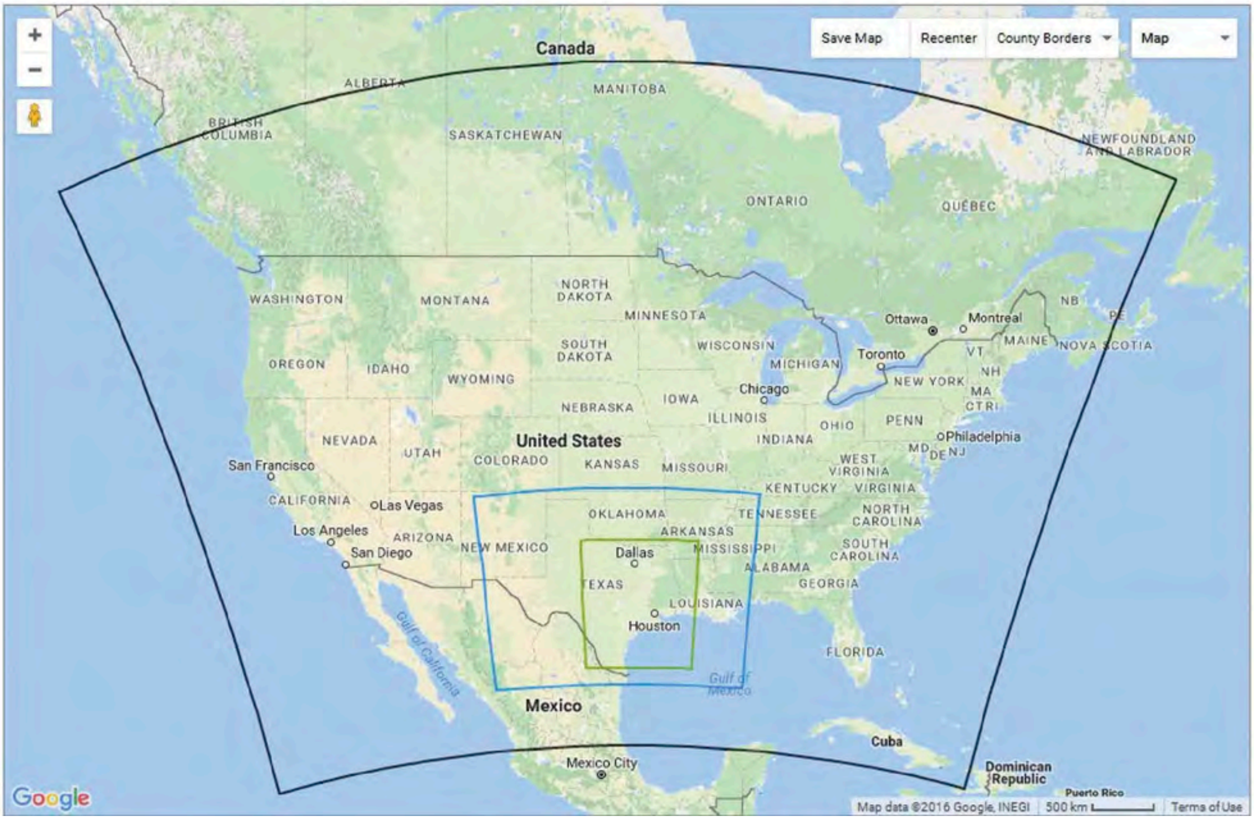

Figure 1. CAMx modeling domains with resolution of 36, 12, and 4 km (TCEQ 2016a).

detailed information on the development of these inputs and on the TCEQ model can be found in Chapters 2 and 3 of TCEQ (2016a). Variabilities in daily emissions rates at each power plant are shown in Figures SI1 and SI2.

All runs were conducted on a High Throughput Computing (HTC) Cluster of the Rice Big Research Data (BiRD) cloud infrastructure (80 dual processor HP SL230s nodes and 16 cores supporting two threads on each node). TCEQ evaluated its model for accuracy in both the meteorological data and ambient air pollution data for ozone and its precursors. Overall, the model outperformed EPA benchmarks for regulatory modeling, although it underpredicted some of the highest ozone peaks (TCEQ 2016a). Because the same inputs were used for this study, and because ozone concentrations did not change significantly with aerosol chemistry included, these model evaluations were sufficient to indicate that the model used in this study also performed adequately for meteorology and gas-phase pollutants.

Model evaluation

TCEQ's simulation did not include aerosol processes needed to simulate $PM_{2.5}$. We conducted sensitivity tests that confirmed that our inclusion of the aerosol chemistry capabilities of CAMx did not substantially change ozone concentrations or their sensitivity to power-plant NO_x emissions. In order to evaluate the model performance in terms of $PM_{2.5}$, modeled concentrations averaged over all episode days for total $PM_{2.5}$ and major $PM_{2.5}$ species were compared to observed 2012 concentrations at monitors averaged in the same manner. The comparisons are imprecise, since the model used 2017 projected emissions with 2012 meteorology, whereas the observations are from 2012, but are the best available since TCEQ did not model PM in 2012. At the power plants considered here, SO_2 emissions declined by 13% and NO_x emissions by 18% from 2012 to 2017. However, PM precursors such as biogenic emissions were not affected by the projections. The model-simulated concentrations were moderately lower than the 2012 observations for total $PM_{2.5}$, sulfate, and ammonium (normalized mean bias [NMB] −13%, −31% and −9%, respectively), consistent with the reduction in SO_2 emissions. However, the model sharply underestimated nitrate (NMB −84%) (Table 1). Similar underestimates of nitrate have been documented in other summertime simulations (e.g., Morris et al. 2005; Tesche et al. 2006); nitrate was a small portion of

Table 1. Performance statistics for CAMx simulations of total and speciated $PM_{2.5}$, evaluated against observations at regulatory monitors.

	Total $PM_{2.5}$	Nitrate	Sulfate	Ammonium
Mean bias	−1.4	−0.3	−0.8	−0.1
Mean error	3.5	0.3	0.8	0.3
Mean normalized bias	−22%	−84%	−30%	2%
Mean normalized error	27%	84%	30%	42%
Normalized mean bias	−13%	−84%	−31%	−9%
Normalized mean error	31%	84%	31%	40%
Mean fractional bias	−8%	−147%	−36%	−7%
Mean fractional error	48%	147%	36%	43%
Root mean square error	4.5	0.3	0.9	0.3

Note. For Mean Bias, Mean error, and Root mean square error, the units are $\mu g/m^3$.

total $PM_{2.5}$ observed at Texas monitors during the episode (0.31 – 0.41 $\mu g/m^3$; 3 – 5%). Organic carbon evaluations were not quantified because of the uncertainty involved in scaling organic carbon measurements (El-Zanan et al. 2005), and because coal-fired power plants are not major sources of the hydrocarbons that form organic aerosols in Texas.

Unfortunately, estimating confidence intervals for responsiveness of ozone and $PM_{2.5}$ to precursor emissions in photochemical models is extraordinarily complex (e.g., Beddows et al. 2017; Digar, Cohan, and Bell 2011; Huang et al. 2017). Thus, uncertainty analysis of the CAMx model sensitivity results is beyond the scope of this study.

Air pollution episodes

Modeling was conducted for two separate 2-week episodes, using WRF-simulated meteorology from June 15–20 and August 1–14, 2012 (Figure 2). These episodes were chosen based on high ozone concentrations in and around Harris, Bexar, Dallas, and Tarrant counties in the Base Case. These counties have the highest peak ozone concentrations in Texas and are thus the focus of regulatory efforts. Ozone concentrations during the episodes were 13–21% higher than observed during the full ozone season in these counties, and $PM_{2.5}$ concentrations were 17–20% higher than the annual averages (Table SI4).

In addition to the simulation with "Base Case" projected 2017 emissions, each "zero-out" run was conducted by removing one of the 13 highest-emitting coal-fired power plants in the fine modeling domain. Zeroing out power plants one at a time is a reasonable approach since impacts of two plumes tend to be additive rather than nonlinear when interactions occur substantially downwind (Cohan et al. 2005), as is the case here. The capacity, generation, and emissions of those power plants are shown in Table 2. Information on control technologies for those power plants is shown in Table SI1.

Emissions

Emissions depend strongly upon control technologies. For example, SO_2 emissions per MWhr are more than an order of magnitude higher at the facilities that lack desulfurization devices (Big Brown, Coleto Creek, J T Deely, and Welsh) than at plants where all the units have wet scrubbers (Fayette, J K Spruce, and Oak Grove). At Monticello and W A Parish, only certain units are scrubbed and thus overall SO_2 emissions are high. Differences in NO_x emissions per MWhr are less extreme, since all of the power plants

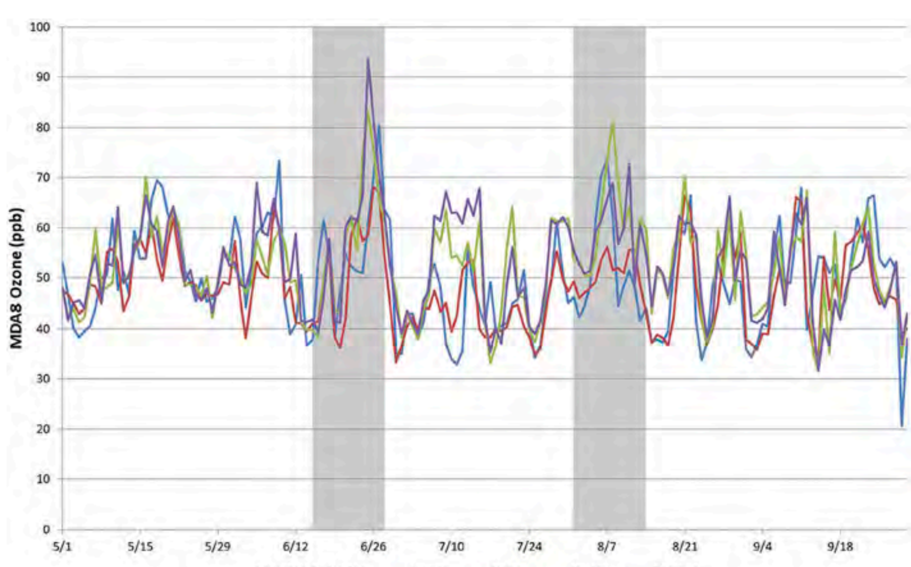

Figure 2. Base Case modeled MDA8 ozone concentrations averaged within selected counties of Texas.

Table 2. Capacities, generation, daily SO_2 and NO_x emissions (averaged over all episode days), and annual CO_2 emissions (2015 data) for coal-fired power plants in Texas (US EPA 2017b).

	Capacity (MW)	Annual generation (GWhr/yr)	Unscaled generation (GWhr/day)	Scaled generation (GWhr/day)	SO_2 (tpd)	NO_x (tpd)	CO_2 (tpy)
Big Brown	1,208	8,200	24.7	20.3	141.6	13.6	8,900,000
Coleto Creek	635	3,400	12.7	14.6	29.3	8.5	3,400,000
Fayette Power Project	1,636	9,400	34.3	34.6	3.3	18.9	10,200,000
J K Spruce	1,350	4,800	20.2	25.0	1.9	11.2	5,200,000
J T Deely	840	3,900	15.7	24.3	38.6	12.4	4,300,000
Limestone	1,689	9,800	33.8	22.1	58.3	19.7	9,900,000
Martin Lake	2,455	11,000	40.7	31.6	70.6	27.3	12,500,000
Monticello	1,955	5,200	33.0	33.9	132.2	26.8	5,900,000
Oak Grove	1,665	12,800	39.8	46.8	11.5	16.2	13,200,000
San Miguel	391	2,400	7.9	6.2	17.2	5.6	3,100,000
Sandow	600	4,500	13.3	22.4	59.8	7.3	4,900,000
W A Parish	2,499	16,100	53.8	63.7	144.9	15.5	16,300,000
Welsh	1,584	4,200	14.8	11.3	34.1	11.2	4,600,000

use some technologies to reduce NO_x emissions. However, the high-performing selective catalytic reduction devices at W A Parish, necessitated by its location within an ozone nonattainment region, enable it to emit a factor of 5 less NO_x per MWhr than the highest emitting power plants. We considered only smokestack emissions from coal combustion, neglecting the upstream emissions from coal mining and transport, which add about 6% to the greenhouse gas footprint (Venkatesh et al. 2012), and fugitive dust from the coal pile (Mueller et al. 2015).

Air quality impacts

Average impacts were determined by differencing the maximum daily 8-hr average (MDA8) ozone and daily 24-hr average (DA24) $PM_{2.5}$ concentrations across the fine domain, for each day of each episode, between the Base Case and each zero-out case. EPA has set ambient air quality standards at 70 ppb for fourth highest MDA8 ozone and 12 μg/m^3 for annual average $PM_{2.5}$. Since this study did not simulate a whole year, the modeled changes to monitor concentrations do not translate perfectly to these regulatory limits, especially since high-ozone periods were chosen for the episodes (Table SI4), but they can indicate the scope of the expected impacts. The representativeness of episodes is especially a concern for ozone, due to the strongly nonlinear response of ozone concentrations to emissions.

For ozone, regulatory impacts were analyzed at the 26 monitors (Figure 3) for which the 2015 design values (DV)

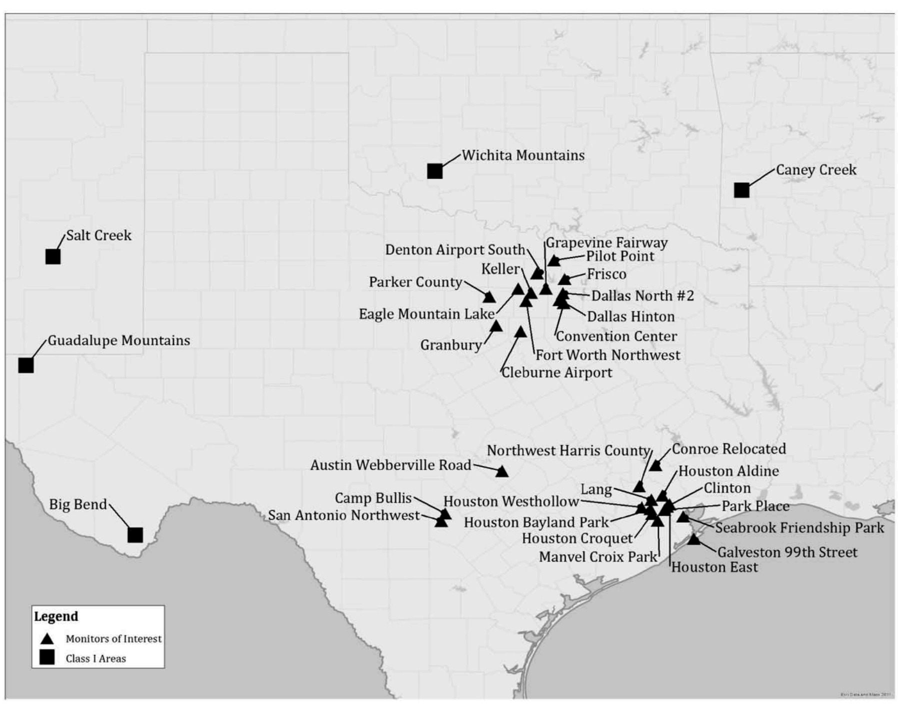

Figure 3. Locations of monitors of interest and Class I areas.

exceeded the 70 ppb MDA8 ozone standard. For each of these monitors, the effect of each zero-out case was measured as (1) the average decrease in the MDA8 ozone concentration across all days and (2) the maximum decrease in the MDA8 ozone concentration across all days.

For $PM_{2.5}$, all Texas monitors attain the 12-μg/m^3 annual standard, but it is possible that EPA could tighten the standard in the future. The World Health Organization sets a guideline value of 10 μg/m^3 for annual $PM_{2.5}$ (http://www.who.int/mediacentre/factsheets/fs313/en), a level exceeded by some Texas monitors. Thus, for $PM_{2.5}$ we focus on effects at the one monitor in each of the four major Texas metropolitan areas (Dallas–Fort Worth, Houston, San Antonio, and Austin) that had the highest 2015 DV (Figure 3). For each of these monitors, the effect of each zero-out case was measured in two ways: (1) the average decrease in the $PM_{2.5}$ concentration across all days and (2) the maximum decrease in the DA24 $PM_{2.5}$ concentration across all days. Impacts of the power-plant plumes on particle-phase water were excluded.

Climate impacts

Climate impacts were assessed based on the CO_2 emissions rate of each power plant. Upstream emissions from coal mining and transport were not considered. We assumed a $52/short ton monetized social cost of CO_2 emissions, based on interpolating between the 2015 and 2020 estimates under a 3% discount rate from the Interagency Working Group on Social Cost of Greenhouse Gases (2016), and converting to 2017 dollars.

Visibility impacts

Changes in visibility at Class I Areas were evaluated using the IMPROVE algorithm (Pitchford et al. 2007). Class I Areas are a group of 158 national parks, fish and wildlife refuges, and Forest Service Wilderness Areas that were given the greatest level of air quality protection under the Clean Air Act in a 1977 amendment. In this study, effects on Big Bend National Park, Guadalupe Mountain National Park, Salt Creek Fish & Wildlife Refuge, Wichita Mountain Fish & Wildlife Refuge, and Caney Creek Forest Service Wilderness Area were considered (Figure 3). To determine the effects on visibility at each of these Class I Areas, the concentrations of each of the components of the IMPROVE equation were averaged for each episode. Then the IMPROVE equation was used to calculate average light extinction for each episode, using the hygroscopicity for that month (Pitchford et al. 2007). These values were then averaged and used to calculate a Haze Index (in deciview, dV) across both episodes. A visibility change of 1 dV is generally recognized to be humanly perceptible (US EPA 2016b).

BenMAP modeling of health impacts

Health impacts stemming from the changes in air quality were analyzed with BenMAP, using the same health impact and valuation functions as were used by US EPA (2015b) to determine and valuate mortality due to long-term exposure to $PM_{2.5}$ (Krewski et al. 2009; Lepeule et al. 2012) and short-term exposure to ozone (Smith, Baowei, and Switzer 2009; Zanobetti and Schwartz 2008) (see Table SI2 for details). For ozone, mortality of all ages was considered, but for $PM_{2.5}$, only adult mortality was considered because the studies used considered only adult mortality and, based on the results from US EPA (2015b), the impacts on infant mortality would be small in comparison. Note that effects from non-mortality-related impacts were not included in this analysis. Because not all impacts are included, our results are conservative estimates of total impacts. Because two health impact functions were used to calculate both ozone and $PM_{2.5}$ impacts, the two results were averaged to obtain the impact from each pollutant. Also, in order to capture the uncertainty in the impacts, we calculated the 95% confidence intervals (CIs) of the health impact functions and the valuation functions. We scaled the ozone impacts by 0.42, following the approach of Digar, Cohan, and Bell (2011), since we expect NO_x reductions to reduce ozone only during the 5-month ozone season. Ozone itself remains unhealthful throughout the year (Bell et al. 2004), but is insensitive to or even negatively correlated with NO_x when cool weather suppresses biogenic VOC emissions (Zhang et al. 2009; Luecken et al. 2018). We did not scale the $PM_{2.5}$ impacts, because NO_x and SO_2 contribute to $PM_{2.5}$ year-round, albeit with temporal variations that cannot be assessed here. Each of these impacts was also normalized based on daily-average generation (MWhr/day).

Because modeling episodes were chosen based on high ozone concentrations, it is possible that this scaling method overestimated ozone impacts (and, to a lesser extent, $PM_{2.5}$ impacts). However, these biases will be lessened by the facts that impacts were calculated based on changes in concentrations, rather than absolute concentrations, and that ozone and $PM_{2.5}$ concentrations during these episodes were just 13–21% higher than seasonal and annual averages, respectively (Table SI4).

Reduced-form modeling of health impacts

Reduced-form modeling was used to provide alternate estimates of the monetized mortality impacts of the power-plant emissions considered in the preceding. We obtained version 2 of APEEP (AP2) from its developer Nick Muller and adopted the updates described by Pourhashem et al. (2017). We obtained EASIUR from its developer Jinhyok Heo (http://barney.ce.cmu.edu/~jinhyok/easiur).

APEEP computes the ozone impacts of NO_x emissions and the PM impacts of NO_x and SO_2 emissions from each county and each of three emissions heights using a Gaussian plume model (Muller 2011; National Research Council 2010). Some applications of APEEP have tallied monetized impacts as an aggregate of marginal effects of emissions on mortality, morbidity, agriculture, visibility, and recreation (Muller 2014). Here, we considered only the premature mortality impacts, since they dominate other impacts on a monetized basis (U.S. EPA, 2011) and for consistency with EASIUR and BenMAP as applied here. APEEP considers impacts of short-term ozone exposure based on Bell et al. (2004), short-term $PM_{2.5}$ exposure based on Klemm and Mason (2003), and long-term $PM_{2.5}$ exposure based on Pope et al. (2002). EASIUR considers only the impacts of $PM_{2.5}$ exposure based on Krewski et al. (2009), which is the less responsive of the two functions averaged in the BenMAP analysis (Table SI4). We treated emissions from J K Spruce, San Miguel, Sandow, and Welsh as being released from medium stacks (250–500 m effective plume height) and the remainder from tall stacks (> 500 m effective plume height), following the recommendation of Nick Muller (personal communication, March 2018). APEEP does not simulate emissions from Oak Grove directly since it opened after 2008, so we use its estimates of marginal damages from emissions from its county at a medium plume height (250–500 m).

EASIUR considers only mortality impacts from $PM_{2.5}$ resulting from emissions in each grid cell (Heo et al. 2016). We applied EASIUR to NO_x and SO_2 emissions from each power plant, mapped to the corresponding EASIUR grid cell. EASIUR models emissions from ground-level, 150-m, and 300-m sources; we assumed a 300-m stack height for all plants. EASIUR computes source–receptor relationships using a tagged emissions version of the CAMx model. That provides a more comprehensive representation of atmospheric photochemistry than the Gaussian plume model used by APEEP, but limits meteorological inputs to a single year, 2005.

APEEP sets the value of a statistical life (VSL) at \$6 million in 2000 USD (Muller 2014), and EASIUR at \$8.6 million in 2010 USD (Heo, Adams, and Gao 2016). The user can choose the value of VSL in BenMAP. U.S. EPA (2015b) reviewed 26 published estimates of VSL and chose a central estimate of \$10.0 million in 2011 USD based on projected 2024 income levels. To neutralize the effect of these assumptions on comparisons and to be roughly consistent with US EPA (2015b), we adjusted all values to a VSL of \$10 million in 2016 USD.

Profitability assessment

Finally, we estimated the profitability of each power plant based on market conditions in 2016. The data used in this analysis were taken from SNL Financial's online data portal. For fuel costs, we used plant-specific estimates reported by each plant or calculated by SNL. We assumed nonfuel variable operations and maintenance (O&M) costs equaled the 2016 average of the costs for Harrington, Tolk, Welsh, Pirkey, and Oklaunion power plants, since these plants are regulated entities and must therefore report these costs. Similarly, the annual capital expenses (Cap-ex) for each plant in this study were assumed to be equal to half of the average across those same five plants of the averaged 2006 to 2016 Cap-ex, which were calculated as the yearly difference between the "Total Cost" values in their FERC Form 1. This number was halved because it is likely that as these plants become less financially stable, they will put less money than in the past into Cap-ex, if at all possible, and that these plants have lower capital expenses than the regulated entities.

For revenues, ERCOT forward market prices were pulled from SNL Financial on July 24, 2017, and averaged across all ERCOT zones and then between on-peak and off-peak prices to obtain an overall monthly ERCOT market price for 2016. Monthly generation for each plant was taken as reported by SNL Financial. Using all of these data, a pretax earnings estimate for 2016 was calculated for each power plant.

Results and discussion

Climate impacts

CO_2 emission rates fell in a narrow range from 1.00 to 1.26 short tons/MWhr in 2015. These values are direct emissions from combustion, and do not consider the life cycle of coal mining and transport or power-plant construction. The range in CO_2 emission rates reflects the relative efficiencies of the power plants and the carbon content of their coal. None of the plants captured their carbon emissions in 2015, though W A Parish now captures CO_2 from a portion of the slipstream of one of its four units. San Miguel and

Monticello had the highest emission rates (1.26 and 1.15 short tons/MWhr, respectively), in part due to their use of lignite, which has a lower heat content than other coal.

Ozone impacts

Ozone impacts were far more varied across the plants, due to their sharply different NO_x emissions and the spatial variability of ozone sensitivity to NO_x. Averaged over the fine domain, Martin Lake and Monticello formed the most ground-level ozone, about 0.06 ppb each (Table 5). As can be seen in Figure 4, ozone impacts were most intense in counties adjacent to the plants, and extended for hundreds of kilometers downwind.

Normalized by daily generation, San Miguel, Limestone, and Welsh most strongly impacted ozone, with impacts near 2.5 ppt/GWhr. Impacts were below 1 ppt/GWhr for four other power plants (Figure 5), reflecting their lower NO_x emission rates (Table 2).

As expected, the power plants closest to each of the three main metropolitan areas (Dallas–Fort Worth, Houston, and San Antonio) tended to have the greatest effects on regulatory monitors in those regions (Figure 6).

In the Dallas–Fort Worth region, averaged over the episodes, Limestone had the greatest impact on a single monitor (0.17 ppb at Dallas Hinton), while Fayette Power Project had the greatest impact on the most monitors (7 of the 12). Monticello had the greatest impact on a monitor on a single day (1.7 ppb at Dallas Hinton). At all four of the monitors with the highest ozone design value, Fayette Power Project, Limestone, and Oak Grove had the largest impacts (Figure 6).

In the Houston region, W A Parish had the largest impact on episode-average ozone at 10 of the 12 monitors examined, including 0.48 ppb at Houston Croquet.

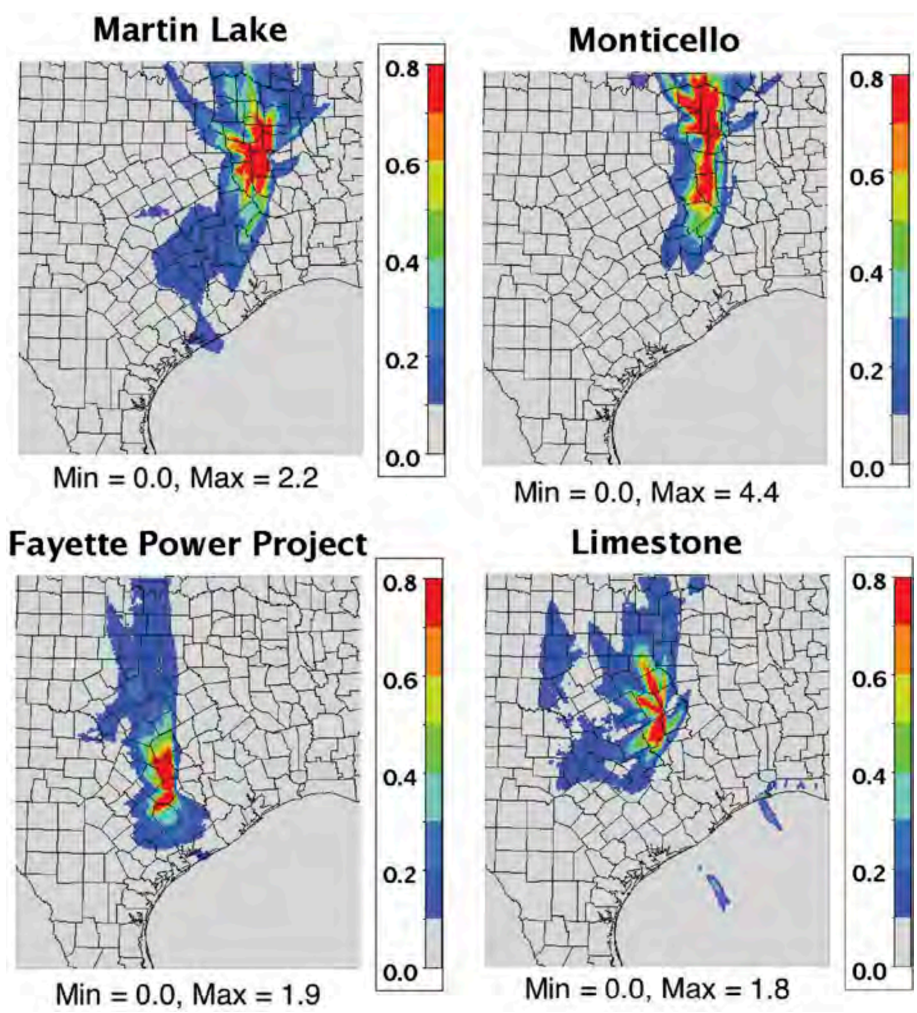

Figure 4. Difference between MDA8 ozone in Base Case and power-plant zero-outs averaged over June episode for plants with high overall impacts (ppb).

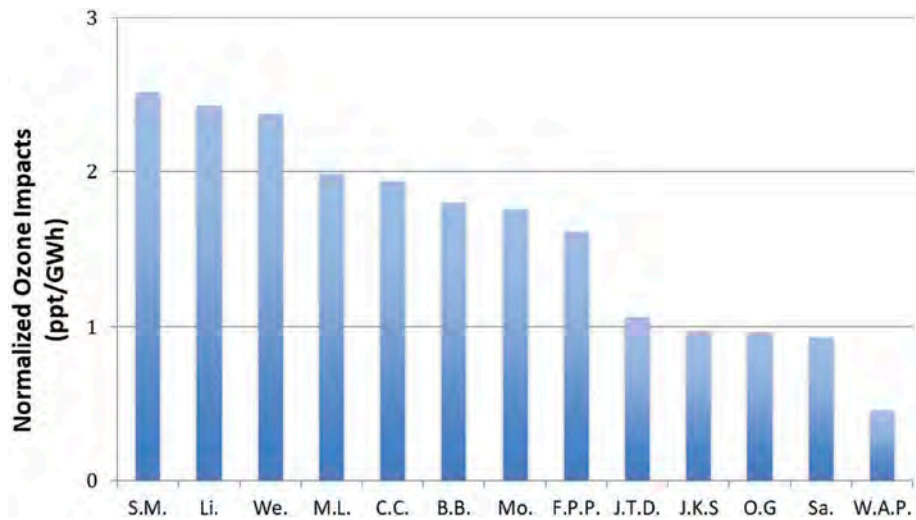

Figure 5. Impacts on MDA8 ozone averaged over all days and over the fine-scale domain and normalized by daily GWhr.

Its peak single-day MDA8 ozone impact was 3.3 ppb at the Northwest Harris County monitor. The large ozone impacts reflect the proximity of W A Parish in the southwest corner of the Houston region and its large size, despite its stringent NO_x control from selective catalytic reduction. W A Parish had by far the largest impacts, followed by Martin Lake, on all four of the monitors with the highest DV (Figure 6).

In the San Antonio region, the nearby J T Deely had the most impact on episode-average ozone at both monitors, including 0.48 ppb at Camp Bullis. Two other nearby power plants, J K Spruce and San Miguel, ranked second and third. J K Spruce had the largest single-day ozone impact, 1.5 ppb at San Antonio Northwest.

In each region, daily variations in power-plant impacts were not significantly correlated with daily ozone concentrations. In other words, power plants did not have a consistently larger impact on high-ozone days than on average- or low-ozone days.

$PM_{2.5}$ impacts

As with ozone, $PM_{2.5}$ impacts varied widely across the plants. Averaged over the fine domain and episodes, the largest amounts of $PM_{2.5}$ formed from W A Parish (0.06 μg/m^3), Monticello (0.03 μg/m^3), Big Brown (0.03 μg/m^3), and Martin Lake (0.02 μg/m^3) (Table 5). These four plants were also the largest SO_2 emitters (Table 2). All other plants had $PM_{2.5}$ impacts below 0.015 μg/m^3. Normalized by daily generation, Big Brown had the largest domain-wide impact (1.3 ng/m^3/GWhr) (Figure 8).

As shown in Figure 9, though located in the Houston region, W A Parish had the largest episode-average impact on $PM_{2.5}$ not only at the most polluted monitor in the Houston region (Clinton; 0.15 μg/m^3), but also in the Dallas–Fort Worth region (Convention Center; 0.08 μg/m^3) and Austin region (Austin Webberville Road; 0.05 μg/m^3). In the San Antonio region, nearby J T Deely had the largest impact at its most polluted monitor (San Antonio Northwest; 0.06 μg/m^3). After normalizing by daily generation, though, Sandow had the largest impact in Dallas–Fort Worth and Austin (3.8 and 3.0 ng/m^3/GWhr, respectively), while W A Parish remained the most important in Houston and J T Deely in San Antonio (2.8 and 3.7 ng/m^3/GWhr, respectively).

In terms of maximum daily impacts, Monticello had the greatest effect in Dallas–Fort Worth (0.43 μg/m^3), W A Parish in Houston (0.92 μg/m^3), Coleto Creek in San Antonio (0.47 μg/m^3), and Big Brown in Austin (0.40 μg/m^3).

Visibility impacts

As shown in Figure 10, among the Class I Areas on an episode-average basis, Caney Creek was most impacted by the power plants—0.25 dV from Monticello, 0.21 dV from Big Brown, 0.16 dV from Parish, and 0.12 dV from Martin Lake. Since 1 dV is recognized as humanly perceptible (US EPA 2016b), these collective impacts can be substantial, especially on days with higher than average impacts. In the Wichita Mountains, average impacts were 0.14 dV from Parish and 0.11 dV from Big Brown. For all other Class I Areas, impacts from individual power plants were below 0.1 dV. This does not necessarily rule out concern about haze impacts in those other areas, since there could be impacts on peak days during nonsummer months.

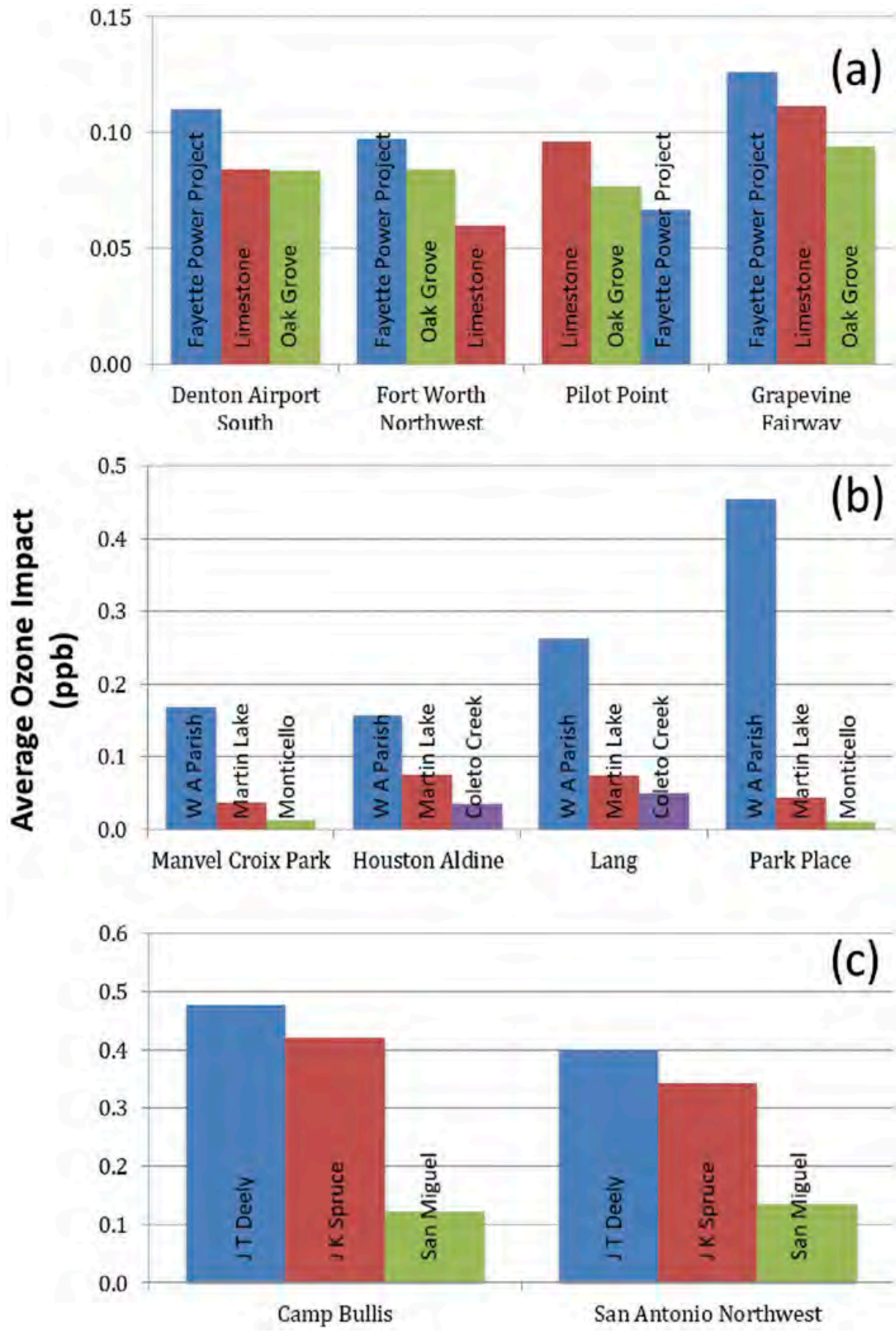

Figure 6. Three largest impacts on MDA8 ozone averaged over all days at the monitors with the highest design values in the (a) Dallas–Fort Worth, (b) Houston, and (c) San Antonio regions.

Health impacts

The air quality impacts computed by CAMx were input into BenMAP to compute resulting impacts on health. BenMAP provides results both in terms of increased mortality and associated monetized impacts, with valuation set at approximately $10 million per death. The 95% CI ranges represent uncertainty only in the health impact functions and valuation functions within BenMAP, because uncertainties of photochemical model outputs from CAMx cannot be readily computed.

Overall in the CAMx/BenMAP modeling, power-plant mortality impacts via $PM_{2.5}$ were more than an order of magnitude larger than those via ozone (Table 5). Martin Lake and Limestone created the most health effects due to ozone (1.1 [0.4–2.0] and 1.0 [0.4–1.9] deaths/yr, respectively), whereas W A Parish and Big Brown had the greatest effects from $PM_{2.5}$ (177 [77–353] and 81 [35–162] deaths/yr, respectively). The top five most impactful plants for each pollutant are shown in Table 3.

After normalizing by generation, San Miguel and Limestone had the largest estimated impacts from ozone (0.13 [0.05–0.24] and 0.13 [0.05–0.23] deaths/TWhr, respectively) and Sandow, Big Brown, and W A Parish had the largest impacts from $PM_{2.5}$ (9.1 [4.0–18.1], 9.0 [3.9–18.0], and 9.0 [3.9–18.0] deaths/TWhr, respectively). The rankings result from relatively high SO_2 emission rates and, for W A Parish, proximity to Houston.

Table 3. Power plants with the five largest impacts on mortality summed over the fine-scale domain, as computed by CAMx/BenMAP. Values in parentheses are 95% CIs of health impact functions.

	Normalization	
	None (deaths/year)	Generation (deaths/TWhr)
MDA8 Ozone	Martin Lake 1.1 (0.4, 2.0)	San Miguel 0.13 (0.05, 0.24)
	Limestone 1.0 (0.4, 1.9)	Limestone 0.13 (0.05, 0.23)
	W A Parish 1.0 (0.4, 1.8)	Big Brown 0.1 (0.04, 0.18)
	Monticello 0.9 (0.4, 1.7)	J T Deely 0.1 (0.04, 0.17)
	Fayette Power Project 0.9 (0.4, 1.7)	Welsh 0.1 (0.04, 0.17)
$PM_{2.5}$	W A Parish 177 (77, 353)	Sandow 9.1 (4.0, 18.1)
	Big Brown 81 (35, 162)	Big Brown 9.0 (3.9, 18.0)
	Monticello 76 (33, 152)	W A Parish 9.0 (3.9, 18.0)
	Sandow 44 (19, 88)	Monticello 6.3 (2.8, 12.6)
	Martin Lake 41 (18, 83)	J T Deely 5.1 (2.2, 10.2)

Table 4. Estimated variable O&M costs and pretax earnings in 2016 for power plants in Texas.

	Variable O&M ($/MWhr)	Pretax earnings (million $)	Pretax earnings ($/MWhr)
Sandow	17.41	−1.7	−0.44
Coleto Creek	25.11	−25.1	−8.04
Oak Grove	19.75	−29.2	−2.41
Limestone	20.88	−46.8	−5.11
Big Brown	24.03	−49.0	−7.80
Martin Lake	19.98	−49.3	−4.39
J T Deely	33.62	−53.7	−22.11
San Miguel	43.67	−63.8	−27.15
Welsh	31.42	−75.4	−16.80
Monticello	26.52	−89.4	−11.87
J K Spruce	31.93	−91.3	−16.76
Fayette	26.65	−100.3	−9.88
W A Parish	25.99	−124.2	−9.87

When considering the value of the impacts from both ozone and $PM_{2.5}$, the largest normalized health impacts (Sandow, Big Brown, and W A Parish) each correspond to a monetized value of approximately $90/MWhr. Each of these plants emitted large amounts of SO_2 upwind of populated areas. By contrast, power plants with modern SO_2 controls such as Fayette, J K Spruce, and Oak Grove (Table SI1) caused health impacts of roughly $10/MWhr. For comparison, Levy, Baxter, and Schwartz (2009) reported a range of $20 to $1,570/MWhr as the health effects associated with electricity generation from coal across U.S. power plants.

Significant additional monetary impacts are realized when considering the social cost of CO_2 emissions. Using a social cost of carbon of $52/short ton (in 2017 dollars), climate impacts range from $47/MWhr at Limestone to $59/MWhr at San Miguel. This narrow range reflects the relatively uniform rates of CO_2 emissions compared to the starkly divergent SO_2 emission rates.

Combining all societal impacts (Figure 11), Big Brown and Sandow had the largest impacts ($143/MWhr), while all of the 13 plants had impacts above $57/MWhr. That is far higher than the average wholesale cost of electricity in ERCOT, which was just $22/MWhr in 2016, according to data from SNL Financial.

The reduced-form models APEEP and EASIUR provide alternatives to CAMx/BenMAP for computing monetized health impacts. For ozone, CAMx/BenMAP estimates an impact of $0.85/MWhr averaged across the power plants, whereas APEEP (normalized to a -$10 million VSL) estimates $0.23/MWhr. This difference likely arises from the use of high ozone episodes in CAMx and annual conditions in APEEP. EASIUR does not model ozone. For $PM_{2.5}$, CAMx/BenMAP estimates $44/MWhr, APEEP estimates $30/MWhr, and EASIUR estimates $42/MWhr. The lower estimates from APEEP may result in part from its use of a relatively simple Gaussian plume model rather than the more sophisticated representation of photochemistry in CAMx and EASIUR.

Comparing individual power-plant impacts across the three methods, the coefficient of determination between EASIUR and CAMx/BenMAP results was R^2 = 0.80, and between APEEP and CAMx/BenMAP it was R^2 = 0.63 (Figure 12). The methods consistently ranked several power plants (e.g., Big Brown) as having the largest impacts on health per MWhr, and certain other plants (e.g., J K Spruce) having an order of magnitude smaller effect. One notable difference is that EASIUR indicated a large spread between the per-

Table 5. Results of the six main impact metrics (maximum MDA8 ozone, average MDA8 ozone, maximum DA24 $PM_{2.5}$, average DA24 $PM_{2.5}$, mortality from ozone, mortality from $PM_{2.5}$) for each of the 13 power plants of interest in CAMx/BenMAP modeling.

	Maximum MDA8 ozone (ppb)	Average MDA8 ozone (ppb)	Maximum DA24 $PM_{2.5}$ (µg/m^3)	Average DA24 $PM_{2.5}$ (µg/m^3)	Ozone health (deaths)	$PM_{2.5}$ health (deaths)
Big Brown	2.1	0.04	0.5	0.031	1	81
Coleto Creek	1.7	0.03	0.2	0.009	0	22
Fayette Power Project	2.2	0.06	0.1	0.003	1	7
J K Spruce	0.7	0.02	0.1	0.001	1	5
J T Deely	0.7	0.03	0.1	0.009	1	29
Limestone	1.8	0.05	0.2	0.014	1	41
Martin Lake	2.9	0.06	0.5	0.020	1	42
Monticello	4.4	0.06	1.0	0.033	1	76
Oak Grove	1.6	0.05	0.2	0.005	1	15
San Miguel	1.2	0.02	0.1	0.003	0	7
Sandow	1.4	0.02	0.6	0.015	1	44
W A Parish	1.0	0.03	1.2	0.062	1	177
Welsh	2.2	0.03	0.2	0.008	0	18

Note. Maximum refers to the grid cell with the maximum impacts after averaging over all days.

MWhr health impacts of Big Brown, Sandow, and W A Parish, whereas CAMx/BenMAP computed a narrower spread (Figure 12). That is because CAMx modeled the W A Parish plume to frequently impact densely populated areas in the nearby Houston suburbs and the Dallas–Fort Worth region downwind during the episodes (Figure 7), counteracting its lower per-MWhr emissions rate (Table 2). The coarse modeling of EASIUR muted the spatial differences of plume locations and population density, and thus found per-MWhr health impacts that more closely resembled the spread in per-MWhr emissions.

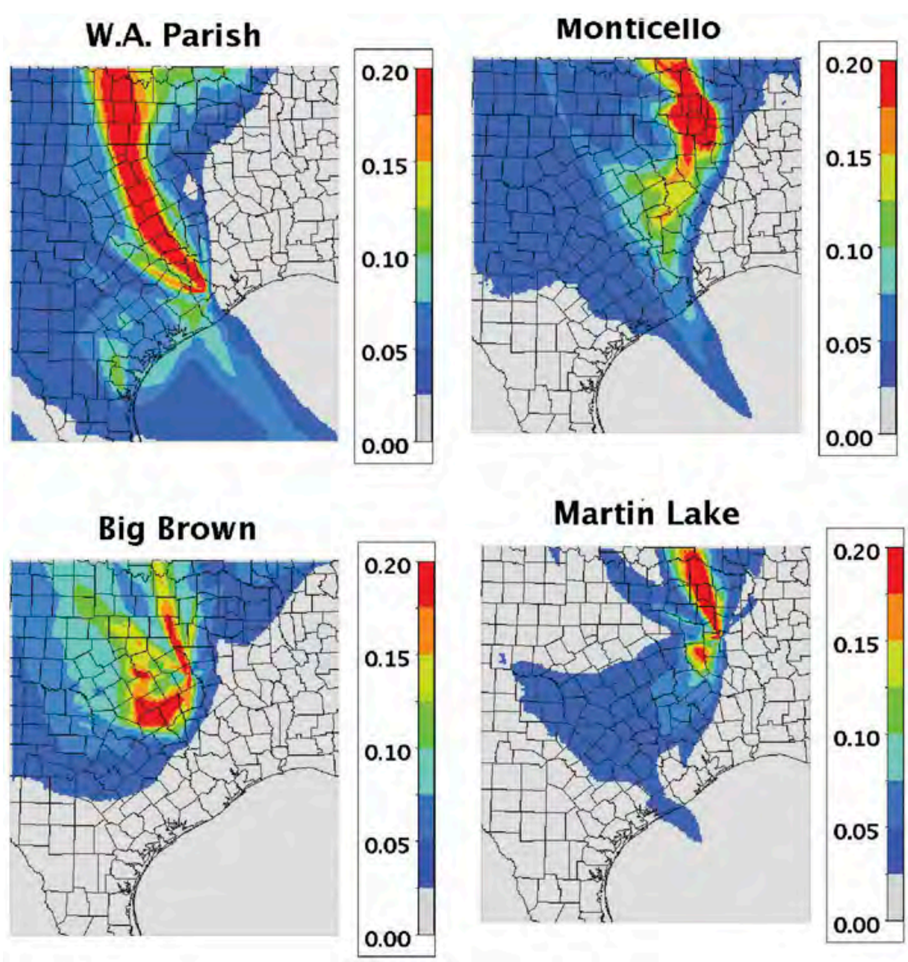

Figure 7. Difference between $PM_{2.5}$ in Base Case and power-plant zero-outs averaged over June episode for plants with high overall impacts (µg/m^3).

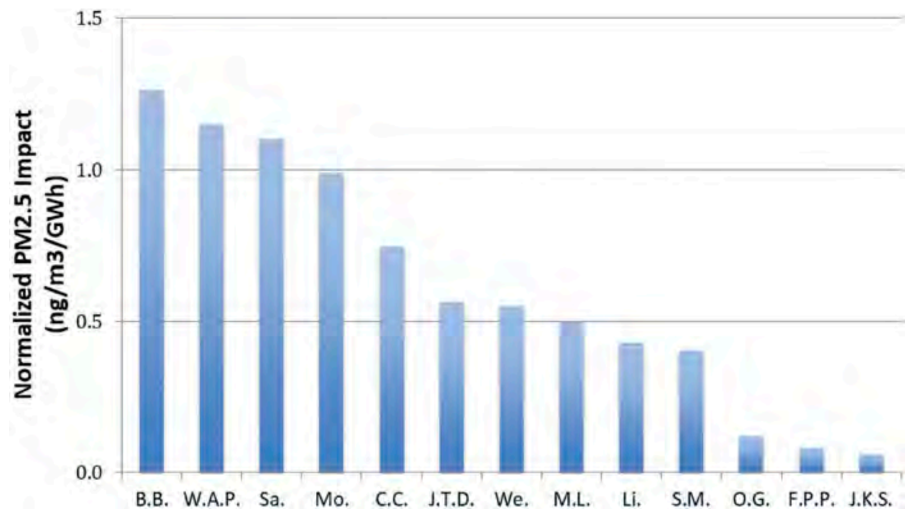

Figure 8. Impacts on $PM_{2.5}$ averaged over all days and over the fine-scale domain and normalized by daily GWhr.

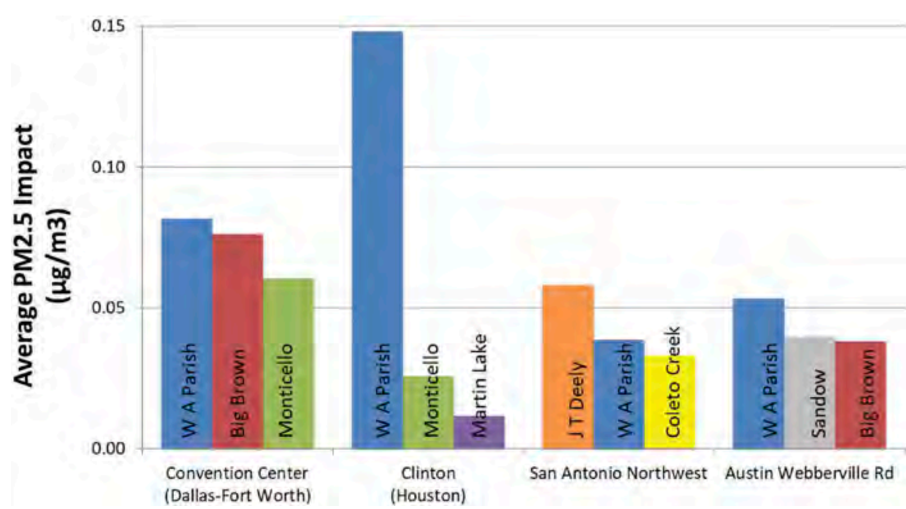

Figure 9. The three largest impacts from power plants on $PM_{2.5}$ averaged over all days at the monitor in each region with the highest $PM_{2.5}$ design value.

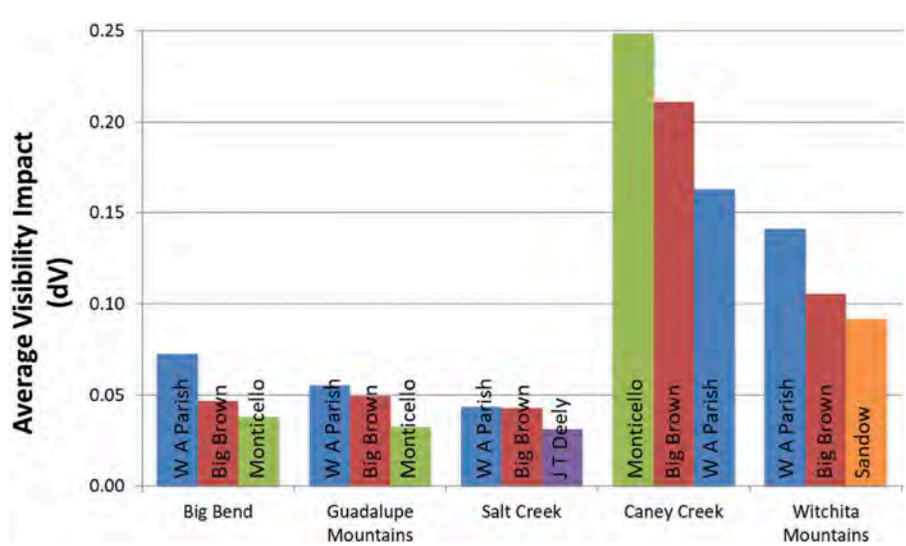

Figure 10. The three largest impacts from power plants on visibility at each Class I area, averaged over all episode days.

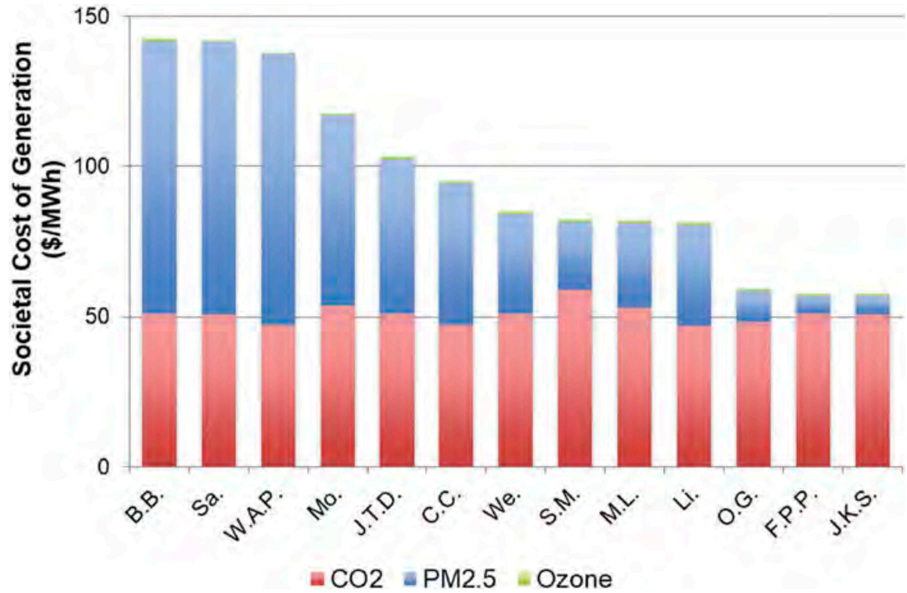

Figure 11. Societal costs of generation for each power plant, based on a \$52/ton social cost of CO_2 and the mortality impacts of $PM_{2.5}$ and ozone.

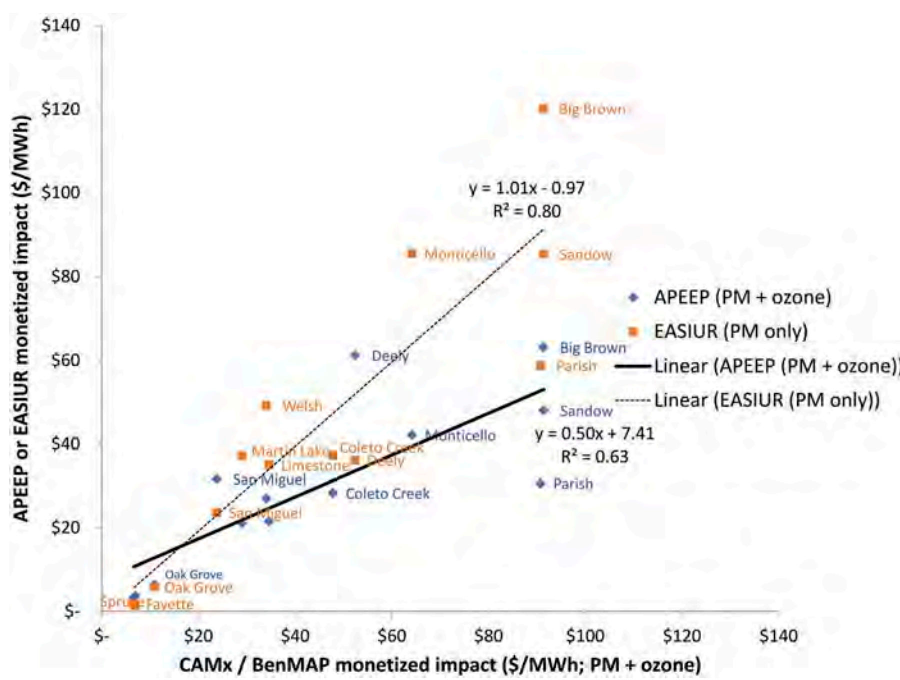

Figure 12. Monetized mortality impacts from each power plant simulated by APEEP or EASIUR compared to the results from CAMx/BenMAP.

Note that the EASIUR results exclude ozone, but that ozone represents a small portion of the CAMx/BenMAP and APEEP monetized impacts. Also, note in Table SI2 that EASIUR uses only the less responsive one (Krewski et al. 2009) of the two $PM_{2.5}$ concentration-response functions considered in our application of BenMAP (Krewski et al. 2009; Lepeule et al. 2012); scaling the EASIUR results by a factor of 1.62 would normalize for that difference. The form of the $PM_{2.5}$ concentration-response function embedded into APEEP (Pope et al. 2002; Table SI3) differs from the ones used by BenMAP and EASIUR, and thus cannot be readily scaled to match the others.

Profitability analysis

Our analysis of power prices, fuel and other operating and maintenance costs, and discounted capital expenses indicates that none of the 13 coal-fired power plants earned a net profit in 2016 (Table 4). Our estimates of net cash flow range from –$1.7 million at Sandow to –$124.2 million at W A Parish. Normalized by 2016 generation, losses ranged from $0.44/MWhr at Sandow to $27.15/MWhr at San Miguel. The range reflects the much lower variable O&M costs for Sandow ($17.41/MWhr) than for San Miguel ($43.67/MWhr). Note that 9 of the 13 power plants had fuel and other variable O&M costs that were, by themselves, more expensive than the average ERCOT market price for 2016 as reported by SNL Financial ($22.10/MWhr).

It is possible that the closure of some of these plants will lead to an increase in the ERCOT market price, which could improve the financial situations of the plants that did not close. This will become apparent in 2018, when four of the plants considered here (Monticello, Big Brown, Sandow, and J T Deely) will close. That may be why other plants have not closed already, despite their likely negative cash flows. However, it is also possible that increased generation during this time period, namely, from natural gas and renewables, will negate some or all of the positive effects of coal plant closures on the finances of other coal plants.

Conclusion

Our results show fairly similar climate impacts from each coal-fired power plant but an order of magnitude range in impacts on ozone and $PM_{2.5}$, both at regulatory monitors and on a health or visibility basis, after normalizing by daily generation. Differing emissions control technologies and proximity to urban areas drove the differences in health impacts, while the narrow range of efficiencies drove the similarities in CO_2 emissions.

Ozone impacts may be overstated because the episodes modeled included periods of high ozone concentrations, although the differences from seasonal averages were modest (Table SI4). Since ozone represents a small portion of overall monetized valuations (Figure 11), the effect of episode selection bias on aggregate impacts will be muted.

Another caveat is that all of our health impacts modeling apply what the Health Effects Institute calls a "chain of accountability" to link emissions with ambient air quality, exposure, and ultimately human health responses (Health Effects Institute 2003). Each link in this chain compounds uncertainty. For example, the historical concentration-response functions computed by epidemiological studies in other regions will not precisely represent conditions in Texas today.

We find that health impacts are more variable and in some cases larger than climate impacts on a monetized basis. In particular, power plants that do not scrub their sulfur are most damaging to health and visibility via impacts on particulate sulfate. Setting policy solely based on carbon emissions may mean foregoing opportunities to accelerate progress on air quality, health, and visibility. Our finding that particulate matter imposes the greatest impact on human health is consistent with other studies (Fann et al. 2012; Pope and Dockery 2006).

Sulfur emissions and associated $PM_{2.5}$ have received less attention in Texas than ozone-forming NO_x, because the state's largest urban areas violate ambient standards for ozone but not for $PM_{2.5}$. In fact, TCEQ regulatory modeling does not even simulate formation of $PM_{2.5}$, requiring us to reactivate this standard feature of the CAMx model to conduct our analysis. While $PM_{2.5}$ modeling may be unnecessary for ozone attainment planning, our results suggest that $PM_{2.5}$ formation from SO_2 emissions is the leading cause of health impacts.

Our findings highlight opportunities for modeling to inform policies that would enhance societal outcomes as the Texas power market evolves. For now, power-plant closure decisions are based almost exclusively upon financial considerations of the facility owner, emitting pollution virtually for free within permitted limits. With health impacts per MWhr varying by an order of magnitude across facilities, policies targeting sulfur emissions and to a lesser extent NO_x could spur closures or emissions abatement at the facilities most potent at forming air pollution and associated health and visibility impacts. Since it will take a number of years before natural gas and renewable energy can fully replace coal on the Texas grid, such policies could accelerate the air quality and health benefits of the ongoing transition from coal to cleaner sources of electricity.

A missed opportunity for accelerating those benefits came with the reversal of the Regional Haze plan issued by EPA for Texas at the end of the Obama Administration (US EPA 2016b). That plan would have required SO_2 controls at eight of the highest emitting power plants considered here. Given the poor financial status of those plants as indicated by our study, such a plan would likely have prompted most of those plants to close or convert to natural gas, yielding substantial benefits for climate, air quality, and health beyond the stated purpose of reducing regional haze. Instead, EPA in 2017 replaced the plan with a cap-and-trade scheme, setting the cap higher than emissions in recent years (2018b; US EPA 2017c). That will allow several power plants to continue operating unscrubbed, resulting in monetized health impacts that far exceed the market price for their electricity.

Future work could compare the multifaceted impacts of power plants elsewhere. Dispatch modeling would be needed to explore how closures of some plants might lead to a rebound in utilization of remaining plants. Also, because $PM_{2.5}$ and associated regional haze affect health and visibility year-round, it will be important to model conditions outside the summer ozone season. The correlation between results from the CAMx/BenMAP, APEEP, and EASIUR approaches suggests that both regional photochemical modeling and reduced-form models are options for informing decision making, though further study is needed to compare the methods in other regions and time periods. Though EASIUR has a shorter track record than APEEP, its more advanced photochemical modeling and closer agreement with our direct modeling (Figure 12) suggest that it deserves more attention in future reduced-form modeling studies.

Acknowledgment

The authors acknowledge David Schlissel from IEEFA for his assistance in the profitability analyses and Jim MacKay, Ron Thomas, Miranda Kosty, and others in the Texas Commission on Environmental Quality Air Modeling Division for their assistance in obtaining, analyzing, and interpreting modeling inputs. The authors thank Nick Muller and Jinhyok Heo for making the AP2 and EASIUR models publically available.

Funding

This work was supported by the National Aeronautics and Space Administration [NNX15AN63G].

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Table 2. Violating Sites in Areas Not Previously Designated Nonattainment for the 2015 8-Hour Ozone NAAQS
AQS Data Retrieval: 5/7/2024 Last Updated: 5/7/2024

State Name	County Name	EPA Region	AQS Site ID	2021-2023 Design Value (ppm) [1,2]	CBSA Name
Arkansas	Crittenden	6	050350005	0.072	Memphis, TN-MS-AR
California	Inyo	9	060270101	0.071	
Colorado	El Paso	8	080410016	0.071	Colorado Springs, CO
Colorado	Gilpin	8	080470003	0.075	Denver-Aurora-Lakewood, CO
Illinois	Jersey	5	170830117	0.073	St. Louis, MO-IL
Illinois	Randolph	5	171570001	0.071	
Illinois	Winnebago	5	172012001	0.071	Rockford, IL
Indiana	LaPorte	5	180910005	0.072	Michigan City-La Porte, IN
Indiana	Marion	5	180970078	0.071	Indianapolis-Carmel-Anderson, IN
Louisiana	Iberville	6	220470012	0.072	Baton Rouge, LA
Missouri	Clay	7	290470006	0.071	Kansas City, MO-KS
Missouri	Perry	7	291570001	0.071	
Nebraska	Knox	7	311079991	0.071	
New Mexico	Bernalillo	6	350011012	0.072	Albuquerque, NM
New Mexico	Dona Ana	6	350130008	0.076	Las Cruces, NM
New Mexico	Eddy	6	350150010	0.078	Carlsbad-Artesia, NM
New Mexico	Eddy	6	350151005	0.078	Carlsbad-Artesia, NM
New Mexico	Lea	6	350250008	0.071	Hobbs, NM
Ohio	Lucas	5	390950035	0.072	Toledo, OH
Oklahoma	McClain	6	400871074	0.071	Oklahoma City, OK
Oklahoma	Oklahoma	6	401091037	0.071	Oklahoma City, OK
Oklahoma	Osage	6	401130226	0.071	Tulsa, OK
Oklahoma	Tulsa	6	401430178	0.073	Tulsa, OK
Tennessee	Shelby	4	471570075	0.072	Memphis, TN-MS-AR
Texas	Bell	6	480271047	0.071	Killeen-Temple, TX
Texas	Hood	6	482210001	0.075	Dallas-Fort Worth-Arlington, TX
Texas	Travis	6	484530014	0.071	Austin-Round Rock, TX
Washington	King	10	530330023	0.073	Seattle-Tacoma-Bellevue, WA
Wisconsin	Kewaunee	5	550610002	0.071	Green Bay, WI
Wisconsin	Rock	5	551050030	0.071	Janesville-Beloit, WI
Wisconsin	Walworth	5	551270006	0.073	Whitewater-Elkhorn, WI

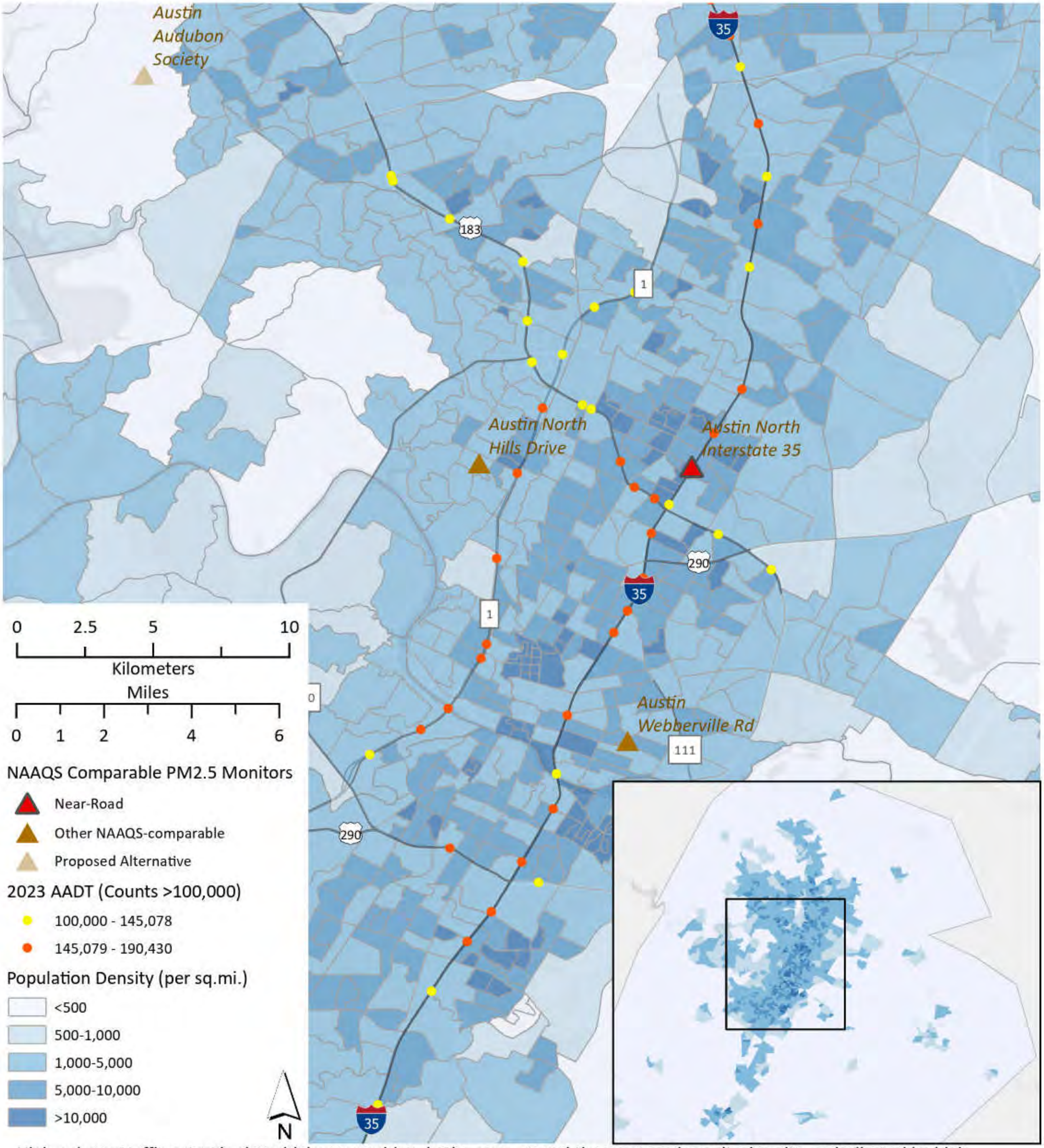
Notes:
1. The level of the 2015 8-hour ozone NAAQS is 0.070 parts per million (ppm). The design value is the 3-year average of the annual 4th highest daily maximum 8-hour ozone concentration.

2. The design values shown here are computed using Federal Reference Method or equivalent data reported by State, Tribal, and Local monitoring agencies to EPA's Air Quality System (AQS) as of May 7, 2024. Concentrations flagged by State, Tribal, or Local monitoring agencies as having been affected by an exceptional event (e.g., wildfire, volcanic eruption) and concurred by the associated EPA Regional Office are not included in these calculations.

Disclaimer: The information listed in this report and in these tables is intended for informational use only and does not constitute a regulatory determination by EPA as to whether an area has attained a NAAQS. The information set forth in this report has no regulatory effect. To have a regulatory effect, a final EPA determination as to whether an area has attained a NAAQS or attained a NAAQS as of its applicable attainment date can be accomplished only after rulemaking that provides an opportunity for notice and comment. No such determination for regulatory purposes exists in the absence of such a rulemaking. This report does not constitute a proposed or final

<u>Exhibit D</u>

Near Road PM2.5 Monitor and Adjacent High-Traffic Corridors
Austin-Round Rock-San Marcos CBSA



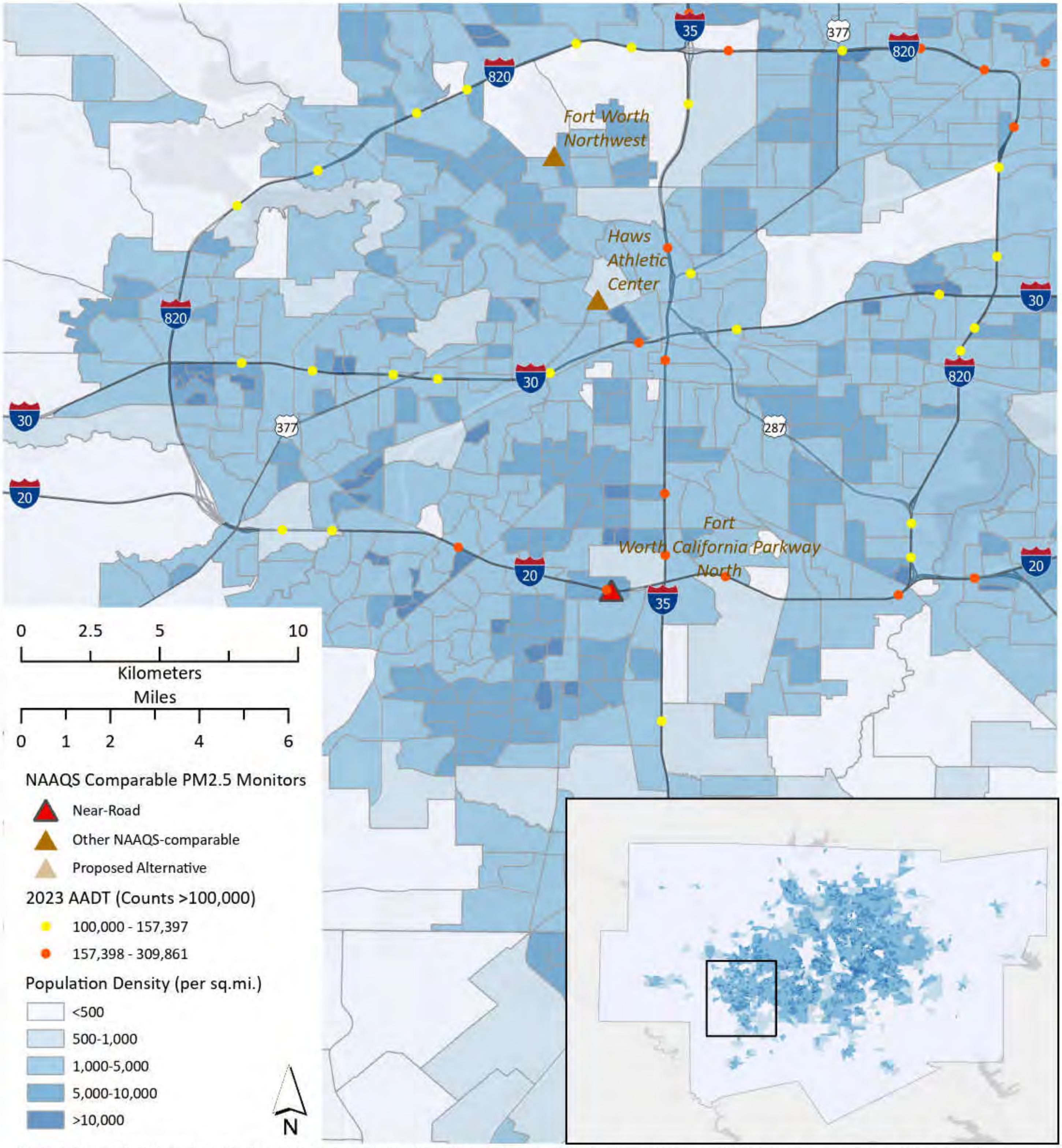
High-volume traffic extends along highway corridors in the area around the near-road monitoring site, as indicated by high-volume traffic count locations. Sites with 2023 AADT greater than or equal to AADT at monitoring site (145,079) shown as orange circles. Additional high-volume counts (greater than 100,000) shown as yellow circles.

These high-volume AADT occur in the most densely populated portions of the CBSA. Population density in near-road block groups is greater than in areas further from the high-traffic corridors, as shown in the inset map, and the average population density for the CBSA overall (541 per square mile).

Layer Credits: Austin Community College, City of Austin, Texas Parks & Wildlife, Esri, HERE, Garmin, USGS, EPA, NPS, Esri, HERE, Garmin, USGS, EPA, NPS

Exhibit E

Near Road PM2.5 Monitor and Adjacent High-Traffic Corridor
Dallas-Fort Worth-Arlington CBSA

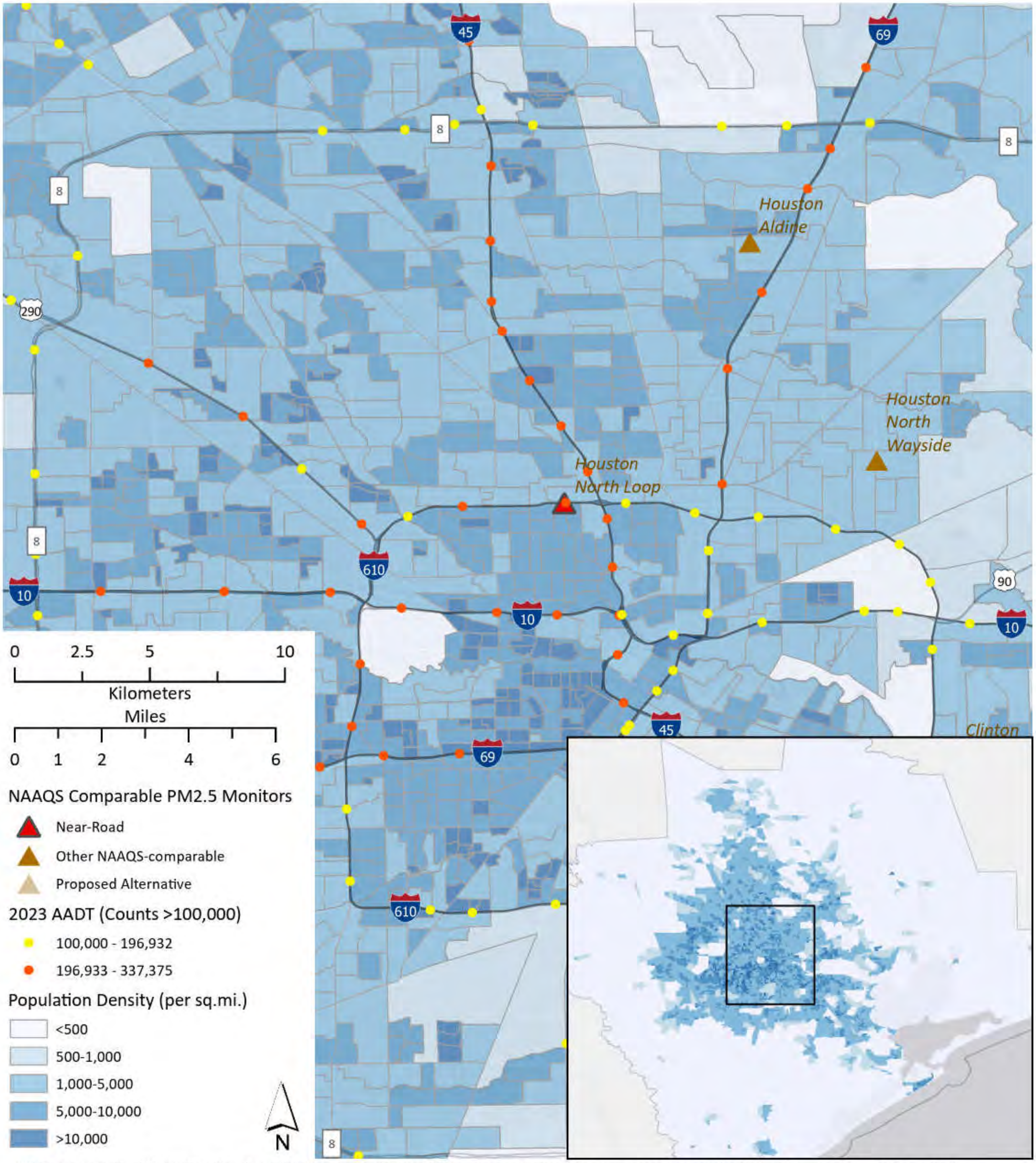


High-volume traffic extends along highway corridors in the area around the near-road monitoring site, as indicated by high-volume traffic count locations. Sites with 2023 AADT greater than or equal to AADT at monitoring site (157,398) shown as orange circles. Additional high-volume counts (greater than 100,000) shown as yellow circles.

These high-volume AADT occur in the most densely populated portions of the CBSA. Population density in near-road block groups is greater than in areas further from the high-traffic corridors, as shown in the inset map, and the average population density for the CBSA overall (880 per square mile).

Layer Credits: City of Fort Worth, Tarrant County College, Texas Parks & Wildlife, Esri, HERE, Garmin, USGS, EPA, NPS, Esri, HERE, Garmin, USGS, EPA, NPS

Near Road PM2.5 Monitor and Adjacent High-Traffic Corridors
Houston-Pasadena-The Woodlands CBSA

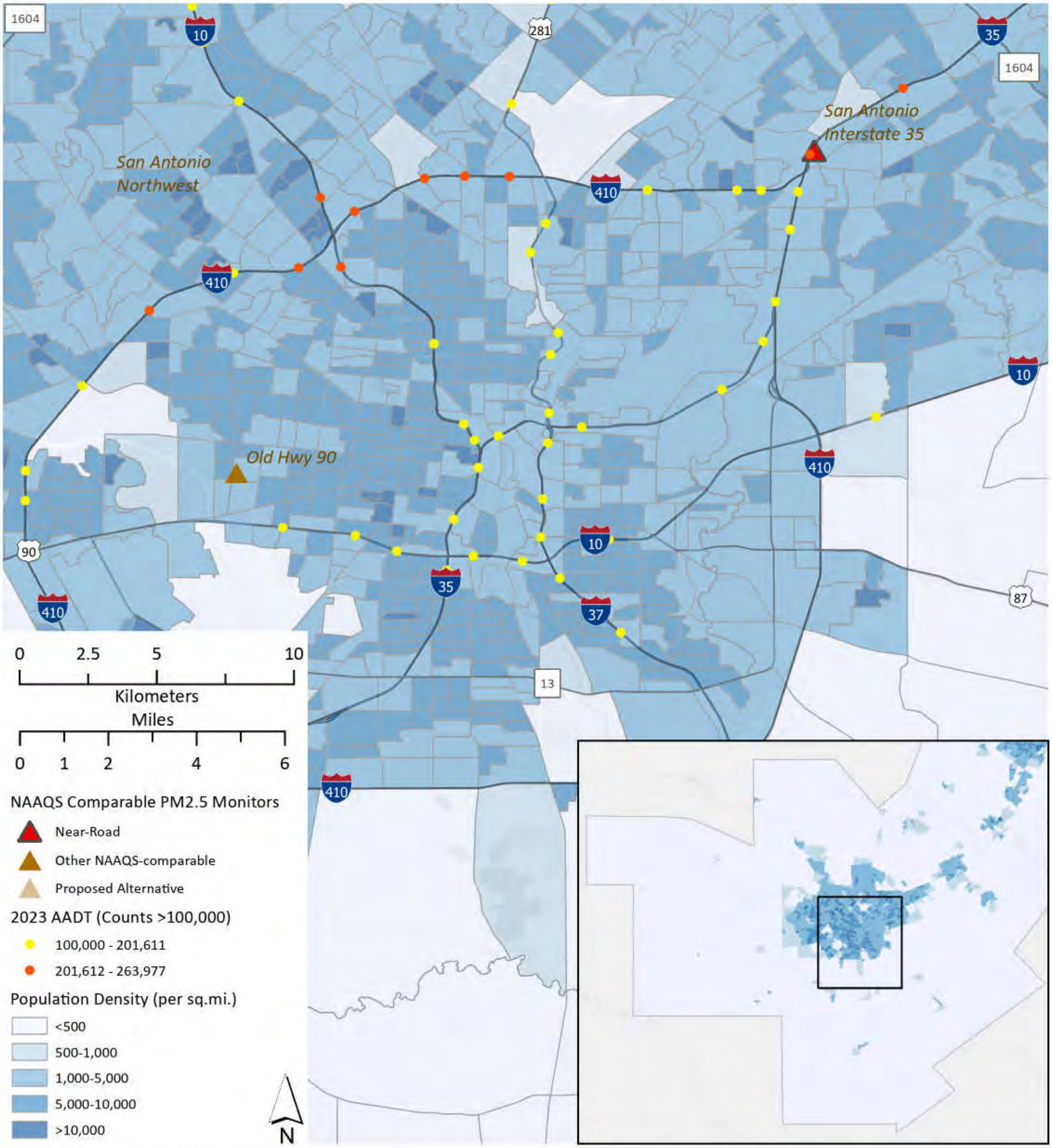


High-volume traffic extends along highway corridors in the area around the near-road monitoring site, as indicated by high-volume traffic count locations. Sites with 2023 AADT greater than or equal to AADT at monitoring site (196,933) shown as orange circles. Additional high-volume counts (greater than 100,000) shown as yellow circles.

These high-volume AADT occur in the most densely populated portions of the CBSA. Population density in near-road block groups is greater than in areas further from the high-traffic corridors, as shown in the inset map, and the average population density for the CBSA overall (809 per square mile).

Layer Credits: City of Houston, HPB, Texas Parks & Wildlife, Esri, HERE, Garmin, USGS, EPA, NPS, Esri, HERE, Garmin, USGS, EPA, NPS

Near Road PM2.5 Monitor and Adjacent High-Traffic Corridors
San Antonio-New Braunfels CBSA

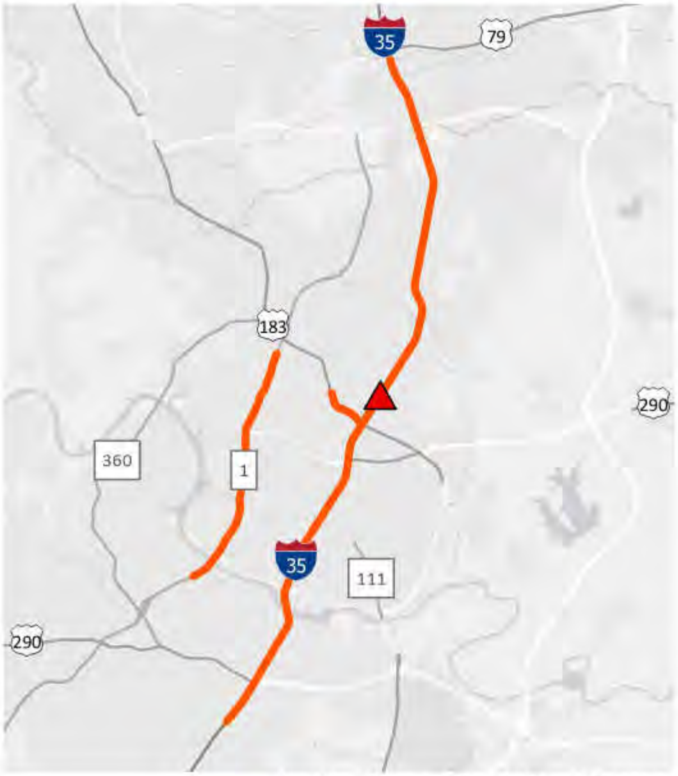


High-volume traffic extends along highway corridors in the area around the near-road monitoring site, as indicated by high-volume traffic count locations. Sites with 2023 AADT greater than or equal to AADT at monitoring site (201,612) shown as orange circles. Additional high-volume counts (greater than 100,000) shown as yellow circles.

These high-volume AADT occur in the most densely populated portions of the CBSA. Population density in near-road block groups is greater than in areas further from the high-traffic corridors, as shown in the inset map, and the average population density for the CBSA overall (350 per square mile).

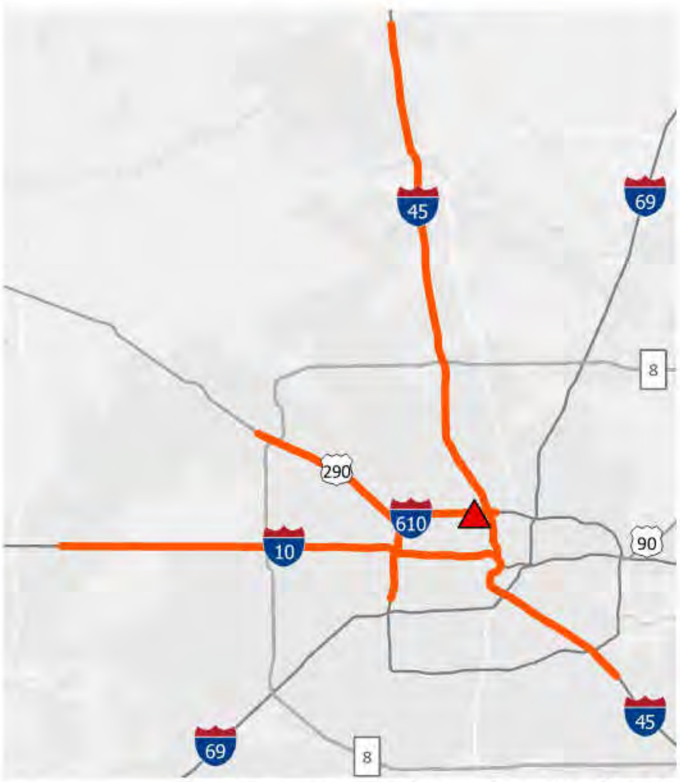
Layer Credits: BCAD, Texas Parks & Wildlife, Esri, HERE, Garmin, USGS, EPA, NPS, Esri, HERE, Garmin, USGS, EPA, NPS

High-Traffic Corridors Used in Near-Road Population Density Calculations



Austin-Round Rock-San Marcos

Dallas-Fort Worth-Arlington



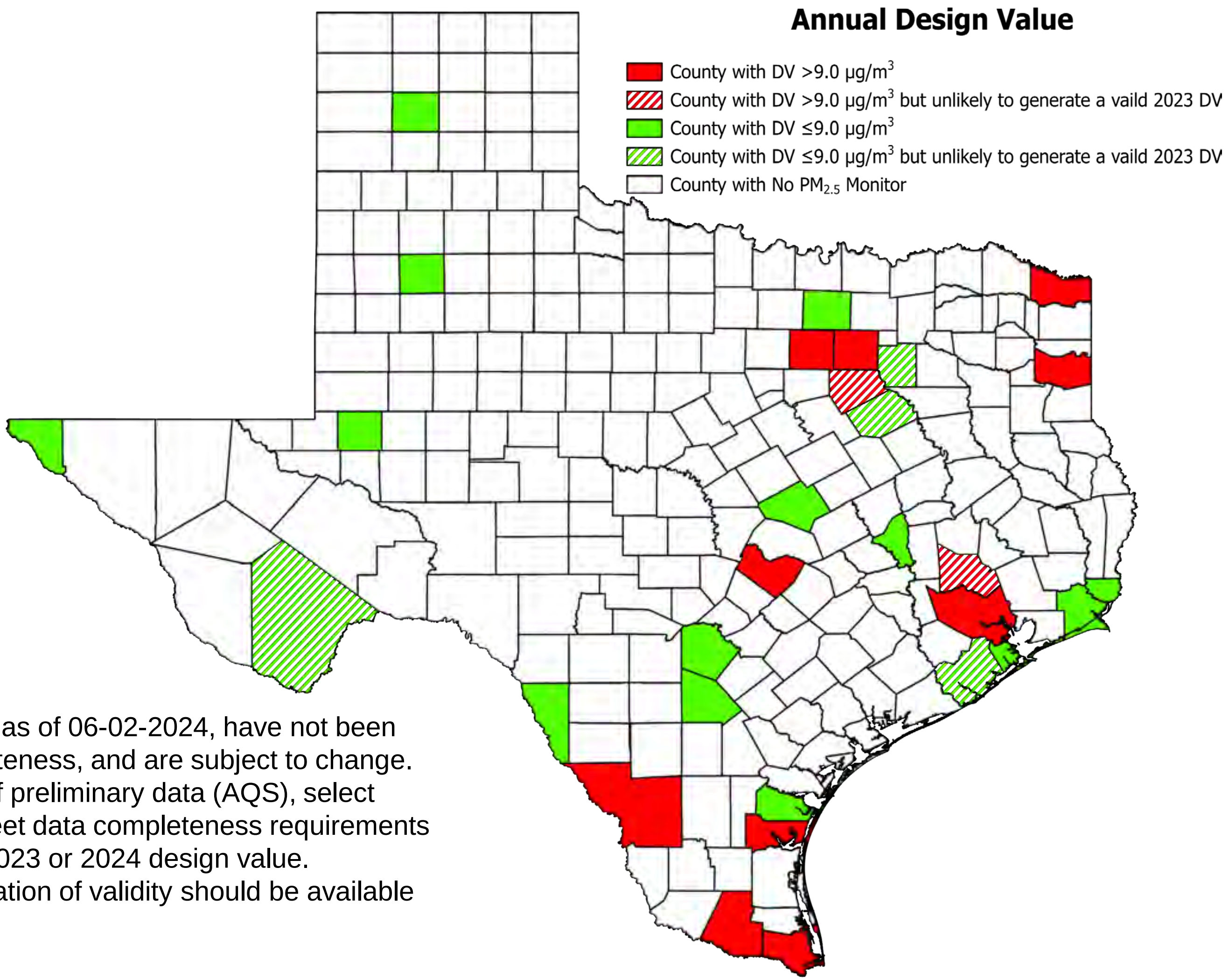
Houston-Pasadena-The Woodlands

San Antonio-New Braunfels

▲ Near-road Monitoring Site — High-Traffic Corridor *Map Scales Vary* N

Layer Credits: Austin Community College, City of Austin, Texas Parks & Wildlife, Esri, HERE, Garmin, USGS, EPA, NPS, Esri, HERE, Garmin, USGS, EPA, NPS

Potentially Affected Counties



Notes:

- Data are preliminary as of 06-02-2024, have not been screened for completeness, and are subject to change.
- Based on a review of preliminary data (AQS), select monitors may not meet data completeness requirements to generate a valid 2023 or 2024 design value.
- The formal determination of validity should be available by June of 2024.

County	Preliminary 2023 Annual DV (µg/m³)
Harris	12.5
Cameron	11.0
Bowie	10.3
Montgomery	10.0*
Dallas	9.9
Kleberg	9.9
Hidalgo	9.7
Webb	9.7
Tarrant	9.6
Travis	9.6
Harrison	9.5
Ellis	9.2**
Atascosa	9.0
El Paso	9.0
Bexar	8.9
Jefferson	8.8
Navarro	8.7**
Nueces	8.4
Brazoria	8.3**
Galveston	8.3
Orange	8.3
Kaufman	8.1*
Brazos	8.0
Maverick	7.9
Denton	7.7
Bell	7.4
Ector	7.3
Brewster	6.2*
Potter	6.0
Lubbock	5.7

*unlikely to generate a valid 2023 DV but may generate a valid 2024 DV

**unlikely to generate a valid 2023 or 2024 DV

Exhibit F

frontiers | Frontiers in Public Health

TYPE Original Research
PUBLISHED 01 December 2023
DOI 10.3389/fpubh.2023.1286755

OPEN ACCESS

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RECEIVED 31 August 2023
ACCEPTED 13 November 2023
PUBLISHED 01 December 2023

CITATION
Bryan L and Landrigan P (2023) $PM_{2.5}$ pollution in Texas: a geospatial analysis of health impact functions.
Front. Public Health 11:1286755.
doi: 10.3389/fpubh.2023.1286755

$PM_{2.5}$ pollution in Texas: a geospatial analysis of health impact functions

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Background: Air pollution is the greatest environmental threat to human health in the world today and is responsible for an estimated 7–9 million deaths annually. One of the most damaging air pollutants is $PM_{2.5}$ pollution, fine airborne particulate matter under 2.5 microns in diameter. Exposure to $PM_{2.5}$ pollution can cause premature death, heart disease, lung cancer, stroke, diabetes, asthma, low birthweight, and IQ loss. To avoid these adverse health effects, the WHO recommends that $PM_{2.5}$ levels not exceed 5 μg/m^3.

Methods: This study estimates the negative health impacts of $PM_{2.5}$ pollution in Texas in 2016. Local exposure estimates were calculated at the census tract level using the EPA's BenMAP-CE software. In BenMAP, a variety of exposure-response functions combine air pollution exposure data with population data and county-level disease and death data to estimate the number of health effects attributable to $PM_{2.5}$ pollution for each census tract. The health effects investigated were mortality, low birthweight, stroke, new onset asthma, new onset Alzheimer's, and non-fatal lung cancer.

Findings: This study found that approximately 26.7 million (98.9%) of the 27.0 million people living in Texas in 2016 resided in areas where $PM_{2.5}$ concentrations were above the WHO recommendation of 5 μg/m^3, and that 2.6 million people (9.8%) lived in areas where the average $PM_{2.5}$ concentration exceeded 10 μg/m^3. This study estimates that there were 8,405 (confidence interval [CI], 5,674–11,033) premature deaths due to $PM_{2.5}$ pollution in Texas in 2016, comprising 4.3% of all deaths. Statewide increases in air-pollution-related morbidity and mortality were seen for stroke (2,209 – CI: [576, 3,776]), low birthweight (2,841 – CI: [1,696, 3,925]), non-fatal lung cancers (636 – CI: [219, 980]), new onset Alzheimer's disease (24,575 – CI: [20,800, 27,540]), and new onset asthma (7,823 – CI: [7,557, 8,079]).

Conclusion: This study found that air pollution poses significant risks to the health of Texans, despite the fact that pollution levels across most of the state comply with the EPA standard for $PM_{2.5}$ pollution of 12 μg/m^3. Improving air quality in Texas could save thousands of lives from disease, disability, and premature death.

KEYWORDS
air pollution, particulate matter, $PM_{2.5}$, Texas, county, census tracts, health impact functions

Exhibit G

1 Background

Air pollution is the greatest environmental threat to human health in the world today and is responsible for an estimated 7–9 million deaths annually, according to the World Health Organization (1). In the United States, approximately 200,000 deaths are due to air pollution each year (2).

One of the most damaging air pollutants is $PM_{2.5}$ (3), fine, invisible airborne particulate matter less than 2.5 micrometers in diameter (4). Most $PM_{2.5}$ is formed by the incomplete combustion of fossil fuels - coal, gas, and oil - or biomass fuels such as wood (5). Other sources include wildfires, road dust, construction sites, landfills, industrial sources, and pollen (5–7). Due to their minuscule size, these tiny particles can enter deep into the lungs and in some cases enter the bloodstream (8, 9). $PM_{2.5}$ pollution has been shown to damage the heart, lungs, and other organs and pose a significant risk to human health (8–12).

Exposure to $PM_{2.5}$ can cause premature death (13–16) from ischemic heart disease, lung cancer, COPD and stroke (10, 16, 17). Exposure to $PM_{2.5}$ also increases non-fatal incidence of these diseases as well as of diabetes and asthma (8, 10, 14, 15, 17–22). $PM_{2.5}$ exposure may also cause pregnancy-related effects such as low birthweight, preterm birth, and stillbirth (9, 19, 23, 24). Recent studies have shown links between $PM_{2.5}$ and neurocognitive disorders such as Alzheimer's disease and IQ loss (17, 18, 25–27).

Recent studies show that $PM_{2.5}$ exposure levels previously thought to be safe cause disease, disability, and premature death (1, 16). In light of these studies, the WHO lowered their recommended guideline for $PM_{2.5}$ pollution to 5 $\mu g/m^3$ in 2021 from their previous recommendation of 10 $\mu g/m^3$ (16, 28). The United States EPA air quality standard for $PM_{2.5}$ is 12 $\mu g/m^3$, calculated as an annual mean (29).

Air pollution is widespread across the state of Texas – a large state in the southern United States with over 27 million people (30). A 2013 study examined data from 18 monitoring stations across Texas and found that the annual mean $PM_{2.5}$ concentrations at all 18 sites were between 6 and 12 $\mu g/m^3$ (31). While the study recognized that these values were below the EPA's standard recommendation of 12 $\mu g/m^3$, the $PM_{2.5}$ levels at each of these monitoring stations were above 5 $\mu g/m^3$. A separate 2022 study found similar results along the Texas-Mexico border, with all monitors observing $PM_{2.5}$ concentrations greater than 5 $\mu g/m^3$ across the year (32).

As previous studies have found hazardous levels of $PM_{2.5}$ throughout the state of Texas, it is important to understand the impact of this pollution. This study seeks to provide localized estimates for health effects attributable to $PM_{2.5}$ pollution. This type of exposomal analysis can provide insight into the burden of disease of air pollution, as $PM_{2.5}$ not only causes premature death, but also disease and disability at all stages of life. This study performs a localized analysis so these costs can be assessed at the state, county, and census tract levels.

Abbreviations: CI, Confidence Interval; EPA, Environmental Protection Agency; NASA, National Aeronautics and Space Administration; $PM_{2.5}$, Particulate Matter 2.5; WHO, World Health Organization; $\mu g/m^3$, Micrograms per meter cubed.

2 Methods

2.1 Overview

This study estimates the negative health impacts of $PM_{2.5}$ pollution across the state of Texas using known health impact functions, local population data, observed health outcomes, and $PM_{2.5}$ data. Population data were obtained from the US Census and were calculated at the census tract level (30). $PM_{2.5}$ estimates came from the NASA 2016 daily $PM_{2.5}$ dataset and were also estimated by census tract (33). Birth and death data, calculated at the county level, came from the Texas Department of State Health Services (34, 35). Lung cancer and asthma data came from the Texas.gov website (36, 37). Stroke data came from a 2011–2019 multi-year analysis of stroke prevalence in Texas (38). Data for Alzheimer's disease incidence came from a 2023 national historical report from the Alzheimer's Association (39). Health impact functions were selected for relevance to health outcomes of interest, their sample sizes, and by the quantity and quality of their citations in other studies. All non-vital health data were approximated at the state level. All estimates were made for 2016, because that is the most recent year for which information from the NASA daily $PM_{2.5}$ dataset was available.

First PM2.5 estimates were generated for each census tract. These data were then joined to population data – also at the census tract level – using the EPA's BenMAP-CE software. Then, all health impact functions were categorized by health outcome and input into BenMAP-CE. Census tract level calculations ran for each health impact function to estimate the number of health effects attributable to $PM_{2.5}$ pollution. Results were then aggregated to observe county and state level trends.

2.2 $PM_{2.5}$ exposure data

The particulate matter data used in this study came from a NASA-sponsored study on national PM pollution which used machine learning to generate daily $PM_{2.5}$ estimates at millions of locations across the United States (33). For the purposes of this study, the 2016 annual means from 1.2 million sites were used.

To estimate air pollution levels across Texas, census tracts were geospatially mapped and compared to the coordinates of the PM2.5 estimates. The $PM_{2.5}$ estimates – which are spaced approximately 1 km apart - overlapped with 5,189 of 5,265 (98.6%) census tracts. An average $PM_{2.5}$ estimate was assigned to each of these tracts using all contained point estimates. For the 76 tracts with no $PM_{2.5}$ intersections, the nearest $PM_{2.5}$ estimate was determined, and that single value was treated as the tract average.

2.3 Population data

The population data used in this study are from the US Census website. The population dataset used was from 2016 and age-stratified. Age estimates were given in percentages of the total population, so exact figures for age were determined prior to any other calculations. Age was the only demographic factored into this study, as the exposure-response functions used did not vary on other demographic data.

2.4 Health effects data

Eight health outcomes were investigated in this study: all-cause mortality, ischemic heart disease mortality, lung-tracheal-bronchial cancer mortality, non-fatal lung cancers, strokes, new onset asthma, new onset Alzheimer's, and low birth weight babies. These health effects were selected based on access to previous research and the ability to obtain incidence rate data. All datasets were applicable to 2016.

Data for all-cause mortality, ischemic heart disease mortality, lung-tracheal-bronchial cancer mortality, and low birth weight babies were obtained from the Texas Department of State Health Services (34, 36). Death counts were compared to the 2016 census population data to generate population-weighted incidence rates, while cases of low birthweight were compared to the total number of births. As all data were available at the county level, disease incidence rates were calculated by county.

The other health outcomes came from a variety of sources. Non-fatal lung cancer data were based on statewide incidence rates from 2015 to 2019 (37). Stroke data were based on 2016 prevalence in a multi-year analysis (38). New onset Alzheimer's data were based on national records of age-based Alzheimer's incidence (39). Asthma incidence was calculated from the statewide prevalence of childhood asthma in Texas (36). Data for these health outcomes were not available at the county level and were assumed to be constant throughout the state.

Studies for each of these health outcomes were identified as sources for health impact functions. The functions used and sources are listed in Table 1.

2.5 Statistical analyses

In generating the estimated exposure-response relationships, this study always assumed a log-linear model. This model factored population and incidence data with interpolated logarithmic measures of $PM_{2.5}$ exposure to generate health-impact estimates for each census tract. This estimated the number of excess health outcomes due to $PM_{2.5}$ air pollution based on previously calculated Beta coefficients. The formula for the log-linear model is below where *Pop* is the study population, *BI* is the baseline incidence, ΔPM is the annual particulate matter concentration in μg/m³, and β is the beta coefficient.

$$\Delta Y = \left(1 - \frac{1}{e^{\beta * \Delta PM}}\right) * BI * Pop$$

The EPA's BenMAP-CE software was used to combine these datasets into health-impact estimations. BenMAP output an Excel file for each health-impact estimate. These files were treated as the results of the experiment.

3 Results

In 2016, the estimated total population of Texas was 26,956,435. Of this population, approximately 15,115,696 (56.1%) were 30 or older and 7,122,868 (26.4%) were below the age of 18. Estimated deaths and non-fatal lung cancers attributable to PM2.5 were examined for people 30–99 and estimated new onset asthma cases attributable to PM2.5 were examined for people 0–17. Thus, 22,238,564 people (82.5%) were included in this study's at-risk population. Additionally, stroke and new onset Alzheimer's cases attributable to PM2.5 were examined for people age 65–99. Approximately 3,096,174 people (11.4%) were above the age of 65. In 2016, there were 5,265 census tracts in Texas.

Air pollution estimates were created using daily $PM_{2.5}$ pollution averages from 2016. Of the 5,265 census tracts, 5,227 had people in the at-risk population. The other 38 tracts contained airports, bodies of water, and other uninhabited or barely inhabited areas. This study estimated that of the 5,227 relevant census tracts, the minimum and maximum annual $PM_{2.5}$ concentrations were 2.4 μg/m³ and 12.4 μg/m³, respectively. Of these tracts, 5,154 had $PM_{2.5}$ levels that exceeded the WHO health recommendation of 5 μg/m³. These census tracts contained 98.9% of the population (26,664,944 people). 2,640,478 people (9.8%) resided in one of the 452 tracts that had annual $PM_{2.5}$ levels greater than 10 μg/m³, and 19,053 (0.07%) resided in one of the four census tracts that exceeded the EPA standard of 12 μg/m³. The eastern part of the state had some of the highest air pollution levels, particularly around the Houston metropolitan area. The western parts of the state, which are generally less populated, contained most of the low-pollution census tracts. Figure 1 shows a tract-by-tract map of all estimated $PM_{2.5}$ levels.

This study estimates that there were 8,405 (5,674, 11,033) premature deaths due to $PM_{2.5}$ air pollution in Texas in 2016. Of the causes investigated, ischemic heart disease had the largest

TABLE 1 Studies and references used for exposure-response functions.

Study Author	Health outcome	Year	Beta	Standard deviation	Ages
Krewski et al. (16)	Mortality, all cause	2009	0.0058268	0.0009628	30–99
Krewski et al. (16)	Mortality, ischemic heart disease	2009	0.021511	0.0020584	30–99
Krewski et al. (16)	Mortality, lung tracheal and bronchial cancer	2009	0.013103	0.0037945	30–99
Kloog et al. (21)	Stroke	2012	0.00343	0.00127	65–99
Ghosh et al. (23)	Low birthweight	2021	0.01094	0.00227	0–0
Gharibvand et al. (22)	Non-fatal lung cancer	2017	0.03784	0.01312	30–99
Kioumourtzoglou et al. (26)	New Onset Alzheimer's	2016	0.13976	0.01775	65–99
Tetreault et al. (20)	New onset asthma	2016	0.044	0.0009	0–17

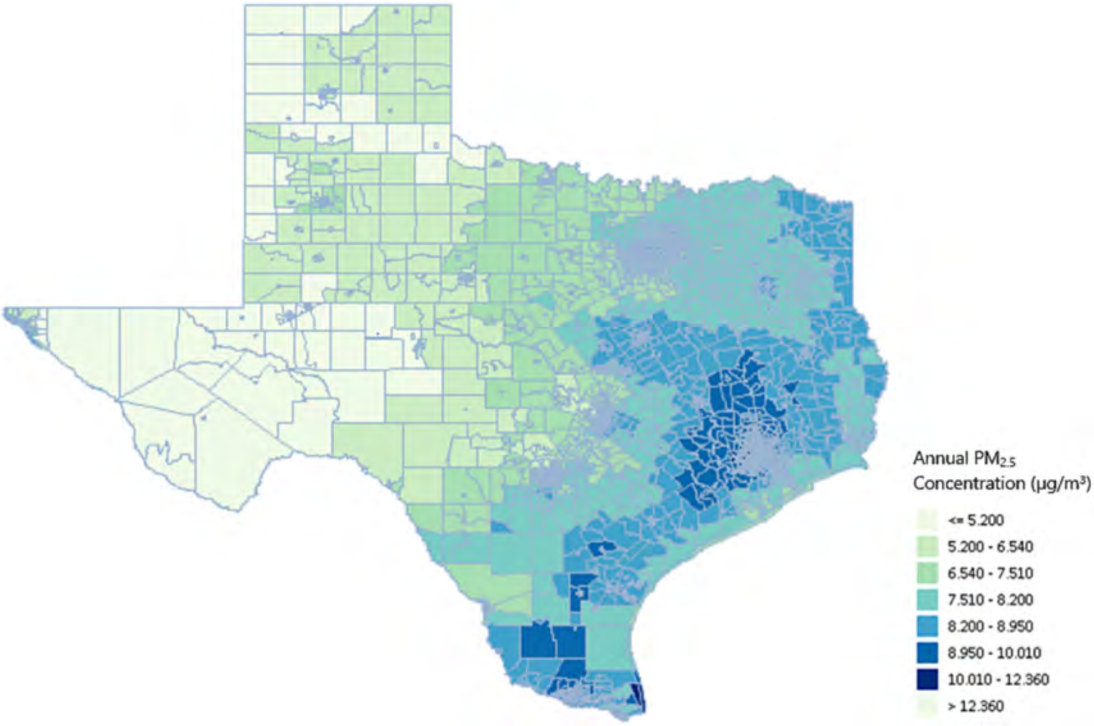

FIGURE 1
Texas $PM_{2.5}$ concentrations (µg/m^3) by census tract.

TABLE 2 Statewide estimates for health effects attributable to $PM_{2.5}$.

Health Effect Attributable to $PM_{2.5}$	Beta coefficient	Age range	Statewide estimate	Statewide confidence interval
Mortality, all cause	0.0058268	30–99	8,405	(5,674, 11,033)
Mortality, ischemic heart disease	0.021511	30–99	3,657	(3,009, 4,273)
Mortality, lung tracheal and bronchial cancer	0.013103	30–99	755	(329, 1,152)
Stroke	0.00343	65–99	2,209	(576, 3,776)
Low birthweight	0.01094	0–0	2,841	(1,696, 3,925)
Non-fatal lung cancers	0.03784	30–99	636	(219, 980)
New onset Alzheimer's[a]	0.13976	65–99	24,575	(20,800, 27,540)
New onset asthma	0.044	0–17	7,823	(7,557, 8,079)

[a]Based on national incidence rate data.

pollution-related incidence rate. There were an estimated 3,657 (3,009, 4,273) deaths due to ischemic heart disease and an estimated 755 (329, 1,152) deaths due to lung cancer attributable to air pollution.

Additional statewide estimates were generated for stroke (2,209 – CI: [576, 3,776]), low birthweight (2,841 – CI: [1,696, 3,925]), non-fatal lung cancers (636 – CI: [219, 980]), new onset Alzheimer's* (24,575 – CI: [20,800, 27,540]), and new onset asthma (7,823 – CI: [7,557, 8,079]). Since these estimates were statewide, they were able to assess overall trends with PM2.5 data, but cannot measure local hotspots of disease. All statewide data for all health effects are listed in Table 2.

Data for death and low birthweight were estimated at the county level. In a county-by-county analysis, Harris County had the largest number of estimated premature deaths at 1,368 (925, 1794). This is expected, as Harris County has nearly double the population of the next largest county. Dallas (673 – CI: [450, 880]), Bexar (541 – CI: [360, 710]), and Tarrant (561 – CI: [380, 740]) counties all had estimates of over 500 deaths per county.

Harris County also had the largest number of estimated low birthweight babies attributable to $PM_{2.5}$ (623 – CI: [370, 850]). Dallas (265 – CI: [160, 360]), Bexar (203 – CI: [120, 280]), and Tarrant (194 – CI: [120, 270]) counties were the next largest (Table 3).

TABLE 3 Top 10 county estimates for vital health effects attributable to $PM_{2.5}$.

County	Mortality, all cause	Mortality, lung tracheal and bronchial cancer	Mortality, ischemic heart disease	Low birth weight
Harris County	1,370 (925 to 1,790)	144 (62.5 to 217)	629 (518 to 731)	623 (371 to 854)
Dallas County	674 (454 to 883)	68.5 (29.5 to 104)	298 (245 to 348)	265 (157 to 365)
Bexar County	562 (378 to 736)	43.4 (18.7 to 65.8)	242 (199 to 283)	203 (120 to 279)
Tarrant County	541 (364 to 709)	65.5 (28.2 to 99.3)	215 (176 to 251)	194 (115 to 268)
Travis County	244 (164 to 320)	24.0 (10.3 to 36.3)	91.7 (75.3 to 107)	109 (64.7 to 150)
El Paso County	227 (153 to 297)	14.9 (6.43 to 22.6)	93.2 (76.6 to 109)	91.9 (54.6 to 127)
Hidalgo County	209 (141 to 273)	14.6 (6.31 to 22.1)	132 (109 to 154)	128 (76.3 to 176)
Collin County	191 (129 to 250)	20.4 (8.82 to 30.9)	83.1 (68.3 to 96.9)	78.9 (46.9 to 109)
Montgomery County	190 (128 to 248)	26.2 (11.4 to 39.5)	71.1 (58.5 to 82.7)	54.2 (32.3 to 74.3)
Fort Bend County	163 (110 to 214)	14.8 (6.4 to 22.3)	62.4 (51.4 to 72.6)	82.9 (49.4 to 114)

BenMAP also provided estimates for non-vital statistics at the county level. For example, Harris County experienced an estimated 1,520 (1,470 to 1,570) new asthma cases, 122 (42.0 to 181) non-fatal lung cancers, 355 (92 to 603) strokes, and 3,470 (2,980 to 3,810) new Alzheimer's cases attributable to $PM_{2.5}$ in 2016. All county-by-county data for vital and non-vital health effects can be found in the Supplementary Table S1.

4 Discussion

The main finding of this study is that air pollution by fine airborne particulate matter ($PM_{2.5}$) is a major cause of disease and premature death in the state of Texas, despite the fact that most $PM_{2.5}$ levels are below the US EPA standard of 12 μg/m^3. These findings indicate that improving air quality in Texas could save thousands of lives from disease, disability, and premature death.

We found that there were 8,405 (5,674, 11,033) premature deaths due to $PM_{2.5}$ pollution in Texas in 2016, comprising 4.3% of all deaths in the state. Harris, Dallas, Tarrant, and Bexar counties had air-pollution-related death tolls of 500–1,400. Statewide increases in air-pollution-related morbidity and mortality were seen for stroke (2,209 – CI: [576, 3,776]), low birthweight (2,841 – CI: [1,696, 3,925]), non-fatal lung cancers (636 – CI: [219, 980]), new onset Alzheimer's (24,575 – CI: [20,800, 27,540]), and new onset asthma (7,823 – CI: [7,557, 8,079]).

A second key finding is that nearly 99% of census tracts across Texas had average annual $PM_{2.5}$ concentrations over 5 μg/m^3, a level that is associated with multiple adverse health effects and that the World Health Organization has declared dangerous. The highest levels of air pollution were seen in Harris County, which contains Houston. Harris County is highly industrialized and by far the most heavily populated county in Texas. The next highest annual $PM_{2.5}$ estimates were seen in Fort Bend County, Waller County, and Montgomery County respectively, all of which share long borders with Harris County. These findings demonstrate that air pollution can cross political boundaries from one county to another and therefore requires large-scale, regional solutions that encompass entire airsheds.

This study has several limitations. The first is in the exposure data. The NASA daily $PM_{2.5}$ dataset that we used to calculate air pollution exposures in the census tracts of Texas is a very highly verified source. It is based on a machine-learning model trained on daily data from across the state and country and is arguably the best available dataset. However, there are large, remote portions of the state of Texas that lack $PM_{2.5}$ monitoring stations, and there is a degree of uncertainty in the estimates for those regions.

A second limitation is that all datasets used in this study were from 2016, 7 years prior to the conduct of the present analysis.

A third limitation is that we had to rely on non-localized data sources for information on health outcomes other than low birthweight and death. Incidence rate data for non-fatal lung cancers, strokes, and new onset asthma, were calculated from state-wide statistics and assumed to be evenly distributed throughout the state. This significantly reduced our ability to identify local hotspots of disease given the uneven distribution of $PM_{2.5}$ concentrations (2.4–12.4 μg/m^3). The incidence data for Alzheimer's disease came from a national study, as there were no state-wide sources to be found.

5 Conclusion

While air pollution levels in most Texas counties comply with the current EPA standard for $PM_{2.5}$ of less than 12 μg/m^3, air pollution is nonetheless responsible for significant disease and death across the state. This finding indicates that the EPA standard is not protective of human health and will need to be reduced.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

LB: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Software, Visualization, Writing – original draft, Writing – review & editing. PL: Funding acquisition, Methodology, Resources, Supervision, Writing – original draft, Writing – review & editing.

Funding

The author(s) declare financial support was received for the research, authorship, and/or publication of this article. Funding for the Primary Investigator – LB – came from the Fund for Investigative Journalism and Public Health Watch, Austin, TX 78734. Funding for PL and the publishing of this paper came from Boston College.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fpubh.2023.1286755/full#supplementary-material

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35. Texas Department of State and Health Services. Deaths. Available at: https://healthdata.dshs.texas.gov/dashboard/births-and-deaths/deaths (accessed June 30, 2023).

36. Texas Department of State and Health Services. Asthma. Available at: https://www.dshs.texas.gov/asthma (accessed June 30, 2023).

37. Texas Department of State and Health Services. Lung Cancer in Texas. Available at: https://www.dshs.texas.gov/sites/default/files/tcccp/pdf/Lung-Cancer-Fact-Sheet.pdf (accessed June 30, 2023).

38. Texas Department of State and Health Services. Texas stroke system of care report. Available at: https://www.dshs.texas.gov/sites/default/files//heart/pdf/2020_Stroke_Report-(FINAL).pdf (accessed June 30, 2023).

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June 27, 2025

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Texas Commission on Environmental Quality
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Submitted via email to: tceqamnp@tceq.texas.gov

Re: Public comment on proposed Five-Year Ambient Air Monitoring Network Assessment ("FYA") by Environmental Defense Fund, Citizens Caring for the Future, New Mexico and El Paso Interfaith Power and Light, Texas Permian Future Generations, and Sierra Club.

On behalf of our members and supporters who live, work, and recreate in Texas and New Mexico, the undersigned ("Commenters") respectfully submit these comments regarding the Texas Commission on Environmental Quality's ("TCEQ") proposed 2025 Five-Year Assessment ("FYA").

While the Annual Monitoring Network Plan ("AMNP") provides annual updates on monitoring compliance, the purpose of the FYA is to "confirm that the existing federal network continues to meet the objectives in 40 CFR Part 58, Appendix D and to evaluate whether individual federal network monitors should be added, relocated, or decommissioned to best understand and evaluate air quality with existing resources."[1] As a result, the 2025 FYA directly informs AMNPs from 2026 to 2030.

Our comments on the FYA are consistent with those we submitted on TCEQ's 2025 AMNP on May 14, 2025. We reiterate many of the same concerns here because, despite extensive evidence of ozone and ozone precursor pollution in the Permian Basin (part of the Panhandle and West Texas planning area), TCEQ's FYA and air monitoring network do not measure ozone pollution levels in the region. The absence of such data undermines the Clean Air Act's mandate for a robust air monitoring network in emission-heavy regions like the Permian Basin.

We thank TCEQ for considering our comments and urge TCEQ to incorporate them as part of its obligation under 40 CFR § 58.10(d) to assess whether its current and proposed monitoring network adequately meets the objectives of Appendix D.

[1] TCEQ, Draft Five-Year Ambient Air Monitoring Network Assessment, 14, https://www.tceq.texas.gov/downloads/air-quality/air-monitoring/network/draft-tceq-2025-5yr-assessment-english.pdf. (June 17, 2025).

I. **Background**

A. The Clean Air Act requires TCEQ to maintain a complete air monitoring network.

Under the federal Clean Air Act, the United States Environmental Protection Agency ("EPA") has established National Ambient Air Quality Standards ("NAAQS") for six criteria pollutants: ozone (O3), particulate matter (PM2.5 and PM10), carbon monoxide (CO), lead (Pb), sulfur dioxide (SO2) and nitrogen dioxide (NO2). The EPA has established NAAQS for ozone limiting 8-hour concentrations to no more than 0.070 parts per million ("ppm").

Section 110 of the Clean Air Act requires that each state submit a state implementation plan ("SIP") that "provide[s] for implementation, maintenance, and enforcement" of the NAAQS. 42 U.S.C. § 7410. SIPs must "provide for establishment and operation of appropriate devices, methods, systems, and procedures necessary to monitor, compile, and analyze data on ambient air quality and upon request, make such data available" to the EPA. *Id.* at (a)(2)(B).

Resting on Section 110, EPA promulgated standards for federal monitoring networks ("network regulations"). To determine whether an area meets a NAAQS, EPA compares monitoring data to the NAAQS using air monitoring networks established under 110(a)(2)(B) and the network regulations. 42 U.S.C. § 7410(a); 40 C.F.R. § 58.10 App. D ¶ 1.1(a)-(b). Areas that fail to meet the NAAQS are subject to more stringent public health protections.

EPA's network regulations require states to submit AMNPs to EPA's regional offices that "shall provide for the documentation of the establishment and maintenance of an air quality surveillance system that consists of a network of" state-run monitors. 40 C.F.R. § 58.10. The monitoring network plan must include detailed information about the network's design and "a statement of whether the operation of each monitor meets the requirements of appendices A, B, C, D, and E" of EPA's network regulations. *Id.* They must also be designed to meet three basic monitoring objectives: (1) "[p]rovide air pollution data to the general public in a timely manner"; (2) "support compliance with ambient air quality standards and emission strategy development, including 'comparing an area's air pollution levels against the NAAQS'"; and (3) "support [] air pollution research studies." 40 C.F.R. § 58.10 App. D ¶1.1(a)-(b).

To meet these objectives, a state's network must include a variety of monitors to inform the state about peak air pollution levels, air pollution transported into and outside of a city or region, and air pollution levels near specific sources. These monitors include those that:

- measure typical concentrations in areas of high population density;
- determine the impact of significant sources or source categories on air quality;
- determine general background concentration levels;
- determine the extent of regional pollutant transport among populated areas; and
- measure air pollution impacts on visibility, vegetation damage, and other welfare-based impacts.

Id. At ¶1.1.1.

Additionally, as part of the second objective (support compliance with the NAAQS) EPA's network regulations provide that plans should include sites that "[monitor in] locations near major air pollution sources" to give "insight into how well industrial sources are controlling their pollutant emissions";[2] "sites located to determine the impact of significant sources or source categories on air quality";[3] and sites that help "track the spatial distribution of air pollution," including placing monitors "near political boundaries or between urban or industrial areas [in order to] characteriz[e] transport of pollutants between jurisdictions."[4] Furthermore, AMNPs must include the identification of sites intended to address pollution "in an at-risk community where there are anticipated effects from sources in the area." 40 C.F.R. § 58.10(b)(14).

EPA's network regulations also require agencies to submit FYAs. The FYAs must "determine, at a minimum, if the network meets the monitoring objectives defined in Appendix D [and] whether new sites are needed." 40 C.F.R. § 58.10(d). They must also "consider the ability of existing and proposed sites to support air quality characterization for areas with relatively high populations of susceptible individuals (*e.g.*, children with asthma) and other at-risk populations." *Id*.

Findings in the FYA must be incorporated into the following year's AMNP, which requires the development of a network modification plan "that addresses the findings of the network assessment required every 5 years by § 58.10(d)." 40 C.F.R. § 58.14(a). In other words, while the FYA and AMNP are submitted concurrently, the Clean Air Act regulations require that the findings of the FYA be implemented through modifications documented in the AMNP due the following year.

B. Exposure to ozone and ozone precursors harms human health.

One of the six criteria air pollutants designated by EPA for regulation under the Clean Air Act and compliance with the NAAQS is ozone. Ozone forms when VOCs and oxides of nitrogen (NOx) react in the presence of sunlight. While ozone forms throughout the year, it becomes more pronounced in the summertime.

A longstanding body of scientific research, including numerous EPA assessments, demonstrates that exposure to ground-level ozone negatively impacts public health. EPA has linked short-term exposure to ozone (defined as hours, days, or weeks)[5] with premature death,[6] respiratory mortality,[7] increased risk of out-of-hospital cardiac arrest and stroke hospitalization.[8] EPA has

[2] *Id.*
[3] *Id*.
[4] EPA, Ambient Air Monitoring Network Assessment Guidance, 2-3 (February 2007), https://www.epa.gov/sites/default/files/2020-01/documents/network-assessment-guidance.pdf ("EPA Guidance").
[5] *Id*.
[6] 2013 *ISA* at 1-14 (concluding that there is "likely to be a causal relationship between short-term exposures to [ozone] and total mortality").
[7] EPA, *National Ambient Air Quality Standards for Ozone,* 80 Fed. Reg. 65,292, 65,307 (Oct. 26, 2015); *see also* 2013 *ISA* 6-220 to 6-221.
[8] Wing JJ, Adar SD, Sánchez BN, Morgenstern LB, Smith MA, Lisabeth LD, *Short-term exposures to ambient air pollution and risk of recurrent ischemic stroke,* Environmental Research, Jan. 2017, 152:304-7 (finding elevated risk of having a first stroke with higher ozone concentrations in the preceding 2 days). Shah, Anoop SV, et al., *Short term exposure to air pollution and stroke: systematic review and meta•analysis,* BMJ 350 (2015): h1295; Yang,

also determined that long-term exposure to ozone, measured in months to years,[9] is associated with stroke, chronic obstructive pulmonary disease, lung cancer, heart failure,[10] death,[11] and respiratory effects like asthma.

According to the Centers for Disease Control and Prevention (CDC), 24 million Americans currently have asthma.[12] Asthma results in 1.6 million emergency room visits, 9.8 million visits to the physician,[13] and 188 thousand hospitalizations per year.[14] Asthma costs the U.S. economy more than $80 billion annually in medical expenses, missed work and school days, and deaths.[15] Multiple studies across various states have found that changes in ozone concentrations were associated with higher asthma emergency room visits, most at concentrations below the current standard.[16] It is estimated that up to 11% of all asthma emergency room visits in the United States are attributed to ozone.[17]

Ozone pollution is particularly harmful for vulnerable populations, such as school-aged children, people with respiratory illness, older adults, and people who are active outdoors, especially outdoor workers.[18] Of the 24 million Americans with asthma, 5.5 million are children. EPA has found that long-term exposure to ozone increases the risk that asthma will develop in children.[19] Additionally, once children are diagnosed with asthma, they face heightened risks from ozone exposure.[20]

Ozone exposure can also result in health complications for mothers, newborns, and the elderly. Elevated exposure during pregnancy is associated with higher risk of pre-term birth[21] and can result in Autism Spectrum Disorder among children.[22] Additionally, a review of epidemiological

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Wan-Shui, et al., *An evidence-based appraisal of global association between air pollution and risk of stroke*, International Journal of Cardiology 175.2 (2014): 307-313.

[9] 2013 ISA at 1-4.

[10] Yazdi, Mahdieh Danesh, et al., *Long-term exposure to PM2. 5 and ozone and hospital admissions of Medicare participants in the Southeast USA*, Environment International 130 (2019): 104879.

[11] 2013 *ISA* at 1-8.

[12] CDC, *Fast Stats: Asthma*, https://www.cdc.gov/nchs/fastats/asthma.htm (last visited May 10, 2025).

[13] *Id.*

[14] CDC, *Most Recent National Asthma Data*, https://www.cdc.gov/asthma/most_recent_data.htm (last visited May 10, 2025).

[15] Tursynbek Nurmagambetov, Robin Kuwahara, Paul Garbe, *The Economic Burden of Asthma in the United States, 2008 -2013*, Annals of the American Thoracic Society, 2018.

[16] Stephanie Holm, John Balmes, Ananya Roy, *Human Health Effects of Ozone: The State of Evidence Since EPA's Last Integrated Science Assessment*, EDF 2018.

[17] Susan C. Anenberg et al., *Estimates of the Global Burden of Ambient PM2.5, Ozone, and NO2 on Asthma Incidence and Emergency Room Visits*, Environmental Health Perspectives, 2018; 126 (10): 107004.

[18] 2013 *ISA* at 1-8; 2013 *ISA* at 7-2.

[19] 2013 *ISA* at 7-2.

[20] K. Mortimer et al., *The Effect of Air Pollution on Inner-City Children with Asthma*, 19 EUR. RESPIRATORY J. 699 (2002), 2013 *ISA*, 6-120-21, 6-160.

[21] Laurent O, Hu J, Li L, et al., *A statewide nested case-control study of preterm birth and air pollution by source and composition: California, 2001-2008*, Environ Health Perspect. 2016;124(9):1479-1486; Ha S, Hu H, Roussos-Ross D, Haidong K, Roth J, Xu X, *The effects of air pollution on adverse birth outcomes*, Environ Res. 2014;134:198-204.

[22] Becerra, Tracy Ann et al., *Ambient air pollution and autism in Los Angeles County, California*, Environmental Health Perspectives 121.3 (2012) 380- 386; Volk HE, Lurmann F, Penfold B, Hertz-Picciotto I, McConnell R, *Traffic- related air pollution, particulate matter, and autism*, JAMA Psychiatry (Jan. 1, 2013) 70(1):71-7.

research found age has the strongest influence on ozone sensitivity, with risks increasing as individuals get older.[23] Ozone exposure can accelerate cognitive decline in the early stages of dementia[24] and has been associated with adverse neural effects in the elderly.[25]

Studies show a direct link between oil and gas sector emissions, including ozone, and health complications. A study by Buonocore et al.[26] found that air pollution in 2016 from the oil and gas sector in the U.S. resulted in 410,000 asthma exacerbations, 2200 new cases of childhood asthma and 7500 excess deaths, with $77 billion in total health impacts. NO2, ozone, and PM2.5 were the main contributors to health impacts. Further, according to a study by Tran et al.[27] in 2016, the state of Texas led the country with the number of deaths and asthma incidences that can be attributed to air pollution from oil and gas flaring and venting.

High levels of ozone are not the only concern to public health – cumulative exposure to ozone precursors can drive health risks. A recent cumulative human health risk assessment in Colorado found that for communities located near unconventional oil and natural gas (UONG) during pre-production in an ozone non-attainment area, respiratory risks surpassed EPA thresholds due to the contribution from not only ozone, but VOC precursors.[28]

C. TCEQ does not monitor for ozone in the Permian Basin.

TCEQ's prior AMNPs and FYAs, as well as EPA's prior AMNP approvals, consistently have noted that TCEQ does not monitor for ozone in the Permian Basin. Recent searches of the Texas Air Monitoring Information System (TAMIS), which is operated by TCEQ, confirm that there is no publicly accessible ozone monitoring data available from any of the six listed sites in TCEQ's Region 7 (Midland zone). Commenters ran queries across all sample duration options (1-, 3-, 8-, and 24-hour) and across multiple years, including 2023 and 2024, and received no data. Additionally, Commenters ran a query limited to the Pecos-Permian Basin Air Quality Control Region (ACQR) which yielded no monitoring data.

II. TCEQ Must Increase Ozone Monitoring in the Permian Basin.

The Permian Basin is one of the world's most prolific oil and natural gas producing regions. In 2022, the Permian Basin comprised 43% of the United States' crude oil production and 17% of its natural gas production.[29] The number of new horizontal wells has dramatically increased in

[23] Bell, Michelle L, Antonella Zanobetti, and Francesca Dominici. "Who Is More Affected by Ozone Pollution? A Systematic Review and Meta-Analysis." American journal of epidemiology 180.1 (2014): 15–28. Web.
[24] Galkina Cleary et al., *Association of Low-Level Ozone with Cognitive Decline in Older Adults*, 61 J. ALZHEIMERS DISEASE 1, 67-78 (2018).
[25] Qu, Rongrong et al. "Short-Term Ozone Exposure and Serum Neural Damage Biomarkers in Healthy Elderly Adults: Evidence from a Panel Study." The Science of the total environment 905 (2023): 167209–167209. Web.
[26] Buonocore et al., *Air pollution and health impacts of oil & gas production in the United States*, 2023 *Environ. Res.: Health* **1** 021006, https://iopscience.iop.org/article/10.1088/2752-5309/acc886.
[27] Tran et al., GeoHealth (2024), *Air Quality and Health Impacts of Onshore Oil and Gas Flaring and Venting Activities Estimated Using Refined Satellite-Based Emissions*, https://doi.org/10.1029/2023GH000938.
[28] Wesiner et al., *Cumulative Human Health Risk Assessment of Regional Ozone and Volatile Organic Compounds from Unconventional Oil and Gas Sites in Colorado's Front Range*, EHP Publishing (April 2025), https://ehp.niehs.nih.gov/doi/10.1289/EHP16272.
[29] U.S. Energy Information Administration, Advances in technology led to record new well productivity in the

the Permian since 2010 due to unconventional oil and natural gas (UONG) extraction techniques, such as horizontal drilling and hydraulic fracturing, with 4,524 new UONG wells alone in 2021 (compared to 350 in 2010).[30] These advancements have driven a rapid increase in extraction in the Permian, contributing to substantial increases in emissions, including methane, NOx and VOCs that act as precursors to the formation of ozone.[31]

For three consecutive years, EPA has recommended that TCEQ deploy one or more monitors in the Permian Basin for NOx, VOCs, and ozone, "to ensure that the impacts of the increased oil and gas production are accurately monitored and recorded."[32] There is substantial evidence that ozone in the area exceeds the NAAQS and that the area should be monitored for ozone and its precursors including the significant oil and gas activity in the region, the sector's contribution to ozone precursor emissions, emissions inventories for the Permian, and direct ozone measurement data in nearby states. TCEQ's failure to monitor runs counter to the Clean Air Act, which requires states to establish adequate monitoring networks to support compliance with the NAAQS. Additionally, it has placed the burden of monitoring air pollution on communities, which is unacceptable.

A. Oil and gas activity in the Permian Basin has increased rapidly.

Oil and gas extraction in the Permian has expanded rapidly, increasing by a factor of 5 between 2012 and 2022, with daily production exceeding 5 million barrels of oil and 600 million m^3 of natural gas as of October 2023.[33] In 2024, the Permian produced more crude oil than any other U.S. region.[34] In Texas in particular, oil and gas production in the Permian has skyrocketed in the last decade, as shown in Tables 1 and 2. According to Enverus data, oil and gas production in the Texas Permian has increased 250%-350% between 2014 and 2024 (Table 1). The Railroad Commission of Texas estimates approximately the same increase during this time period (Table 2).

Permian Basin in 2021 (September 2022), https://www.eia.gov/todayinenergy/detail.php?id=54079.

[30] *Id.*

[31] Francoeur, Colby B et al. "Quantifying Methane and Ozone Precursor Emissions from Oil and Gas Production Regions across the Contiguous US." *Environmental science & technology* 55.13 (2021): 9129–9139. Web. https://doi.org/10.1021/acs.est.0c07352.

[32] EPA's 2024 Response: https://www.tceq.texas.gov/downloads/air-quality/air-monitoring/network/historical/epa-response-to-2024-amnp.pdf; EPA's 2023 Response: https://www.tceq.texas.gov/downloads/air-quality/air-monitoring/network/historical/epa-response-to-2023-amnp.pdf; EPA's 2022 Response: https://www.tceq.texas.gov/downloads/air-quality/air-monitoring/network/historical/epa-response-to-2022- amnp.pdf.

[33] Marvasin et al., *Summertime Ozone Production at Carlsbad Caverns National Park, New Mexico: Influence of Oil and Natural Gas Development* , JGR Atmosphere (July 2024), https://agupubs.onlinelibrary.wiley.com/doi/10.1029/2024JD040877#jgrd59642-bib-0088; *see also* Jeremy Nichols, "Petition to Designate Permian Basin of Southeast New Mexico a Nonattainment Area Due to Ongoing Violations of Ozone Health Standards," March 2, 2021, https://pdf.wildearthguardians.org@pdf.wildearthguardians.org/support_docs/2021-3-2%20FINAL%20Permian%20Basin%20Ozone%20Nonattainment%20Petition.pdf.

[34] EIA, https://www.eia.gov/todayinenergy/detail.php?id=65024 (April 16, 2025).

Table 1: Oil and Gas Production in the Permian Basin in Texas
Source: Enverus Production dataset.

	Oil and Condensate Production Volume (BBL)	**Gas and Casinghead Production Volume (MCF)**
January 2014	36,803,586	117,586,324
January 2024	127,339,611	510,205,149
Percent increase	246.00%	333.90%

Table 2: Oil and Gas Production in the Permian Basin in Texas

	Oil Production Volume (BBL)	**Casinghead Production Volume (MCF)**	**Gas Production Volume (MCF)**	**Condensate Production Volume (BBL)**
January 2014	35,733,593	77,830,186	38,424,669	1,070,772
January 2024	107,266,084	345,595,955	160,307,512	18,021,617
Percent increase	200.18%	344.04%	317.20%	1583.05%

Source: Railroad Commission of Texas, Permian Basin Historical Production (2014 data) and Current Annual Production (2024 data), accessed 5/1/2025, https://www.rrc.texas.gov/oil-and- gas/major-oil-and-gas-formations/permian-basin/.

B. The oil and gas sectors are a significant source of ozone and ozone precursors.

The oil and natural gas sectors are a substantial source of smog-forming emissions. According to EPA's most recent National Emissions Inventory (NEI), "Oil and Gas Production" is the largest source of human-caused VOCs nationally and a major contributor to NOx emissions, both of which are ozone precursors.[35]

Regional analyses underscore the significant ozone-forming emissions from the oil and gas sector, including in the Uinta Basin in Utah,[36] the Barnett Shale in Texas,[37] the Upper Green

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[35] Calculation based on EPA, *National Emissions Inventory (NEI) Sector Data*, *available at* https://www.epa.gov/air-emissions-inventories/2017-national- emissions-inventory-nei-data; see also EPA, "Basic Information about Oil and Natural Gas Air Pollution Standards," Other Policies and Guidance, September 20, 2016, https://www.epa.gov/controlling-air-pollution-oil-and-natural-gas-operations/basicinformation-about-oil-and-natural.

[36] Warneke, C. et al., *Volatile organic compound emissions from the oil and natural gas industry in the Uintah Basin, Utah: oil and gas well pad emissions compared to ambient air composition*, 14 Atmos. Chem. Phys., 10977-10988 (2014), *available at* www.atmos-chem-phys.net/14/10977/2014/; ENVIRON, *Final Report: 2013 Uinta Basin Winter Ozone Study* (Mar. 2014), *available at* https://deq.utah.gov/locations/U/uintahbasin/ozone/docs/2014/06Jun/UBOS2013FinalReport/Title_Contents_UBOS_2013.pdf.

[37] David T. Allen, *Atmospheric Emissions and Air Quality Impacts from Natural Gas Production and Use*, Annu. Rev. Chem. Biomol. Eng. 5:55-75 (2014), *available at* https://www.annualreviews.org/doi/abs/10.1146/annurev-chembioeng- 060713-035938.

River Basin in Wyoming,[38] and in Colorado.[39] A recent study by NOAA scientists at the Cooperative Institute for Research in Environmental Sciences (CIRES) found that, on high ozone days on Colorado's Northern Front Range, oil and gas operations contribute roughly 50% to regional VOC reactivity and that these activities are responsible for approximately 20% of ozone produced locally in the nonattainment area.[40]

The contribution of UONG on ozone formation has been quantified in North Texas, where mean values of all meteorologically adjusted ozone were 8% higher at monitoring sites located within the shale gas region than in the non-shale gas region.[41] Directional analysis in North Texas also found that when winds were from areas with high shale gas activity, higher ozone downwind occurred.

C. Ozone concentrations in the Texas Permian are likely significant.

NOx and VOC emissions in the Permian Basin are dominated by the oil and gas sector and are specifically linked to the intensity of operations in the region, including frequent flaring and leaking facilities.[42] Based on EPA's National Emissions Inventory data from 2017, oil and gas exploration and production activities in the Permian Basin were responsible for 12,793 tons of

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[38] *See* B. Rappengliick et al., *Strong wintertime ozone events in the Upper Green River basin*, Wyoming, Atmos. Chem. Phys. (2014), *available at* https://doi.org/10.5194/acp-14-4909-2014.

[39] Helmig, D., *Air quality impacts from oil and natural gas development in Colorado*, 8,4 Elem Sci. Anth. (2020), *available at* https://doi.org/10.1525/elementa.398; Brantley et al., *Assessment of volatile organic compound and hazardous air pollutant emissions from oil and natural gas well pads using mobile remote and onsite direct measurements*, Journal of the Air & Waste Management Association 1096-2247 (Print) 2162- 2906 (Online) (2015); Petron, G. et al., *A new look at methane and non-methane hydrocarbon emissions from oil and natural gas operations in the Colorado Denver-Julesburg Basin*, 119 J. Geophys. Res. Atmos., 6836-6852 (2014), *available at* http://onlinelibrary.wiley.com/doi/10.1002/2013JD021272/full.

[40] McDuffie, E. E., et al. (2016), *Influence of oil and gas emissions on summertime ozone in the Colorado Northern Front Range*, J. Geophys. Res. Atmos., 121, 8712- 8729, doi:10.1002/2016JD025265, *available at* http://onlinelibrary.wiley.com/doi/10.1002/2016JD025265/abstract; *see also* Gilman, J. B., B. M. Lerner, W. C. Kuster, and J. A. de Gouw (2013), *Source signature of volatile organic compounds from oil and natural gas operations in northeastern Colorado*, Environ. Sci. Technol., 47(3), 1297-1305, *available at* http://pubs.acs.org/doi/abs/10.1021/es304119a (finding 55% of VOC reactivity in the metro-Denver area is due to nearby oil and natural gas operations and calling these emissions a "significant source of ozone precursors"); Cheadle, LC et al., *Surface ozone in the Colorado northern Front Range and the influence of oil and gas development during FRAPPE/DISCOVER-AQ in summer 2014*, Elementa (2017), *available at* http://doi.org/10.1525/elementa.254 (finding on "individual days, oil and gas O3 precursors can contribute in excess of 30 ppb to O3 growth and can lead to exceedances" of the EPA ozone standards).

[41] Ahmadi, M., and K. John. 2015. Statistical evaluation of the impact of shale gas activities on ozone pollution in North Texas. Sci. Total Environ. 536:457–67. doi:10.1016/j.scito tenv.2015.06.114.

[42] Adkins, Sarah B, and Michael S Zavada. "A Review of the Status of Air Quality Monitoring in the Permian Basin, USA, and Its Implications for Effective Long-Term Monitoring of Industrial Operations." *Palynology* 48.4 (2024): n. pag. Web. ; *See also* Benedict, K.B., A.J. Prenni, M.M. H. El-Sayed, A. Hecobian, Y. Zhou, K.A. Gebhart, B.C. Sive, B.A. Schichtel, and J.L. Collett. 2020. Volatile organic compounds and ozone at four national parks in the southwestern United States. Atmos. Environ. 239:117783. doi:10.1016/j.atmosenv.2020.117783; Dix, B., J. de Bruin, E. Roosenbrand, T. Vlemmix, C. Francoeur, A. Gorchov-Negron, B. McDonald, M. Zhizhin, C. Elvidge, P. Veefkind, et al. 2020. Nitrogen oxide emissions from U.S. Oil and gas production: Recent trends and source attribution. Geophys. Res. Lett. 47(1): e2019GL085866. doi:10.1029/2019GL085866 (linking oil and gas production that occurs in the Permian Basin to increased emissions of ozone precursors in the region).

NOx and 82,442 tons of VOCs.[43] This made oil and gas the single largest source of NOx and VOCs in the region, responsible for twice as much anthropogenic NOx pollution as all mobile sources (e.g., cars, trucks, trains, planes, etc.) and for more VOCs than all other anthropogenic sources combined.

Particular counties in the Permian Basin experience heightened levels of ozone precursors from the oil and gas sector. For example, out of all oil and gas producing counties in the Texas Permian, the top three highest emitters of VOC and NOx emissions in 2020 were the counties of Reeves, Loving, and Midland, respectively (see Table 3).

Table 3: Total Emissions (tons per year) of NOx and VOC from O&G Production in the Texas Permian in 2020[44]

County	VOC emissions	NOx emissions
Reeves	163,020	15,773
Loving	93,147	5,452
Midland	86,016	8,943
Pecos	26,057	3,522
Winkler	18,604	2,678
Ector	14,009	2,894
Crane	3,560	7,544

Data demonstrating the abundance of ozone precursors in the Permian Basin suggests that ozone is likely high in the Basin as well. The accumulation of ozone precursors and formulation of ozone is strongly influenced by spatial and temporal patterns of NOx and VOC emissions, and it is widely accepted that proximity of UONG to population centers can affect National Ambient Air Quality Standards (NAAQS) for ozone exceedances.[45] Additionally, research finds that respiratory risks exceed U.S. EPA thresholds when UONG pollutants are emitted into communities within an ozone nonattainment area.[46]

In addition to the presence of ozone precursors, monitors that directly measure ozone in and near the Texas Permian demonstrate the region is likely exceeding the ozone NAAQS.[47]

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[43] Emissions data queried from EPA's 2017 National Emissions Inventory Data, available online at https://www.epa.gov/air-emissions-inventories/2017-national-emissions-inventory-nei-data (last accessed Feb. 26, 2021).

[44] Exhibit A, University of North Carolina Chapel Hill, *Assessing Permian Basin's Contributions to Ozone Nonattainment at Carlsbad, New Mexico* (July 31, 2023)*;* Exhibit B, University of North Carolina Chapel Hill, *Assessing Permian Basin's Contributions to Ozone Nonattainment at Carlsbad, New Mexico, Supplemental Information.*

[45] Modi, Mrinali et al. "Fine Scale Spatial and Temporal Allocation of NOx Emissions from Unconventional Oil and Gas Development Can Result in Increased Predicted Regional Ozone Formation." *ACS ES&T air* 2.2 (2025): 130–140. Web. https://doi.org/10.1021/acsestair.4c00077?urlappend=%3Fref%3DPDF&jav=VoR&rel=cite-as

[46] Weisner et al.

[47] A violation of the National Ambient Air Quality Standard (NAAQS) for 8-hour ozone (8HO3) is triggered when the three-year average of the annual fourth highest daily maximum (MDA8_O3) reading exceeds the NAAQS. The 2015 form of the ozone NAAQS sets this threshold at 70 ppb or 0.070 ppm.

The Guadalupe Mountains National Park ozone monitor (AQS ID 481090002) in Culberson County is the only government-run ozone monitoring site on the Texas side of the Permian Basin. Though the monitor stopped collecting data in 2022, the most recent design values demonstrate ozone exceedances and an increasing trend – both for the highest and 4th highest MDA8_O3 values each year. The American Lung Association's 2024 State of the Air report gave Culberson County an "F" grade for ozone as a result of these measurements.

Table 4: Design Values at Guadalupe Mountains National Park Monitor[48]

Year	1st Highest	2nd Highest	3rd Highest	4th Highest	Design Value
2019	0.073	0.072	0.07	0.068	-na-
2020	0.074	0.074	0.072	0.072	-na-
2021	0.078	0.072	0.071	0.071	0.070
2022	0.076	0.076	0.074	0.071	0.071

The most recent design values at regulatory monitors on the New Mexico side of the Permian Basin, a mere 40 miles from the NM-TX border, also demonstrate ozone exceedances.

Table 5: Design Values at Ozone Monitors in Southeast New Mexico[49]

Monitor	ODV 2017 - 2019	ODV 2018-2020	ODV 2019 - 2021	ODV 2020 - 2022	ODV 2021 - 2023
Carlsbad 350151005 (Eddy County)	0.079	0.078	0.077	0.077	0.078
Hobbs 350250008 (Lea County)	0.071	0.068	0.066	0.066	0.071
Carlsbad Caverns[50] 350150010 (Eddy County)	N/A	N/A	0.074	0.077	0.078

EPA's Air Data is only available through June 30, 2024, as of now, so ODVs for 2024 are not yet available. However, the current standing 4th highest Ozone 8-hour average at AQS sites at

[48] This presents top 4 highest Ozone 8-hour average, as obtained from EPA's Air Data. (https://aqs.epa.gov/aqsweb/airdata/download_files.html), during the ozone season in 2019 – 2022, based on which the "Design Values" were calculated (i.e., average for 4th highest values in three consecutive years). No data beyond 2022 is available.

[49] Design Values were obtained from "Table5. Site Status" from the Ozone Design Values Excel workbook downloaded from EPA's Air Quality Design Values (https://www.epa.gov/air-trends/air-quality-design-values).

[50] This monitor is operated by the National Park Service.

Carlsbad, Carlsbad Caverns, and Hobbs are 0.073, 0.082, and 0.067 ppm, respectively.[51] If these 4th highest Ozone 8-hour average values hold through 2024, the corresponding 2024 ODVs for these three sites would be 0.076, 0.082, and 0.071, respectively.

Because the most recent complete three consecutive calendar year Design Values at these regulatory monitors show Design Values exceeding the ozone NAAQS limit of 70 ppb, the area is in violation of the NAAQS and should be designated by EPA as nonattainment. These exceedances also indicate that ozone concentrations in the Texas Permian might also exceed the NAAQS.

Private monitoring data in Midland County further supports this assumption. Texas Permian Future Generations, a local environmental advocacy group, purchased a PurpleAir monitor to monitor ozone in Midland County. That monitor's ozone data shows an average of 146 parts per billion on most days. While the data is not collected in accordance with federal requirements, TCEQ should consider it as it provides a direct data point for Midland County. It also demonstrates how communities have resorted to private monitoring to provide for data in TCEQ's absence and the need for regulatory monitoring in the county.

Lastly, recent collections from MethaneSAT[52] developed by EDF, demonstrate the relative scale of methane emissions from the Permian Basin, suggesting that smog-forming emissions are relatively high compared to other regions. MethaneSAT delivers comprehensive and precise emissions data at the basin scale, including detections of smaller, dispersed sources of methane, identifying where emissions are coming from, how much is being emitted, and how those emissions change over time. Collections from 2024 show that the Permian Basin's methane emissions are the highest of those yet measured in the United States and among the highest in the world. For example, a September 2024 image of the Permian Basin[53] estimated oil and gas methane emissions of 280 metric tons per hour (roughly four times higher than EPA's latest emissions inventory estimate).[54] By comparison, the San Juan Basin's oil and gas methane emissions were 133 MT/hr and the Appalachian's were 129 MT/hr. To further demonstrate the relative importance of emissions from the Texas side of the Permian, the September 2024 Permian MethaneSAT collection was split across the TX-NM state line. Even after removing emissions from the New Mexico side of the Permian, total methane emissions from the Basin as a whole remain higher than U.S. basins already collected by MethaneSAT, demonstrating the Texas Permian alone leads the country in methane emissions.[55] Globally, these 2024 observations show the Permian's oil and gas methane emissions were the second highest in the world of those already collected, behind the South Caspian Basin in Turkmenistan at 418 MT/hr.

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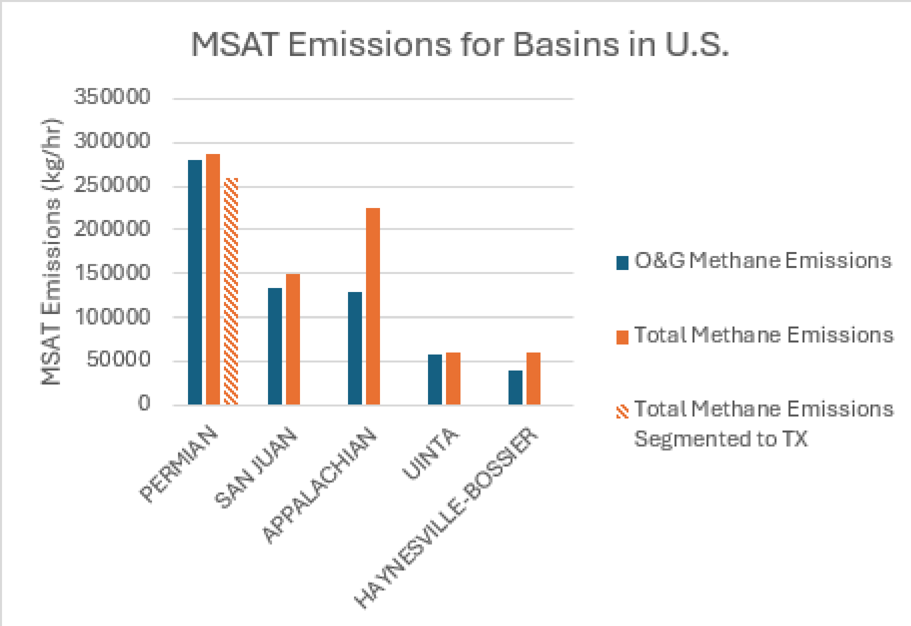
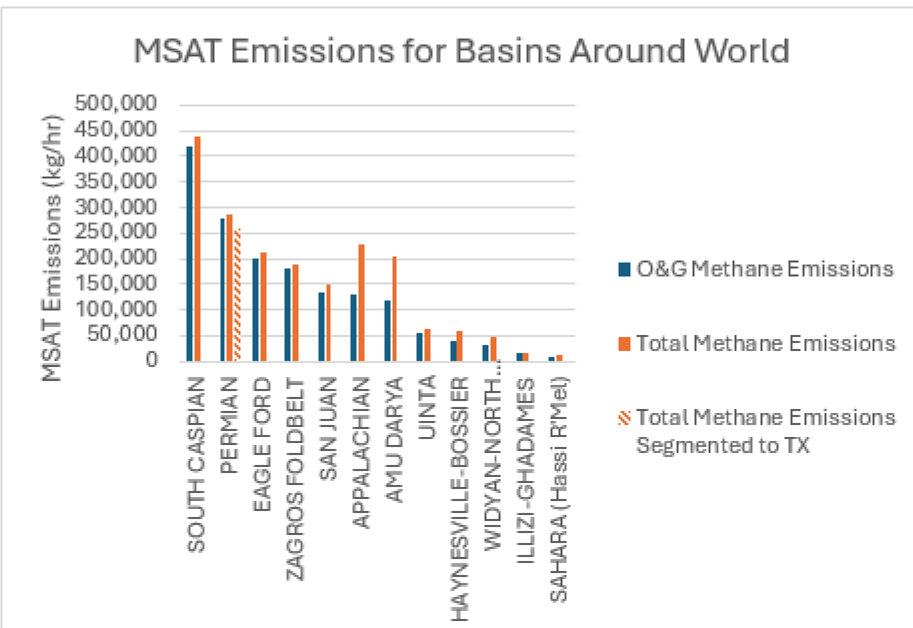
[51] Design values were obtained from EPA's Air Data site (https://aqs.epa.gov/aqsweb/airdata/download_files.html).
[52] https://www.methanesat.org/satellite.
[53] See MethaneSAT, New data reveal previously undetectable methane emissions, https://www.methanesat.org/project-updates/new-data-reveal-previously-undetectable-methane-emissions (March 7, 2025).
[54] *See* EPA, U.S. Gridded Methane Emissions, https://www.epa.gov/ghgemissions/us-gridded-methane-emissions (last updated November 22, 2024).
[55] Though the segmentation was done for total methane emissions and not oil and gas methane emissions, oil and gas methane emissions dominate for the Permian.





D. Current monitoring data shows contributions from the Texas Permian to Carlsbad exceedances.

A 2023 study conducted by the University of North Carolina at Chapel Hill investigated the cause of exceedances at the Carlsbad ozone monitor in New Mexico and found that oil and gas sources in the Texas Permian Basin are contributing to exceedances at the site.[56]

[56] *See* Exhibits A and B.

To identify specific regions that may have contributed to exceedances, UNC employed the Hybrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT) model v5.2.3 (Stein et al., 2015) from NOAA to calculate trajectories of airmasses that reached the monitor on high ozone days. UNC also conducted an emissions inventory analysis for oil and gas production in New Mexico and Texas in 2020 using data from the New Mexico Environmental Department (NMED) and TCEQ.

The results of UNC's report show that high ozone days (i.e., MDA8O3 > 70 ppb) at the Carlsbad monitor are associated with airmasses passing through counties in the southeast and southwest regions of the Permian Basin. The relative impact of counties can be assessed by ranking their contribution. In the table below, we provide data for the counties in the Permian Basin that rank high in oil and gas NOx and VOC emissions and the concentration of trajectories contributing to exceedances at the Carlsbad monitor (Table 6).

Table 6: County Contribution to Ozone Exceedances at the Carlsbad Monitor[57]

County	Rank in Contribution Factors
Eddy (Carlsbad Monitor)	#2 NOx emissions #5 VOC emissions
Lea (Hobbs Monitor)	#1 NOx emissions #2 VOC emissions #6 Minor point source VOC #7 Large point source VOC
Culberson	#6 NOx emissions #8 VOC emissions #8/10 Trajectories
Reeves	#1 VOC emissions #3 NOx emissions #3 Minor point source NOx and VOC #4-6 Trajectories
Loving	#3 VOC emissions #5 NOx emissions #1 Trajectories
Winkler	#5 Minor point source NOx #3 Large point source NOx #9 Large point source VOC #3 Trajectories
Ward	#10 VOC #9 Minor point source VOC #2 Trajectories
Crane	#2 Large point source NOx #4 Large point source VOC #3-5 Trajectories
Ector	#4 +7 Trajectories

[57] This chart was created by combining several tables and findings in Exhibits A and B.

	#7 Large point source NOx #10 Large point source VOC
Midland	#4 NOx #4 VOC #4 Minor point source VOC #4 Minor point source NOx #5 Large point source VOC #6 Large point source NOx #8 Trajectories
Martin	#6 OG VOC #8 OG NOx #9 Trajectories (100 m)
Upton	#7 Minor point source NOx #9 NOx #9 VOC #8-10 Trajectories
Pecos	#2 Large point source VOC #3 Large point source NOx #6 Minor point source NOx #10 Minor point source VOC
Howard	#7 OG VOC #6 Trajectories (100 m) #9 Minor point source NOx
Chaves (NM)	#5 Minor point source VOC #8 Large point source VOC #10 Large point source NOx

As these results show, certain counties – including Loving, Reeves, Crane, Ward, Winkler, Ector and Midland Counties in Texas – are relatively high in their VOC and NOx pollution and have a relatively high number of trajectories reaching Carlsbad on ozone-exceedance days.[58] UNC's study concludes that these combined factors demonstrate that Texas counties are contributing to NAAQS exceedances at the Carlsbad monitor.

E. <u>At-risk populations in the Permian Basin, including children with asthma, disproportionately live in proximity to oil and gas sites emitting ozone pollution.</u>

EDF analyzed the demographics of populations living near oil and gas sites in the Texas Permian using Enverus Prism and U.S. Census Bureau tract data.[59] Our analysis shows that a large

[58] While significant increases in oil and gas VOC and NOx emissions have occurred in both the TX and NM areas of the Permian, the majority of airmass trajectories associated with high ozone days passed through the east and southeast regions of the Permian.

[59] EDF analyzed the number and demographics of the populations living in close proximity to oil and gas wells using the methodology described in Proville et al (2022). We first identified active oil and gas well sites with reported production in 2023 using Enverus Prism. By identifying active oil and gas sites, we are also able to identify

percentage of the population, including the elderly, children, and those with health conditions, live intimately close to oil and gas sites emitting harmful smog-forming pollution.

Of the nearly 600,000 people living in one of the 14 counties identified above, well over half live within one mile of an active oil or gas well. In Loving and Martin counties, one hundred percent of the population lives within a mile of a site, and in Ward and Winkler counties, over 90% of the population lives within a mile of an active site. When looking at populations living even closer to these wells (Table 7), almost 200,000 people live within a half-mile of an active oil or gas well. Over a third of the population in Ector and Midland counties live within a half-mile of an active site, and 93% of people in Martin County live within a half-mile.

Table 7: Populations Living Within a Half-Mile of an Oil or Gas Well

County	State	Total Population within 1/2 mile of an active oil or gas well	County Total Population	% of Population within 1/2 mile of an active oil or gas well
Chaves	**New Mexico**	800	65,000	1%
Eddy	**New Mexico**	22,000	58,000	38%
Lea	**New Mexico**	24,000	70,000	35%
Andrews	**Texas**	6,400	18,000	35%
Crane	**Texas**	2,600	4,800	55%
Culberson	**Texas**	110	2,200	5%
Ector	**Texas**	56,000	160,000	35%
Loving	**Texas**	70	100	70%
Martin	**Texas**	5,300	5,600	93%
Midland	**Texas**	65,000	170,000	39%

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the local communities that are impacted by the air pollution from these well sites. Using the US Census Bureau's American Community Survey 5-year estimates for 2017-2021 and health data from the Centers for Disease Control and Prevention's Places dataset, we were able to estimate the populations living within a half mile radius of the previously identified wells using areal apportionment. This method (Proville et al 2022) determines the area encompassed within a half mile buffer radius of all active wells, and overlays those buffers onto census tracts to calculate the percentage of each tract comprised of buffers (i.e. the area of each tract within a half mile of an affected well). Because the areal apportionment method assumes that populations are spread evenly across a given census tract (excluding water bodies), we are able to estimate the populations at a census tract level of those living within a half mile or a mile of a well.

Pecos	**Texas**	1,100	16,000	7%
Upton	**Texas**	2,000	3,700	56%
Ward	**Texas**	7,900	12,000	68%
Winkler	**Texas**	5,700	7,900	72%

People living in these counties, and especially those living in close proximity to oil and gas sites, are comprised of historically vulnerable populations, such as people living in poverty, people of color, young children, the elderly, and those with existing health conditions that could be exacerbated by air pollution from oil and gas operations. Below is a table summarizing these populations in the 14 counties (Table 8).

Of the counties analyzed, Ector and Midland counties have the highest concentration of elderly adults, people in poverty, and people of color. These counties also have the highest concentration of children under the age of 5 living within a half-mile of an oil or gas site, exceeding counties with the next highest count by a factor of three.

Additionally, certain populations are disproportionately closer to oil and gas wells when compared to the county's population at large. For example, in Ector County, 13% more people in poverty live near wells when compared to the rest of the county. In Eddy, Lea, Pecos, and Upton counties, 20-50% more Native Americans live near wells than the county populations as a whole. In Midland and Ector counties, as well as Lea, Pecos, Ward and Winkler, there are increased rates of children under the age of 5 living within a half-mile of a well when compared to the rest of the county.

Table 8: Demographics of Populations Living Within a Half-Mile of an Oil or Gas Well

County Name	Pop within ½ mile Living in Poverty	County Living in Poverty	People of Color within ½ mile	County People of Color	Children Under 5 within ½ mile	County Children Under 5	Adults 65 and Over within ½ mile	County Adults 65 and Over
Ector	7,500	19,000	40,000	110,000	5,400	15,000	4,600	15,000
Midland	6,000	16,000	34,000	92,000	6,100	15,000	5,700	17,000
Lea	4,100	11,000	16,000	45,000	1,900	5,500	2,700	7,800
Eddy	2,800	8,300	11,000	31,000	1,500	4,200	3,200	8,300
Ward	990	1,400	4,800	7,000	590	850	1,100	1,600

Winkler	860	1,200	3,800	5,100	460	620	650	910
Andrews	510	1,600	3,600	11,000	520	1,600	630	1,800
Martin	440	470	2,400	2,600	430	460	640	680
Upton	280	500	1,200	2,200	140	260	340	610
Crane	210	380	1,800	3,300	210	380	360	650
Chaves	80	12,000	270	40,000	20	4,400	60	10,000
Pecos	80	2,000	560	12,000	60	1,000	110	2,000
Culberson	30	650	80	1,700	10	230	20	330
Loving	10	20	10	20	10	20	20	20

EDF's analysis also finds that there are larger populations of adults with CHD, COPD or who have had a stroke compared to the state averages in Chaves, Culberson, Loving, Martin, Pecos, Upton, Ward, and Winkler counties.[60]

Table 9: People with Health Conditions Living within a Half-Mile of an Oil or Gas Well

	Within 1/2 mile of an active well					County Total				
County	Adults with Asthma	Adults with CHD	Adults with COPD	Adults with Stroke	Adults with Cancer	Adults with Asthma	Adults with CHD	Adults with COPD	Adults with Stroke	Adults with Cancer
Midland	3,800	2,200	2,600	1,300	2,700	10,000	6,200	7,100	3,500	7,400
Ector	3,400	2,200	2,600	1,200	2,000	9,800	6,200	7,200	3,500	6,300
Lea	1,700	1,000	1,200	570	950	4,900	2,800	3,200	1,600	2,800
Eddy	1,500	960	1,000	520	1,100	4,000	2,600	2,800	1,400	2,900
Ward	500	400	450	220	390	740	590	660	320	570

[60] Health data from the CDC was not available for Loving County for the year analyzed.

Andrews	380	260	310	140	270	1,100	720	870	400	760
Winkler	350	270	310	150	250	490	370	430	200	340
Martin	**310**	**230**	**260**	**120**	**230**	**340**	**240**	**280**	**130**	**250**
Crane	**160**	**110**	**120**	**60**	**110**	**280**	**200**	**230**	**110**	**200**
Upton	**130**	**110**	**120**	**60**	**100**	**230**	**190**	**210**	**100**	**180**
Pecos	**60**	**40**	**50**	**20**	**40**	**960**	**750**	**780**	**410**	**650**
Chaves	**30**	**20**	**20**	**10**	**20**	**4,600**	**3,400**	**3,500**	**1,800**	**3,100**
Culberson	**-**	**-**	**-**	**-**	**-**	**140**	**140**	**140**	**80**	**100**
Loving	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

Lastly, the CDC and County Health Rankings (2022) provide data for some select health metrics including childhood asthma, infant mortality and child mortality.[61] Data was not available for all counties for infant mortality, and the childhood asthma rate is only available at the state level. Of all the 14 counties for which data was available, child mortality rates were highest in Culberson, Andrews, Lea, Ector and Pecos counties, all of which were above the state average child mortality rate. Additionally, although childhood asthma rates are only available at the state level, we estimate that the population of children with asthma is greatest in Ector and Midland counties based on a combination of factors including the state's asthma rate, census data, and the large number of children living near wells in those counties.[62]

F. The Clean Air Act requires TCEQ to place an ozone monitor in the Permian Basin.

i. High ozone and ozone precursor levels in the Texas Permian justify siting a monitor in the region.

The Clean Air Act requires that SIPs and air monitoring networks maintain and support compliance with and enforcement of the NAAQS. TCEQ's AMNP does not provide for ozone or

[61] University of Wisconsin Population Health Institute, County Health Rankings National Findings (2022), https://www.countyhealthrankings.org/reports/2022-county-health-rankings-national-findings-report.

[62] To estimate the number of children with asthma living in these counties, we combined the states' childhood asthma rate with census data on the number of children (those younger than 18) in each county as well as our estimate of the number of children within ½ mile of an active oil and gas well (using the methodology previously described).

ozone precursor monitoring from the country's leading source of ozone-forming VOCs[63] – the oil and gas industry – in the largest oil and gas producing basin in the world.[64] And it fails to provide for such monitoring despite compelling evidence that ozone in the region is exceeding the NAAQS. TCEQ's AMNP thus fails to adhere to the spirit and text of the Clean Air Act.

Additionally, TCEQ's FYA insufficiently addresses whether its monitoring network satisfies Appendix D. The FYA concludes that the only additional ozone monitor that is necessary is one for Lubbock due to Table D-2's population-based requirements being triggered. As discussed below, TCEQ must consider more than simply population requirements; it must also consider prevalent emissions sources that may warrant monitoring. TCEQ's FYA acknowledges it should assess more than Table D-2 because it includes a section evaluating the Panhandle and West Texas Area's air quality by reviewing source emissions and non-attainment status.[65] Region 7 is responsible for 74% of VOC emissions and 46% of NOx emissions in the Panhandle and West Texas Area.[66] Oil and gas facilities are included in these area source emissions. But in its assessment of point-source and area-wide emissions in the Panhandle, TCEQ ignores these emissions from oil and gas operations in the Permian Basin,[67] overlooking substantial evidence of ozone risk.

EPA's network requirements provide clear guidance on ways states can comply with the Act in submitting AMNPs and FYAs. For example, they provide that a network must assess peak air pollution levels and monitor near "significant" and "major" sources of air pollution. 40 C.F.R. § 58.10 App. D ¶ 1.1. TCEQ's network clearly does not monitor for peak air pollution or significant sources of air pollution when it fails to monitor for ozone and ozone precursors in the Permian Basin.

TCEQ's network also does not adequately track the spatial distribution of air pollution or have the ability to characterize the transport of pollutants between jurisdictions when private data suggests such monitoring is necessary.[68] As the authors of the UNC report observed: "Additional ozone monitoring, especially in Texas counties of the Permian basin, would be beneficial in not only assessing the potential impacts of Permian on causing high ozone values [], but also in determining the spatial extent of ozone nonattainment in the Permian basin."[69]
For the same reasons, the plan fails to provide adequate and timely air pollution data to the public as required by the Act.[70] Data is essential for populations that live near significant sources of ozone pollution, such as the Permian Basin, to take action to protect their health.

Lastly, TCEQ's network currently fails "to support air quality characterization for areas with

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[63] EPA, EPA Initiates New Review of the Ozone National Ambient Air Quality Standards to Reflect the Latest Science (August 2023), https://www.epa.gov/newsreleases/epa-initiates-new-review-ozone-national-ambient-air-quality-standards-reflect-latest.
[64] Enverus, Permian Basin Oil and Gas Overview, https://www.enverus.com/permian-basin/ (last visited May 14, 2025); Energy in Depth, The Permian Basin Is Now the Highest Producing Oilfield in the World (April 2019), https://www.energyindepth.org/the-permian-basin-is-now-the-highest-producing-oilfield-in-the-world/.
[65] FYA at 257.
[66] FYA at 255.
[67] *Id*. at 255.
[68] *Supra* note 5.
[69] Exhibit A at 18.
[70] See 42 U.S.C. §§ 7410, 74714.

relatively high populations of susceptible individuals" including children with asthma and other at-risk populations. A high number of people with pre-existing conditions, the elderly, children, children with asthma, people of color and people in poverty live close to oil and gas wells in the Texas Permian.[71] In 2020, TCEQ's response to comments on the FYA explained that TCEQ was unable to evaluate this factor because EPA's network requirements do not define "susceptible individuals." But EPA does provide guidance, citing children with asthma as an example. Even if it didn't, that does not remove TCEQ's obligation to assess this factor, which, as EDF's analysis has shown, is feasible. Particular populations are more susceptible to ozone and oil and gas pollution than others, and county-by-county data on the concentration of certain populations exists.[72]

TCEQ's failure to assess these factors in the AMNP and FYA run counter to the Clean Air Act.

ii. TCEQ must add additional monitors to the Midland-Odessa area based on 40 C.F.R. § 58, App'x D, Section 4.1.

Under 40 C.F.R. § 58, App'x D, Section 4.1, Metropolitan Statistical Areas ("MSA") or Combined Statistical Areas ("CSA"s) with more than 350,000 persons require at least one ozone monitor if the design value for that area is less than 85% of the NAAQS; and at least two monitors if the design value for the area is equal to or greater than 85% of the NAAQS. MSAs or CSAs with fewer than 350,000 people still require at least one ozone monitor if the design value for the area is equal to or greater than 85% of the NAAQS. *Id*. The regulations make clear that the monitoring network:

> must be designed to record the maximum concentration for that particular metropolitan area. More than one maximum concentration site may be necessary in some areas. Table D-2 of this appendix does not account for the full breadth of additional factors that would be considered in designing a complete O3 monitoring program for an area. Some of these additional factors include geographic size, population density, complexity of terrain and meteorology, adjacent O3 monitoring programs, air pollution transport from neighboring areas, and measured air quality in comparison to all forms of the O3 NAAQS (i.e., 8- hour and 1-hour forms). Networks must be designed to account for all of these area characteristics.

Id.

The Midland-Odessa CSA is one of the fastest growing regions in the United States.[73] According

[71] *Supra* Section I(B) (ozone health impacts) and Section II(E) (demographics discussion).
[72] The plan also fails to address requirements for air quality control regions. Indeed, there are no ozone monitors at all in the Midland-Odessa-San Angelo Intrastate Air Quality Control Region established by C.F.R. § 81.137. With no ozone monitors, it is impossible for the State of Texas to fulfill its responsibility for assuring that the ozone NAAQS "will be achieved and maintained within each air quality control region" in the state. 42 U.S.C. § 7407(a).
[73] U.S. Census Bureau Press Release, Growth in Metro Areas Outpaced Nation (Mar. 13, 2025),

to the U.S. Census Bureau, Midland had a population of 188,766 as of July 2024, while Odessa had a population of 170,022.[74] Accordingly, the combined population of this CSA is 358,788. Together, the Midland-Odessa CSA includes three counties— Martin, Midland, and Ector Counties—which have an area of about 2,700 square miles (much smaller than other areas in Texas subject to Table D-2). Odessa's north-east border (near Mission Blvd) is about 3 miles away from the Midland airport—which is incorporated within the city limits of Midland. About 20 miles separate the centers of each city. Under longstanding EPA regulations, Midland and Odessa are included in the same Intrastate Air Quality Control Region. *See* 40 C.F.R. § 81.137.

Where a metropolitan area is divided into multiple MSAs, EPA regulations require regulators to consider the entire CSA for purposes of designing the air quality monitoring network. *See* 40 C.F.R. § 58, App. D, ¶ 4.1(b) ("Within an O3 network, *at least one O3 site for each MSA, or CSA if multiple MSAs are involved*, must be designed to record the maximum concentration for that particular metropolitan area.") (emphasis added). Here, the combined population of the Midland-Odessa CSA exceeds the threshold above which an ozone monitor is required under Table D-2. Accordingly, under 40 C.F.R. § 58, App. D, ¶ 4.1(a)-(b), TCEQ must operate "at least one O3 site for . . . [the] CSA" for the purpose of "record[ing] the maximum concentration for that particular metropolitan area."

Other metropolitan areas that span much greater distances are treated as a single unit for purposes of Table D-2. The Houston MSA spans nine counties and has an area of 9,444 square miles. One can drive for 110 miles along I-10 (from Sealy to Winnie) without leaving the MSA. The Dallas-Fort Worth-Arlington MSA is over 9,000 square miles. About 30 miles separate downtown Dallas from downtown Fort Worth. The San Antonio MSA includes eight counties and has an area of 7,340 square miles. It would be arbitrary and capricious to treat these large urban conglomerations as single units under Table D-2, while refusing to do the same for the much smaller Midland-Odessa CSA.

Even if TCEQ disagrees that Table D-2 requires an O3 monitor for the Midland-Odessa CSA, and treats Midland and Odessa as MSAs, the end result is the same: two ozone monitors must be added in the area (one in Midland and one in Odessa). Midland and Odessa have more than 50,000 people. Given that there is no monitor in Midland or Odessa, EPA's regulations suggest that TCEQ should look to representative monitors in the region to determine whether the area exceeds 85 percent of the NAAQS and therefore warrants an additional monitor pursuant to Table D-2. The regulations indicate that, in general, "regional scale measurements would be most applicable to sparsely populated areas." 40 C.F.R. § 58, App. D, ¶ 4.7.1(c)(5) (design criteria for PM). Although that provision specifically addresses particulate matter, the regulations also make clear that for ozone, the "appropriate" scale for siting a representative monitor may entail looking at "areas with dimensions of as much as hundreds of kilometers." *See* 40 C.F.R. § 58, App. D, ¶ 4(c)(3). The nearest monitor is in Hobbs, New Mexico, which, like Midland-Odessa, is located in the Permian Basin region. The most recent, EPA-verified three-year design value (2021-2023)

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https://www.census.gov/newsroom/press-releases/2025/population-estimates-counties-metro-micro.html (from 2023 to 2024, Midland and Odessa experienced the eighth and ninth largest percentage growth, respectively, of any metropolitan areas in the nation, each growing by approximately 2.8 percent).

[74] *Id.*

for this monitor is 0.071 ppm—more than 100 percent of the 2015 eight-hour ozone NAAQS.[75] Other nearby monitors in Carlsbad, NM, are also exceeding the NAAQS. Given the absence of local monitors, these regional data suggest a high likelihood that Midland-Odessa's design value exceeds 85% of the NAAQS, necessitating at least one monitor under Table D-2. Absent some other data for Midland-Odessa, TCEQ must use these as the best estimate available for Midland-Odessa's design value. If TCEQ does have other information about the likely design value, it must provide this information and allow the public the opportunity to comment on it.[76]

iii. TCEQ must consider whether plans meet the entirety of Appendix D, not just Table D-2's requirements.

TCEQ's 2025 AMNPs and FYAs relied solely on Table D-2's population-based requirements to justify plan adequacy, adding an ozone monitor in Lubbock, TX alone because it has reached the delineated population thresholds. However, the Clean Air Act and EPA's regulations require that AMNPs and FYAs meet requirements beyond those outlined in Table D-2.

When determining where to place monitors, Table D-2 provides a starting point but not an ending point. As EPA has explained, it is expected that "[t]he total number of O3 sites needed to support the basic monitoring objectives of public data reporting, air quality mapping, compliance, and understanding O3-related atmospheric processes *will include more sites than these minimum numbers [in Table D-2]* . . . ." and that" [t]he total number of monitoring sites . . . *will be substantially higher* than these minimum requirements provide." 40 C.F.R. § 58, App. D, ¶ 1.1.2 (emphasis added). The regulations further provide that "[t]he total number of ozone sites needed to support the basic monitoring objectives of public data reporting, air quality mapping, compliance, and understanding ozone-related atmospheric processes *will include* more sites than the minimum number required in Table D-2." *Id.* ¶ 4.1 (emphasis added).

Furthermore, Appendix D explicitly states that the "purpose of [the] appendix" is to do two things. First, it must "describe monitoring objectives and general criteria to be applied in establishing [monitoring stations] and for choosing general locations for additional monitoring sites." 40 C.F.R. § 58, App. D, ¶ 1. Second, and separately, the "appendix *also* describes specific requirements for the number and location of FRM and FEM sites for specific pollutants" including ozone. *Id*. (emphasis added). Table D-2 provides for the "specific requirements for the number and location of FRM and FEM sites." The rest of Appendix D is thus separate from the population-based requirements under Appendix D, section 4. Additionally, Appendix D 1.1.1 lists monitors in areas with large populations as just one of the six types of monitors that network plans should include, confirming that population is but one factor in assessing network adequacy. Thus, while siting determinations and network adequacy are based "in part" on population counts,[77] TCEQ must also ensure its plans achieve the objectives and requirements established

[75] *See* EPA 2023 Design Value Report, https://www.epa.gov/system/files/documents/2024-06/o3_designvalues_2021_2023_final_06_04_24.xlsx.
[76] In the past, TCEQ has suggested that Hobbs, New Mexico, is delineated by the OMB as a separate metropolitan statistical area and is not associated with the Midland or Odessa MSAs. TCEQ misunderstands the point. While Hobbs is not part of the Midland-Odessa metropolitan area, it contains the nearest ozone monitor and TCEQ must use the best available estimate of regional ozone values in applying Table D-2.
[77] *Miss. Comm'n on Envtl. Quality v. EPA*, 416 U.S. App. D.C. 69, 85, 790 F.3d 138, 154 (2015).

elsewhere in Appendix D. TCEQ's reliance on Table D-2 alone ignores these broader objectives, failing to address the Permian Basin's significant emissions and regional transport impacts.

If Table D-2 were the sole measure against which TCEQ must assess its network adequacy, that would violate the spirit of the Act by allowing states to ignore significant emissions by failing to monitor in an area. The Permian Basin is a perfect example of this flawed rationale and logic loop. Without an active ozone monitor in the Permian Basin, there can be no design values for the region; without design values for the Permian Basin, TCEQ finds it need not monitor in the region based on Table D-2. This rationale undermines the Clean Air Act's mandate for proactive air quality surveillance,[78] particularly in emission-heavy regions like the Permian Basin.

Other states have gone beyond Table D-2 when establishing their network plans for ozone. For example, Washington's network includes additional ozone monitors that exceed those required by Table D-2 to jointly monitor the Portland–Vancouver–Hillsboro Metropolitan Statistical Area with Oregon and to assess regional transport and background levels.[79] Illinois' network also includes additional sites to support not only public reporting and regulatory compliance, but also enhanced monitoring, air quality research, and mapping efforts.[80]

iv. TCEQ should consider the private monitoring data presented in this comment.

Because TCEQ and EPA do not manage a regulatory-grade ozone monitor in the Texas Permian, ozone levels are assessed by private entities and Commenters must rely on private data to illustrate the pressing need for adequate regulatory monitoring in the region.

While agencies may not be required to rely on private monitoring data to make non-attainment designations[81] or specific siting determinations,[82] no court has held agencies may ignore private data when determining whether to place a monitor at all in a region of the state when the data indicates NAAQS exceedances are likely. In fact, ignoring private data suggesting a region violates the NAAQS would be unreasonable and arbitrary and capricious. TCEQ has previously used private monitoring data to make siting determinations,[83] and, as discussed above, substantial evidence exists to imply that parts of the Texas Permian likely exceed the ozone NAAQS.[84]

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[78] 42 U.S.C. § 7410(a).
[79] Washington Dep't of Ecology, *2024 Ambient Air Monitoring Network Plan*, at 44–45.
[80] Illinois Envtl. Prot. Agency, *2024 Air Monitoring Network Plan*, at 12–14.
[81] *See Miss. Comm'n on Envtl. Quality v. EPA*, 790 F.3d 138, 154 (D.C. Cir. 2015).
[82] *See* Berks Cnty. v. EPA, 619 F. App'x 179, 182 (3d Cir. 2015).
[83] *See, e.g.*, TCEQ, Response to Comments on 2020 Five-Year Assessment at 1, https://www17.tceq.texas.gov/tamis/index.cfm?fuseaction=home.welcome (non-regulatory monitors did not meet requirements to compare to NAAQS, but supported TCEQ's air monitoring decisions).
[84] *See Sw. Pa. Growth All. v. Browner*, 121 F.3d 106, 115 (3d Cir. 1997) (when EPA has information that a region is potentially in non-attainment, including data from private monitors, it cannot designate that areas as "attainment"); Miss. Comm'n on Envtl. Quality v. EPA, 790 F.3d 138, 154 (D.C. Cir. 2015) (private data, even if unverified, implied that a NAAQS violation was possible.).

v. TCEQ should place at least one monitor in Midland-Odessa.

Per EPA's network requirements, states should site monitors close to specific source hot spots and for secondary pollutants, such as ozone, in areas of maximum precursor emissions. 40 C.F.R. § 58, App'x D, ¶ 4.1. Moreover, when deciding where to place a new monitor, TCEQ must consider the objectives in Appendix D—including the presence of high-density populations, at-risk populations, and the goal of assessing ozone transport between jurisdictional boundaries. Applying these factors, Commenters urge TCEQ to place an ozone monitor in the Midland-Odessa region. Midland county has the fourth-highest ozone precursor emissions in the Permian Basin (for both NOx and VOCs) and has a high number of trajectories contributing to non-attainment at the Carlsbad monitor in New Mexico.[85] Ector county is in the top 10 for large oil and gas point source VOC and NOx emissions in the Permian, and has the 4th highest number of trajectories contributing to non-attainment at Carlsbad. Placing a monitor in Midland-Odessa would assist Texas in assessing ozone transport issues.[86]

Additionally, the population in the Midland-Odessa region is significant compared to others in the Permian, including large at-risk populations that live next to oil and gas activity. In Martin County, nearly 100% of the population lives within a mile of an oil or gas well and 94% live within a half-mile.[87] Martin county also has some of the highest rates of CHD, COPD, and stroke compared to the rest of Texas.[88] Additionally, over a third of the population in Ector and Midland counties live within a half-mile of an oil or gas site. Of all the counties in the Texas Permian, Midland and Ector have the highest concentration of children under the age of 5 living within a half-mile of an oil or gas well.[89] To address these risks and comply with Appendix D § 1.1.1, TCEQ should place ozone monitors in Midland-Odessa to capture peak concentrations and protect vulnerable populations.

III. Conclusion

Commenters urge TCEQ to enhance ozone and ozone precursor monitoring in the Permian Basin. There is considerable data indicating ozone in the region likely exceeds the NAAQS and is harming the health of vulnerable populations living near oil and gas facilities. TCEQ's failure to make and consider planning changes based on this data is putting the health of communities at risk and runs counter to the Clean Air Act. We look forward to working with TCEQ on this issue in the future and thank TCEQ for the opportunity to comment.

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[85] *Supra* Section II(C).
[86] *Id.*
[87] *Supra* Section II(E).
[88] *Id.*
[89] *Id.*

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Exhibit A

INSTITUTE FOR
THE ENVIRONMENT

Assessing Permian Basin's Contributions to Ozone Nonattainment at Carlsbad, New Mexico

Final Report

Submitted to:
Environmental Defense Fund

Submitted by:

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July 31, 2023

Table of Contents

List of Figures

List of Tables

Background

Emissions from oil and gas activities in the Permian basin (PMB) have been implicated for contributing to high ozone levels in the Texas and New Mexico region. Under this study, the UNC Institute for the Environment (UNC-IE) performed two specific analyses (HYSPLIT back-trajectory modeling and emissions inventory analyses) to assess if emissions from the PMB contributed to ozone nonattainment at specific monitors in New Mexico. This report presents outcomes of these analyses performed by UNC-IE.

Task 1: HYSPLIT Modeling and Analyses

Review of historical Ozone at Carlsbad monitoring site

The Carlsbad (AQS Site ID 350151005) ozone monitor, situated in Eddy county in Southeast New Mexico is maintained by the New Mexico Environment Department (NMED). Recent observations in the past few years have shown Carlsbad to record higher ozone levels than in the past. A violation of the National Ambient Air Quality Standard (NAAQS) for 8-hour ozone (8HO3) is triggered when the three-year average of the annual fourth highest daily maximum (MDA8_O3) reading exceeds the NAAQS. The 2015 form of the ozone NAAQS sets this threshold at 70 ppb or 0.070 ppm[1]. This three-year average is considered the “Design Value” (DV) for a monitor, and recent data have shown that the DV for Carlsbad has been continuously rising, and there is concern that the Carlsbad region can be potentially designated to be in nonattainment of the NAAQS for ozone. According to the U.S. Census Bureau[2], the 2020 population in Eddy county is 62,314, and the population in Carlsbad city is 32,238. The city of Carlsbad is part of the Carlsbad-Artesia micropolitan statistical area (µSA).

Note that there is another ozone monitor at the Carlsbad Caverns National Park (CAVE) (AQS Site ID: 350150010) also in Eddy county, which also has recorded high ozone levels in the recent past. In the year 2022, Carlsbad recorded 22 exceedances of the ozone NAAQS through September, CAVE recorded 21, while Houston, Texas, and Dallas – Fort Worth, Texas (top 4 locations with high ozone in EPA Region 6) recorded 25 and 38 exceedances respectively. The rest of this report only discusses the Carlsbad site.

Figure 1 presents daily maximum 8-hour average of ozone concentration (MDA8_O3) and number of days when MDA8_O3 above 70 ppb (hereafter referred as ozone exceedances) at Carlsbad. As shown in this Figure (bottom-right), ozone exceedances typically occurred during May through September at Carlsbad monitoring site. July is the month with highest number of exceedances. During the period 2017 – 2022, the highest number of annual exceedances is 23, and seen during both 2021 and 2022. Lowest number of exceedances in 2020 is due to technical issue at the monitoring site[3] and therefore does not represent typical ozone

[1] https://www.epa.gov/criteria-air-pollutants/naaqs-table
[2] https://www.census.gov/quickfacts/eddycountynewmexico
[3] https://www.currentargus.com/story/news/local/2020/08/13/nmeds-ozone-air-monitor-carlsbad-shut-down-most-july/3338346001/

conditions in 2020. The number of ozone exceedances increased from 2017 (10 exceedances) to 2022 (23 exceedances). Figure 1 (bottom-left) also suggests an increasing trend of MDA8_O3 at Carlsbad since 2017. Increases in MDA8_O3 and ozone exceedances are also observed at CAVE monitoring site (Figure S1 and Figure S2).

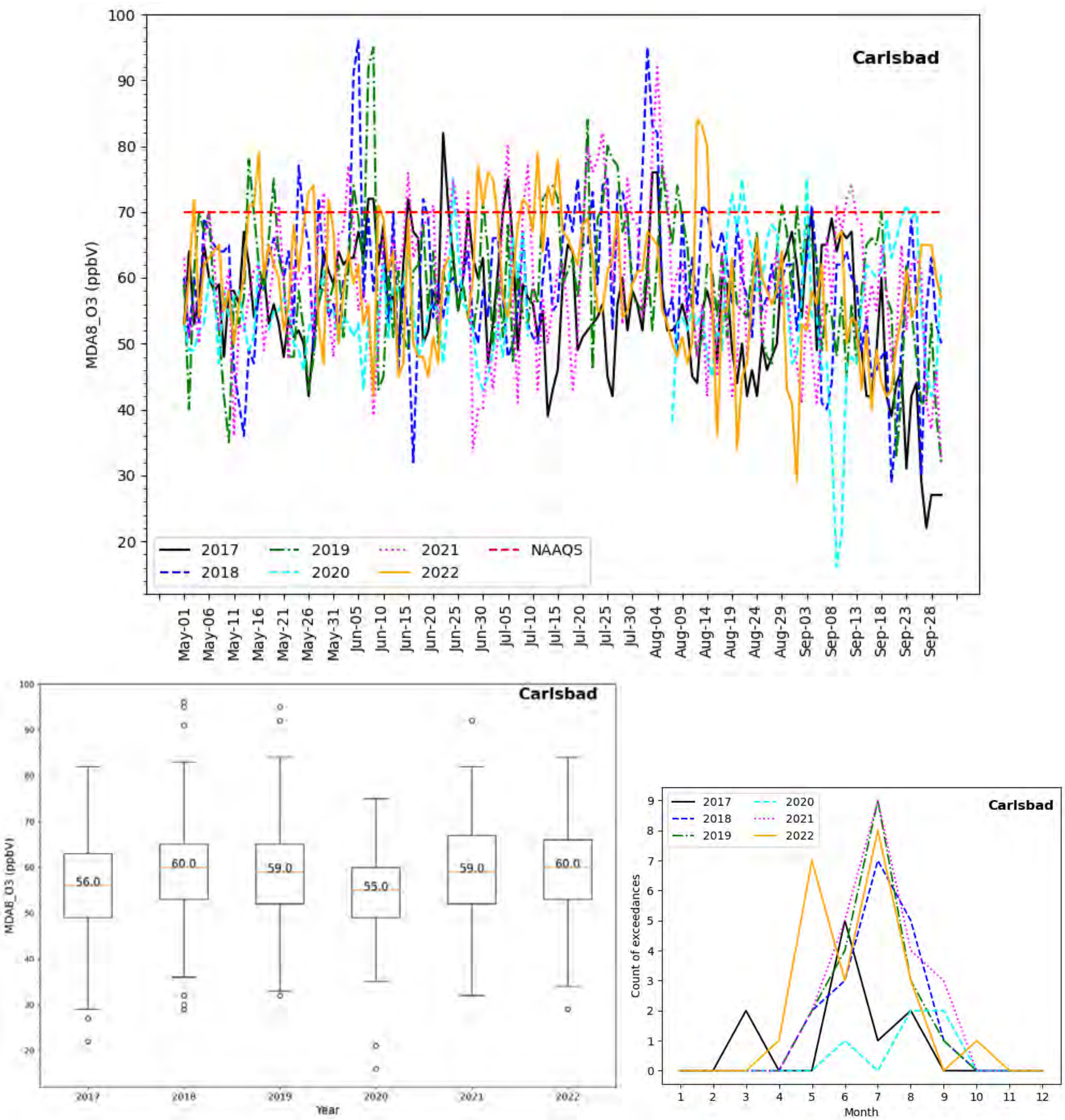

Figure 1. (Top) Daily distribution and (bottom-left) box and whisker plot of MDA8_O3 during May – September, and (bottom-right) number of ozone exceedances when MDA8_O3 was above 70 ppb at Carlsbad monitoring site during 2017 – 2022 period. Caution should be made in interpreting MDA8_O3 in 2020 due to incomplete monitoring data at Carlsbad during this year.

Table S2 presents summary statistics of observed MDA8_O3 at 8 monitoring sites throughout 2017 – 2022 within and near the Permian basin (see Figure 2 for locations). On the New Mexico side of the Permian basin, besides Carlsbad and CAVE, ozone exceedances were also commonly observed at Hobbs in Lea county. Guadalupe, Culberson county is the only ozone monitoring site on the Texas side of the Permian basin and observed ozone exceedances during 2019-2021, the three years when data at this site are available and showing an increasing trend – both for the highest and 4th highest MDA8_O3 values each year. There is lack of additional ozone monitoring in Texas counties of the Permian basin where ozone exceedances are likely to be seen. The three monitoring sites (San Antonio, Camp Bullis, Calaveras) within the San Antonio ozone nonattainment area (Figure 2) also frequently observed ozone exceedances during May – September each year. Likewise, ozone exceedances were observed at several ozone monitoring sites within the Dallas Forth Worth (not shown in Table S2). Causes of ozone exceedances in San Antonio and Dallas Forth Worth are not discussed here.

HYSPLIT model configuration

To identify specific emissions source regions that may have contributed to ozone exceedances at Carlsbad, we employ the Hybrid Single-Particle Lagrangian Integrated Trajectory (HYSPLIT) model v5.2.3 (Stein et al., 2015) from the National Oceanic and Atmospheric Administration (NOAA) to calculate trajectories of airmasses that reached Carlsbad monitoring site on high ozone days. We reviewed prior applications of HYSPLIT for regulatory purposes, particularly in designation of nonattainment areas for common best practices (summarized in Table S1). Based on results from this review and from EPA's recommendations on HYSPLIT application(U.S. EPA, 2016), we set up the HYSPLIT model with the following configurations:

- The MDA8_O3 above 70 ppb threshold is used as the criterion to determine high ozone days.
- For each of the above exceeding MDA8_O3 values, the eight hours based on which the 8HO3 was determined from (base hours) are identified. HYSPLIT is then applied to simulate 48-hour back trajectories starting from each of the eight identified base hours.
- Input meteorological data for HYSPLIT are processed from the High-Resolution Rapid Refresh (HRRR) meteorological model[4] (Dowell et al., 2022; James et al., 2022). HRRR data is approximately 3 km x 3 km in horizontal resolution and available hourly.
- The 48-hour back trajectories are estimated for four elevation levels above Carlsbad: 100, 200, 500 and 1,000 meters.
- Vertical motion is extracted directly from HRRR model.

We examined observed ozone during May through September from 2017 to 2022 to identify the hours for which HYSPLIT back trajectories are estimated. Table 1 presents exceedance counts of MDA8_O3, 8HO3 and the total of base hours for each year. Due to incompleteness of HRRR input data at times, back trajectories were not estimated for certain base hours of the MDA8_O3. Overall, 48-hour back trajectories were estimated for 636 hours (simulated-hours) out of 664 base-hours (equivalent to 96% completeness) during this six-year period.

[4] https://rapidrefresh.noaa.gov/hrrr/

We also conducted HYSPLIT simulations for low ozone days which are identified as days when MDA8_O3 are below 10th percentile (pctl) and 25th pctl of all values during May – September, 2017 – 2022. They are determined to be 46 ppb and 51 ppb, respectively (see Table S3 for distribution of MDA8_O3 at Carlsbad. The number of base hours for each scenario are presented in Table 1. Note that 70 ppb threshold is approximately 90 pctl (or 68 ppb) of all MDA8_O3 values during May – September, 2017 – 2022 (see Table S3).

Table 1. Number of base-hours for HYSPLIT back trajectory simulations when MDA8_O3 exceeded 70 ppb, less than 46 ppb and 51 ppb.

	2017	**2018**	**2019**	**2020[1]**	**2021**	**2022[2]**	**Total**
MDA8_O3 < 46 ppb (10th pctl)	*26*	*13*	*13*	*15*	*17*	*3*	*87*
# of base-hours (trajectories)	*208*	*104*	*101*	*115*	*136*	*24*	*688*
MDA8_O3 < 51 ppb (25th pctl)	*48*	*28*	*34*	*39*	*37*	*12*	*198*
# of base-hours (trajectories)	*384*	*224*	*259*	*283*	*296*	*96*	*1,542*
MDA8_O3 > 70 ppb (90th pctl)	*10*	*18*	*19*	*5*	*23*	*10*	*83*
# of base-hours (trajectories)	*64*	*144*	*132*	*32*	*184*	*80*	*636*

[1] Ozone data for 2020 is incomplete due to technical issues in monitoring equipment[5]

[2] At the time of conducting HYSPLIT back trajectory analyses, ozone data in 2022 was not completed and thus number of MDA8_O3 > 70 ppb shown in this Table is less that what was shown in Figure 1

Trajectory analyses

We conducted a heatmap analysis to identify footprint of source regions that may contribute to ozone at Carlsbad. We first identify a domain comprised of grid-cells at a 3 km x 3 km horizontal resolution centered on the Carlsbad monitoring site. This domain covers a surface area of 1,200 x 1,200 km (or 400 x 400 grid-cells) to ensure that all HYSPLIT-simulated trajectories are captured (Figure 2). We also divided the counties in Permian basin into four groups – Northeast, Northwest, Southeast, and Southwest (referred to as NE, NW, SE, and SW, respectively) as shown in Figure 2 for ease of analyses and discussions later. Heatmap value of each grid-cell represents number of trajectory passages over that grid-cell and divided by total number of trajectories during a defined period and under specific condition (e.g., high vs. low ozone days; see below for more details). We also conducted heatmap analyses at the county-level (# of times the trajectory goes through a county) to facilitate a direct comparison to county-level emissions (source regions) from Oil and Gas productions in New Mexico and Texas.

[5] https://www.currentargus.com/story/news/local/2020/08/13/nmeds-ozone-air-monitor-carlsbad-shut-down-most-july/3338346001/

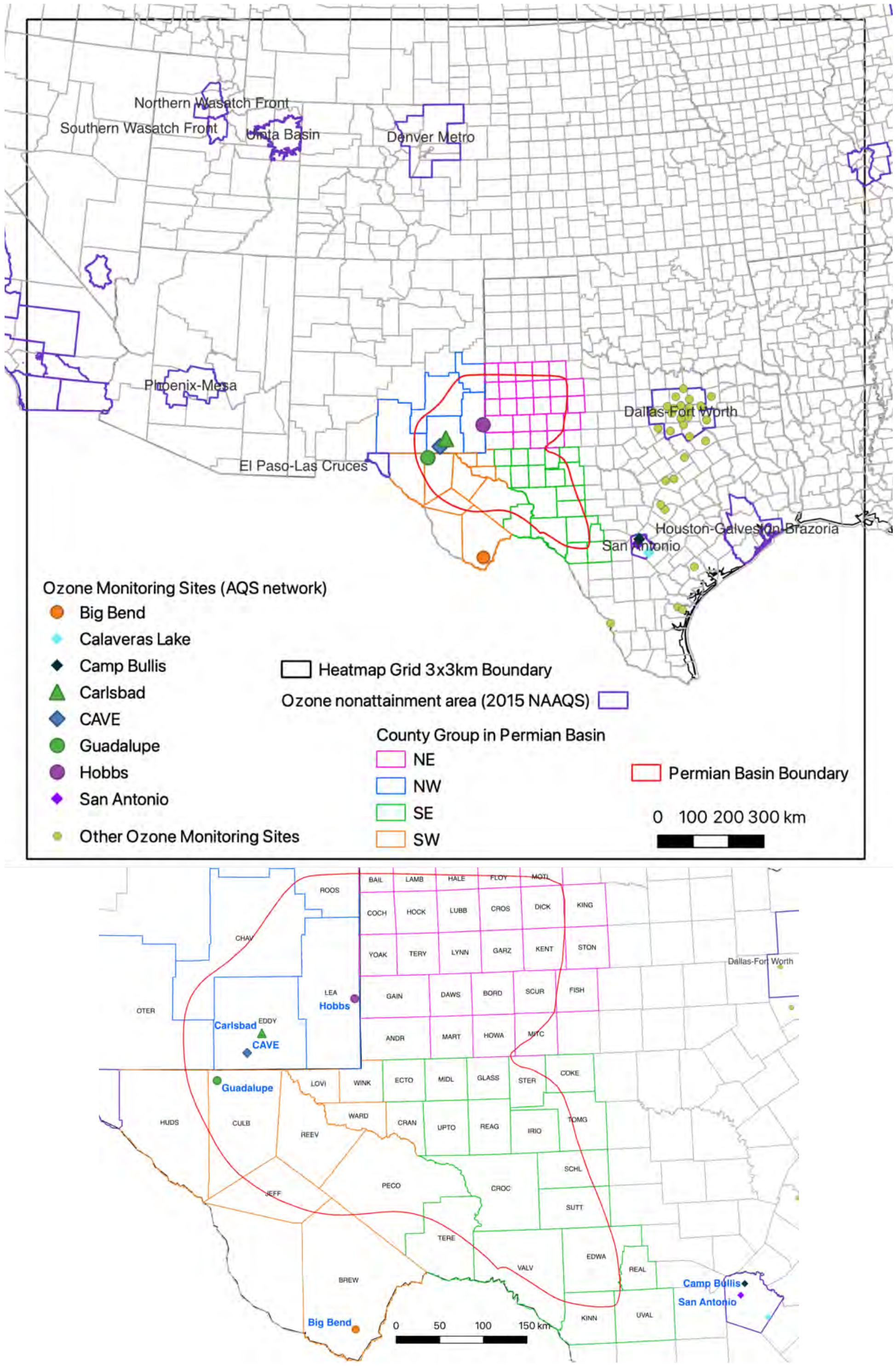

Figure 2. (Top) Layout of 3 km x 3 km domain for heatmap analyses and (bottom) zoom-in of ozone monitoring sites within the PMB. In this figure, locations of other ozone monitoring sites outside PMB and current ozone nonattainment areas are shown; pink, green, orange, and blue polygons depict counties designated as northeast (NE), southeast (SE), southwest (SW) and northwest (NW), respectively, of the PMB.

Figure 3 presents actual HYSPLIT 48-hour back trajectories for the base hours described in Table 1 (e.g., when MDA8_O3 > 70 ppb) reaching Carlsbad at 4 levels above ground level. We found the trajectory patterns to be consistent throughout 2017 – 2022. For trajectories that ended at 100 m and 200 m above Carlsbad, most of them passed through the counties located in east and southeast of Carlsbad. Trajectories passing through counties located in northeast and southwest of Carlsbad are found more frequently among those ended at 500 m and 1000 m above Carlsbad.

Figure 4 presents percentage of total number of trajectories (heatmap value) of 3 km x 3 km grid-cells (Figure 2) as they are mapped to the trajectories in Figure 3. There are several aspects to be noted in our heatmap analyses:

- Because all trajectories arrive at the grid-cell where Carlsbad site is in, the heatmap value for this cell is 100%.
- Consequentially, top heatmap values are also found for grid-cells in Eddy county (EDDY) as they are on the dominant path of trajectories.
- Furthermore, the farther away a grid-cell is from Carlsbad, the more likely that its heatmap value decreases.

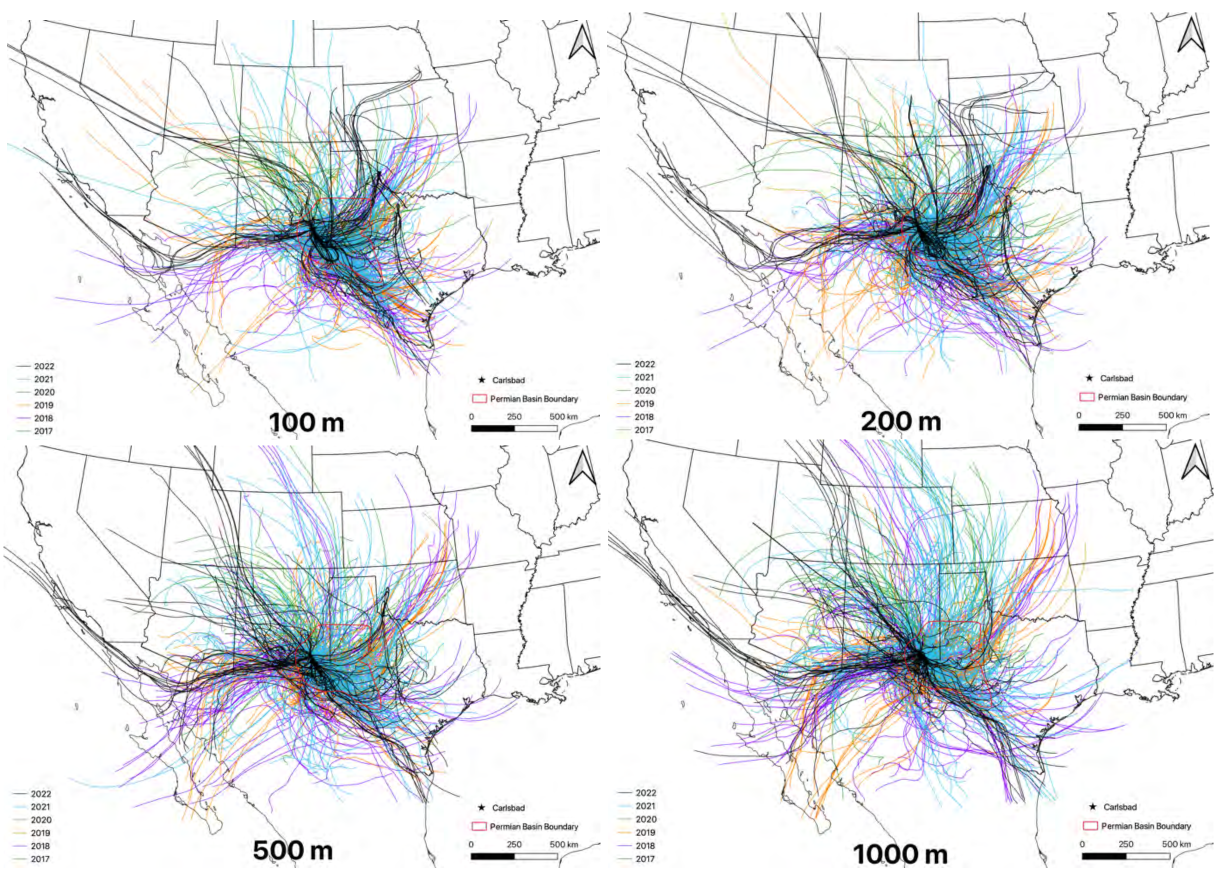

Figure 3. HYSPLIT 48-hour back trajectories ending at 100 m, 200 m, 500 m, and 1000 m above Carlsbad on days when MDA8_O3 was above 70 ppb.

As shown in Figure 4, greater than 4% of trajectories passing through the SW and SE regions (counties LOVI, WARD, REEV, PECO; see Table S5 for full names of all county abbreviations) of PMB. Meanwhile, fewer number of trajectories (below 2%) passed through NW and NE regions of PMB implying rather insignificant impact of emissions sources located within these regions on Carlsbad (Figure 4).

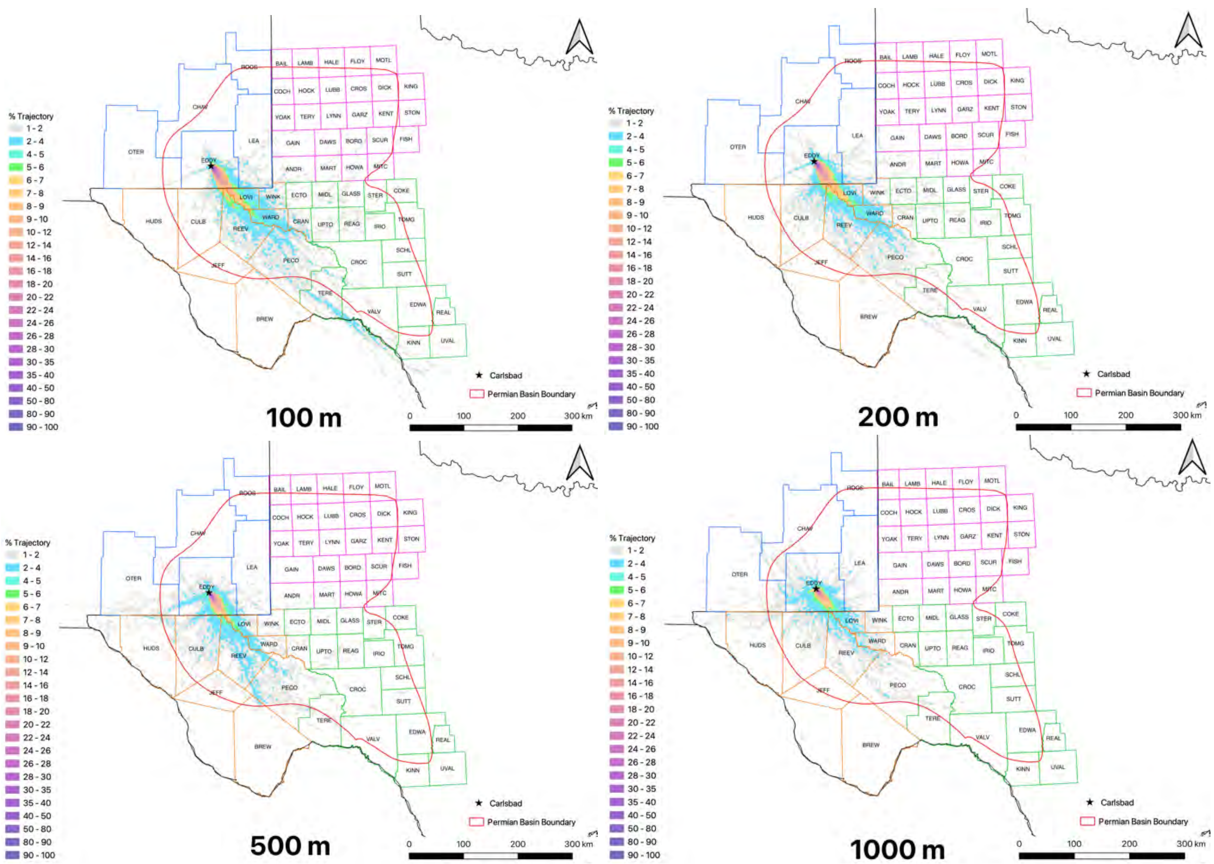

Figure 4. HYSPLIT 48-hour back trajectories presented as heatmap values (% of trajectory) ending at 100 m, 200 m, 500 m, and 1000 m above Carlsbad on days when MDA8_O3 was above 70 ppb.

As shown in Figure 5, heatmap values above 5% are found for grid-cells toward northeast and southwest of Carlsbad (associated with trajectories passing though counties LEA, CHAV and OTER in NW region) during low ozone days which is a rather distinctive difference from Figure 4. This finding implies that trajectories passing though these counties (and NE region of PMB) are typically associated with low ozone at Carlsbad. Furthermore, grid-cells with high heatmap values (above 5%) are also found in counties toward southeast of Carlsbad (Figure 5). This implies airmasses passing through these counties could either cause high or low ozone at Carlsbad. However, we find from this analysis that airmasses passing through counties in SW and SE regions of PMB are those that always lead to high ozone at Carlsbad.

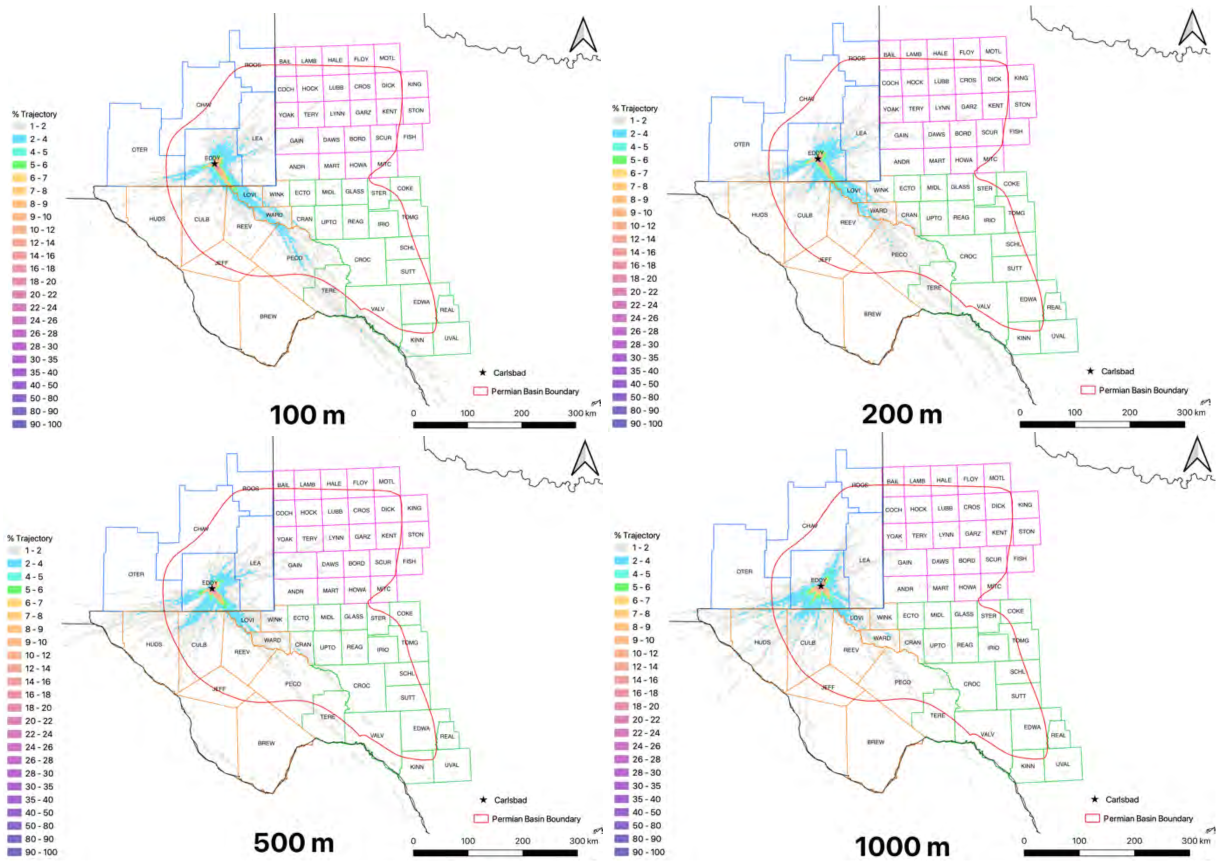

Figure 5. HYSPLIT 48-hour back trajectories presented as heatmap values (% of trajectory) ending at 100 m, 200 m, 500 m, and 1000 m above Carlsbad in days when MDA8_O3 was below 46 ppb (10th percentile).

Figure S4 and S5 present heatmap values evaluated at county-level. Note that it is more likely for a larger county in area to have more trajectories pass through it than for a smaller county if they are at equal distance from Carlsbad. To account for this potentially misleading insight, we further normalized the county-level heatmap value by the county area and the results are shown in Figure 6 and Figure 7 for high and low ozone days, respectively. Figure 6 shows that top heatmap values are found in LOVI, WARD, WINK, and CRAN counties during high ozone days (see Tables S5 and S6 for numerical values).

To better identify the source regions that may contribute to high ozone days at Carlsbad, we subtracted the heatmap values associated with low ozone days when MDA8_O3 < 46 ppb (Figure 5) from the heatmap values associated with high ozone days when MDA8_O3 > 70 ppb (Figure 4). The results are shown in Figure 8 for 3 km x 3 km grid-cells and in Figure 9 for counties in the PMB. Negative heatmap values in these figures indicate grid-cells/counties that are typically associated with low ozone days, and vice versa.

Figure 8 clearly indicates two groups of sources regions: the source regions between east and south of Carlsbad are often associated with high ozone days; the source regions toward northeast and southwest of Carlsbad are often associate with low ozone days. Similar finding is also found in Figure 9 where trajectories passing through counties that are in SE (e.g., ECTO , MIDL, STER, GLASS , COKE, CULB, REEV, LOVI, WARD, CRAN, PECO, TERE, UPTO, REAG, IRIO), SW (e.g., WINK, LOVI, WARD, REEV) and a few counties in NE but close to SE (e.g., ANDR, MART, HOWA, MITC) of the Permian Basin are associated with high ozone days at Carlsbad. These counties listed above have large number of oil and gas wells (Figure S3) and also are among the top counties in NOx and VOC emissions from O&G (Figure 11 and Figure 12; Table S8). On the other hand, trajectories passing through counties that are northeast (e.g., YOAK, TERY, LYNN, COCH, HOCK, LUBB, CROS, ROOG, BAIL, LAMB, HALE) and southwest (e.g., HUDS, OTER) of Carlsbad are often associated with low ozone days (Figure 9). NOx and VOC emissions from O&G in these counties are lower than in other counties in PMB (Figure 11 and Figure 12; Table S8).

Note that in Figure 9, difference in heatmap value of EDDY county is zero since all trajectories on low and high ozone days arrive at this county that contains the Carlsbad monitor.

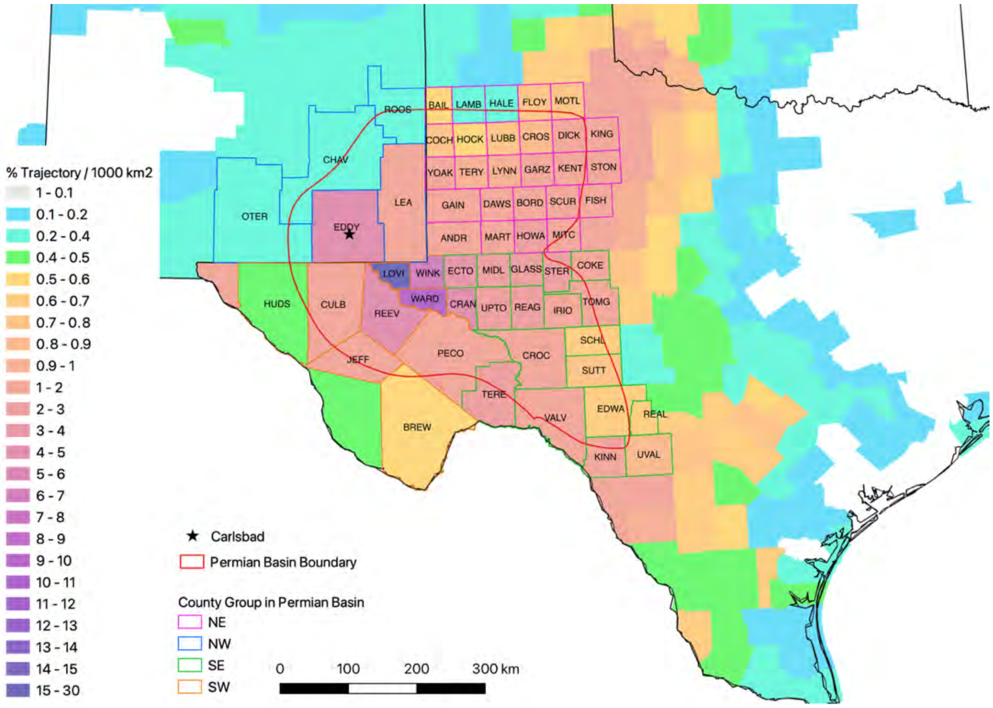

Figure 6. County heatmap normalized by number of trajectories and county area for high ozone days (MDA8_O3 > 70 ppb)

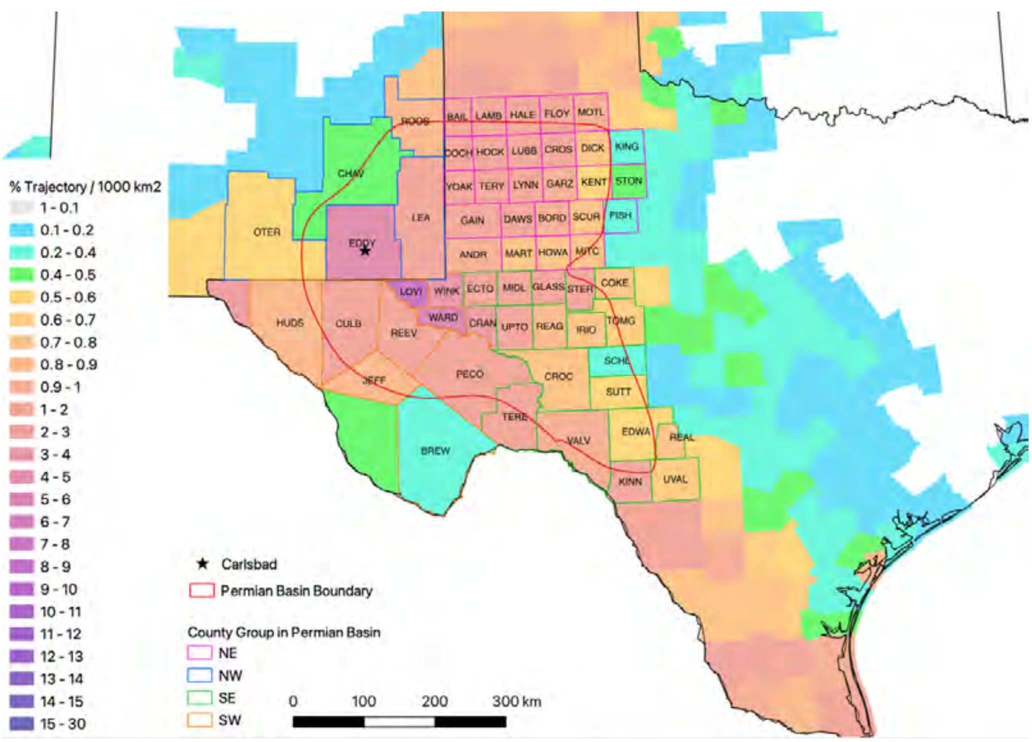

Figure 7. County heatmap normalized by number of trajectories and county area for low ozone days (MDA8_O3 < 46 ppb)

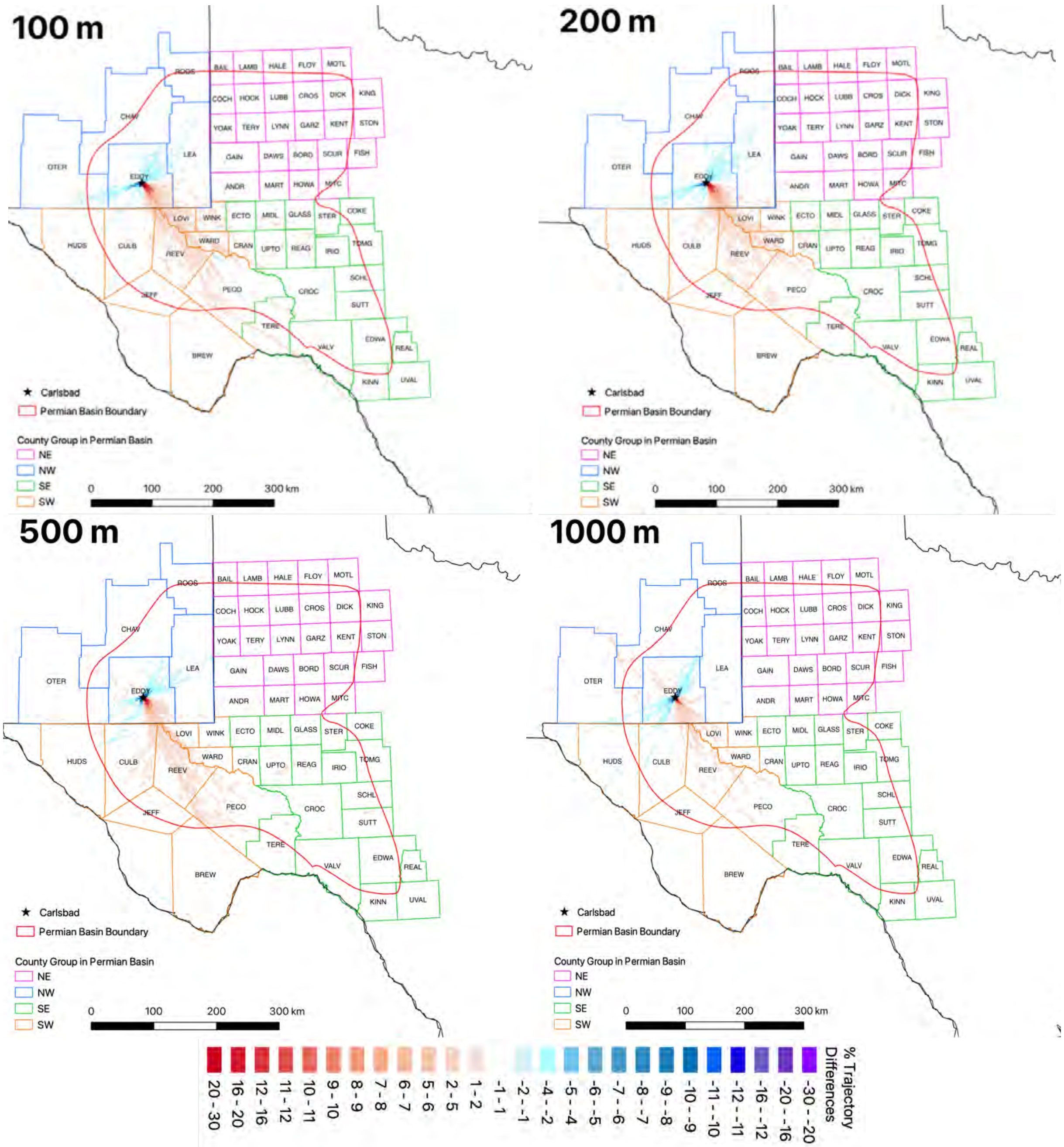

Figure 8. Differences in heatmap values between high (MDA8_O3 > 70 ppb) and low (MDA8_O3 < 46 ppb) ozone days for 3 km x 3 km grid-cells.

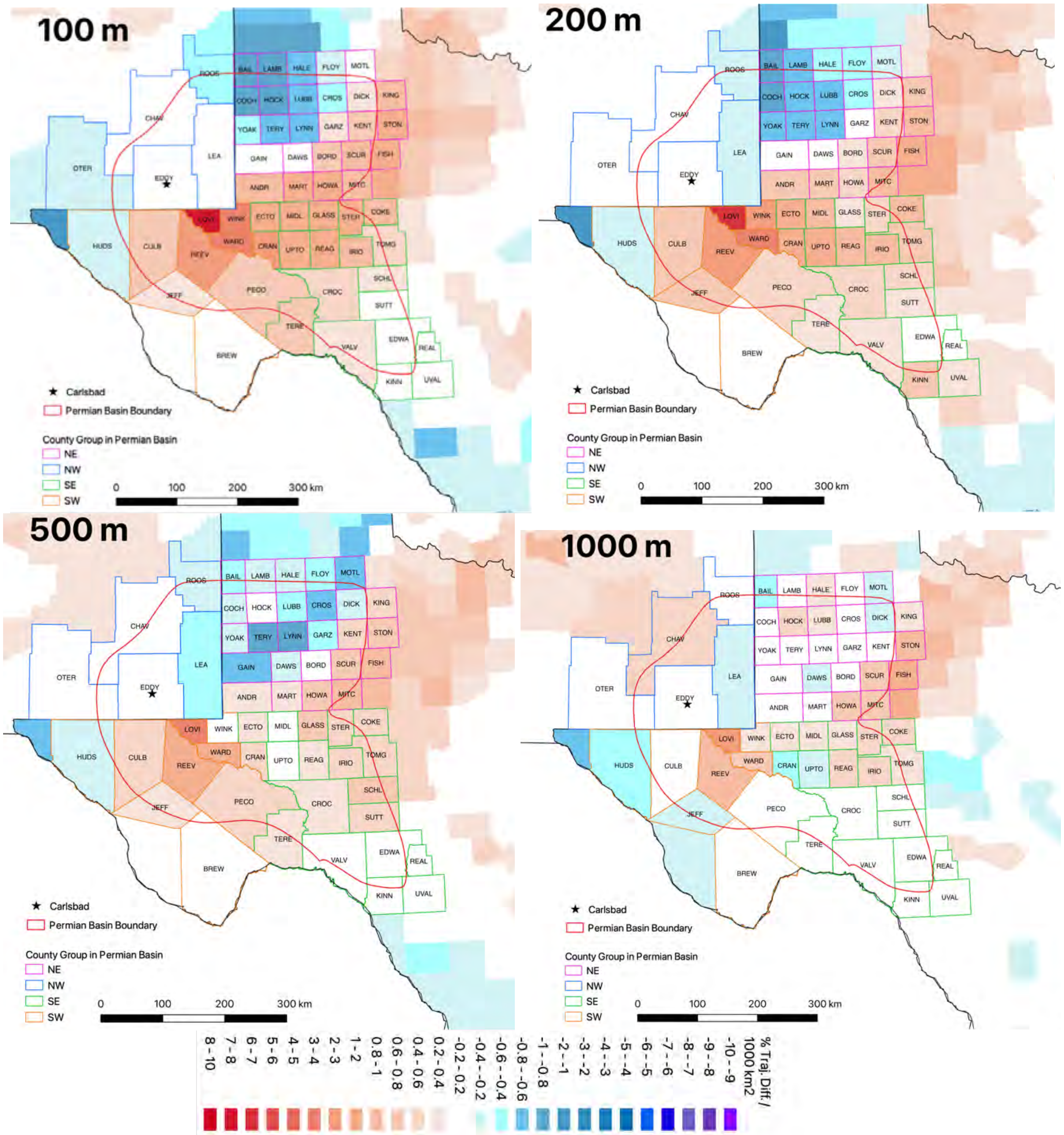

Figure 9. Differences in heatmap values between high (MDA8_O3 > 70 ppb) and low (MDA8_O3 < 46 ppb) ozone days for counties in Permian basin.

Task 2: Emissions Inventory Analyses

We obtained emissions inventory data from New Mexico Environmental Department (NMED) and from the Texas Commission on Environmental Quality (TCEQ) for oil and gas (O&G) production in New Mexico and Texas in 2020. We also obtained oil and gas emissions data in 2017, 2018 and 2019 from the EPA's National Emission Inventories (NEI). Note that unlike the typical triennial NEI such as NEI 2017 and NEI 2020 which are released every three years and incorporated emissions data developed by state, tribal and local agencies, EPA developed the NEI 2018 and NEI 2019 based on NEI 2017 with some updates to represent emissions in year 2018 and 2019[6].

Table S7 summaries data sources for O&G emissions in New Mexico and Texas in 2017 – 2020. In general, O&G emissions in the triennial NEI 2017 and NEI 2020 in Texas were developed by TCEQ, whereas in New Mexico emissions from point O&G sources were developed by NMED and emissions from non-point O&G were developed using EPA's O&G Tool.

Our O&G emissions analyses for New Mexico and Texas as presented in the following sections are based on the best emission data we obtained at this time. EPA and state/local agencies may revise their O&G emission inventories in future releases.

At the state level, emissions of NOx and VOC from O&G increase by 19% and 45%, respectively, in New Mexico and by -1% and 33%, respectively, in Texas in 2020 as compared to 2017 (Figure 10). Changes in VOC emissions are much stronger than changes in NOx emissions. There is also significant increase in SO_2 emission from O&G in 2020 in New Mexico due to updated emission factor which is a result of a recent oil and gas survey by states belong to Wester Regional Air Partnership (WRAP) with includes New Mexico but excludes Texas (EPA 2022, personal communication). This significant increase of SO_2 emission is applicable to source classification code (SCC) 2310010200 (O&G Exploration & Production / Crude Petroleum / Oil Well Tanks – Flashing & Standing / Working / Breathing) and 2310011001 (On Shore Crude Oil Production All Processes). (Note SO_2 emissions are not relevant to ozone pollution at Carlsbad).

Table S8 shows total emissions of NOx and VOC from O&G productions in counties within the PMB in inventory years 2017 and 2020. Figure 11 through Figure 14 compare total NOx and VOC emissions at county level from oil and gas productions between inventory years 2017 and 2020. Table 2 summarizes the emissions by four regions in the PMB.

As shown in Figure 11 and Figure 12, counties within the PMB have high amount of emissions from O&G. Figure S6 indicates that O&G emissions in these counties account for more than 90% of total anthropogenic emissions. There are also high O&G emissions in counties in the Western Gulf basin (southeast of PMB) and in counties in the San Juan basin (northwest of PMB), but they are far away from Carlsbad and the HYSPLIT trajectories suggest insignificant impact from these counties on Carlsbad (Figure 3).

[6] https://gaftp.epa.gov/Air/emismod/2019/2018_2019_platform_Eyth_seminar_01262022.pdf

Figure 13 shows that while decreases in O&G NOx emissions are observed at most counties in PMB, there are large increases in some counties especially in EDDY (196%), LEA (271%), CHAV (68%) and REEV (40%) in 2020 (Table 2). O&G VOC emissions increased in most counties in PMB with strongest increases observed in counties that have high ozone day heatmap values (Figure 4) including EDDY (108%), LEA (127%), CULB (99%), REEV (165%), WINK (193%), WARD (122%), PECO (120%) (Figure 14). In 2017 and over the entire Permian basin, REEV, MILD and LOVI (all in Texas) are the top three counties with O&G NOx emissions; REEV, MILD (Texas) and LEA (New Mexico) are the top three counties with O&G VOC emissions (Table S8). While O&G VOC emissions do not change appreciably in 2020 (REEV, LEA and LOVI are the top three), there are significant changes in O&G NOx emissions ranking where LEA and EDDY, followed by REEV (ranked 10th, 8^{th,} and 1st, respectively, in 2017) are the top three counties. In fact, LEA and EDDY observe the largest changes in O&G NOx emissions over the entire Permian basin.

Figure 15 and Figure 16 show locations of major and minor point sources in the PMB. Here the point sources are considered due to their potential long-range impacts on Carlsbad, and the point sources are not necessarily associated with O&G wells (whose emissions are typically represented as nonpoint sources in the NEI). Most point sources outside PMB boundary are at great distances from Carlsbad. Combined with HYSPLIT trajectory analyses, we expect impact of point sources outside PMB on Carlsbad to be insignificant except some major point sources at the southwest corner of OTER (Figure 15).

While we observed increase in ozone concentration at Carlsbad in 2020 and in 2021 compared 2017 (Figure 1) which corresponds with an associated increase in O&G emissions, to understand the causal pathways of specific emissions source regions/magnitudes that impact ozone at Carlsbad requires a full photochemical modeling analysis with source apportionment techniques (zero-out approach, or sensitivity approach like direct decoupled method (DDM) or source apportionment modeling like integrated source apportionment method (ISAM)). Earlier modeling study (Ramboll, 2021) suggests that ozone in Carlsbad region tends to be NOx-sensitive. Dix et al. (2020) shows that NO_2 atmospheric column over the PMB drastically increased in 2018 in comparison to earlier years (Figure S7), which implies rapid changes in the underlying emissions. Changes in emissions in counties with highest heatmap value certainly have the most implication on ozone at Carlsbad. To quantify impacts from O&G emissions in each of these counties requires a detailed source apportionment modeling study.

Additional ozone monitoring, especially in Texas counties of the Permian basin, would be beneficial in not only assessing the potential impacts of Permian on causing high ozone values in those counties, but also in determining the spatial extent of ozone nonattainment in the Permian basin. There are 1.1% of trajectories per 1000 square km (comparable to heatmap values of JEFF,VALV and CROC in Permian basin) passing through El Paso-Las Cruces ozone nonattainment area before reaching Carlsbad (Figure 6 and Figure 7). Since the Guadalupe site in Culberson (CULB) county of Texas shows increasing high ozone from 2019 – 2021 (See SI Table S2) concurrent with increasing trend in Carlsbad, it is possible that the ozone plume in the NM/TX border region around Carlsbad due to O&G emissions from PMB may span a larger area, and thus adversely affecting the public health of more people than currently known.

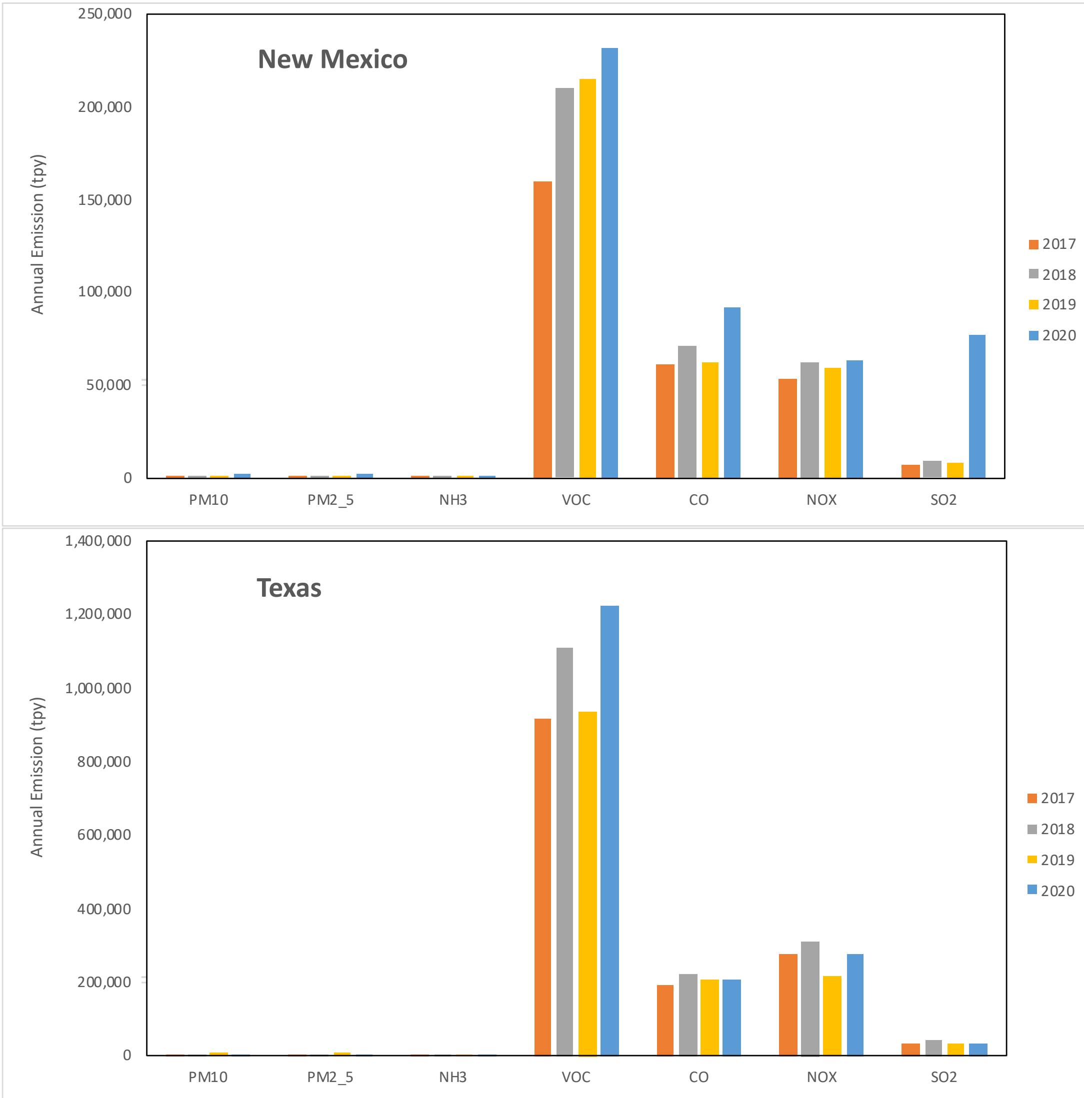

Figure 10. Annual emissions of criteria pollutants from total O&G production in New Mexico and Texas from 2017 – 2020.

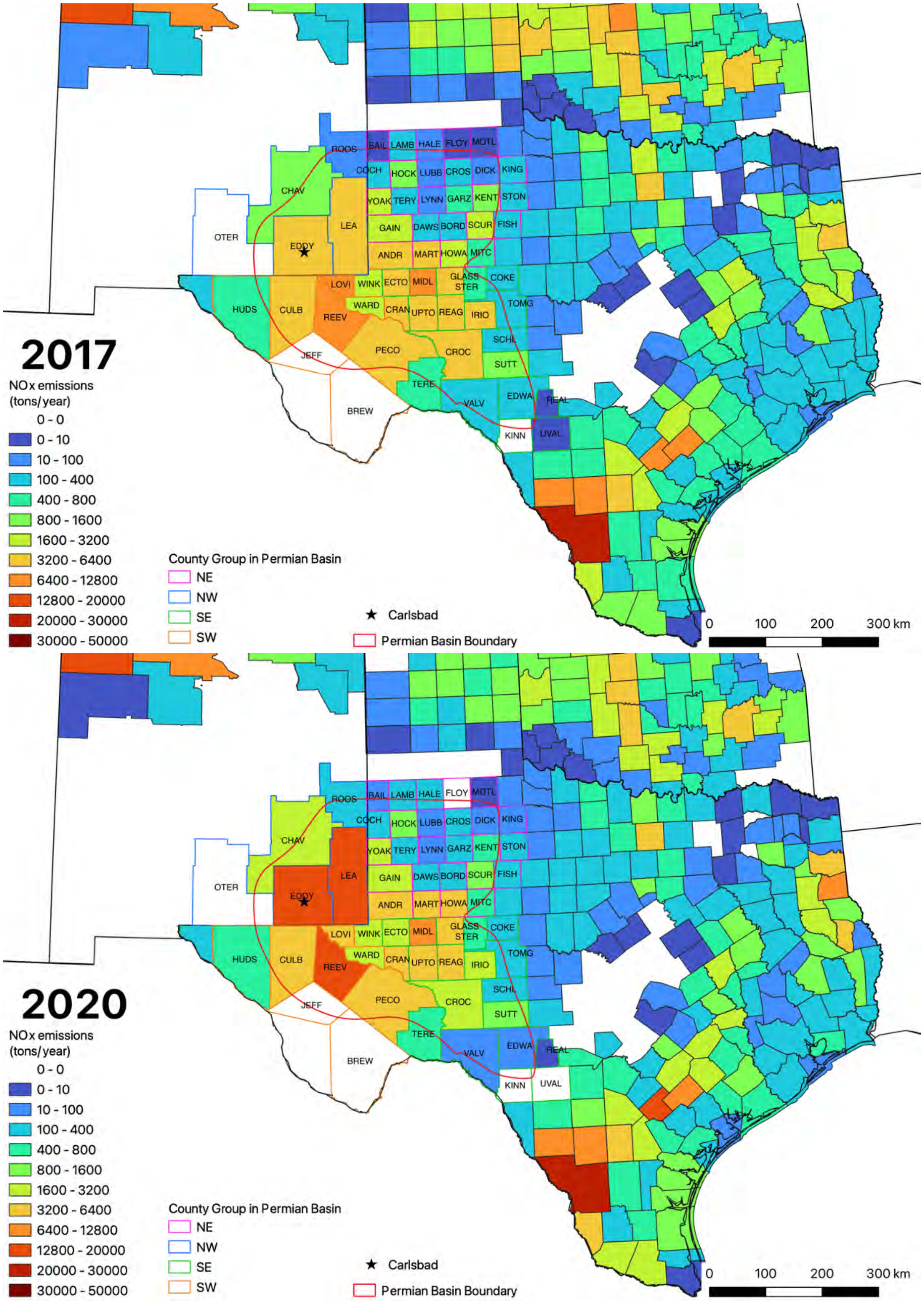

Figure 11. NOx emissions from O&G production in New Mexico and in 2017 and 2020 (Permian basin boundary shown).

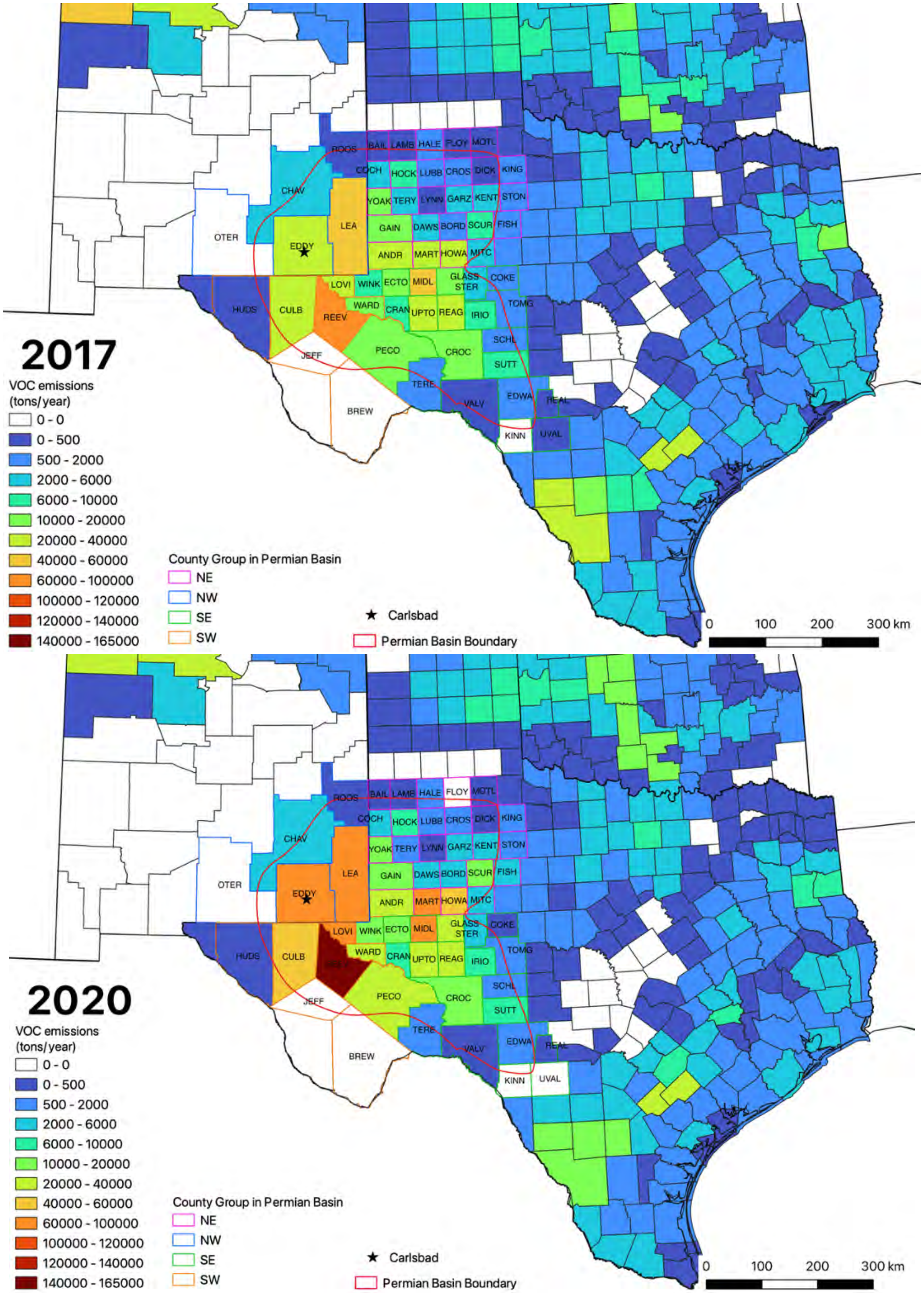

Figure 12. VOC emissions from O&G production in New Mexico and Texas in 2017 and 2020 (Permian basin boundary shown).

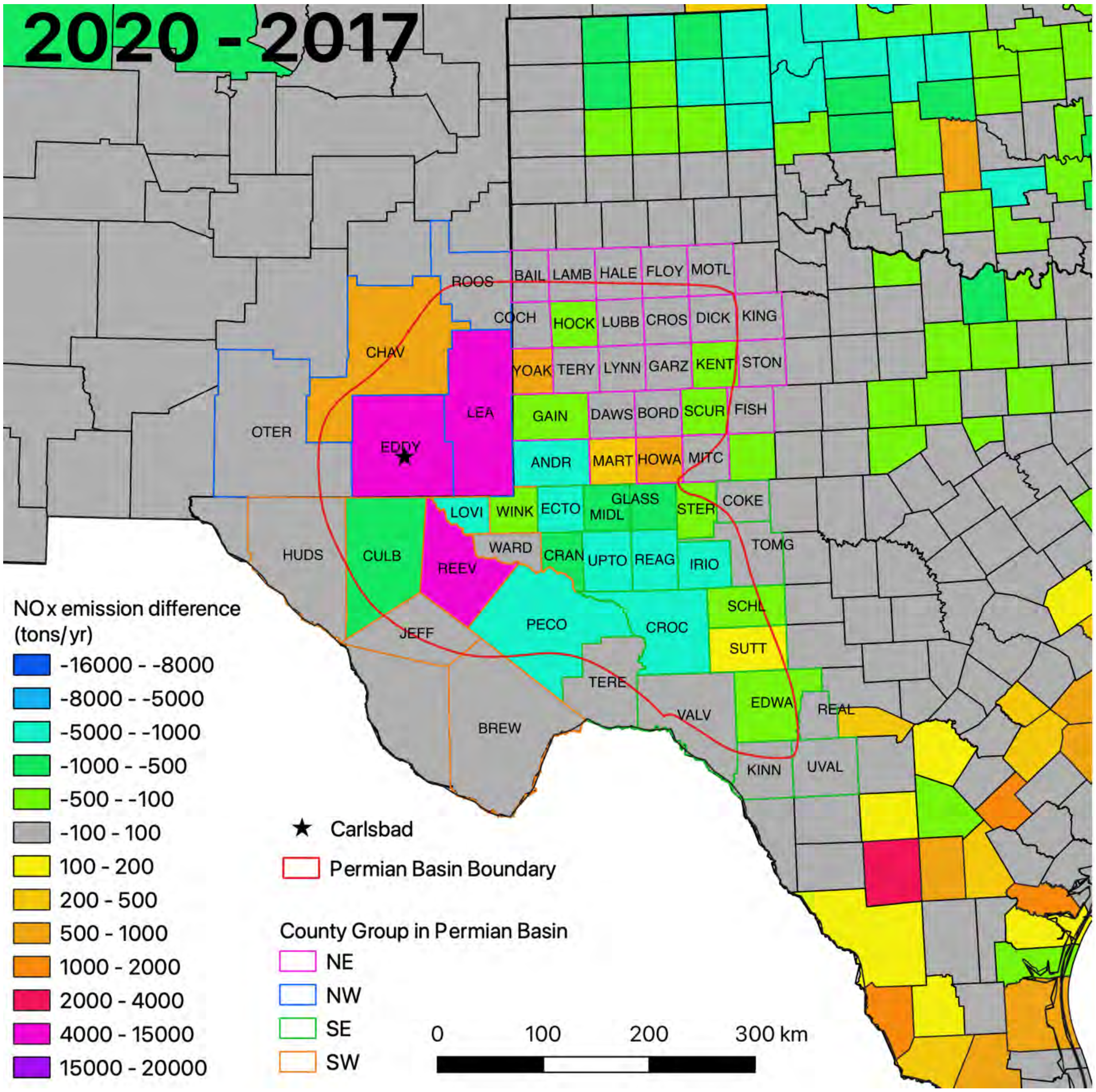

Figure 13. Changes in NOx emissions from O&G production in the Permian Basin in 2020 from 2017

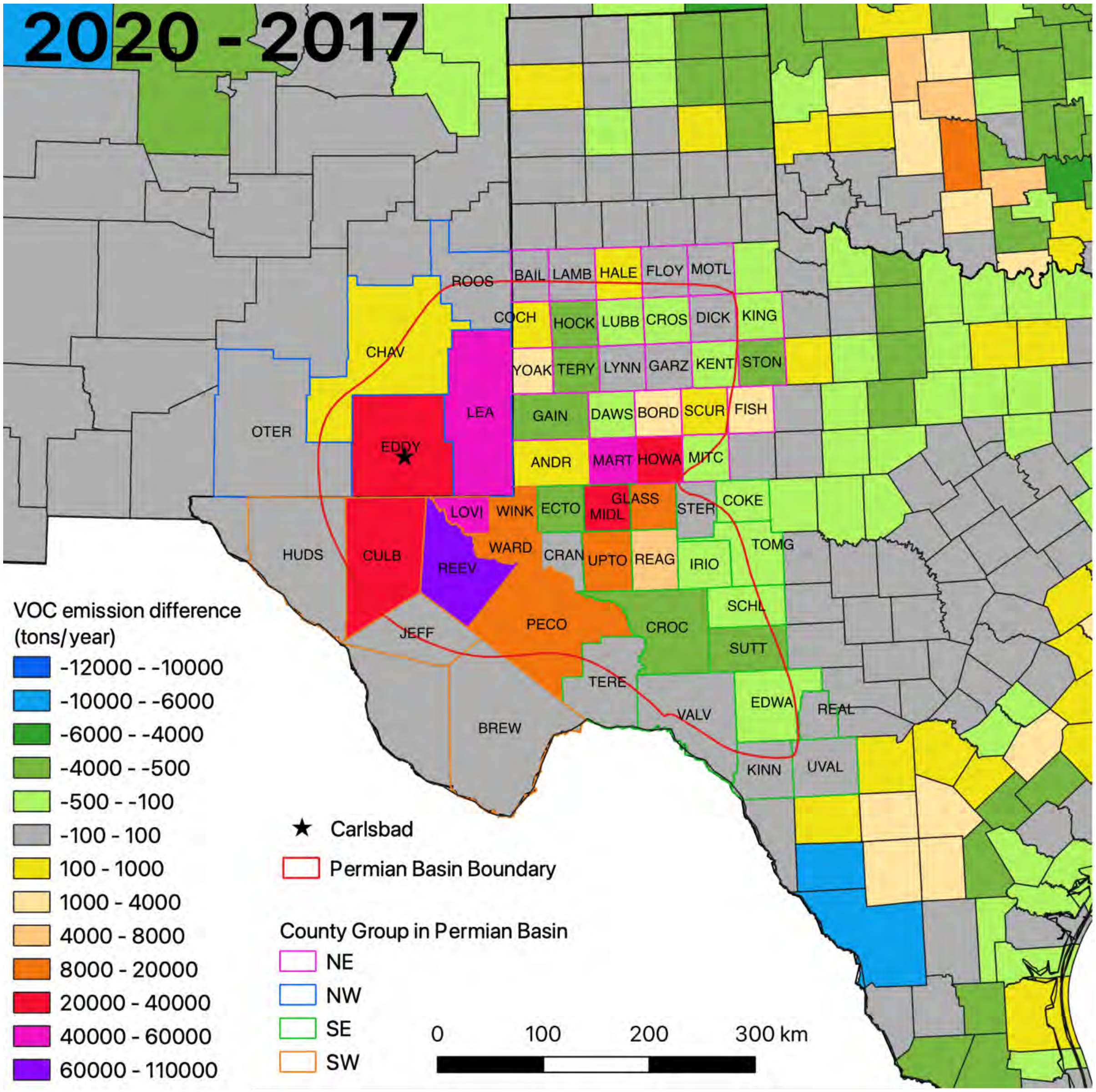

Figure 14. Changes in VOC emissions from O&G production in the Permian Basin in 2020 from 2017

Table 2. Total emissions (tons per year) of NOx and VOC from O&G productions in four regions of the PMB

Regions	**2017**				**2020**			
	NOx		**VOC**		**NOx**		**VOC**	
	(tons per year)	**Top 3 counties[1]**	**(tons per year)**	**Top 3 counties[1]**	**(tons per year) [2]**	**Top 3 counties[3]**	**(tons per year) [2]**	**Top 3 counties[3]**
NW	12,317	EDDY (4.8%) LEA (4.5%) CHAV (1.1%)	81,560	LEA (7.7%) EDDY (6.3%) CHAV (0.6%)	38,633 (214%)	LEA (15%)*(271%)* EDDY (13%)*(196%)* CHAV (2%)*(68%)*	174,054 (113%)	LEA (9.7%)(127%) EDDY (7.3%)(108%) CHAV (0.4%)(7%)
NE	23,901	ANDR (4.7%) MART (3.5%) HOWA (2.3%)	147,030	MART (5.2%) ANDR (4.6%) HOWA (3.7%)	22,151 (-7%)	MART (3%)(12%) HOWA (3%)(21%) ANDR (2%)(-42%)	216,246 (47%)	MART (7.1%)(142%) HOWA (4.8%)(133%) ANDR (2.6%)(1%)
SE	45,552	MILD (8.2%) REAG (5.3%) UPTO (4.8%)	177,693	MILD (9.4%) UPTO (5.0%) REAG (3.8%)	35,599 (-22 %)	MILD (7%)(-8%) REAG (4%)(-23%) UPTO (3%)(-26%)	227,860 (28%)	MILD (8.6%)(64%) UPTO (3.7%)(32%) REAG (2.6%)(21%)
SW	36,158	REEV (9.5%) LOVI (5.9%) PECO (4.9%)	153,290	REEV (11%) LOVI (6.5%) CULB (4.0%)	35,451 (-2%)	REEV (12%)(40%) LOVI (4%)(-22%) CULB (4%)(-14%)	377,723 (146%)	REEV (16.4%)(165%) LOVI (9.4%)(155%) CULB (4.5%)(99%)
Total	117,928		559,572		131,834 (12%)		995,884 (78%)	

[1] Numbers in parentheses are emissions in the respective county in relative to total emissions from all counties in PMB.

[2] Numbers in parentheses are changes in emissions in the respective region in 2020 relative to 2017.

[3] Numbers in 1st parenthesis are emissions in the respective county relative to total emissions from all counties in PMB; numbers in 2nd parenthesis are changes in emissions in the respective county in 2020 relative to 2017.

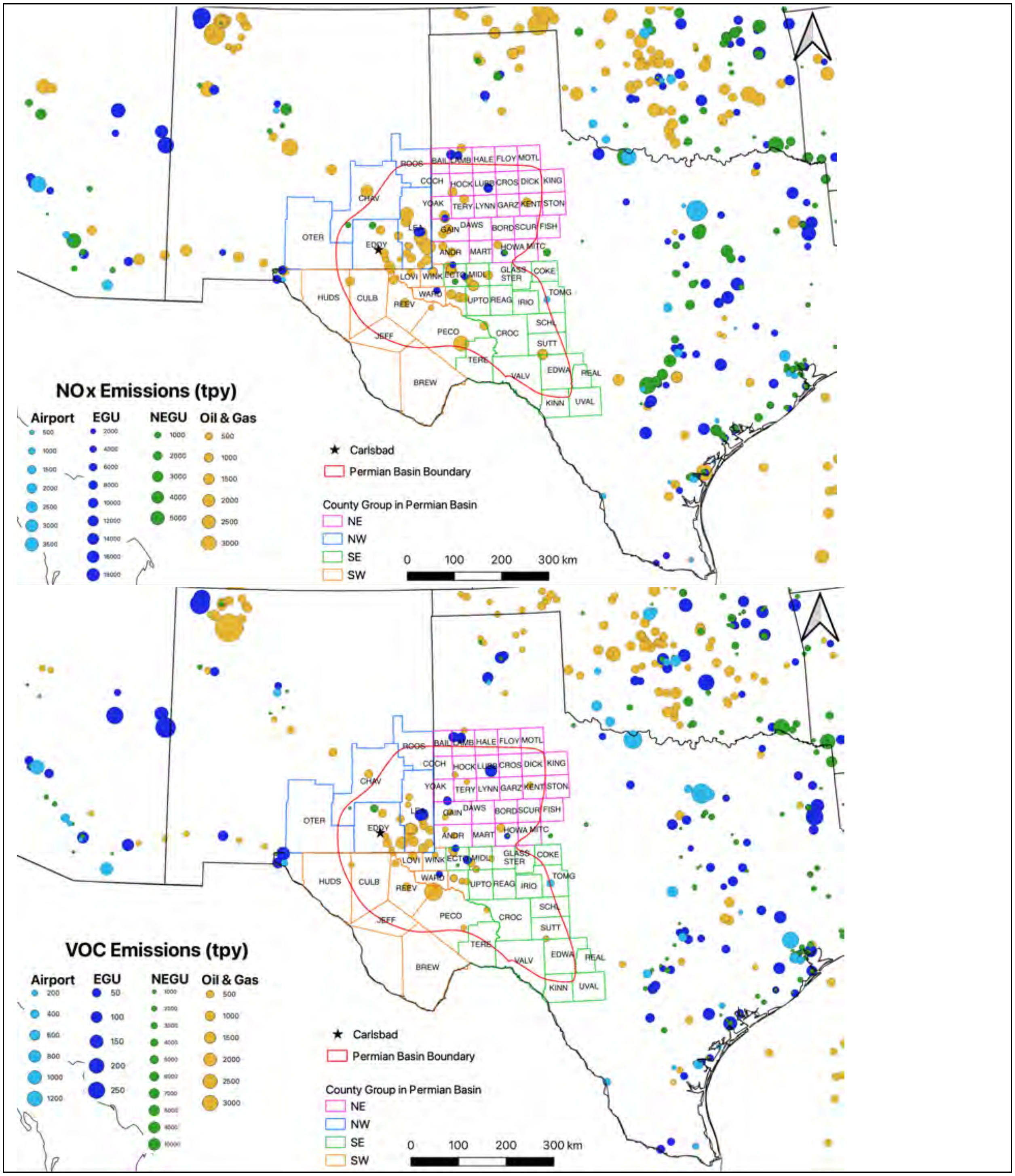

Figure 15. NOx and VOC Emissions from major point sources (> 100 tpy) in New Mexico and Texas in 2020. EGU indicates electric generating unit (e.g., power plant); NEGU indicates non-electric generating unit (e.g., boilers, heaters).

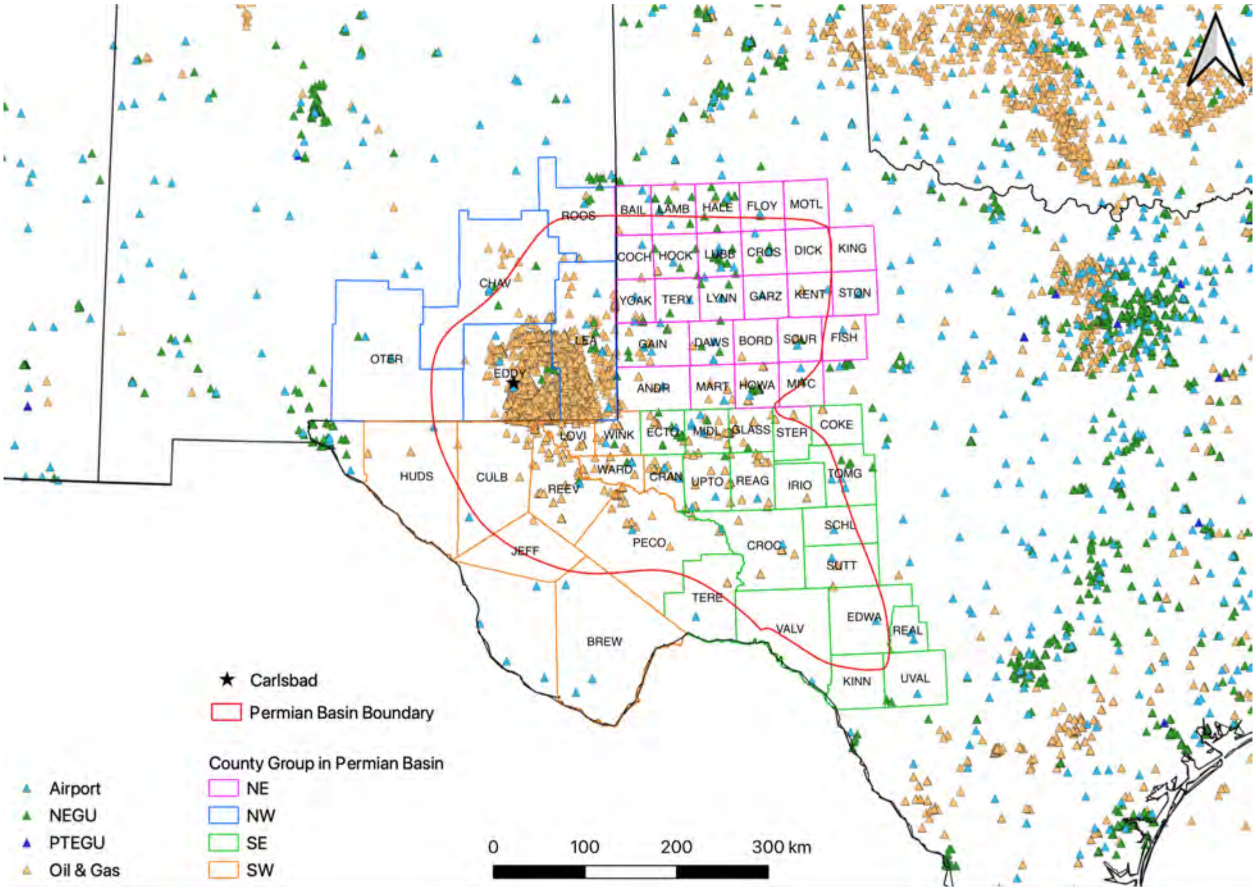

Figure 16. Locations of minor point sources (< 100 tpy in both NOx and VOC) in 2020.

Conclusions

Based on the HYSPLIT modeling of back trajectories and detailed analyses, we found the majority of airmass trajectories associated with high ozone days (MDA8 Ozone > 70 ppbV) passed through east and southeast regions of the Permian basin which are associated with high magnitudes of oil and gas emissions. Although trajectories passing through these regions were also associated with low ozone days, we find that high ozone days at Carlsbad are always associated with airmasses passing through counties in southeast and southwest regions of PMB. On the other hand, trajectories passing through west, southwest and northeast regions of the Permian basin are often associated with days having MDA8 Ozone < 43 ppbV.

There were significant increases in VOC emissions from Oil & Gas in 2020 in comparison to 2017 (45% for New Mexico, 33% for Texas, state-wide) and the increases in O&G VOC emissions are observed in majority of counties in the PBM. Changes in O&G NOx emissions are to a relatively lesser extent (19% in New Mexico and -1% in Texas, state-wide) but there are significant increases in some counties in PMB (e.g., EDDY, LEA, REEV) that are in the immediate vicinity of Carlsbad. These counties are often the ones that have high heatmap values (e.g., most trajectories passed through) associated with high ozone days. Therefore, changes in O&G emissions in these counties and in PMB in recent years have significant impacts on ozone at Carlsbad. Impacts of other (non-O&G) point and non-point sources outside the PMB on Carlsbad are expected to be marginal, based on their distance from Carlsbad, and the trajectory analyses presented here.

Determining boundary for potential Carlsbad ozone nonattainment area may be supported by additional analyses besides what have been performed in this study. Such additional analyses could include targeted analysis recommended by the EPA in its 5-factor approach (U.S. EPA, 2016) such as identifying the relationship between meteorological conditions (e.g., temperature, wind speed and wind direction, barometric pressure) and ozone level at Carlsbad; geography and topography analysis to understand mountain ranges or other physical features that may influence transport of emissions of ozone precursors to Carlsbad.

Further comprehensive photochemical modeling study with ozone source apportionment technique could be performed on PMB to quantify impact of O&G emissions from each county to Carlsbad ozone, and to understand if preferentially controlling NO_X vs. VOC would result in reduction of ozone levels at Carlsbad to improve air quality in the region. Though these analyses are not required for EPA to determine the non-attainment boundary, it could provide additional support for boundary determinations.

Understanding how O&G emission changes across specific O&G source categories (e.g., oil and condensate tanks, compressor stations, well drilling and completions, etc.) from 2017 to a recent year is critical for developing modeling scenarios for source apportionment analyses, as well as for developing emission control strategies in the future. We attempted to conduct such analyses with the 2020 emission data that we gathered from NMED, TCEQ and the EPA. We found the results, however, incomplete for interpretation due to mismatched source classification codes (SCC) NEI 2017 and interim 2020 for a direct comparison. We recommend that this analysis be performed when the NEI 2020 becomes officially available from the EPA.

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Exhibit B

Assessing Permian Basin's Contributions to Ozone Nonattainment at Carlsbad, New Mexico

Final Report

Supporting Information

List of Tables

List of Figures

Table S1. Previous applications of HYSPLIT model for regulatory purposes

State	Date	Trajectory Type	Height level (m)	Application	Reference
Exceptional Event Demonstration					
Louisiana	March 2018	24-hour back trajectories, each hour of the day of exceedances and the day prior	Not specified	Ozone exceptional event demonstration	https://www.epa.gov/sites/default/files/2018-08/documents/ldeq_ee_demonstration_final_w_appendices.pdf
California	September 2021	36-hour forward trajectory starting from fire locations	Not specified	Ozone exceptional event demonstration	https://ww2.arb.ca.gov/sites/default/files/2021-09/2018_Southern_California_EE_Full_Demo_3.pdf
		48-hour back trajectory	100, 500, 1000		
Ohio	November 2021	48-hour back trajectories	10, 500	Ozone exceptional event demonstration	https://epa.ohio.gov/static/Portals/27/sip/ozone/USEPA_EELtr_11-22-21.pdf
		120-hour forward trajectories	1000		
Michigan	March 2021	48-hour back trajectories	10, 500	Ozone exceptional event demonstration	https://www.michigan.gov/egle/-/media/Project/Websites/egle/Documents/Programs/AQD/State-Implementation-Plan/recent-aq-planning-actions-and-documents/ozone-exceptional-events-demo-west-mi-august-2020-episode.pdf
		120-hours forward trajectories	500, 1500, 2000		
Arizona	March 2019	36-hour forward and backward trajectories	Between 1,500 – 3,000	June 2015 ozone exceptional even demonstration	https://static.azdeq.gov/aqd/ee/2019addendum_2015wildfireEE.pdf
Illinois	December 2020	120-hour forward trajectories	1000, 1500, 2000	Ozone exceptional event demonstration	https://www2.illinois.gov/epa/topics/air-quality/planning-reporting/Documents/Chicago%202008%20NAA%20EE%20Demo%20Final%20Draft%20For%20Public%20Notice%2012-21-20.pdf https://www2.illinois.gov/epa/public-notices/Documents/General%20Notices/2021/Wildfire%20Exceptional%20Events%20Demonstration%20for%20Ground-Level%20Ozone%20in%20the%202008%20Ozone%20Nonattainment%20Area.pdf
		48-hour backward trajectories	10, 100, 500		
Non-Attainment Area Demonstration/Designation					
Colorado	February 2021	24-hour back trajectory, each of the 8 hours contributing to MDA8 O3 of the 4^{th} highest in each year in 2016-2019	100	Ozone nonattainment Area Boundary Assessment for Denver Metro/Northern Front Range	https://downloads.regulations.gov/EPA-HQ-OAR-2017-0548-0484/attachment_2.pdf
Washington	February 2018	12-hour back trajectory	10, 75, 300	Assessing contribution of emissions in Washington to PM2.5 air quality in other state	https://apps.ecology.wa.gov/publications/documents/1802004.pdf
Texas	July 2021	24-hour back trajectories, starting from a single hour of	100, 500	Ozone nonattainment assessment for El Paso County	https://www.tceq.texas.gov/downloads/air-quality/sip/ozone/designations/naaqs-2015/elp_2015ozonedesignation_120-day_response-to-epa_07262021.pdf

		daily maximum O3 on days when MDA8 O3 > 70 ppb			
Wisconsin	September 2017	72-hour back trajectory, starting at hours 1 ,3, 5, 7 of the MDA8 O3 > 65 ppb threshold	Unspecified	Sheboygan county, Wisconsin 2008 8-hour ozone nonattainment area	https://www.ladco.org/wp-content/uploads/Documents/Reports/TSDs/O3/LADCO_Ozone_TSD_FINA_Feb_3_2017.pdf
California	January 2018	24-hour back trajectories, starting from 18:00 local time on days of MDA8 O3 > 70 ppb	100, 500, 1000	Intended Area Designations for the 2015 Ozone NAAQS, multiple nonattainment areas as shown in Table 1 of this TSD	https://www.epa.gov/sites/default/files/2017-12/documents/ca_120d_tsd_combined_final.pdf
Pennsylvania	August 2016	24-hour back trajectories	Unspecified	O3 nonattainment designation (multiple area)	https://files.dep.state.pa.us/air/AirQuality/AQPortalFiles/Regulations%20and%20Clean%20Air%20Plans/attain/Ozonedes/2015_NAAQS_Ozone_Designation_Recommendations.pdf
Utah	May 2021	120-hour back trajectories, starting from last hour of the MDA8 O3	Assuming line source with particle distributed uniformly between 100 and 1000 m over receptor	Demonstration for Ozone nonattainment area for Utah's Northern Wasatch Front	https://documents.deq.utah.gov/air-quality/planning/air-quality-policy/DAQ-2021-005764.pdf
Illinois	October 2013	24-hours back trajectories	100	Recommended annual $PM_{2.5}$ nonattainment designations in Illinois	http://www.epa.state.il.us/public-notices/2013/pm25-nonattainment/Chi_annualPM25_Oct_23_2013.pdf
Maine	June 2018	48-hour back trajectories (HYSPLIT performed by the State), starting from every hour of the 8-hour ozone > 70 ppb	10	Ozone nonattainment area analyses	https://legacy-assets.eenews.net/open_files/assets/2018/06/28/document_gw_01.pdf
		24-hour back trajectories (HYSPLIT performed by EPA)	100, 500, 1000		
Virginia, Maryland, Washington DC	2018?	24-hour back trajectories, for each exceedance day (MDA8 O3 > 70 ppb) (unclear starting from what hour)	100, 500, 1000	Baltimore, MD and Washington, DC-MD-VA Ozone Nonattainment Areas	https://www.epa.gov/sites/default/files/2018-05/documents/wash-dc-va-md_and_baltimore_tsd_final.pdf

New Mexico	February 2021	72-hour back trajectories, starting at every hour of the MDA8 O3	100, 500, 1000	Ozone nonattainment demonstration for Paso del Norte Airshed	https://www.cccjac.org/uploads/9/1/9/2/91924192/jac_179b-_nmed__1_.pdf
South Carolina	March 2009	24-hour back trajectories, starting from 19:00 or 20:00 local time on days when MDA8 O3 > 75 ppb.	500	Ozone Nonattainment Boundary Recommendation	https://scdhec.gov/sites/default/files/docs/HomeAndEnvironment/Docs/Ozone%20Boundary%20Recommendations%203-12-09%20Final.pdf
Cross State Impact Analyses					
Arkansas	April 2022	72-hour back trajectories		Cross state impact analyses	https://www.adeq.state.ar.us/air/planning/sip/pdfs/2015/2015-O3-Transport-Disapproval_Comments_AR_Final_4-22-22.pdf
EPA	August 2016	96-hour back trajectories	250, 500, 750, 1000		https://www.epa.gov/sites/default/files/2017-05/documents/aq_modeling_tsd_final_csapr_update.pdf
EPA	March 2020	HYSPLIT is no longer discussed in this updated CSAPR rule			https://www.epa.gov/sites/default/files/2021-03/documents/air_quality_modeling_tsd_final_revised_csapr_update.pdf

*Table S2. Summary statistics of observed ozone in Permian basin region**

Site Code	Site Name	County	2017		2018		2019		2020		2021		2022	
			1st and 4th highest (ppb ; date)	95th/75th/ 50th percentile	1st and 4th highest (ppb ; date)	95th/75th/ 50th percentile	1st and 4th highest (ppb ; date)	95th/75th/ 50th percentile	1st and 4th highest (ppb ; date)	95th/75th/ 50th percentile	1st and 4th highest (ppb ; date)	95th/75th/ 50th percentile	1st and 4th highest (ppb ; date)	95th/75th/ 50th percentile
350151005	Carlsbad	Eddy	82 (06/22) 76 (08/03)	67/58/49	96 (06/05) 83 (08/03)	70/60/50	95 (06/08) 80 (07/25)	71/59/51	75 (06/24) 73 (08/19)	66/54/46	92 (08/04) 80 (07/21)	72/59/50	79 (05/16) 73 (04/30)	71/60/51
350150010	CAVE	Eddy	69 (07/05) 65 (08/31)	62/55/49	99 (06/04) 80 (07/25)	70/61/56	82 (07/25) 74 (08/05)	69/56/46	74 (08/18) 72 (09/03)	67/56/49	85 (08/04) 77 (07/21)	69/57/50	85 (07/08) 78 (07/01)	71/60/52
350250008	Hobbs	Lea	80 (09/13) 69 (09/12)	63/55/46	83 (06/04) 76 (08/01)	67/57/47	82 (06/07) 70 (06/05)	64/55/47	62 (09/25) 60 (09/20)	55/48/42	86 (07/24) 68 (08/04)	62/51/45	75 (06/29) 70 (05/26)	60/53/46
481090002	Guadalupe	Culberson					73 (07/27) 68 (08/06)	62/52/47	74 (07/31) 72 (08/23)	71/61/55	78 (08/04) 71 (08/03)	67/56/50		
480430101	Big Bend	Brewster	66 (06/05) 63 (04/21)	59/50/44	69 (04/21) 65 (05/19)	60/49/42	68 (07/26) 64 (05/20)	59/50/43	64 (06/13) 60 (05/07)	54/49/43	63 (07/20) 61 (07/21)	57/50/44	66 (05/20) 63 (07/06)	58/52/46
480290032	San Antonio	San Antonio	80 (06/08) 73 (08/04)	62/49/41	83 (08/02) 72 (07/26)	62/46/38	78 (06/13) 75 (07/26	59/49/42	71 (08/20) 69 (04/30)	63/50/41	76 (09/10) 70 (09/23)	63/48/41	79 (06/29) 65 (05/27)	59/51/45
480290052	Camp Bullis	San Antonio	89 (06/08) 72 (08/01)	64/50/43	83 (05/07) 73 (07/26)	64/48/41	76 (07/26) 69 (07/25	59/51/44	81 (04/30) 74 (10/07)	70/54/45	84 (09/10) 78 (09/23	70/53/44	75 (06/29) 67 (07/01)	64/54/47
480290059	Calaveras	San Antonio	69 (09/12) 65 (06/07)	59/49/41	79 (08/01) 71 (05/07)	62/45/38	64 (07/26) 63 (06/13)	57/49/42	73 (08/19) 66 (10/07)	59/49/42	68 (09/10) 66 (10/06)	60/48/40	78 (06/29) 61 (03/25)	54/46/41

** Values in red indicate MDA8_O3 above 70 ppb.*

Note: Guadalupe, operated by NPS was established in 2019, but no data available for 2022.

Table S3. Distribution of MDA8 Ozone at Carlsbad monitoring station during May - September

Percentile	2017	2018	2019	2020	2021	2022	allYears
10	43	48	47	46	45	48	46
20	48	52	51	48	50	51	50
25	50	53	53	49	52	53	51
50	56	60	59	55	60	60	58
75	63	65	65	60	67	67	65
80	64	67	68	62	68	69	66
85	65	69	70	64	70	71	68
90	67	71	72	67	73	71	71
95	70	75	76	69	77	73	75
99	76	93	88	75	81	78	82

Table S4. Distribution of MDA8 Ozone at CAVE monitoring station during May - September

Percentile	2017	2018	2019	2020	2021	2022	allYears
10	NA	NA	44	48	43	51	46
20			47	50	49	53	50
25			50	50	51	55	51
50			56	54	57	60	57
75			64	60	63	68	63
80			65	62	64	69	65
85			68	64	66	71	67
90			70	67	69	71	70
95			73	70	72	74	72
99			81	74	79	83	80

*Table S5. Normalized heatmap values (% of trajectory) by counties in the Permian Basin (PMB) during high (MDA8_O3 > 70 ppb) and low (MDA8_O3 < 46 ppb) ozone days**

County	State	Abbr.	PMB Region	Area (10^3 km^2)	Normalized heatmap value (%) on high ozone day				Normalized heatmap value (%) on low ozone day			
					100 m	200 m	500 m	1000 m	100 m	200 m	500 m	1000 m
Eddy	NM	EDDY	NW	21.6	100	100	100	100	100	100	100	100
Lea	NM	LEA	NW	22.7	30.7	26.9	24.1	26.4	33	34.4	33.7	31.4
Chaves	NM	CHAV	NW	31.4	11.8	15.1	18.7	24.8	15.7	14.1	12.9	11.9
Otero	NM	OTER	NW	34.3	10.5	16.2	24.4	27.8	19.5	19.8	22.4	25.4
Roosevelt	NM	ROOS	NW	12.7	4.7	5.8	4.9	5.5	10.9	10.2	8	6.7
Andrews	TX	ANDR	NE	7.8	13.8	13.5	10.2	9.7	7.1	7.8	8.4	8.3
Gaines	TX	GAIN	NE	7.8	11	10.8	6.9	9.3	9.9	11.8	11.9	9.6
Howard	TX	HOWA	NE	4.7	9.7	6	6.8	6.4	3.5	4.1	3.9	3.6
Martin	TX	MART	NE	4.7	9	8.2	7.2	5	3.8	4.5	5.7	5.1
Scurry	TX	SCUR	NE	4.7	8	6.3	7.2	5.7	3.6	3.1	3.6	2.5
Mitchell	TX	MITC	NE	4.7	7.7	6.8	7.9	6.1	3.5	2.3	3.8	2.5
Borden	TX	BORD	NE	4.6	7.5	6.6	4.4	4.9	4.5	5.2	4.4	4.4
Fisher	TX	FISH	NE	4.7	7.1	7.4	6.9	7.4	1.3	2.3	2.8	2
Stonewall	TX	STON	NE	4.7	7.1	6	5.5	6.3	2.2	1.9	2.5	1.6
Dawson	TX	DAWS	NE	4.7	6.6	7.5	5.2	4.4	6.4	7.4	6.7	6.1
King	TX	KING	NE	4.7	6.1	4.9	4.7	3.3	1.7	1.6	2.2	1.7
Kent	TX	KENT	NE	4.7	5.8	5.8	6	3.8	2.6	3.5	3.5	3.3
Garza	TX	GARZ	NE	4.6	5.5	5.3	2.5	3.9	4.2	5.8	4.9	4.8
Dickens	TX	DICK	NE	4.7	5.2	5.5	3	2.4	3.5	4.4	3.9	3.3
Yoakum	TX	YOAK	NE	4.1	5.2	4.7	4.4	5.2	7.4	7.3	5.8	4.9
Lynn	TX	LYNN	NE	4.6	4.4	4.2	3	4.4	7.3	7.6	7.1	5.2
Terry	TX	TERY	NE	4.6	4.2	4.1	3.6	6	7.3	7	7.6	5.4

County	State	Abbr.	PMB Region	Area (10^3 km^2)	Normalized heatmap value (%) on high ozone day				Normalized heatmap value (%) on low ozone day			
					100 m	200 m	500 m	1000 m	100 m	200 m	500 m	1000 m
Crosby	TX	CROS	NE	4.7	3.9	3.1	1.7	3.8	6	5.7	5.4	3.6
Floyd	TX	FLOY	NE	5.1	3.8	2	1.4	3.9	5.7	4.5	4.4	2.9
Motley	TX	MOTL	NE	5.1	3.8	3.8	2.2	2.2	4.8	5.5	5.4	3.3
Lubbock	TX	LUBB	NE	4.6	3.6	2.8	2.7	4.9	7	6.1	5.2	3.2
Cochran	TX	COCH	NE	4	3.1	2.8	3.5	4.4	6.8	6.5	4.5	4.5
Bailey	TX	BAIL	NE	4.3	2.5	2	2.5	3.9	6.1	6	4.5	5.7
Hockley	TX	HOCK	NE	4.7	2.5	2.4	3.3	4.2	6.4	6	4.1	2.3
Hale	TX	HALE	NE	5.2	2	2.2	1.7	3.8	5.2	5.1	3.8	2.6
Lamb	TX	LAMB	NE	5.3	1.4	2.2	2.2	3.6	5.7	6	4.1	3.5
Terrell	TX	TERE	SE	12.2	26.3	20.4	17.1	13.7	18.6	15.8	14.1	13.2
Val Verde	TX	VALV	SE	16.3	20.9	15.7	12.6	9.7	15.1	11.8	12.6	8.7
Crane	TX	CRAN	SE	4.1	19.8	15.6	12.9	9	10.2	9.9	11.2	10.9
Crockett	TX	CROC	SE	14.5	17.9	17.1	15.6	14	11.5	10.8	11.2	12.2
Upton	TX	UPTO	SE	6.4	16	14.6	11.3	8.8	7.1	8.1	10.9	10.3
Ector	TX	ECTO	SE	4.7	14.2	12.9	9.6	8.5	6.7	7	8.4	6.8
Midland	TX	MIDL	SE	4.7	13.4	11.2	6.9	6.3	6.1	6.5	6.4	5.2
Reagan	TX	REAG	SE	6.1	13.4	11.6	9.7	8.3	4.9	5.7	7.4	5.2
Glasscock	TX	GLASS	SE	4.7	11.6	7.7	7.4	6.1	4.8	6.3	4.1	4.9
Kinney	TX	KINN	SE	7	10.8	9.9	5.8	5.2	9.4	5.4	6.5	4.2
Sterling	TX	STER	SE	4.8	10.5	7.4	8	7.1	5.7	5.1	5.2	4.4
Tom Green	TX	TOMG	SE	7.9	9.4	10.8	10.1	8.3	5.2	5.4	6.8	6.4
Irion	TX	IRIO	SE	5.4	8.6	8.6	7.4	7.2	3.9	3.5	5.1	4.2
Coke	TX	COKE	SE	4.7	7.4	6.9	6.1	6.4	3.3	3.1	3.8	3.8
Edwards	TX	EDWA	SE	11	6.9	7.4	7.4	5.7	6.3	5.5	5.7	4.7

County	State	Abbr.	PMB Region	Area (10^3 km^2)	Normalized heatmap value (%) on high ozone day				Normalized heatmap value (%) on low ozone day			
					100 m	200 m	500 m	1000 m	100 m	200 m	500 m	1000 m
Uvalde	TX	UVAL	SE	8	6.8	6.8	4.7	3.9	5.4	4.2	3.9	3.9
Sutton	TX	SUTT	SE	7.5	5.7	6	7.5	3.9	4.4	4.1	3.5	3.6
Schleicher	TX	SCHL	SE	6.8	4.2	6.3	7.1	3.9	2.5	2.8	2.9	4.5
Real	TX	REAL	SE	3.6	2.4	2.4	2.4	2.5	2.8	3.1	2.2	2.5
Reeves	TX	REEV	SW	13.7	55.3	52.4	44.2	31.8	26.5	25	20.9	18.5
Loving	TX	LOVI	SW	3.5	52.7	47.2	32.7	25.6	26.6	25.6	21.8	18
Pecos	TX	PECO	SW	24.7	43.6	37.9	33	24.8	26.3	23.8	20.5	21.1
Ward	TX	WARD	SW	4.3	40.3	35.4	21.5	18.1	23	20.3	16.9	14.8
Culberson	TX	CULB	SW	19.7	35.7	39.2	39.9	33.5	23.8	25.3	30.4	34.6
Winkler	TX	WINK	SW	4.4	27.7	22.3	12.7	13.8	13.4	13.1	13.1	12.2
Brewster	TX	BREW	SW	32	16.5	15.9	14	8	10.8	11.9	13.2	12.2
Jeff Davis	TX	JEFF	SW	11.7	13.2	18.6	17.3	11.9	10.5	10.9	12.6	15.1
Hudspeth	TX	HUDS	SW	23.7	11.6	15.9	21.5	21.4	19.8	22.1	28.8	31.8

**Heatmap values in this table are grouped by 4 regions (NW, NE, SE, SW) and then sorted by heatmap value on high ozone day at 100 m in descending order for each region.*

*Table S6. Normalized heatmap values (% of trajectory per 1000 km²) by counties in the Permian Basin (PMB) during high (MDA8_O3 > 70 ppb) and low (MDA8_O3 < 46 ppb) ozone days**

County	State	Abbr.	PMB Region	Area (10^3 km²)	Normalized value on high ozone day				Normalized value on low ozone day			
					100 m	200 m	500 m	1000 m	100 m	200 m	500 m	1000 m
Eddy	NM	EDDY	NW	21.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6
Lea	NM	LEA	NW	22.7	1.3	1.2	1.1	1.2	1.5	1.5	1.5	1.4
Chaves	NM	CHAV	NW	31.4	0.4	0.5	0.6	0.8	0.5	0.4	0.4	0.4
Roosevelt	NM	ROOS	NW	12.7	0.4	0.5	0.4	0.4	0.9	0.8	0.6	0.5
Otero	NM	OTER	NW	34.3	0.3	0.5	0.7	0.8	0.6	0.6	0.7	0.7
Howard	TX	HOWA	NE	4.7	2.1	1.3	1.4	1.4	0.7	0.9	0.8	0.8
Martin	TX	MART	NE	4.7	1.9	1.7	1.5	1.1	0.8	1	1.2	1.1
Andrews	TX	ANDR	NE	7.8	1.8	1.7	1.3	1.3	0.9	1	1.1	1.1
Scurry	TX	SCUR	NE	4.7	1.7	1.3	1.5	1.2	0.8	0.7	0.8	0.5
Mitchell	TX	MITC	NE	4.7	1.6	1.4	1.7	1.3	0.7	0.5	0.8	0.5
Borden	TX	BORD	NE	4.6	1.6	1.4	0.9	1	1	1.1	0.9	0.9
Fisher	TX	FISH	NE	4.7	1.5	1.6	1.5	1.6	0.3	0.5	0.6	0.4
Stonewall	TX	STON	NE	4.7	1.5	1.3	1.2	1.3	0.5	0.4	0.5	0.3
Gaines	TX	GAIN	NE	7.8	1.4	1.4	0.9	1.2	1.3	1.5	1.5	1.2
Dawson	TX	DAWS	NE	4.7	1.4	1.6	1.1	0.9	1.4	1.6	1.4	1.3
King	TX	KING	NE	4.7	1.3	1	1	0.7	0.4	0.3	0.5	0.4
Yoakum	TX	YOAK	NE	4.1	1.3	1.1	1.1	1.3	1.8	1.8	1.4	1.2
Kent	TX	KENT	NE	4.7	1.2	1.2	1.3	0.8	0.6	0.7	0.7	0.7
Garza	TX	GARZ	NE	4.6	1.2	1.2	0.5	0.8	0.9	1.3	1.1	1
Dickens	TX	DICK	NE	4.7	1.1	1.2	0.6	0.5	0.7	0.9	0.8	0.7
Lynn	TX	LYNN	NE	4.6	1	0.9	0.6	1	1.6	1.6	1.5	1.1
Terry	TX	TERY	NE	4.6	0.9	0.9	0.8	1.3	1.6	1.5	1.6	1.2
Crosby	TX	CROS	NE	4.7	0.8	0.7	0.4	0.8	1.3	1.2	1.2	0.8

County	State	Abbr.	PMB Region	Area (10^3 km^2)	Normalized value on high ozone day				Normalized value on low ozone day			
					100 m	200 m	500 m	1000 m	100 m	200 m	500 m	1000 m
Lubbock	TX	LUBB	NE	4.6	0.8	0.6	0.6	1.1	1.5	1.3	1.1	0.7
Cochran	TX	COCH	NE	4	0.8	0.7	0.9	1.1	1.7	1.6	1.1	1.1
Floyd	TX	FLOY	NE	5.1	0.7	0.4	0.3	0.8	1.1	0.9	0.8	0.6
Motley	TX	MOTL	NE	5.1	0.7	0.7	0.4	0.4	0.9	1.1	1	0.7
Bailey	TX	BAIL	NE	4.3	0.6	0.5	0.6	0.9	1.4	1.4	1.1	1.3
Hockley	TX	HOCK	NE	4.7	0.5	0.5	0.7	0.9	1.4	1.3	0.9	0.5
Hale	TX	HALE	NE	5.2	0.4	0.4	0.3	0.7	1	1	0.7	0.5
Lamb	TX	LAMB	NE	5.3	0.3	0.4	0.4	0.7	1.1	1.1	0.8	0.7
Crane	TX	CRAN	SE	4.1	4.9	3.8	3.2	2.2	2.5	2.4	2.8	2.7
Ector	TX	ECTO	SE	4.7	3	2.8	2.1	1.8	1.4	1.5	1.8	1.5
Midland	TX	MIDL	SE	4.7	2.9	2.4	1.5	1.3	1.3	1.4	1.4	1.1
Upton	TX	UPTO	SE	6.4	2.5	2.3	1.8	1.4	1.1	1.3	1.7	1.6
Glasscock	TX	GLASS	SE	4.7	2.5	1.7	1.6	1.3	1	1.3	0.9	1.1
Reagan	TX	REAG	SE	6.1	2.2	1.9	1.6	1.4	0.8	0.9	1.2	0.9
Sterling	TX	STER	SE	4.8	2.2	1.5	1.7	1.5	1.2	1.1	1.1	0.9
Terrell	TX	TERE	SE	12.2	2.1	1.7	1.4	1.1	1.5	1.3	1.2	1.1
Irion	TX	IRIO	SE	5.4	1.6	1.6	1.4	1.3	0.7	0.6	0.9	0.8
Coke	TX	COKE	SE	4.7	1.6	1.5	1.3	1.4	0.7	0.6	0.8	0.8
Kinney	TX	KINN	SE	7	1.5	1.4	0.8	0.7	1.3	0.8	0.9	0.6
Val Verde	TX	VALV	SE	16.3	1.3	1	0.8	0.6	0.9	0.7	0.8	0.5
Crockett	TX	CROC	SE	14.5	1.2	1.2	1.1	1	0.8	0.7	0.8	0.8
Tom Green	TX	TOMG	SE	7.9	1.2	1.4	1.3	1.1	0.7	0.7	0.9	0.8
Uvalde	TX	UVAL	SE	8	0.8	0.8	0.6	0.5	0.7	0.5	0.5	0.5
Sutton	TX	SUTT	SE	7.5	0.8	0.8	1	0.5	0.6	0.5	0.5	0.5
Real	TX	REAL	SE	3.6	0.7	0.7	0.7	0.7	0.8	0.8	0.6	0.7

County	State	Abbr.	PMB Region	Area (10^3 km^2)	Normalized value on high ozone day				Normalized value on low ozone day			
					100 m	200 m	500 m	1000 m	100 m	200 m	500 m	1000 m
Edwards	TX	EDWA	SE	11	0.6	0.7	0.7	0.5	0.6	0.5	0.5	0.4
Schleicher	TX	SCHL	SE	6.8	0.6	0.9	1	0.6	0.4	0.4	0.4	0.7
Loving	TX	LOVI	SW	3.5	15.2	13.6	9.4	7.4	7.7	7.4	6.3	5.2
Ward	TX	WARD	SW	4.3	9.3	8.2	5	4.2	5.3	4.7	3.9	3.4
Winkler	TX	WINK	SW	4.4	6.4	5.1	2.9	3.2	3.1	3	3	2.8
Reeves	TX	REEV	SW	13.7	4.1	3.8	3.2	2.3	1.9	1.8	1.5	1.4
Pecos	TX	PECO	SW	24.7	1.8	1.5	1.3	1	1.1	1	0.8	0.9
Culberson	TX	CULB	SW	19.7	1.8	2	2	1.7	1.2	1.3	1.5	1.8
Jeff Davis	TX	JEFF	SW	11.7	1.1	1.6	1.5	1	0.9	0.9	1.1	1.3
Brewster	TX	BREW	SW	32	0.5	0.5	0.4	0.3	0.3	0.4	0.4	0.4
Hudspeth	TX	HUDS	SW	23.7	0.5	0.7	0.9	0.9	0.8	0.9	1.2	1.3

**Heatmap values in this table are grouped by 4 regions (NW, NE, SE, SW) and then sorted by heatmap value on high ozone day at 100 m in descending order for each region.*

Table S7. Data sources of Oil & Gas emissions inventories in New Mexico and Texas

NEI version	**New Mexico**		**Texas**	
	Non-point O&G	**Point O&G**	**Non-point O&G**	**Point O&G**
NEI 2017	EPA Oil & Gas Tool**	Including ~ 140 major sources (Title V) and estimated by NMED*	Estimated by TCEQ**	Estimated by TCEQ**
NEI 2018	Projected from NEI 2017 by EPA with representative data for 2018**			
NEI 2019	Projected from NEI 2017 by EPA with representative data for 2019**			
NEI 2020	EPA Oil & Gas Tool	Including ~ 5000 major sources (Title V) and estimated by NMED*	Estimated by TCEQ*	Estimated by TCEQ**

** Data retrieved from NMED and TCEQ through personal communications*

*** Data retrieved from EPA*

Table S8. Total emissions (tons per year) of NOx and VOC from O&G production in counties within the Permian basin in 2017 and 2020.

County[1]	State	Abbr.	PMB Region	2017				2020			
				NOx[4]	NOx Rank[2,5]	VOC[4]	VOC Rank[2,5]	NO_X[3, 4]	NO_X Rank[2,5]	VOC[3, 4]	VOC Rank[2,5]
Eddy	NM	EDDY	NW	5,607	8 (4.8 %)	35,160	5 (6.3 %)	16,589 (196 %)	2 (12.6 %)	73,072 (108 %)	5 (7.3 %)
Lea	NM	LEA	NW	5,305	10 (4.5 %)	42,810	3 (7.7 %)	19,682 (271 %)	1 (14.9 %)	97,077 (127 %)	2 (9.7 %)
Chaves	NM	CHAV	NW	1,329	23 (1.1 %)	3,322	25 (0.6 %)	2,235 (68 %)	20 (1.7 %)	3,568 (7 %)	25 (0.4 %)
Roosevelt	NM	ROOS	NW	76	48 (0.1 %)	269	47 (0 %)	128 (68 %)	43 (0.1 %)	337 (25 %)	45 (0 %)
Otero	NM	OTER	NW	0	56 (0 %)	0	56 (0 %)	0	54 (0 %)	0	54 (0 %)
Andrews	TX	ANDR	NE	5,562	9 (4.7 %)	25,562	8 (4.6 %)	3,235 (-42 %)	14 (2.5 %)	25,883 (1 %)	12 (2.6 %)
Martin	TX	MART	NE	4,118	14 (3.5 %)	29,136	6 (5.2 %)	4,591 (11 %)	8 (3.5 %)	70,499 (142 %)	6 (7.1 %)
Howard	TX	HOWA	NE	2,755	18 (2.3 %)	20,684	11 (3.7 %)	3,343 (21 %)	13 (2.5 %)	48,116 (133 %)	7 (4.8 %)
Gaines	TX	GAIN	NE	2,206	20 (1.9 %)	14,297	15 (2.6 %)	1,910 (-13 %)	22 (1.4 %)	13,420 (-6 %)	18 (1.3 %)
Yoakum	TX	YOAK	NE	2,010	21 (1.7 %)	14,162	16 (2.5 %)	2,688 (34 %)	16 (2 %)	16,286 (15 %)	16 (1.6 %)
Scurry	TX	SCUR	NE	1,678	22 (1.4 %)	9,756	19 (1.7 %)	1,233 (-27 %)	24 (0.9 %)	10,352 (6 %)	20 (1 %)
Hockley	TX	HOCK	NE	1,281	24 (1.1 %)	9,068	20 (1.6 %)	1,142 (-11 %)	25 (0.9 %)	7,531 (-17 %)	22 (0.8 %)
Kent	TX	KENT	NE	825	26 (0.7 %)	2,390	30 (0.4 %)	553 (-33 %)	27 (0.4 %)	2,047 (-14 %)	33 (0.2 %)
Mitchell	TX	MITC	NE	527	30 (0.4 %)	2,865	26 (0.5 %)	484 (-8 %)	29 (0.4 %)	2,393 (-16 %)	28 (0.2 %)
Garza	TX	GARZ	NE	406	31 (0.3 %)	2,309	31 (0.4 %)	400 (-1 %)	31 (0.3 %)	2,226 (-4 %)	30 (0.2 %)
Cochran	TX	COCH	NE	395	32 (0.3 %)	2,477	28 (0.4 %)	386 (-2 %)	33 (0.3 %)	2,914 (18 %)	27 (0.3 %)
Dawson	TX	DAWS	NE	334	33 (0.3 %)	2,606	27 (0.5 %)	393 (18 %)	32 (0.3 %)	2,347 (-10 %)	29 (0.2 %)
Borden	TX	BORD	NE	298	34 (0.3 %)	1,887	33 (0.3 %)	281 (-6 %)	36 (0.2 %)	3,240 (72 %)	26 (0.3 %)
Terry	TX	TERY	NE	290	36 (0.2 %)	2,396	29 (0.4 %)	288 (-1 %)	35 (0.2 %)	1,710 (-29 %)	34 (0.2 %)
Lamb	TX	LAMB	NE	271	37 (0.2 %)	230	49 (0 %)	290 (7 %)	34 (0.2 %)	241 (5 %)	48 (0 %)
Fisher	TX	FISH	NE	218	38 (0.2 %)	881	40 (0.2 %)	262 (20 %)	37 (0.2 %)	2,164 (146 %)	31 (0.2 %)
Stonewall	TX	STON	NE	212	39 (0.2 %)	1,509	35 (0.3 %)	131 (-38 %)	40 (0.1 %)	949 (-37 %)	37 (0.1 %)
Crosby	TX	CROS	NE	146	43 (0.1 %)	1,137	37 (0.2 %)	112 (-23 %)	44 (0.1 %)	756 (-34 %)	40 (0.1 %)
King	TX	KING	NE	111	45 (0.1 %)	1,266	36 (0.2 %)	83 (-25 %)	45 (0.1 %)	903 (-29 %)	39 (0.1 %)

County[1]	State	Abbr.	PMB Region	2017				2020			
				NOx[4]	NOx Rank[2,5]	VOC[4]	VOC Rank[2,5]	NO_X[3, 4]	NO_X Rank[2,5]	VOC[3, 4]	VOC Rank[2,5]
Hale	TX	HALE	NE	99	46 (0.1 %)	1,007	38 (0.2 %)	161 (63 %)	38 (0.1 %)	1,118 (11 %)	36 (0.1 %)
Lubbock	TX	LUBB	NE	87	47 (0.1 %)	797	41 (0.1 %)	77 (-11 %)	46 (0.1 %)	638 (-20 %)	41 (0.1 %)
Dickens	TX	DICK	NE	41	49 (0 %)	321	46 (0.1 %)	37 (-10 %)	48 (0 %)	259 (-19 %)	47 (0 %)
Lynn	TX	LYNN	NE	24	50 (0 %)	244	48 (0 %)	20 (-17 %)	51 (0 %)	193 (-21 %)	49 (0 %)
Motley	TX	MOTL	NE	6	51 (0 %)	42	50 (0 %)	5 (-17 %)	52 (0 %)	53 (26 %)	50 (0 %)
Floyd	TX	FLOY	NE	0	54 (0 %)	0	55 (0 %)	0	54 (0 %)	0	54 (0 %)
Bailey	TX	BAIL	NE	0	53 (0 %)	1	54 (0 %)	45 (> 100%)	47 (0 %)	7 (600 %)	52 (0 %)
Midland	TX	MIDL	SE	9,710	2 (8.2 %)	52,445	2 (9.4 %)	8,943 (-8 %)	4 (6.8 %)	86,016 (64 %)	4 (8.6 %)
Reagan	TX	REAG	SE	6,285	4 (5.3 %)	21,243	10 (3.8 %)	4,852 (-23 %)	7 (3.7 %)	25,785 (21 %)	13 (2.6 %)
Upton	TX	UPTO	SE	5,698	7 (4.8 %)	28,083	7 (5 %)	4,238 (-26 %)	9 (3.2 %)	37,114 (32 %)	9 (3.7 %)
Ector	TX	ECTO	SE	4,398	11 (3.7 %)	16,586	13 (3 %)	2,894 (-34 %)	15 (2.2 %)	14,009 (-16 %)	17 (1.4 %)
Crane	TX	CRAN	SE	4,283	12 (3.6 %)	7,538	22 (1.3 %)	3,560 (-17 %)	11 (2.7 %)	7544 (0 %)	21 (0.8 %)
Glasscock	TX	GLASS	SE	4,235	13 (3.6 %)	16,705	12 (3 %)	3,654 (-14 %)	10 (2.8 %)	24,953 (49 %)	14 (2.5 %)
Crockett	TX	CROC	SE	4,015	15 (3.4 %)	13,721	17 (2.5 %)	2,273 (-43 %)	19 (1.7 %)	12,592 (-8 %)	19 (1.3 %)
Irion	TX	IRIO	SE	3,416	16 (2.9 %)	6,444	23 (1.2 %)	2,008 (-41 %)	21 (1.5 %)	6,266 (-3 %)	24 (0.6 %)
Sutton	TX	SUTT	SE	1,226	25 (1 %)	7,812	21 (1.4 %)	1,415 (15 %)	23 (1.1 %)	7,278 (-7 %)	23 (0.7 %)
Terrell	TX	TERE	SE	676	27 (0.6 %)	933	39 (0.2 %)	747 (11 %)	26 (0.6 %)	931 (0 %)	38 (0.1 %)
Sterling	TX	STER	SE	631	28 (0.5 %)	2,158	32 (0.4 %)	531 (-16 %)	28 (0.4 %)	2,100 (-3 %)	32 (0.2 %)
Schleicher	TX	SCHL	SE	295	35 (0.3 %)	1,553	34 (0.3 %)	131 (-56 %)	40 (0.1 %)	1,314 (-15 %)	35 (0.1 %)
Coke	TX	COKE	SE	210	40 (0.2 %)	695	43 (0.1 %)	157 (-25 %)	39 (0.1 %)	491 (-29 %)	44 (0 %)
Tom Green	TX	TOMG	SE	180	41 (0.2 %)	674	44 (0.1 %)	128 (-29 %)	42 (0.1 %)	524 (-22 %)	43 (0.1 %)
Edwards	TX	EDWA	SE	159	42 (0.1 %)	751	42 (0.1 %)	32 (-80 %)	50 (0 %)	620 (-17 %)	42 (0.1 %)
Val Verde	TX	VALV	SE	133	44 (0.1 %)	342	45 (0.1 %)	37 (-72 %)	49 (0 %)	321 (-6 %)	46 (0 %)
Real	TX	REAL	SE	2	52 (0 %)	8	52 (0 %)	0 (-100 %)	53 (0 %)	5 (-38 %)	53 (0 %)
Kinney	TX	KINN	SE	0	56 (0 %)	0	56 (0 %)	0	54 (0 %)	0	54 (0 %)

County[1]	State	Abbr.	PMB Region	2017				2020			
				NOx[4]	NOx Rank[2,5]	VOC[4]	VOC Rank[2,5]	NO_X[3, 4]	NO_X Rank[2,5]	VOC[3, 4]	VOC Rank[2,5]
Uvalde	TX	UVAL	SE	0	55 (0 %)	1	53 (0 %)	0	54 (0 %)	0 (-100 %)	54 (0 %)
Reeves	TX	REEV	SW	11,228	1 (9.5 %)	61,624	1 (11 %)	15,773 (40 %)	3 (12 %)	163,020 (165 %)	1 (16.4 %)
Loving	TX	LOVI	SW	6,994	3 (5.9 %)	36,565	4 (6.5 %)	5,452 (-22 %)	5 (4.1 %)	93,147 (155 %)	3 (9.4 %)
Pecos	TX	PECO	SW	5,837	5 (4.9 %)	11,840	18 (2.1 %)	3,522 (-40 %)	12 (2.7 %)	26,057 (120 %)	11 (2.6 %)
Culberson	TX	CULB	SW	5,759	6 (4.9 %)	22,376	9 (4 %)	4,936 (-14 %)	6 (3.7 %)	44,593 (99 %)	8 (4.5 %)
Winkler	TX	WINK	SW	3,135	17 (2.7 %)	6,340	24 (1.1 %)	2,678 (-15 %)	17 (2 %)	18,604 (193 %)	15 (1.9 %)
Ward	TX	WARD	SW	2,659	19 (2.3 %)	14,536	14 (2.6 %)	2,635 (-1 %)	18 (2 %)	32,291 (122 %)	10 (3.2 %)
Hudspeth	TX	HUDS	SW	545	29 (0.5 %)	10	51 (0 %)	455 (-17 %)	30 (0.3 %)	12 (20 %)	51 (0 %)
Brewster	TX	BREW	SW	0	56 (0 %)	0	56 (0 %)	0	54 (0 %)	0	54 (0 %)
Jeff Davis	TX	JEFF	SW	0	56 (0 %)	0	56 (0 %)	0	54 (0 %)	0	54 (0 %)

[1] *Counties in this table are in highest-to-lowest order of their O&G NOx in 2017 and in their respective Permian region.*

[2] *NOx and VOC emissions are ranked with respect to all counties in the Permian basin.*

[3] *Values in parenthesis indicate changes in O&G NOx and VOC emissions (%) in 2020 from 2017.*

[4] *Values in blue and red indicate top 5 counties in NOx and VOC emissions, respectively, in the Permian basin.*

[5] *Numbers in parentheses indicate percentage of O&G emission over entire Permian basin*

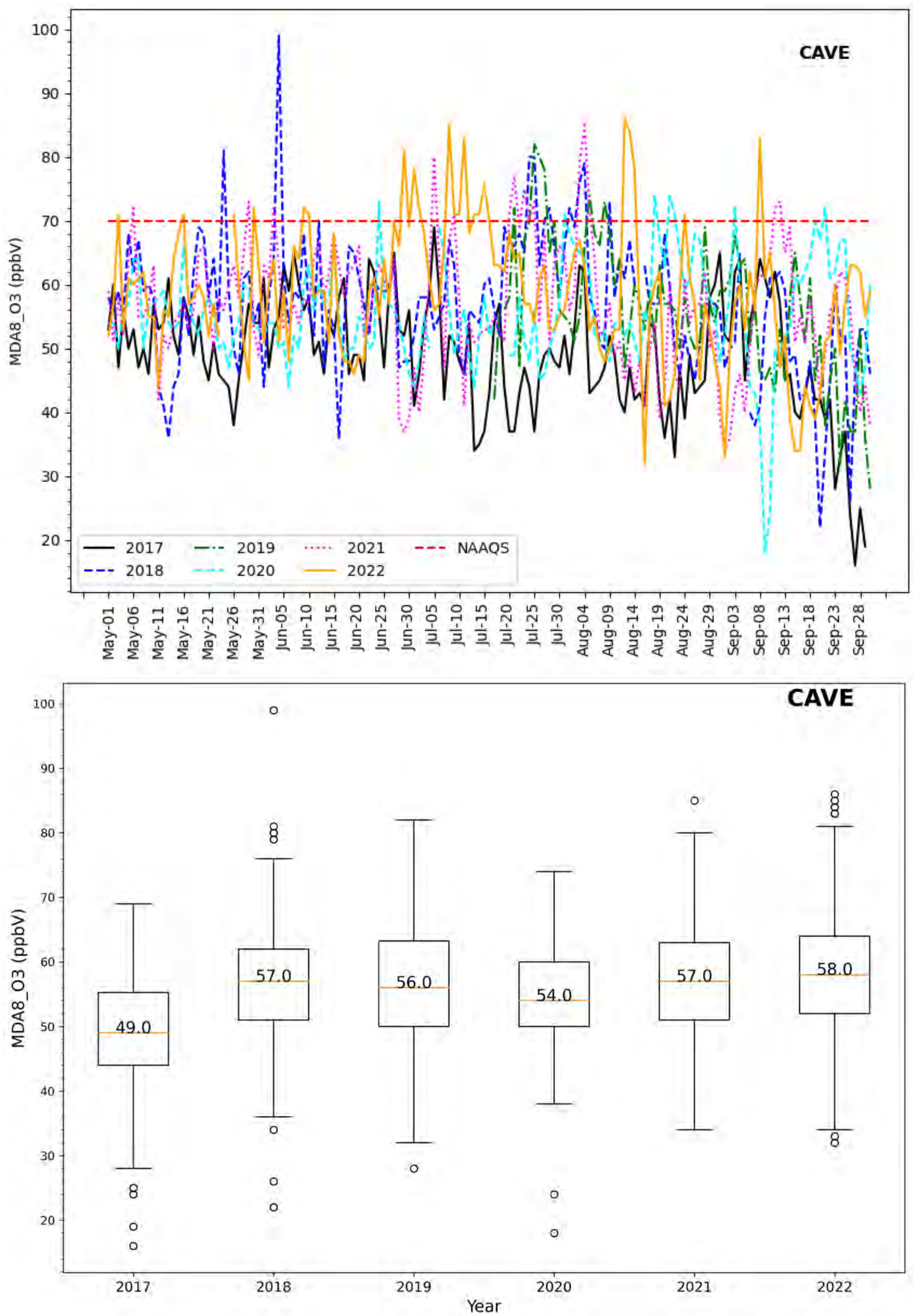

Figure S1. (Top) Daily distribution and (bottom) box and whisker plot of MDA8_O3 at CAVE monitoring station in May – September during 2017 – 2022 period.

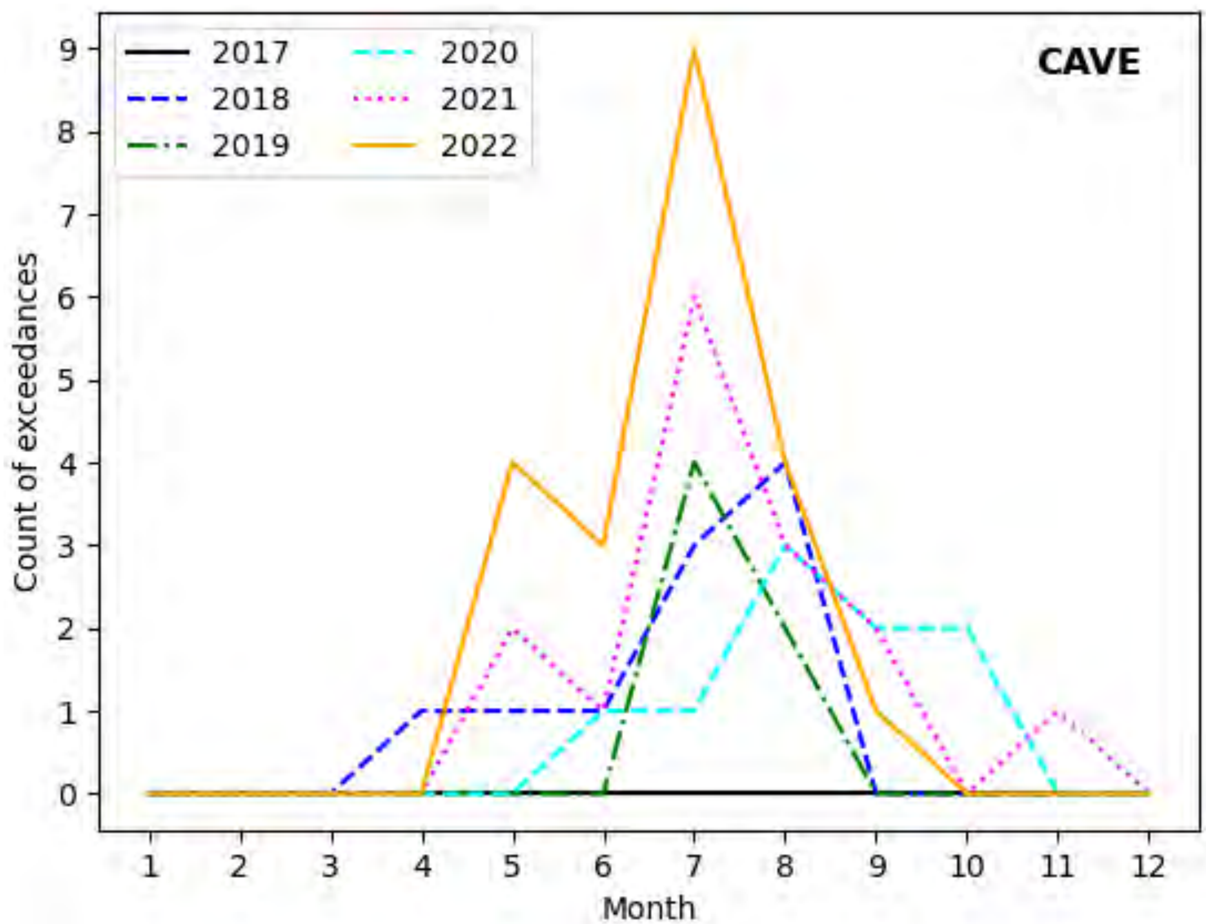

Figure S2. Distribution of MDA8_O3 exceedances at CAVE monitoring station

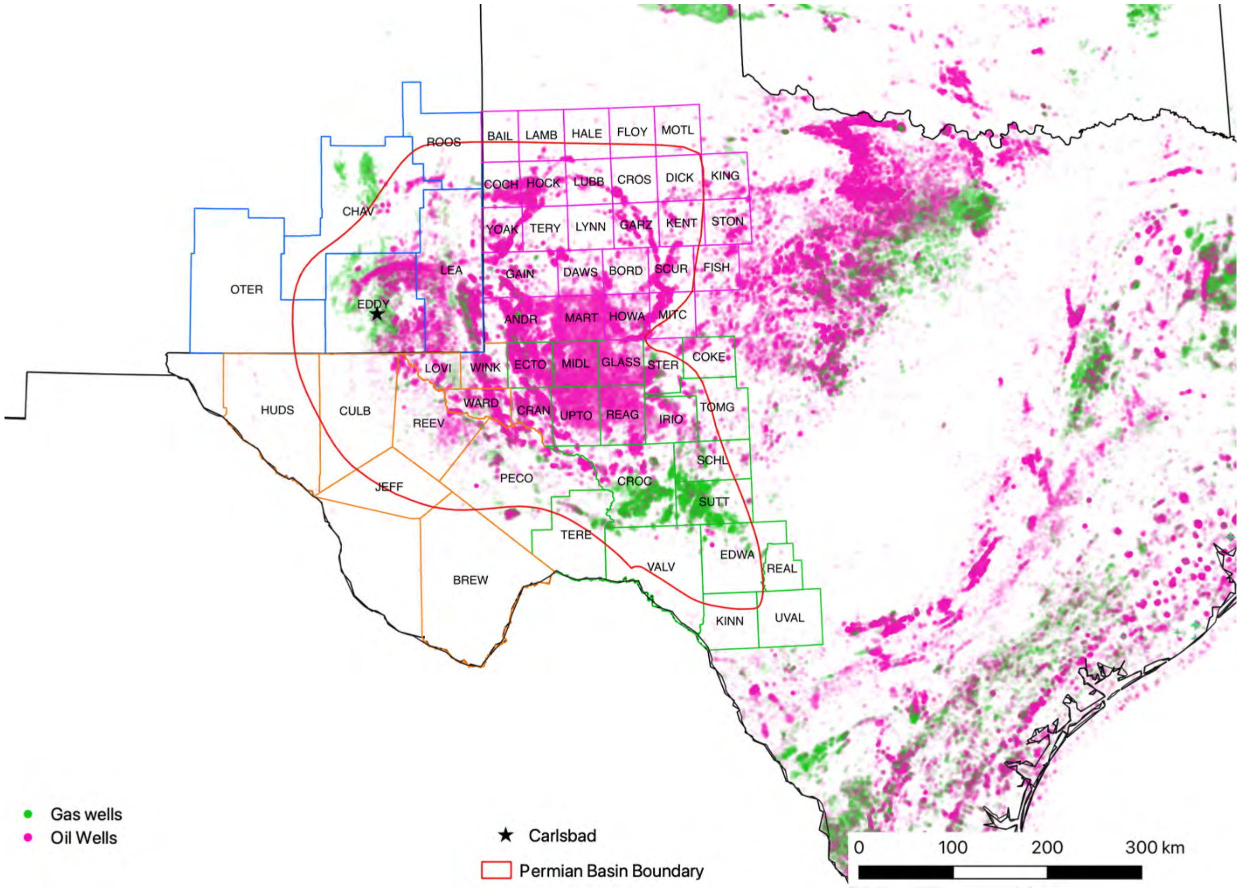

Figure S3. Locations of oil and gas wells in the Permian Basin

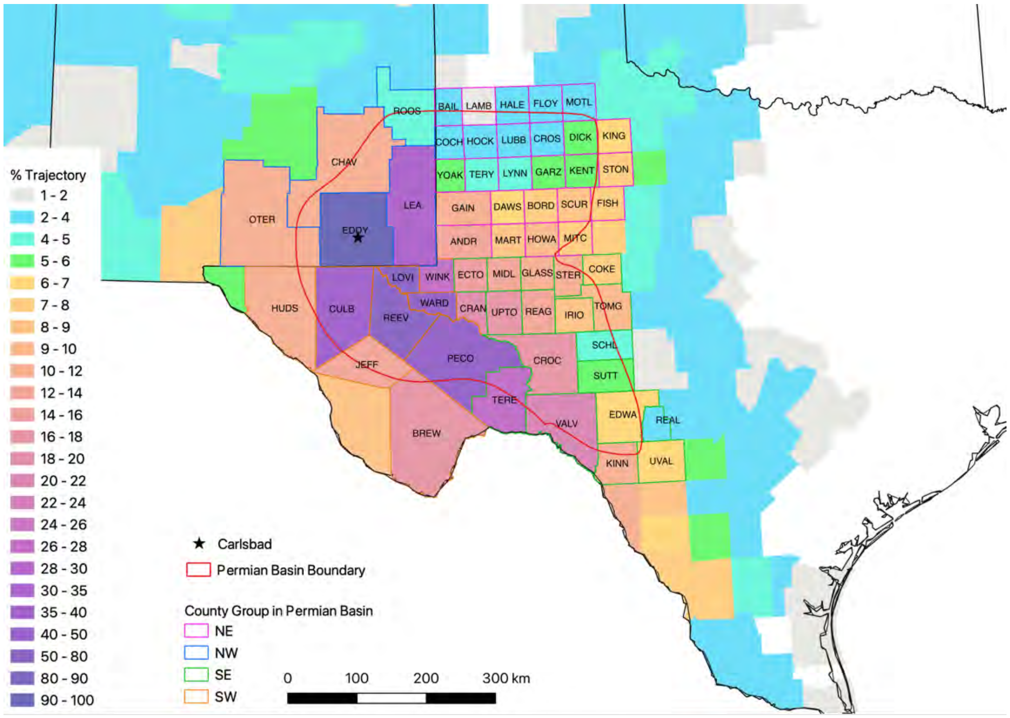

Figure S4. County heatmap normalized by number of trajectories for high ozone days (MDA8_O3 > 70 ppb).

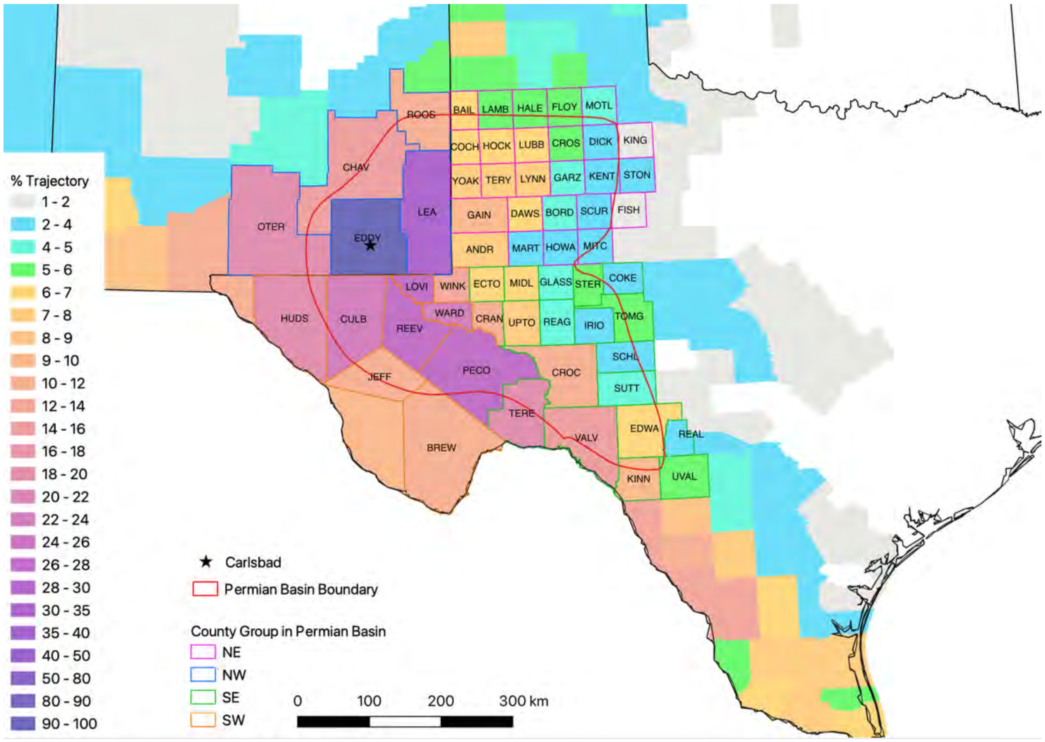

Figure S5. County heatmap normalized by number of trajectories for low ozone days (MDA8_O3 < 46 ppb).

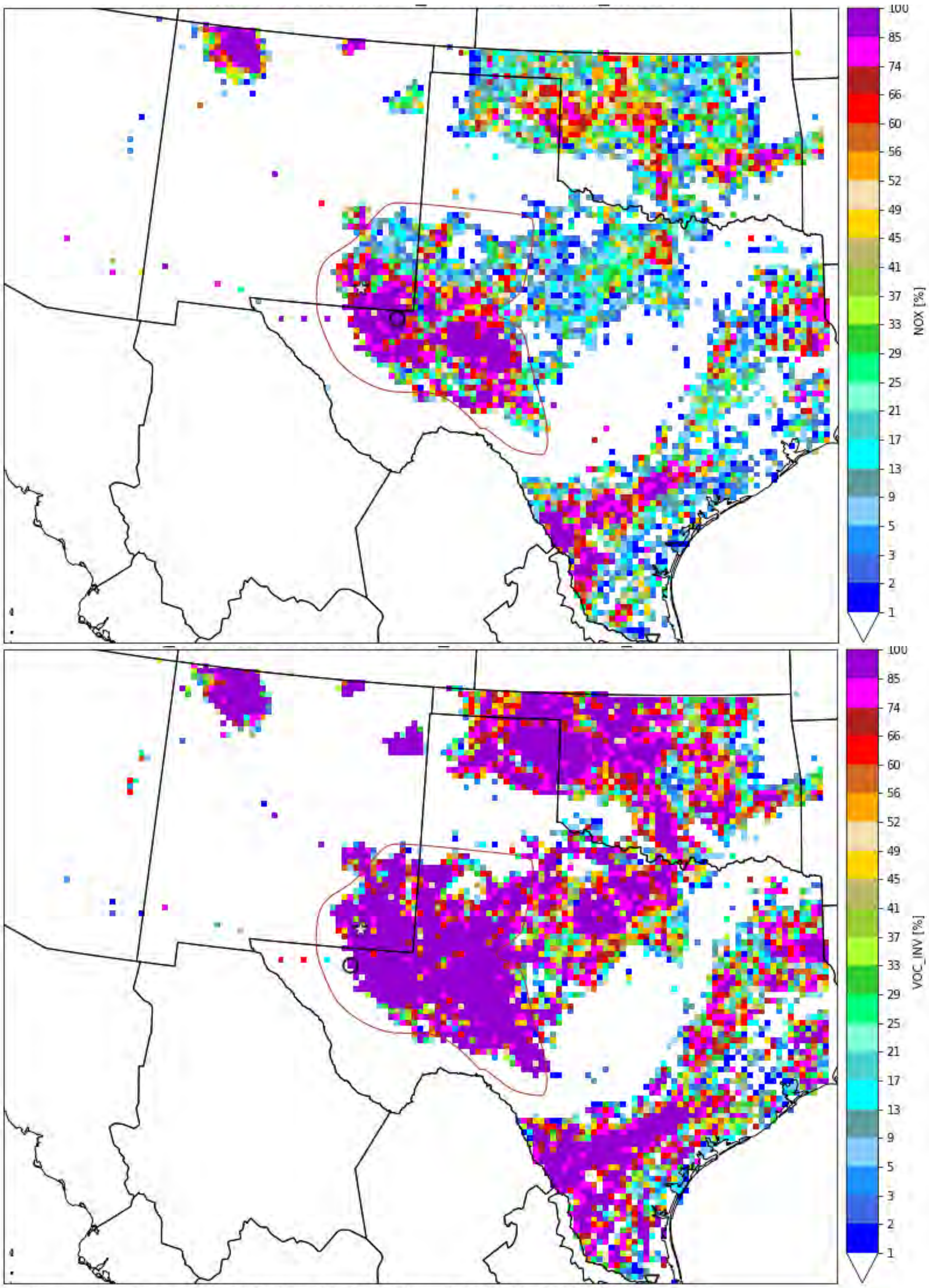

Figure S6. Contribution of NOx (top) and VOC (bottom) emissions (%) from oil and gas sector to the emissions from all anthropogenic sources. Star symbol indicates location of Carlsbad monitoring site. Emissions data were derived from EPA's NEI 2016v1.

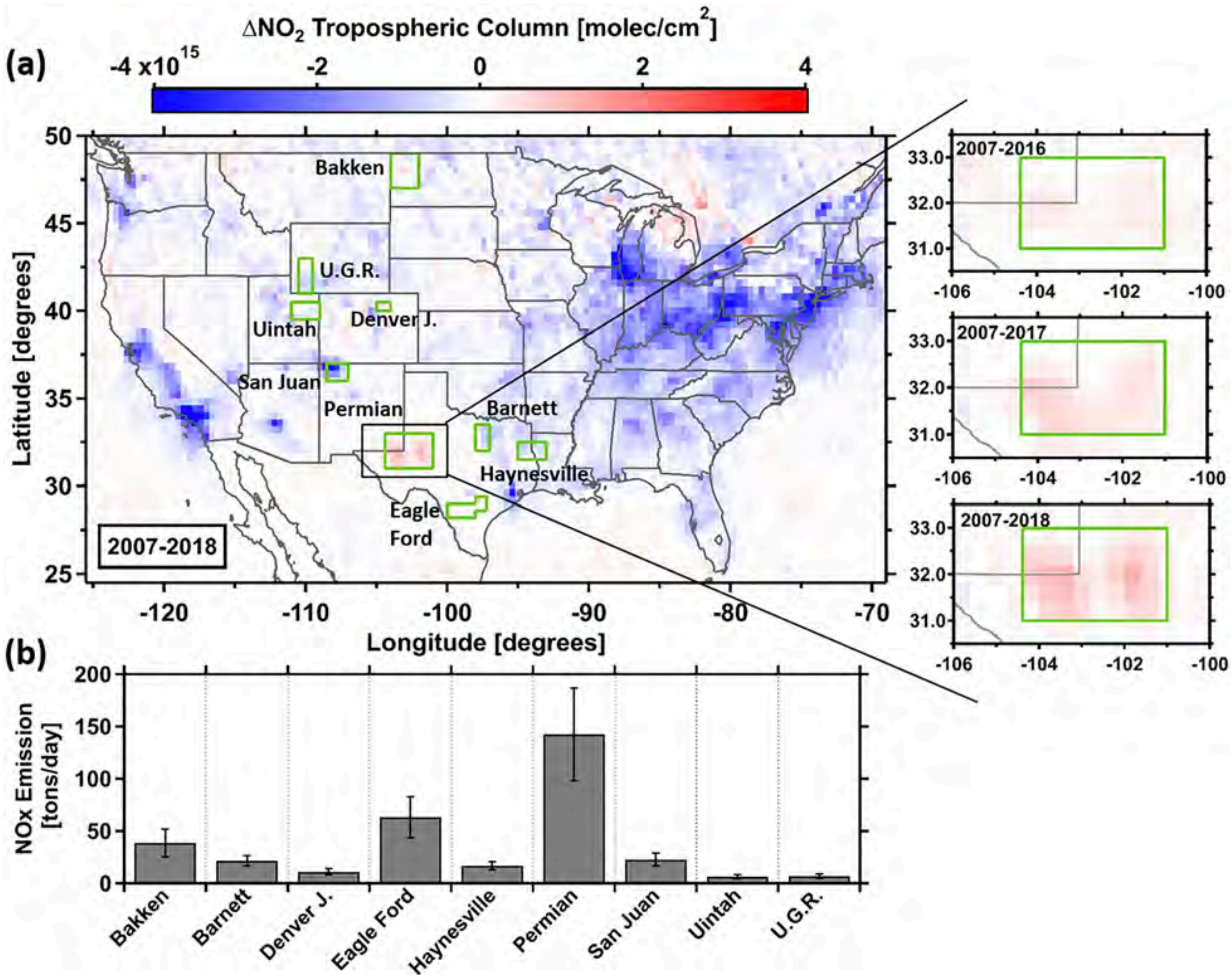

Figure S7. OMI NO_2 map and FOG NOx emission estimates by Dix et al. (2020). (a) Absolute changes in OMI tropospheric NO2 VCDs between 2007 and 2018 for the continental U.S. Green boxes denote major U.S. oil and gas production regions. The insets show the NO_2 VCD change between 2007 and 2016, 2017 and 2018, respectively, over the Permian basin. (b) 2015 FOG NOx emission estimates for the areas outlined in (a).

Reference:

Dix, B., de Bruin, J., Roosenbrand, E., Vlemmix, T., Francoeur, C., Gorchov- Negron, A., et al. (2020). Nitrogen oxide emissions from U.S. oil and gas production: Recent trends and source attribution. Geophysical Research Letters, 47, e2019GL085866. https://doi. org/10.1029/2019GL085866